

**Staff's Review of California Public Utility
Commission's September 17, 2002 Investigative
Report On Wholesale Electric Generation**



**Prepared by Staff of the Federal Energy Regulatory Commission
March 26, 2003**

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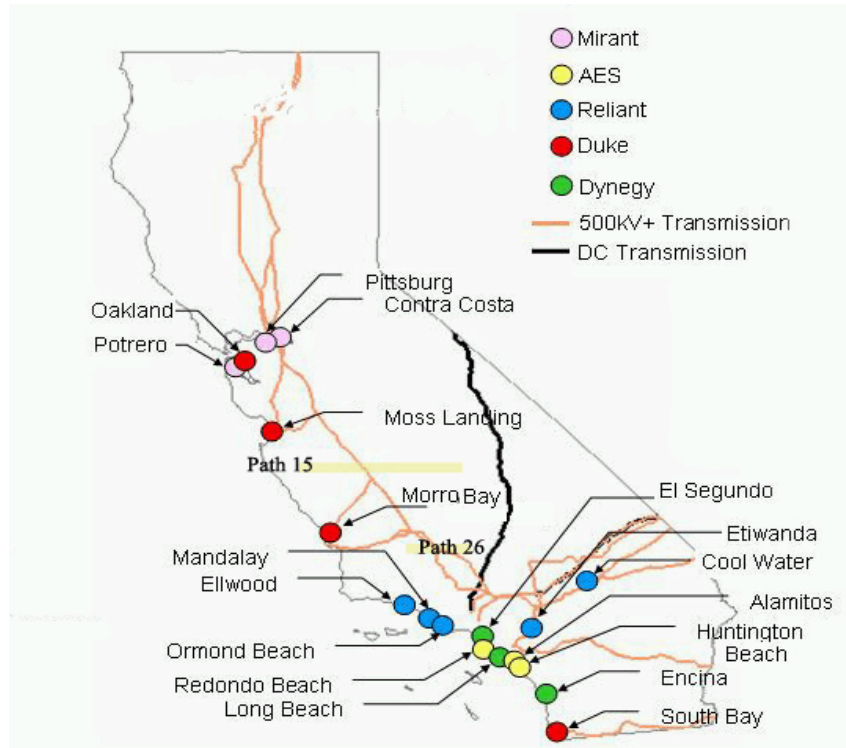
I. EXECUTIVE SUMMARY

This is the Commission staff's analysis of the "Investigative Report on Wholesale Electric Generation" (Report) by the California Public Utilities Commission (CPUC) in which the CPUC analyzed data on electric power production and bidding behavior of five electric generators on 38 days from November 2000 through May 2001 during which California experienced interruptions of firm or non-firm service. The CPUC concluded, in that Report and elsewhere, that the merchant generators in California engaged in significant physical withholding (reducing the amount of generation made available to the market to increase the value of their remaining generation) and economic withholding (raising the asking price for their generation to levels well above marginal costs).

In the narrow context of staff's review of the Report, staff concludes that the CPUC significantly overstated the degree to which the generators held power out of the market on those days when firm service was interrupted. This is a very narrow conclusion. The Commission has not concluded its investigations of whether physical and economic withholding occurred in California or its magnitude and effect. The conclusion here, that the merchant generators were not withholding during the six days of firm service interruptions, does not mean that staff or the Commission have determined that no physical or economic withholding occurred during 2000 or 2001. Those investigations are continuing and require a much broader analysis of more extensive data than the analysis discussed here.

More specifically, the Report concluded that had California's five largest independent non-utility generators produced their available capacity during the relevant period, the majority of the service interruptions could have been avoided. The Report also found that the five generators failed to bid all of their available power into the relevant California markets, further contributing to the service interruptions. The five generators are affiliates of: Duke Energy Corporation (Duke); Dynegy Inc. (Dynegy); Mirant Americas, Inc. (Mirant); Reliant Resources, Inc. (Reliant); and Williams Energy Marketing & Trading Company (Williams). All of the generators except Williams market energy generated from plants that they operate within the state of California. Williams markets power for California plants operated by subsidiaries of AES Corporation (AES) under an agreement between Williams and AES. The five generators have a total of 18 plants with an aggregate of 66 individual generating units in California.¹

¹ The CPUC excluded from its examination Dynegy's Cabrillo plant because
(continued...)



At the request of Senator Dianne Feinstein and as part of the Commission's oversight responsibilities, staff reviewed the data and analysis presented in the Report to determine if the CPUC's conclusions were reasonable based on available data and information. The scope of staff's analysis was narrowly limited to reviewing the specific analysis contained in the Report. Thus, staff's analysis was limited to whether there was available power not generated (Available Power Not Generated) *assuming, as the CPUC did, that all reported outages were legitimate* and whether the generators failed to bid available power (Power Not Bid). Similarly, like the CPUC, staff did not examine whether any Available Power Not Generated related to the exercise of market power or the prices at which the generators may have bid power—*i.e.*, economic withholding. Staff's focus was primarily on the days that firm service interruptions (*i.e.*, blackouts) actually occurred—January 17, 18, 21, 2001, March 19, 20, 2001, and May 7, 8, 2001, and concludes that there was not any material withholding *on those days*. But, as noted, staff's analysis was not an exhaustive study of generator performance for the 2000 through 2001 time period. Staff did not make any findings with respect to whether there was physical withholding on other days during 2000 and 2001, or whether any of the reported outages were not in fact legitimate.

¹(...continued)
the generating units are less than 50 megawatts. Report

The CPUC recently stated in response to criticism of its Report that its study "did not attempt to answer the question of why, at each plant and for each hour, the generators did not generate all available power."² In contrast, staff has answered that very question for the days on which there were firm service interruptions. Staff's review demonstrates that most of the power that the CPUC concluded was Available Power Not Generated during the firm service interruptions was actually unavailable for use. More specifically, based on its review, staff concludes:

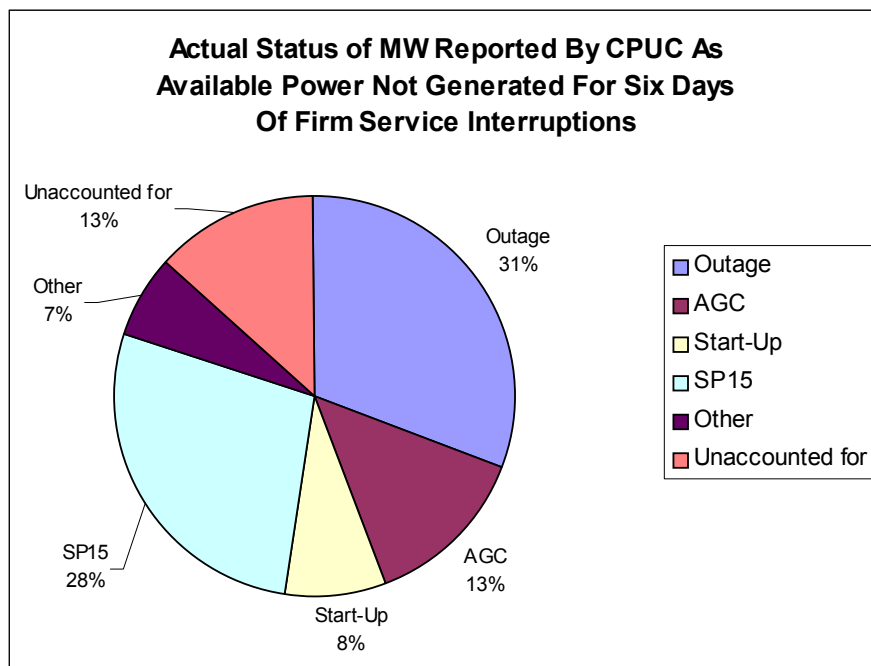
- (1) There is no evidence that any of the generators withheld any material amounts of available power *during the hours of the firm service interruptions*.
- (2) The CPUC's conclusion, that had Duke, Dynegy, Mirant, Reliant, and Williams provided their available power, the majority of the service interruptions could have been avoided, is not supported by the evidence.
- (3) The CPUC's analysis is incomplete and resulted in the CPUC overstating, in large part, the amount of Available Power Not Generated by Duke, Dynegy, Mirant, Reliant, and Williams.
- (4) Staff's review and analysis of the hours during which firm service interruptions occurred reveals that approximately 87 percent of the power that the CPUC concluded was Available Power Not Generated was not in fact available. Staff found that most of the power that the CPUC concluded was available and withheld by the generators was actually unavailable because a generating unit was:

- experiencing an outage;
- operating at least some of its capacity under the Automatic Generation Control (AGC) of the California Independent System Operator (CAISO), and being dispatched by the CAISO to decrease power in order to control the grid;
- the unit was starting up from having been off-line due to a repair or having tripped (an automatic shutdown) such that it was not yet capable of producing its full capacity;

² CPUC Supplemental Report 1 (January 30, 2003) (emphasis original).

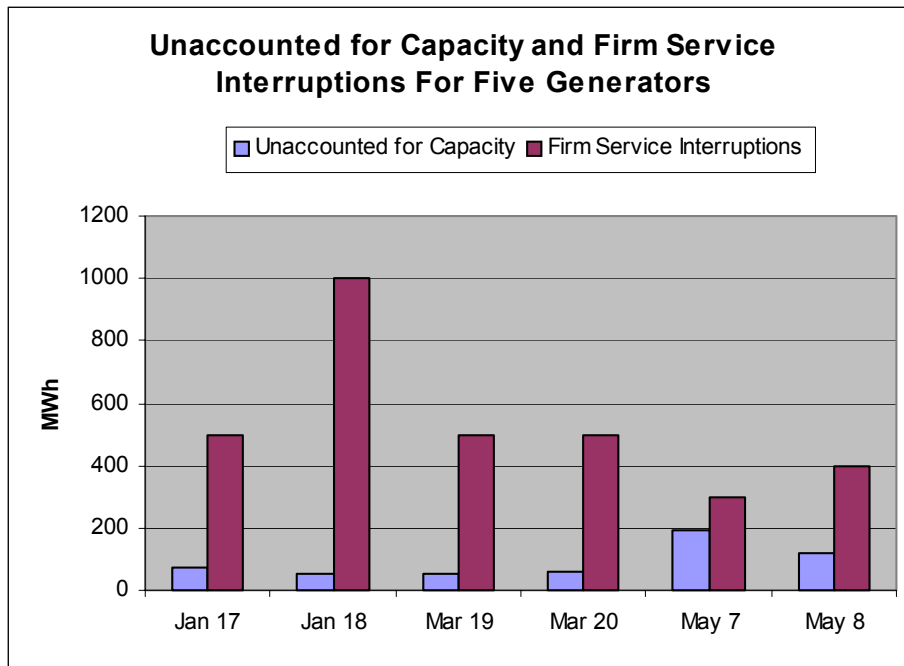
- located south of an overloaded transmission path that prevented the transmission of energy to the area suffering firm service interruptions; or
- experiencing other constraints limiting its generation.

The following chart reflects the relative breakdown of the results of staff's review of the days on which there were firm service interruptions:



(5) For the six days of service interruptions examined, staff could not account for 13 percent of the amount that the CPUC identified as Available Power Not Generated for the firm service interruptions; some of these megawatts could have been withheld, as the CPUC contends. But the amount of unaccounted for Available Power Not Generated is insufficient to have caused the firm service interruptions, as shown by the chart below. On each of the days for which there was a firm service interruption, the amount of Available Power Not Generated is less than 100 to 200 megawatts, while between 300 and 1000 megawatts were interrupted. Thus, had the additional capacity been available, it could not have closed the shortfall. Further, during each of the firm service interruptions the unaccounted for Available Power Not Generated was spread among dozens of generating units (primarily less than five megawatts per generating unit per hour), making

it likely that this is rounding, reporting, or recording error rather than deliberate withholding.



(6) Because the CPUC was not able to correctly identify Available Power Not Generated, its Power Not Bid estimates are overstated. In addition, the CPUC's analysis of the bidding behavior of the generators did not consider all of the relevant variables, such as environmental restrictions, start-up limitations, certain bilateral contracts, and non-electronic bids that were submitted by telephone or fax. Because the CPUC did not consider these factors, it overstated the amount of Power Not Bid by the generators.

Accordingly, based on its review and findings, staff recommends that no further investigation is required with respect to the CPUC's specific claims that the generators had available power that was not provided during the service interruptions in late 2000 and early 2001. Specifically, for the six days on which firm service interruptions were experienced, the CPUC's numbers simply do not accurately reflect the amounts of Available Power Not Generated or Power Not Bid.

The Commission has taken several measures to reduce the likelihood of withholding by generators beginning in late 2000.³ These include:

- eliminating rules that ended the investor-owned utilities' reliance on spot markets and increased the use of longer-term contracts;
- establishing penalties for underscheduling load;
- requiring the CAISO to submit to the Commission staff for monitoring purposes weekly reports on schedule, outage, and bid data; and
- establishing a price mitigation plan requiring generators, as well as non-public utility generators in California, to offer the CAISO all of their capacity in real time during all hours if it is available and not already scheduled to run (*i.e.*, the "must-offer" rule).⁴

As the Report acknowledges, there have been no price spikes or market-related supply constraints since the implementation of the Commission's must-offer rule on May 29, 2001. *See* Report 10, 14, 30.⁵

It is also important to note that the analysis that the CPUC attempted to do—*i.e.*, calculate the amount of Available Power Not Generated during the seven month time

³ *See, e.g.*, 93 FERC ¶ 61,294 (December 15, 2000); 95 FERC ¶ 61,115 (April 26, 2001); 95 FERC ¶ 61,418 (June 19, 2001); 97 FERC ¶ 61,275 (December 19, 2001); 100 FERC ¶ 61,060 (July 17, 2002); 101 FERC ¶ 61,061 (October 11, 2002); 101 FERC ¶ 61,084 (October 25, 2002); 101 FERC ¶ 61,266 (November 27, 2002); 102 FERC ¶ 61,050 (January 17, 2003).

⁴ During the time period studied by the CPUC, there was no requirement that generators bid all of their available power into the California markets.

⁵ The Report also stated that while the Commission took many corrective measures to address remaining market problems in its July 17, 2002 Order, those actions are insufficient and that additional reforms are needed. Report 6-7, 63-69. However, staff believes that this is not the appropriate forum in which to address CPUC's disagreement with the Commission's July 17, 2002 Order. In fact, the CPUC's differing view on some of the measures adopted in that Order have already been fully aired and the Commission has explained at length why it did not adopt the CPUC's proposals. *See* 100 FERC ¶ 61,060 (July 17, 2002).

period from November 2000 through May 2001 on the days when California experienced firm or non-firm service interruptions—is extremely difficult and complex given the variables and the record-keeping systems in place at the CAISO during the relevant time. The CAISO's data and information systems were forward looking and designed as planning tools; they were not intended to gauge performance of past events or to reconstruct causes of service interruptions. Further complicating the CPUC's efforts to determine the extent of any Available Power Not Generated was that the CPUC did not identify to the CAISO what it was attempting to do when it asked for data and information prior to releasing its Report. As a result, and as discussed in this report, staff concludes that the CPUC's analysis was incomplete.

Commission staff informed the CAISO of the review that it was conducting and discussed in detail with the CAISO the various data sources available and the appropriateness of each for determining whether there was any Available Power Not Generated. Then, for the firm service interruptions, staff conducted a detailed unit-by-unit time intensive analysis, including reviewing and interpreting the CAISO's voluminous operational log entries, something the CPUC did not do. In addition to obtaining data from the CAISO, staff obtained from the CPUC information regarding the data sources and assumptions it used in its analysis. Staff also reviewed data and responses to the Report that each of the five generators and the CAISO submitted in response to a request to comment on the Report from the California Senate Select Committee to Investigate Price Manipulation of the Wholesale Energy Market (Select Committee).

This report consists of six additional sections. Section II summarizes the findings of the Report. Section III summarizes the responses to the Report by the generators and the CAISO. Section IV summarizes the CPUC's Supplemental Report. In Section V staff analyzes the Report's methodology and explains the different approach adopted by staff based on the data received from the CAISO. In Section VI staff explains its findings from the detailed analysis and review it conducted for the hours during which firm service interruptions occurred. Finally, in Section VII staff presents its conclusions.

II. THE REPORT

The Report concluded that had Duke, Dynegy, Mirant, Reliant, and Williams produced all of their Available Power Not Generated, the majority of the service interruptions would not have occurred. Although the five generators were only

responsible for 38 percent of the generation capacity in California,⁶ the Report claimed that "blackouts and service interruptions occurred because generators, Duke, Dynegy, Mirant, Reliant, and this AES/Williams, did not produce needed power even though their plants could have met California's electricity needs." Report 2. The Report asserted that between 37 percent to 46 percent of each of the five generator's total generating capacity was either not available, or not supplied, on the relevant service interruption days. Additionally, the Report made specific findings regarding each generator's alleged effect on the service interruptions for certain days. *Id.* at 24-28.

In calculating available power, the CPUC explained that it subtracted from each plant's generation capacity: (1) megawatts that were out of service as a result of planned or unplanned outages; (2) obligations to provide reserve power; and (3) all megawatts actually generated. Report 15. The CPUC claimed that it gave the "benefit of the doubt" to the generators in the methodology it employed to ascertain their available capacity because it accepted as legitimate the plants' reported outages. *Id.* at 14.

The Report also concluded that the generators did not bid all available power into the markets on the relevant service interruption days, stating that "[i]f a generator neither bid power into markets nor supplied that power 'out of market' to the ISO, the ISO could not dispatch that power to meet electricity demand within its control area." *Id.* at 30.

Finally, the Report alleged that, in addition to not bidding, "there were many other strategies the five generators could and did use to withhold power under rules then current at the ISO" and listed examples of "evidence that one or more generators may have deliberately withheld power they could have generated during blackouts and service interruptions." Report 51. The examples of the alleged withholding strategies included:

- Generators failed to follow the CAISO dispatch instructions to move all available units to full load or to start up a plant.
- Generators declined the CAISO's automated dispatch instructions, citing "economic considerations" even though the generator had made a bid. According to the CPUC, this occurred 262 times from January 18, 2001 to February 16, 2001.

⁶ The majority of California's in-state generation capacity was comprised of generating facilities owned by municipalities, investor-owned utilities, or "qualifying facilities" (QFs) that are independent generators who sell their power directly to the utilities.

- Generators failed to take all actions necessary to make plants available to the CAISO as soon as possible after outages.
- Generators failed to provide adequate fuel and staffing for plants.
- Generators argued with the CAISO operators over price and terms.

Report 51-55.

Although the CPUC concluded that the five generators contributed to the service interruptions, it also explained that "considerable additional work remains . . . [and] this study does not attempt to answer fully the question of why, at each plant and for each hour, the generators did not generate all available power during each service interruption hour." Report 20. Further, the CPUC noted that the "ultimate determination of the relative role of each of the five generators . . . cannot be made until a more detailed examination of plant outages has been completed." *Id.* at 50.⁷

III. RESPONSES TO THE REPORT

A. The Generators' Responses

Each of the five generators submitted a response to the Select Committee. Although each generator's response varied in the level of detail provided and differed in emphasis based on its particular situation, there were many common themes, such as:

- The CPUC's generation capacity numbers were incorrect.
- The CPUC failed to account for environmental restrictions.
- The CPUC's outage data was incorrect.
- The CPUC did not consider the conduct of the majority of the market—*e.g.*, the investor-owned utilities, the qualifying facilities, or the municipal owned utilities.

⁷ Similarly, in an October 2, 2002 letter to the vice-chair of the Select Committee, CPUC's president stated that the Report is but one step in examining the factors that explain the operations of the five generators, and not the last or only step. Letter from Loretta M. Lynch to Senator Bill Morrow 2 (October 2, 2002).

- The CPUC did not take into account in its analysis of bids the generators' bilateral contracts with the CAISO or the California Department of Water Resources (CDWR).
- The CPUC did not take into account that the CAISO had emergency dispatch authority that enabled it to order generators to produce power irrespective of bids.
- The CPUC stated that it assumed all outages were legitimate, yet throughout its Report the CPUC appeared to question the genuineness of the generators' scheduled and unscheduled outages, without providing any substantiation for questioning the outages.

The generators also directly and indirectly criticized the CAISO, suggesting that the CAISO did not appropriately dispatch power that was made available to it. Duke, Mirant, and Reliant additionally claimed that they cooperated with the CAISO and attempted to assist during the periods of emergency. With respect to the CPUC's specific allegations regarding Available Power Not Generated directed at the individual generators for particular days, the generators offered their own numbers and computations with different results, showing little available capacity on the relevant days.

B. The CAISO's Response

Pursuant to the Select Committee's request, the CAISO also submitted a "Commentary" on the Report. The CAISO agreed with the CPUC that the generators did not bid all of the available generation into the CAISO's markets which, according to the CAISO, caused it to procure resources in real time to balance the system. CAISO Commentary 1.⁸ The CAISO also agreed that it encountered situations when the generators refused to produce available power for what appeared to be inappropriate reasons. *Id.* But the CAISO could not agree with the quantitative conclusions reached by the CPUC because:

(1) the CAISO was unable to verify the data used by the CPUC;

(2) the CPUC did not take into account all relevant factors; and

⁸ "CAISO Commentary" refers to the CAISO's October 25, 2002 submission to the Select Committee entitled, "Commentary by the California Independent System Operator Corporation on the CPUC Staff Investigative Report on Wholesale Electric Generation released September 17, 2002."

(3) even if the quantitative analysis of the CPUC was correct and took into account all relevant factors, an after-the-fact calculation of "available" generation is not possible because the decision to curtail load had to be made in advance on the basis of projections and other factors.

Id. at 1, 7.

More specifically, the CAISO explained that it could not replicate the CPUC data because the CPUC used aggregate numbers relating to the generators and the CAISO's data is maintained on a plant-by-plant basis. CAISO Commentary 4. Nor could the CAISO, in many instances, determine how the CPUC applied its stated methodology. *Id.* Further, with respect to available capacity, the CAISO pointed out that generating units' capacity can be limited by a number of operating constraints and that at least some of the outage data used by the CPUC may not be reliable, a fact about which the CAISO advised the CPUC at the time the data was provided. *Id.* at 4.

Additionally, the CAISO noted that it is unclear whether the CPUC accounted for decreases in generator power in response to an automatic dispatch instruction by the CAISO through its AGC. *Id.* at 6. Indeed, in response to Duke's rebuttal to the Report, the CAISO stated that according to the CAISO records during Hour 15 on May 8, 2001, Duke was generating at full capacity. However, the Report indicated that Duke withheld over 600 megawatts during that hour, making it appear that the CPUC did not account for the amount of megawatts of Duke's units that the CAISO controlled through its AGC. *Id.* at 6-7. Finally, the CAISO also stated that the CPUC failed to consider that capacity may have been bid into the CAISO markets (or otherwise be available), but not dispatched because of locational transmission constraints. *Id.* at 5.

Despite its misgivings over the CPUC's data, methodology, and conclusion, the CAISO agreed with the CPUC that the generators did not bid all of their available capacity into the CAISO's markets and that the generators many times declined to follow dispatch instructions for inappropriate reasons, such as "economic considerations," or argued over the prices at which they would run. *Id.* at 3. Further, the CAISO disagreed with the implication by the generators that its emergency dispatch authority was a substitute for bids. Rather, the CAISO explained that despite its authority to issue emergency dispatch instructions to generators for available power, the CAISO had no control over the generators' performance of those instructions. In fact, according to the CAISO, "refusals to follow dispatch instructions occurred with great frequency." *Id.* at 8. However, in its

Commentary, the CAISO did not quantify or otherwise provide specific information regarding such refusals, such as on what days the refusals occurred or by what generators.⁹

The CAISO similarly noted that while some environmental restrictions did actually exist that affected the generators' ability to provide power, at times such restrictions appear to have been "feigned." *Id.* However, no details were provided by the CAISO in its Commentary as to when restrictions were allegedly feigned, by which generators, or why the CAISO believed they were feigned.¹⁰

IV. THE CPUC'S SUPPLEMENTAL REPORT

In response to comments by the generators, the Select Committee, and the CAISO, the CPUC issued a Supplemental Report on January 30, 2003. The CPUC did not change any of its conclusions but it did refine downward some of its computed amounts of Available Power Not Generated. *See* Supplemental Report Appendices. The CPUC also defended its methodology by explaining that it was a "macro-level overview of available power not generated and not bid The study did not attempt to answer the question of why, at each plant and for each hour, the generators did not generate all available power." Supplemental Report 1 (emphasis original).

The Supplemental Report emphasized that its investigation is not final and is continuing, especially with respect to looking into what it characterizes as "suspicious outages." *Id.* At 6-8. In fact, the CPUC described five particular instances that it is investigating as potential illegitimate outages. *Id.* Despite this, however, the CPUC did not change the analytical approach that it adopted in its initial Report, which was to

⁹ *See* Section VI.E. *infra* regarding the data provided by the CAISO to staff relating to the generators' declines of emergency dispatch instructions.

¹⁰ In response to a request from staff for details regarding instances that generators alleged feigned environmental restrictions, the CAISO provided information about two instances that occurred in early February 2001 in which the CAISO believed that Williams and Dynegy falsely claimed they could not run certain of their units because of environmental limitations. Litigation ensued, but the issue of whether the environmental restrictions were feigned was not directly resolved because it was mooted when the environmental governing authority agreed to allow the generators to continue operating without violating emission regulations.

assume all outages were legitimate for purposes of its study of the alleged available power that was not generated and not bid.¹¹

The CPUC further noted that additional study is needed regarding the generating units that were operating under AGC, and therefore under the control of the CAISO. *Id.* at 12. As part of its continuing investigation, the CPUC stated that it will analyze all data regarding the CAISO's control of power plants on AGC. *Id.* at 13.

In response to comments that the CPUC had not considered the CAISO's emergency dispatch and RMR¹² dispatch authority, the CPUC contended that (1) it accounted for all power generated pursuant to RMR, and (2) despite the CAISO's ability to issue emergency dispatch orders, the generators were nonetheless obligated to bid their available power into the market. *Id.* at 9-11. The CPUC further stated that the emergency authority of the CAISO was "sub-optimal at best," explaining that "[t]he ISO cannot use its efficient, automated systems to dispatch power under such circumstances." *Id.* at 11. The CPUC similarly dismissed the generators' arguments that they had legitimate financial reasons not to bid all available power into the market as unpersuasive. *Id.* at 14. Rather, according to the CPUC, once the CDWR took over procurement responsibilities for the state in mid-January 2001, the generators' concerns about creditworthiness were nearly eliminated. *Id.* Finally, the CPUC also dismissed many of the generators' criticisms as being of "questionable validity," including: (1) not taking into account lengthy start-up times; (2) environmental limitations; (3) imports and exports by generators; and (4) the generators' claims that they operated more during the crisis than previously. *Id.* at 13-16.

V. STAFF'S APPROACH TO DETERMINE WHETHER THERE WAS AVAILABLE POWER NOT GENERATED

A. Data Collection And Methodology

To review the Report, staff sought more specific information from the CPUC regarding its methodology, including: (a) the sources of the data that it utilized, (b) how it accounted for such factors as environmental restrictions, export sales, bilateral contracts, ramp rates, grid transmission constraints, and derates, and (c) how it determined the

¹¹ For this reason, staff also made that assumption and did not undertake an investigation of outages in this report. Staff is independently examining the alleged improper outages cited in the Supplemental Report, none of which had been previously referred to the Commission by the CPUC or the CAISO.

¹² In the case of localized reliability problems, the CAISO can dispatch generating units that have a Reliability Must Run (RMR) agreement with the CAISO.

maximum capacity of each generating unit. In response, the CPUC explained that it relied on information provided by the CAISO and described whether and, if so how, it accounted for the factors inquired about.

From the CAISO, staff attempted to obtain all relevant data that reflected any available power and/or bids for each of the five generators' units for January 15, 16, 17, 18, 19, 20, 21, 22, 23, 2001, March 17, 18, 19, 20, 22, 2001; and May 5, 6, 7, 8, 9, 10, 2001.¹³ In particular, staff requested thirty specific pieces of information for each relevant hour and each relevant generating unit.¹⁴ In addition, staff requested from the CAISO data relating to: grid transmission constraints; forecast and actual load generation; plant outages (scheduled and forced); import capability; amount of imports; and amount of exports.

Although the CAISO attempted to provide everything staff requested, it was produced piecemeal over three months and required considerable follow-up by staff to obtain the data it needed. Additionally, the CAISO was not able to provide all of the specific data requested for a variety of reasons. In some instances, the CAISO simply did not maintain the information, such as snapshots of real-time topology during the service interruptions. In other instances, the CAISO was only able to provide partial information. Moreover, in several instances, the CAISO did not have a distinct database that contained the requested information, but referred staff to its SLIC logs that the CAISO said *might* reflect the information that was sought.¹⁵ Specifically, for example, staff was advised by the CAISO that some, but not all, environmental and start-up limitations would be in the SLIC logs.

Staff also obtained the data that the CAISO had provided to the CPUC that the CPUC identified as having used in its analysis. In addition to collecting and analyzing the CAISO data and information, staff held numerous conference calls with CAISO personnel to understand how the CAISO compiled the data that it provided and what the data represented to ensure that staff was correctly analyzing the material.

¹³ These are the days that a firm service interruption was experienced, either in Southern or Northern California, and two days before and after each firm service interruption.

¹⁴ See Appendix A for a list of the thirty items requested.

¹⁵ SLIC (Scheduling Logging for the ISO of California) is the name of the data system the CAISO uses to record a variety of operational information including some outage information.

At the outset, it is important to understand not only the analysis and review that staff conducted, but also what staff did **not** do. Staff did not, and could not attempt to determine all the factors that contributed to the service interruptions. That is beyond the scope of this study.¹⁶ Rather, staff limited the scope of its review to the subjects of the Report—*i.e.*, the Available Power Not Generated and the Power Not Bid. Moreover, the scope of staff's review, like that of the CPUC, did not include whether the Available Power Not Generated related to the exercise of market power, whether plant outages were legitimate, or whether any of the bids related to the exercise of market power.

B. The CPUC's Calculation Of Available Power Not Generated And Staff's Method Of Estimating Available Power Not Generated

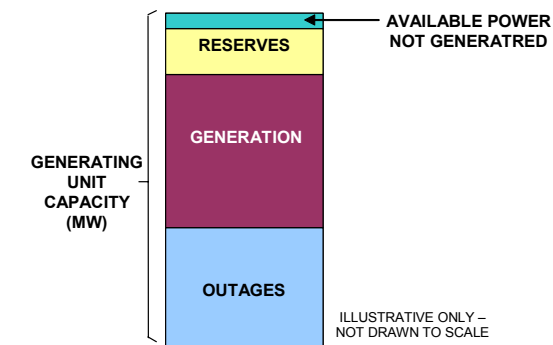
The CPUC described its methodology in computing the available power not generated as subtracting from each plant's generation capacity: (1) megawatts that were out of service as a result of planned or unplanned outages; (2) all megawatts actually generated;¹⁷ and (3) obligations to provide reserve power. Report 15. Thus, the CPUC apparently used the following arithmetical calculation:

$$\text{Available Power Not Generated} = \text{Capacity} - \text{Outages} - \text{Generation} - \text{Reserves}$$

Graphically, the CPUC's calculation was:

¹⁶ Many reports and studies on the California electricity crisis have been published and although their views may disagree on many issues, most agree that there were many causes that contributed to the crisis. *See, e.g.*, Christopher Weare, *The California Electricity Crisis: Causes and Policy Options* 2003.

¹⁷ Generation includes all generation by a generating unit, irrespective of whether it was exported out of California or pursuant to a bilateral contract and not bid into one of the CAISO markets.



On its face, this calculation seems logical and uncomplicated. The difficulty in reviewing the Report, however, is that the CPUC did not provide the actual numbers it used for each element of the equation and the numbers that are provided are aggregated by generator and not for each generating unit.¹⁸ Therefore, staff could not precisely replicate CPUC's computations.

Even more problematic, however, is the outage data used by the CPUC. The CPUC informed staff that it used a table referred to as "SchOut" that the CAISO prepared based on an algorithm from CAISO's SLIC database. However, in an July 23, 2002 email, the CAISO specifically advised the CPUC that:

The SchOut table is intended to reflect a higher-level picture of outages and is not intended to be used in micro-investigations of specific generating unit behavior during a specific subset of hours. . . . I become concerned that you may be placing too much stock in the data contained in that table.

July 23, 2002 email from Jeff McDonald at the CAISO to Charles Magee at the CPUC. In fact, when staff inquired of the CAISO about the SchOut file, the CAISO informed staff that it would not be of assistance in reviewing the Available Power Not Generated for specific days or generators.

¹⁸ The CPUC claims that it was required to aggregate its numbers for confidentiality reasons. Supplemental Report 4.

Because of the potential for overlap with respect to concurrent outage problems on the same generating unit,¹⁹ the CAISO required generators to also report the amount of megawatts that the units can generate, known as an "availability" number, at the same time outages are reported to the CAISO. The amount reported as available represents the amount of megawatts that the generating unit is then capable of generating, taking into account all outages. Staff was advised by CAISO that the availability database should be the starting place to calculate the amount of power not generated at a given point in time. Because the CAISO availability database was designed to account for all outages and because of the reliability problems with the CAISO outage databases, staff concluded that the availability database is the appropriate data source to use to estimate the amount of Available Power Not Generated.²⁰

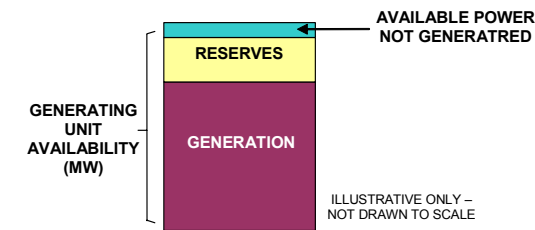
Using the availability database, the staff subtracted from the amount of megawatts that the generators reported as available: (1) the amount generated; and (2) the amount of reserve obligations:

$$\text{Available Power Not Generated} = \text{Available Generation} - \text{Actual Generation} \\ - \text{Reserves}$$

¹⁹ For example, if a generating unit that has a maximum capacity (known as P_{MAX}) of 100 megawatts experiences a pump failure on January 17, causing a 30 megawatts derate, the unit then has a derated P_{MAX} of 70 megawatts. On January 18, the same unit experiences a clogged condenser, which does not cause a further derate below the 70 megawatts. However, if the unit had been at its full P_{MAX} of 100 megawatts, the clogged condenser would have derated the unit by 20 megawatts, down to a P_{MAX} of 80 megawatts. Although the unit has two separate outages concurrently (30 megawatts and 20 megawatts, respectively) they are not cumulative. The availability capacity of the unit is still 70 megawatts despite the additional problem on January 18. Similarly, assume that the second outage on January 18 caused a derate of 40 megawatts instead of only 20. The derated P_{MAX} would then be 60 megawatts with the January 17 outage of 30 megawatts subsumed by the larger 40 megawatts outage on January. Again, the outages are not cumulative. If, in fact, the concurrent outages were erroneously treated as cumulative, it would cause an underestimate of the Available Power Not Generated.

²⁰ The CAISO implemented a new system of reporting outages on February 19, 2003, which is fully integrated with the CAISO's other systems in an attempt to eliminate problems encountered in the past regarding outage information.

Alternatively, in graphic format, the staff's approach was as follows:²¹



Although this equation provides a better estimate of the amount of Available Power Not Generated than that used by the CPUC, this equation must also be qualified to some degree. Upon comparing the availability database of the CAISO to the availability data provided by some of the generators to the Commission, staff discovered inconsistencies. There were not only discrepancies between the data provided by the CAISO and that of the generators, but in some instances there were discrepancies among the generators' own data.²² Thus, even the results of this equation are an estimate and not so reliable such that staff can precisely determine to the megawatt the amount of Available Power Not Generated.²³ Significantly, however, the initial results of the staff's estimate for the days during which there were firm service interruptions roughly correlate to those of the CPUC –*i.e.*, the results appear to reflect that there was a substantial amount of Available Power Not Generated by the five generators, in the aggregate range of 425 to 856 megawatts for

²¹ The outage element included in the CPUC's equation is not separately identified in the graph of staff's equation because it has already been subtracted from a unit's maximum capacity in determining availability.

²² The generators provided available generation data in two different formats; one as to available generation by generating unit and one listing detailed event data describing outages or de-rates. These two sets of data were not always entirely consistent.

²³ Because of some reliability problems with the CAISO data as discussed more fully in Section VI.D, staff uses the term "estimate" as opposed to "calculation" when describing its analysis.

each of the relevant days.²⁴ But, as described in the next section, this step of the estimate is just the beginning, not the end of the analysis.

C. The CPUC's Analysis Is Incomplete—The Results Of The Equation Must Be Compared To The CAISO's SLIC Logs

Due to the manner in which the CAISO maintains its records, using the above mathematical formulas to estimate Available Power Not Generated is only the first step, not the final one. Rather, as the CAISO stressed to staff, after calculating what appears to be Available Power Not Generated by a particular generating unit for a given hour, the circumstances surrounding the particular generating unit must be carefully scrutinized by examining all relevant SLIC operation log entries that can reveal additional information about the unit at the relevant time. This is not an easy task—the log entries are narrative notations made by the CAISO operations personnel contemporaneous with events and are not always entered the same day that is being examined with regard to whether potential power is available. For instance, while examining whether there was Available Power Not Generated on January 17, 2001, it may be necessary to review SLIC log entries for an earlier time period. Specifically, a particular generating unit that appears to have Available Power Not Generated on January 17 may have experienced an outage on January 3. As a result, the unit's status on January 17, both as to megawatt capacity and repairs, may be detailed in the January 3 outage report. Thus, in this example, unless that January 3 outage report is reviewed, as well as any subsequent relevant reports, it may not be possible to know the accurate state of affairs for that unit on January 17.

Because the results of the first step (the arithmetical equation) revealed many instances of what appeared to be Available Power Not Generated by the generators, staff narrowed its focus on the hours during which firm service interruptions occurred on January 17, 18, March 19, 20, and May 7, 8, 2001 to conduct the critical second step of

²⁴ Included as Appendix B are bar charts that reflect the CPUC's and staff's aggregate estimates of Available Power Not Generated as a result of their respective equations. Because most of the information staff obtained from the CAISO is confidential pursuant to the CAISO's tariff and was provided to staff with the understanding that it would remain confidential, staff's detailed calculations revealing names of generating units and amounts of megawatts are not revealed in this report. Further, based on the results of staff's review—*i.e.*, the CPUC's analysis is incomplete and its conclusions unsupported--publicly revealing the details of the first step in the analysis is unnecessary.

reviewing the SLIC log entries.²⁵ Thus, staff examined the SLIC logs for 58 instances where a generating unit appeared to have Available Power Not Generated for one of the firm service interruption hours.²⁶

In addition, because the SLIC logs vary in their detail, contain abbreviations, and can be subject to different interpretations, after reviewing the log entries and determining what it believed was the explanation for the unit not generating to its full capacity, staff consulted with the CAISO to confirm that staff was correctly interpreting the log entries. Based on this process and, as discussed in further detail below, staff was able to ascertain in most cases why the unit was not producing its entire capacity and determined that it was not in fact available to generate additional power.

VI. STAFF'S FINDINGS

A. There Was No Material Amount Of Available Power Not Generated During The Firm Service Interruptions

²⁵ Firm service interruptions also occurred in the north on Sunday, January 21, 2001. However, the CAISO's decision to interrupt firm service on January 21 was due to its effort to mitigate severe overloading of Path 15 that was caused by the loss of the Pacific DC Intertie while carrying 1700 megawatts. Because of the much larger magnitude of the of the system disturbance (1700 megawatts) compared to the small amount of generation the CPUC claimed that generating units north of Path 15 were not generating (8 to 21 megawatts), staff did not include January 21 in its analysis.

²⁶ These 58 instances were the aggregate number of times where it appeared that a generating unit had Available Power Not Generated during the first hour of one of the six days during which firm service interruptions occurred. Only the first hour of each of the service interruptions was examined closely by staff because of the time and resource intensive nature of the necessary review of the SLIC log entries and because the first hour of the firm service interruption is the most critical. According to the CAISO, many other variables enter into the picture after the first hour of a service interruption, such as large load curtailments that often resulted in response to the CAISO's public announcements about the service interruptions and requests to conserve energy. Another reason staff focused on the first hour of the interruptions is that frequently the reason explaining why a unit was in fact unavailable continued throughout the entire service interruption (*e.g.*, an outage, the unit was located south of an overloaded transmission path, or the unit was experiencing a physical constraint limiting its output).

Applying the detailed analysis and review described above, staff was able to determine that approximately 87 percent of the power that its arithmetical estimate showed as potentially Available Power Not Generated was not in fact available. In general, the explanations for why the power was not actually available fell into five categories:

- (1) the unit was unavailable due to an outage (that had been erroneously recorded or overlooked in the outages file, but was contained in the SLIC log entry);
- (2) the unit was on AGC and was being dispatched by the CAISO to decrease power in order to control the grid;
- (3) the unit was starting up from having been off-line due to a repair or having tripped (an automatic shutdown) such that it was not yet capable of producing its full capacity;
- (4) the unit was located south of an overloaded transmission path that prevented the transmission of energy to the area suffering firm service interruptions; or
- (5) the unit was experiencing some other physical constraint that prevented it from producing at full capacity.

(1) Erroneously recorded outages: Staff discovered many instances where the availability log and outage database (which were used for the equations, respectively by staff and the CPUC) were in error.²⁷ Illustrative is Ormond Beach Unit No. 1, that was listed in the CAISO's availability and outage databases as available for March 19, 2001 at 724 megawatts. In reality, however, the unit was only capable of producing 550 megawatts due to an outage.²⁸ The SLIC log entries revealed that the unit had been curtailed to 550 megawatts on March 12, 2001 due to a gas recirculation casing expansion joint leak and not released to full load until April 3, 2001. However, the log entries also reflected that from 11:30 p.m. on March 15 until 4:00 a.m. on March 16, the unit was down completely due to condenser cleaning. Apparently, when the condenser cleaning was completed, and the unit returned from that outage, 724 megawatts was erroneously entered in the availability and outage databases instead of only 550 megawatts to correctly

²⁷ See also Section VI.D, *infra*.

²⁸ This unit's outage was publicly reported on the CAISO's web site on March 19, 2001.

reflect the limitation from the concurrent outage caused by the gas recirculation problem.²⁹ Thus, under the CPUC's analysis, which stopped with the arithmetical equation and used the CAISO's erroneous outage information, this unit had 174 megawatts of Available Power Not Generated, which the CPUC concluded was withholding by the generator. In fact, however, the generator was not withholding and the unit was producing to the full limit of its then capacity. Errors such as this in the CAISO's availability log and outage files account for 31 percent of the CPUC's Available Power Not Generated where generation was assumed as available when it was not during the firm service interruptions.

(2) Units on Automatic Generation Control (AGC): If a generating unit is operating on AGC, a prescribed range of the unit's capacity is under the CAISO's control. The generating unit automatically responds to signals from the CAISO's control systems in real time to control the power output of the generators within a prescribed capacity band in response to changes in system frequency or tieline loading. This is done to maintain the frequency or to maintain interchange with other control areas within predetermined limits. The CAISO's control over the generating units is effected by the CAISO purchasing ancillary services known as Regulation Up and Regulation Down from generators. Regulation Up is a band of capacity set aside by a generating unit to accommodate an increase of output by a generating unit. Regulation Down is a band of capacity set aside for a generating unit to decrease its output. When the CAISO exercises Regulation Up that it has procured from a generating unit, the unit must generate additional power; when the CAISO exercises Regulation Down procured from a generating unit, the unit's production of power is decreased. Thus, a generating unit from which the CAISO has purchased Regulation Up has capacity that it must set aside to await instruction from the CAISO and a generating unit from which the CAISO has purchased Regulation Down may be underproducing relative to its capacity because the CAISO controlled its output for that purpose.

Regulation Up and Regulation Down are distinct capacity products and are separately bid by the generators and purchased by CAISO. The CPUC, however, stated in

²⁹ This error also illustrates a problem with the consistency of the CAISO's outage data. During the relevant time period, it had several distinct sources of data regarding outages. On its web site during the relevant time period the CAISO posted a daily report of planned and unplanned outages based on the generators' oral reports to the CAISO. However, as its web site noted, the outages "may overlap or may not all be simultaneously in effect." In addition to the outage numbers reported on the CAISO web sites, the CAISO also maintained a record of outages in its availability log taken from its SLIC logs. However, on February 19, 2003, the CAISO revised its system of collecting and reporting outage information in an attempt to improve the consistency problem.

its initial Report that Regulation Up and Regulation Down "should roughly balance out, in which case, it is a wash for the purposes of this analysis." Report at 17 n. 15. That statement is not accurate. From the CAISO data provided to staff, there is nothing to indicate that Regulation Up and Regulation Down "balance out." In fact, it is not unusual for a generating unit to bid for only one or the other. Regulation Up and Regulation Down are separate products and were bid and purchased in distinct amounts that bore no relationship to one another in terms of the amount of megawatts. Thus, treating it as a wash is inappropriate when attempting to determine the amount of available power not generated. By ignoring the Regulation Down service a generator provided, the CPUC was inaccurately increasing the generators' purported Available Power Not Generated. Indeed, as discussed earlier, the CAISO pointed out a specific instance of this occurring relating to Duke on May 8, 2001. See page 11, *supra*.³⁰

(3) Start-Ups and Ramps: There are physical limitations on how fast a generating unit, once synchronized to the grid, can increase its output to the maximum operating level. For some units, it can take several hours to reach maximum capacity operating levels. Power level increase restrictions may result from operational causes such as turbine heating precautions or, for some maintenance outages, certain testing or configuration changes which lengthen the time it takes to generate at full capacity. In addition to start-up limitations (starting up from a shutdown condition), there are ramp rate limitations when a unit's power is ramped up (or down) in response to changes in demanded output levels. These limitations affect the availability of units due to the time it takes to increase or decrease power from one level to the next.

The CPUC informed staff that it did not take into account start-up limitations or ramp rates in its analysis in its initial Report. However, in its Supplemental Report, the CPUC noted that it made changes to its calculations to account for start-up times following

³⁰ In its Supplemental Report, the CPUC appears to recognize the flaw in its approach to handling units on AGC, but stops short of acknowledging that its approach overstated the amount of available power not generated. Supplemental Report 12-13. Rather, it contends that AGC "needs further study." For instance, the CPUC admits that the CAISO's statement "appears to support a claim by Duke that the ISO reduced Duke's generation up to 600 MW during that day [May 8, 2001]." *Id.* at 13. The CPUC further notes that it has data to reflect that the CAISO accepted Duke's bid for Regulation Down and sent AGC signals to reduce generation, but nonetheless claims that it needs data on the CAISO's "use" of the Regulation Down bids. *Id.* at n 9.

outages. Supplemental Report 14-15.³¹ Staff's examination of the SLIC logs, together with each unit's start-up information,³² revealed that start-up or ramp rate limitations affected nine separate units' performances on a total of nine occasions during the firm service interruption days.³³

An illustration of the effect that a start-up and ramp rate limitation can have on the potential availability of a unit is depicted in the figure below, representing the start-up of the Encina Unit 2 that occurred on May 7, 2001, following a trip of the unit that was reflected in the SLIC log entries.³⁴ By not reflecting in its calculations that the unit could not instantly achieve its full capacity after being reconnected to the grid after the unit tripped, the CPUC overstated this unit's Available Power Not Generated for at least the first hour as represented by the yellow shaded area for the hour ending 1700 in the figure below.

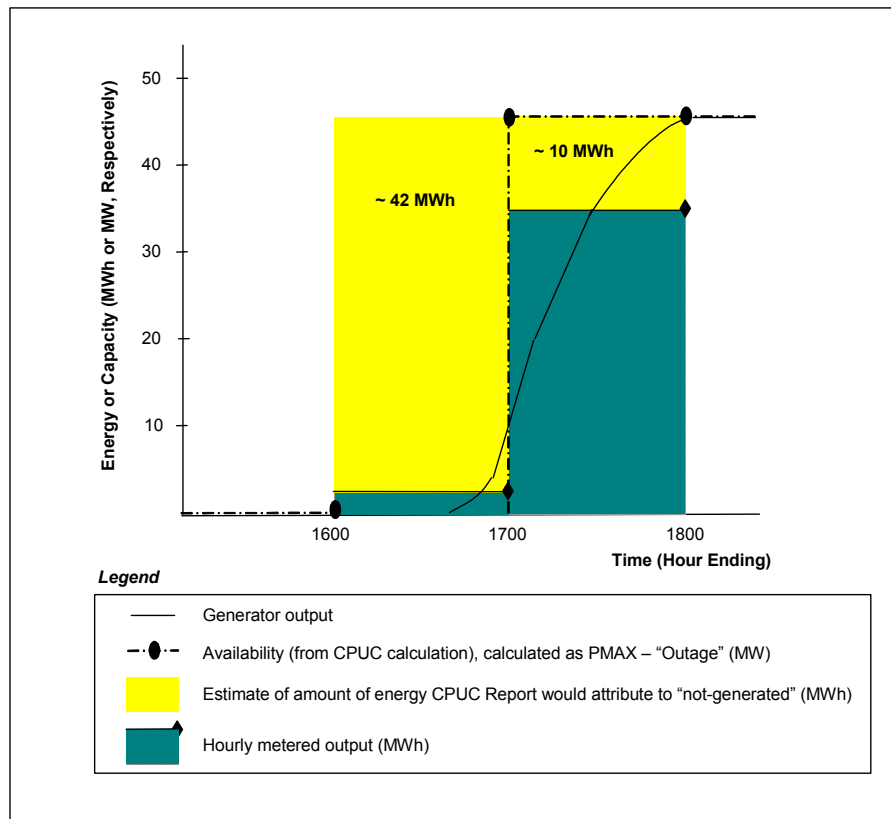
³¹ Neither the CPUC's Supplemental Report nor its revised appendices, however, detail which start-ups or the amount of megawatts that were included in its adjustments.

³² Staff obtained each unit's start-up and ramp rate information from the CAISO.

³³ Staff excluded start-ups of peaking units that can reach full capacity very rapidly within a few minutes of start-up. Additionally, staff only reviewed start-ups that spanned on-peak hours of the days of firm service interruptions.

³⁴ The generator, at staff's request, waived its confidentiality of this data solely for purposes of this report.

Encina Unit 2 Start-up, May 7, 2001



Included as Appendix C is a detailed explanation of the start-up depicted by this figure.

Overall, the failure to take into account the start-up limitations associated with the nine start-ups during the firm service interruptions resulted in an overstatement by the CPUC of alleged Available Power Not Generated. Staff estimates that the nine start-ups included approximately 2,700 megawatt hours that the CPUC attributed to Available Power Not Generated in its original Report.³⁵

³⁵ Up to 40 percent of those 2,700 megawatt hours consist of apparent "hold points" which are assumed to be part of the normal start-ups. "Hold points" occurred during some start-ups where the generating unit's power was halted and held constant for a certain time. Although the CAISO informed staff that its system operators had no consistently employed method for tracking and recording such hold points, hold points are common to many start-ups. Examples of where hold points are sometimes needed include maintenance, post-repair checks from a boiler casing leak, and testing during
(continued...)

(4) Generating units located south of Path 15 on January 17 and 18, 2001: On January 17 and 18, 2001, the firm service interruptions occurred only in northern California. In its report to the Department of Energy on these incidents, the CAISO stated that the firm service interruptions were necessary because the limits on Path 15 were exceeded due to hydro generation in northern California that had to be reduced because of low water levels. CAISO Electric Power System Emergency Report 2 (January 20, 2001). More specifically, according to the report, during the reduction of those hydro facilities, a thermal plant in central California tripped and created an overload on Path 15. *Id.* Similarly, on January 18, 2001 the CAISO reported that Path 15 limits necessitated the firm service interruptions. *Id.*

As a result, the only power that could have averted the firm service interruptions on January 17 and 18 had to be generated from units located north of Path 15. Path 15 consists of two 500 kV and four 230 kV lines located in central California. When Path 15 becomes constrained in the south to north direction, generation located south of Path 15 cannot be dispatched to serve load north of Path 15. Similarly, when Path 15 is constrained in the north to south direction, generation located north of Path 15 cannot be dispatched to serve load south of Path 15. As the map depicted on page 2 *supra* reflects, all of the generating units operated by Dynegy, Reliant, and Williams were located south of Path 15, while Duke operated generating units located both north and south of Path 15. Mirant's generating units were located north of Path 15.

Approximately 28 percent of the initial estimate of Available Power Not Generated was from generating units located south of Path 15. That power from those units could not therefore have averted the firm service interruptions in the northern part of the state. Specifically, on January 17 and 18, additional generation at the Dynegy, Reliant, and Williams and some of Duke's plants could have had no effect on northern California outages. Moreover, staff discovered that the CAISO's records show that those generating units located south of Path 15 that appeared to have Available Power Not Generated on January 17 and 18 were following the CAISO's dispatch instructions.³⁶

³⁵(...continued)
start-ups.

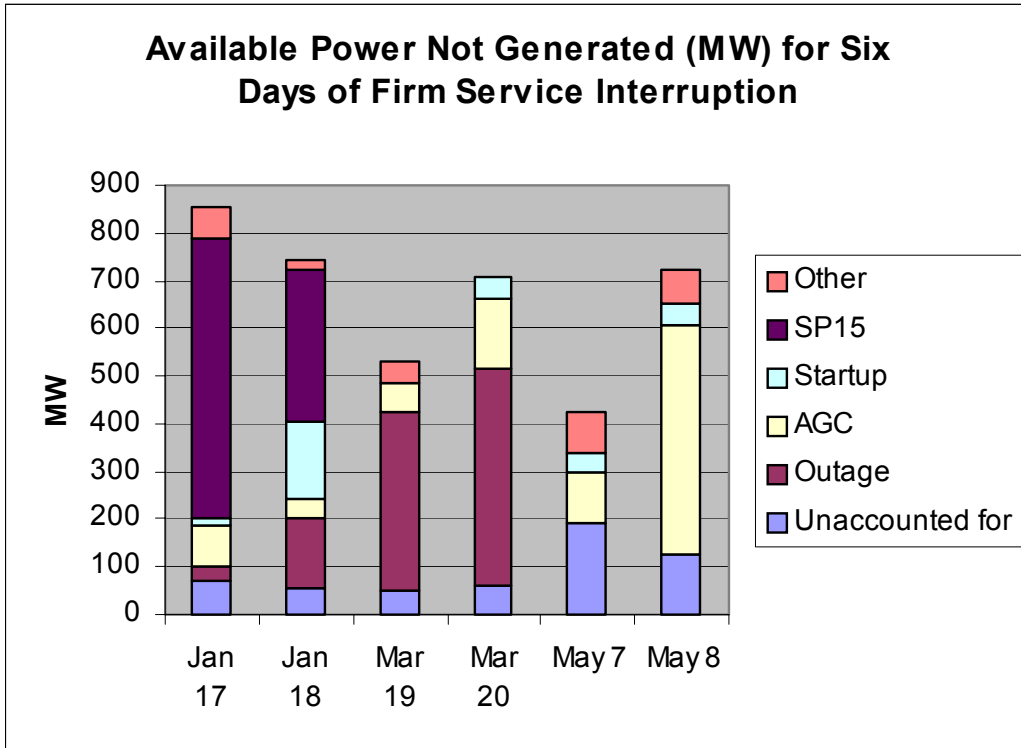
³⁶ Although there were also some non-firm service interruptions south of Path 15 on January 17 and 18, according to the CAISO, it was unable to use all of the available power to avoid those interruptions because of the more restrictive nature of non-firm interruptions. For example, most non-firm interruptions must be provided with advance notice of at least 30 minutes and there cannot be more than one interruption per day which means that non-firm interruptions typically last for several hours. *See, e.g.,*

(continued...)

(5) Other circumstances: The review of the SLIC log entries in consultation with the CAISO personnel revealed other limitations on generating units that explained why they were not generating at full capacity during firm service interruptions. For instance, some units were apparently experiencing an "ambient derate" on May 7 and 8 whereby a unit's capacity slowly decreases during the day by one or two megawatts an hour due to the air and cooling water temperatures increasing or the degrading of the cooling water intake screens. Another limitation staff found was that sometimes a generating unit was required to decrease its output by a few megawatts throughout the day because it had reached an equipment thermal limit that was causing overheating, requiring the unit to be operated at a reduced capacity.

In summary, by analyzing the detailed SLIC log entries, staff was able to account for 87 percent of the potentially Available Power Not Generated, demonstrating that in fact only a small amount of megawatts was not accounted for during the firm service interruptions. The figure below graphically reflects for each of the relevant days, the amount of power that the staff was able to verify was not actually available and the reasons that the generators were unable to produce their full capacity. More particular, the chart reflects the amount of the total megawatts of potentially Available Power Not Generated by all of the five generators' during the first hour of the firm service interruptions for which staff was able to explain its status as unavailable due to outages, start-ups, located South of Path 15, operating under AGC, or other physical constraints. In addition, the chart reflects the small amount of total megawatts for which staff could not account—*i.e.*, Available Power Not Generated.

³⁶(...continued)



B. The Amount Of Available Power Not Generated Does Not Suggest Material Withholding During The Firm Service Interruptions

Staff's review of the SLIC log entries accounts for most, but not all of the potentially Available Power Not Generated by the five generators studied during the firm service interruptions. It appears that a small amount of Available Power Not Generated existed during the firm service interruptions for which staff's investigation found no explanation. Specifically, the estimated amount of aggregate (by all of the five generators) megawatts that were available, not generated and not accounted for on the first hour of the firm service interruptions were as follows:

Interruption Date	Available MW Unaccounted For	MW Interrupted
January 17, 2001	73 MW	500 MW
January 18, 2001	55 MW	1000 MW
March 19, 2001	50 MW	500 MW
March 20, 2001	62 MW	500 MW
May 7, 2001	194 MW	300 MW
May 8, 2001	120 MW	400 MW

No one generator ever accounted for more than 75 megawatts in one of those hours. Moreover, the megawatts were widely spread among the multiple generating units of each generator. Listed below is an example of staff's detailed analysis of multiple generating units for one generator during hour ending 10 on January 18, 2001.³⁷

Generating Unit	CPUC's Calculation³⁸	Staff's Estimate	Accounted For By Staff	Unaccounted For By Staff
El Segundo 7, #1	N/A	8		8
El Segundo 7, #2	N/A	46	46	
El Segundo 7, #3	N/A	0		
El Segundo 7, #4	N/A	0		
Encina 7, #1	N/A	0		
Encina 7, #2	N/A	18	18	
Encina 7, #3	N/A	0		
Encina 7, #4	N/A	163	163	
Encina 7, #5	N/A	0		
Long Beach, #2	N/A	1		1
Long Beach, #6	N/A	20	20	
Total	269	256	247	9

As the above illustration demonstrates, the nine megawatts of power not produced for which there is no explanation do not appear to represent purposeful withholding and are plainly not in the order of magnitude that could have averted the firm service interruptions had they been produced. Moreover, although eight megawatts were not produced from the El

³⁷ The generator, at staff's request, waived its confidentiality of this data solely for purposes of this report.

³⁸ The CPUC did not provide the results of its computations on an individual unit basis; rather, it provided the aggregate numbers for each of the five generators.

Segundo 7, #1 unit, that unit had bid its full capacity into the ancillary services and supplemental markets,³⁹ but the eight megawatts were not called upon by the CAISO. With respect to the one remaining megawatt that the Long Beach #2 unit purportedly had available and did not produce, it is more likely attributable to an error in the CAISO database or a minor deviation in the production level that is endemic to generating plants.

There were six instances among the 58 studied in which the amount of apparent Available Power Not Generated was greater than 20 megawatts (per generating unit) for which staff's review of the CAISO's SLIC logs could not account. None of these six unaccounted for situations exceeded 53 megawatts, but staff could not determine why the power was not generated. For instance, on January 17, 2001 at hour ending 12, a generating unit with a maximum capacity of 57 megawatts was only generating 27 megawatts. The SLIC logs reflected only that an outage occurred due to a lockout, but that it lasted only nineteen minutes and was over by 7:18 am. According to the CAISO and its records, the CAISO was not notified by the generator that the problem was repaired until two days later, so it was not called upon by the CAISO.

In the final analysis then, as the chart set forth on page 5 *supra*, demonstrates, the estimated amount of Available Power Not Generated by Duke, Dynegy, Mirant, Reliant, and Williams for which staff was unable to account was not sufficient to have averted the firm service interruptions.

C. The CPUC's Analysis Of The Generators' Bidding Overstates The Amount Of Power Not Bid

1. The CPUC's Calculation Of The Amount Of Power Not Bid

To review the CPUC's calculation of the amount of Power Not Bid, it is necessary to understand the structure of the CAISO's markets during the time period studied.⁴⁰ The CAISO had three markets: (1) the day ahead; (2) the hour ahead; and (3) real time. In the day ahead and hour ahead markets, the generators could bid, and the CAISO could purchase, ancillary services, consisting of regulation up, regulation down, spinning reserve, non-spinning

³⁹ See Section VI.C.1 *infra* for a discussion of the CAISO's markets.

⁴⁰ The California Power Exchange (California PX) ceased operations in January 2001. However, the CAISO informed staff that by the time of the first firm service interruption on January 17, 2001, the volumes of transactions conducted in the California PX had dropped to a practically negligible level.

reserve, and replacement reserve. In the real time market, the generators could bid supplemental energy and, in order to balance the system, the CAISO could call upon the ancillary services it had procured or purchase supplemental energy. The table below reflects the products of the CAISO's markets:

Product	Day Ahead	Hour Ahead	Real Time
Regulation Up	x	x	
Regulation Down	x	x	
Spinning Reserve	x	x	*
Non-spinning Reserve	x	x	*
Replacement Reserve	x	x	*
Supplemental Energy			x

* Spinning Reserve, non-spinning reserve, and replacement reserve are capacity products available for procurement by the CAISO in the day ahead and hour ahead markets. Energy corresponding to those capacities is available for purchase by the CAISO in the real time market.

The CAISO market system was designed to receive bids electronically from the generators in the three markets and pricing was established through a market clearing auction. If the CAISO needed additional energy not bid through one of its three markets, it could reach agreements with generators to supply energy at agreed upon prices referred to as out of market (OOM) sales.⁴¹

In addition to the amount of Available Power Not Generated, the CPUC attempted to calculate the amount of power that Duke, Dynegy, Mirant, Reliant, and Williams did not bid into the California market during the service interruptions. The methodology employed by the CPUC, as described in its Report, was to subtract from each generating unit's capacity:

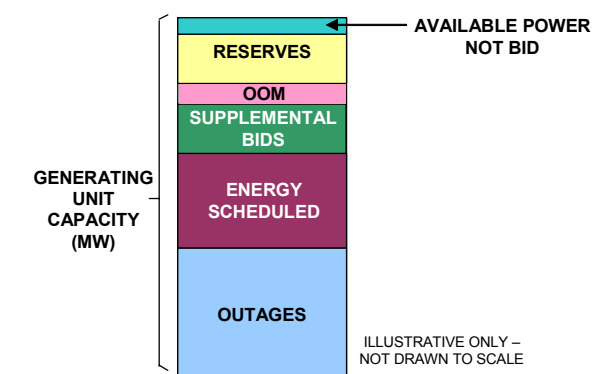
⁴¹ The CAISO uses the term OOM to refer to all generation purchased outside of the generators' electronic bids that are known as the BEEP stack (BEEP refers to Balanced Energy Ex Post Pricing).

- (1) outages;
- (2) hour ahead energy schedules;
- (3) bids into the real time supplemental energy market;
- (4) agreements to supply power out of market (OOM); and
- (5) any reserve obligations.

Report 17-18. Thus, the CPUC's apparent calculation was as follows:

Available Power Not Bid = Capacity - Outages - Energy Scheduled - Supplemental Bids - OOM - Reserves

Or, graphically, the CPUC's calculation of Power Not Bid was:

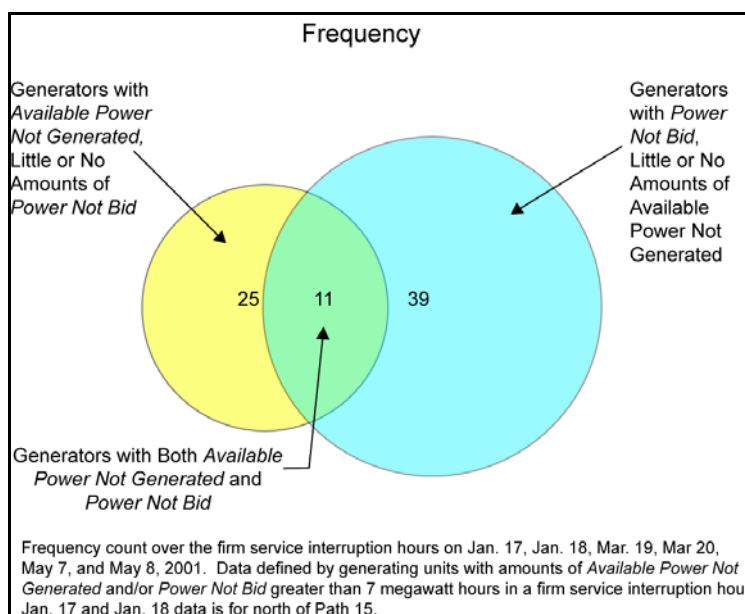


Once again, at first glance, the CPUC's equation appears simple and reasonable. However, again the CPUC's analysis stopped too soon and it did not look at the detailed unit level as is required. Staff replicated the CPUC's calculations for the days of the firm service interruptions with the CAISO's assistance.⁴² But staff then went further and looked at the SLIC logs and reviewed the individual units that appeared not to have bid for the firm service interruptions. The results of that endeavor are principally two:

⁴² The CAISO provided the component bid quantities of "Reserves" in the CPUC's equation and provided the algorithm by which the components should be combined. For the reasons discussed below, however, in Sections VI.C.2 and VI.C.3, staff's replication does not suggest that the CAISO's bid analysis represents all offers of power to the CAISO.

- (1) Many of the instances where generators did not bid are explained by the outages errors, unit start-ups, and the provision of Regulation Up or Regulation Down, discussed previously; and
- (2) The CPUC's conclusion, that the generators "did not generate all available power . . . in significant part because they did not bid all available power into the ISO real-time market on those days,"⁴³ is not supported by the calculations.

In approximately 35 percent of the instances that the CPUC claimed generators were not bidding all of their available power during firm service interruptions, staff's review shows that the generating units did not have available power. In over half of the instances where staff could not account for the Power Not Bid by its review of the SLIC logs, the CPUC attributes a quantity of Power Not Bid to generating units that produced all of their available capacity in the same hour. In other words, the CPUC's Power Not Bid numbers do not coincide with the generating units that were allegedly not generating, as the following figure demonstrates:



⁴³ Report 29 (emphasis original). See also Report 37 ("[I]t is reasonable to conclude that failure to bid was a major reason why the five generators did not generate all available power on the 32 days statewide blackout and service interruptions day that occurred between November 2000 and May 2001."

Power Not Bid and Available Power Not Generated Quantities Coincide With The Same Generator In Only Limited Cases

In the few cases where both the Power Not Bid and Available Power Not Generated coincided (*i.e.*, the same generating unit), the amount of relevant megawatts was significantly less than the amount of firm load that was interrupted during the same hour.⁴⁴

Furthermore, the CPUC overstates the estimated amount of Power Not Bid by the generators because the CPUC's analysis of bidding by the generators fails to take into account several significant factors, such as start-up rates, environmental restrictions, and non-electronic bids, as discussed below. Staff was unable to quantify the actual amount of available Power Not Bid because not all the necessary data was maintained by the CAISO for the relevant time period. However, when the CPUC ignored these factors it overstated the available Power Not Bid by the generators, as more fully discussed below in Sections C.2 and C.3.

2. The CPUC Did Not Consider Non-electronic Bids And Certain Bilateral Contracts/Offers With CAISO And CDWR

The CPUC calculated the amount of bids made by the generators based on energy scheduled in the hour ahead market, bids into the supplemental energy market, and OOM sales. Report 17-18. But the CPUC did not account for all energy that was offered by the generators in at least two respects.

First, the CPUC used only OOM *sales*, not OOM-related offers. The CAISO only has data on completed OOM sales and this is the data used by the CPUC. However, an OOM-related offer that the CAISO may not have accepted because it was deemed too high a price (or for any other reason) is still an offer and should not be excluded from an analysis of whether all available capacity was bid into the market. As noted, the Report did not analyze prices or possible exercises of market power so the fact that a generator's requested price in a potential OOM transaction was deemed excessive by the CAISO should not have been a reason to exclude it from being a legitimate offer to provide power. For example, Dynegy faxed to the CAISO on a regular basis during January 2001 through March 2001 what it referred to as its "OOM sheets." The Dynegy OOM sheets set forth the amount of megawatts that its units had available and at what OOM price Dynegy would produce energy for the

⁴⁴ For a detailed explanation of staff's analysis of the relationship of the Power Not Bid and the Available Power Not Generated during the firm service interruptions, see Appendix D.

following day.⁴⁵ Staff found no indication that the CPUC considered such offers in its analysis.⁴⁶

The CAISO informed us that it did not provide to the CPUC, nor did the CPUC request, any information on bids by the generators other than what the CAISO had available in its electronic database. Yet, during the relevant time period generators periodically called or faxed in bids. For example, in addition to the Dynegy OOM sheets that were faxed to the CAISO, Reliant noted in its Response to the Select Committee that after the CDWR contract discussed below expired, "Reliant continued to offer bilateral generation that was available to CDWR by phone." Reliant October 11, 2002 letter to Select Committee 7. Williams similarly pointed out that the CPUC did not apparently factor in bids made by telephone that were often required since the rules in effect at the time did not allow bids to be taken after 45 minutes before the hour (for power) or three hours before the hour (for ancillary services). Williams October 1, 2002 letter to Select Committee 2.

Second, some of the generators entered into agreements with the CAISO or CDWR whereby they offered to generate power at OOM prices. Those agreements do not appear to have been included in the CPUC's analysis. For example, from February 21, 2001 through March 22, 2001, Reliant entered into a contractual arrangement in which it offered its power for sale directly to CDWR rather than through the CAISO.⁴⁷ Similarly, Dynegy entered into a contract with the CAISO that gave the CAISO the right to all generation capacity under Dynegy's control between December 5 and 15, 2000 at a price determined by an agreed upon formula.

⁴⁵ Whether Dynegy's offers were an attempt to exercise market power was beyond the scope of this study and not considered.

⁴⁶ In fact, the CPUC admitted that it did not consider "rejected" bids in the day ahead market because, according to the CPUC, that market was "dysfunctional, and the fact that a bid was rejected simply does not imply that the associated power was not needed." Supplemental Report 12. The CPUC fails to acknowledge, however, that rejected bids were nonetheless bids and that by not taking them into account, it was overstating the amount of available power not bid by the generators.

⁴⁷ In its Supplemental Report, the CPUC noted that the CDWR entered into agreements with some of the generators. Supplemental Report 16. However, instead of acknowledging that the amount of Power Not Bid may have been overstated by failing to account for any such offers that CDWR did not accept, the CPUC merely stated that it is important to find out if the CDWR had a good reason for turning down any offers of power. *Id.*

In short, the CPUC's Report's review of the generators bids did not take into account the entire universe of generators' offers to produce energy. Moreover, that information cannot be accurately replicated at this time because, at least with respect to the non-electronic offers of power, the CAISO has not retained the records. The CAISO informed staff that it keeps records only of its completed OOM transactions, but not of any OOM offers that were not accepted by the CAISO.

3. The Effect Of Unit Start-Ups And Environmental Restrictions On The Bidding Process Were Not Considered In The CPUC's Analysis

The CPUC's bidding analysis focused on the real time market, which closed 45 minutes prior to each hour, because, according to the CPUC, "[b]y this time, the generators knew their commitments in all other markets, and could have bid in all their remaining power into California's market." (Report 30). However, the CPUC's statement overlooks at least two fundamental factors that may have affected the generators' bidding behavior.

As discussed earlier, many generating units take several hours to start up once they have been off-line before they can generate power at full capacity. Indeed, older units can take as long as twelve hours to ramp up. Duke, Dynegy, Reliant, and Williams each pointed out in their responses to the Select Committee that long ramp times and operational problems sometimes incurred in starting up units and can result in discrepancies in actual availability of power and CAISO's records of availability.⁴⁸ Dynegy also noted that the CAISO bid system in place during late 2000 and early 2001 did not take into account the long start-up times that made it "neither economically nor practically feasible to submit bids on a 10-minute, or even hourly, basis for a unit that needs eight or more hours to ramp-up." Dynegy October 3, 2002 letter to Select Committee 3. Similarly, Reliant stated that if "energy was not taken in the Day Ahead market, then units might not be available for bidding into the real-time energy market due to start-up lead time constraints." Reliant October 11, 2002 letter to Select Committee 2.

Environmental restrictions also may have affected certain generators' ability to bid in all of their available capacity in either the day-ahead or real-time markets.⁴⁹ Williams noted

⁴⁸ The CAISO advised staff that it did not have data relating to start-up times of generating units until 2002.

⁴⁹ Environmental factors can cause a unit to be unavailable for service. For example, there are restrictions on units exceeding annual permissible levels of nitrous

(continued...)

in its response to the Select Committee, that two of its units are peaking units that are capable of producing 133 megawatts each, but have high NOx emissions levels. As a result, they have limitations to yearly operating hours imposed by the Southern California Air Quality Management District (SCAQMD). For example, one of the peakers (Alamitos Unit 7) had an annual limit of only 200 megawatt-hours of operation per year, a limit that had already been reached by February 2001. According to Williams, although a series of Executive Orders by California's governor permitted the units to continue operating, SCAQMD imposed restrictions, including that they operate only upon the request of the CAISO during emergencies to avoid service interruptions or maintain essential reserves. Thus, Williams contends that it could not bid these units' generation until the CAISO requested the units since Williams could not predict when the system emergencies would be declared by the CAISO.

Similarly, Mirant representatives advised staff that the Delta Dispatch provisions restrict Mirant from running its Pittsburg and Contra Costa units at full capacity from approximately May 1 until mid-July. Under Delta Dispatch, the discharge water temperatures must not exceed 86 degrees, thus including two of the firm service interruptions. Mirant must estimate the dispatch limitations on its plants based on water temperatures and schedule its units accordingly. Mirant advised staff that in 2001, it scheduled its units in the day ahead market consistent with the Delta Dispatch protocols and *estimates* of available capacity. Because bids were due in the real time market 45 minutes prior to the applicable hour, Mirant could not bid all available supplemental energy into the real time market if it was unsure 45 minutes in advance whether the generation would result in temperature above 86 degrees.⁵⁰

⁴⁹(...continued)

oxides (NOx) emissions, particularly in southern California. Unless waivers from the applicable agencies are granted, the generators can face expensive fines for exceeding those limits. Other important environmental factors include potential impacts on water quality and temperature. For example, units located in the Sacramento River and Delta area must be shut down or have their output reduced when the unit discharge causes the ambient water temperature to exceed a certain level. This requirement is to protect the reproductive success of the indigenous and anadromous fishery. The timing of such reductions in output, while anticipated, cannot be predicted with certainty and can result in short term fluctuations in supply.

⁵⁰ Although the Delta Dispatch requirements limited Mirant's ability to bid all available capacity in the day ahead and real time markets, Mirant told staff that when the CAISO instructed it to deviate from the Delta Dispatch provisions by producing more generation, it did so.

In summary, by failing to take into account the effect that environmental restrictions and unit start-ups had on generators' bidding patterns, and focusing instead on bidding in the real time market only, the Report ignores significant aspects of the generators' bidding behavior. This, along with the CPUC's failure to account for non-electronic bids and bilateral contracts with the CAISO and CDWR, undermines the CPUC's conclusion that generators failed to bid all of their available power into the markets as part of a deliberate withholding strategy.

D. There Were Problems With The CAISO's Data

The CAISO has acknowledged that many of its data collection and reporting processes during the time period of the service interruptions were deficient and in need of improvement. In fact, in mid-2001, the CAISO performed "a comprehensive assessment of control room dispatch documentation for the period from November 1, 2000 through May 13, 2001," which became known as Project X. (Project X Recommendations, July 18, 2001). Among the findings of Project X was that there existed many differences and irregularities between the documentation in the CAISO dispatch logs and the recorded data in other databases of the CAISO. These differences and irregularities related to, *inter alia*, start and ending times, the amount of megawatts generated, and the type of dispatch instructions. Although many of these discrepancies were corrected during Project X and a number of new procedures were implemented as the result of Project X, it appears that not all the data errors for the November 2000 through May 2001 time period were corrected. For example, some of the Project X work papers reflect that a record in the SLIC log was missing or an entry was never made in the SLIC log.⁵¹

Staff also knows from experience that the generator outage data reported by the CAISO in the spring of 2001 was inconsistent and inaccurate. Beginning in December 2000, the CAISO began providing staff with outage information on a daily basis. However, there were frequent discrepancies between the outage data the CAISO was providing staff and the outage

⁵¹ See, e.g., Workpaper No. 007108 (noting entries for January 17, 2001 in the CAISO's OSMOSIS database (reflecting bids that were accepted out of market and/or out of sequence) were not reflected as dispatched in the SLIC log because "[d]ispatch was likely logged on the whiteboard in the control room."); Workpaper No. 006799 (entry for January 18, 2001 contained in OSMOSIS database, but not the SLIC log, with notation that "[n]o correction required, missing SLIC log."); Memorandum from Sean Barry to Charlie Robinson (No. 015469) ("As a practical matter it is very difficult to recreate exact control room conditions several months after the fact Accordingly, there was no effort to reassess the quality of dispatch decisions made; nor was it practical to ascertain if all dispatches were initially logged.").

data posted on the CAISO's web site. Staff also discovered inaccurate information while attempting to confirm the CAISO's outage information with the generators. At the time, staff informed the CAISO of the discrepancies and understands that the CAISO has undertaken some steps to correct the problems.⁵² But the fact remains that the CAISO's outage data for the time period prior to mid-May of 2001 is not consistently reliable.

Similarly, the CAISO maintained two different data sets listing capacity for the generating units. A unit's maximum generation capacity is known as PMAX. The CAISO has a master PMAX file. However, one of the SLIC databases for outages also listed the PMAX of the units. The problem is that the CAISO advised staff that the SLIC PMAX file is sometimes different than its master PMAX file. Apparently, the CAISO operations personnel sometimes changed a PMAX number in the SLIC records when they learned that a unit's generating capacity had changed even though the process required to make a change in the master PMAX file had not yet occurred.⁵³

The purpose of these comments regarding the CAISO's data is not to criticize the CAISO. In fact, the CAISO should be commended for acknowledging that some of its data reporting processes needed improvement and attempting to develop new systems to correct the problems. However, the unreliable nature of the historical data is important for staff's review of the Report on service interruptions in late 2000 and early 2001. Much of the CAISO data utilized by the CPUC must be recognized as potentially inaccurate or incomplete. The CPUC's Report, however, did not recognize this important fact in reaching conclusions drawn from that data.⁵⁴

⁵² In an email, a CAISO employee noted that he appreciated staff pointing out the errors in the CAISO's outage data and "drawing attention to the growing importance of accurate outage data as part of market power monitoring/mitigation and the poor quality of data compiled by the ISO to date. It confirms/supports an internal battle we have been waging for some time . . . to improve outage and tracking and reporting.").

⁵³ Staff understands that the CPUC used the PMAX numbers from the SLIC outage database. This may account for some of discrepancies in the generators' PMAX numbers and those used by the CPUC that were noted by some of the generators in their responses to the Select Committee. *See, e.g.*, Duke September 26, 2002 letter to CPUC 2; Mirant September 26, 2002 letter to Select Committee 4; Williams October 1, 2002 letter to Select Committee 3.

⁵⁴ In its Supplemental Report, the CPUC appears to acknowledge that there may have been errors in the CAISO's databases, but nevertheless maintains that its unqualified reliance on them was reasonable. Supplemental Report 9-10.

E. The CAISO's Emergency Dispatch Authority Did Not Materially Affect The Firm Service Interruptions

The initial Report did not discuss the CAISO's emergency authority under its tariff to dispatch available power that was not bid into the market. In fact, the CPUC stated that "[i]f a generator neither bid power into markets nor supplied that power 'out-of-market' to the ISO, the ISO could not dispatch that power to meet electricity demand within its control area." Report 30. That is not entirely correct. The CAISO had emergency authority to dispatch power instructions to a generator. Section 5.6.1 of the CAISO Tariff for the relevant time provided, in pertinent part, that:

The ISO shall . . . have the authority to instruct a Participating Generator to bring its Generating Unit on-line, off-line, or increase or curtail the output of the Generating Unit and to alter scheduled deliveries of Energy and Ancillary Services into or out of the ISO Controlled Grid, if such an instruction is reasonably necessary to prevent an imminent or threatened System Emergency or to retain Operational Control over the ISO Controlled Grid during an actual System Emergency.

CAISO Tariff § 5.6.1. The CAISO's authority to dispatch generation not bid during emergency situations is germane to the CPUC's conclusion that the generators' failing to bid available power was a major factor in causing the service interruptions. Specifically, before blaming the five generators for causing the service interruptions, the CPUC should have considered whether there was any available power from those and other California generators that the CAISO failed to attempt to dispatch with its emergency authority. The effect of the CAISO's emergency authority requires an examination of the circumstances during the relevant time period, both from the CAISO's perspective and that of the generators.

In its Commentary regarding the Report, the CAISO took strong exception to the suggestion by some generators that its emergency powers were the equivalent of "control" over the generators. CAISO Commentary 8. Rather, the CAISO claimed that generators routinely ignored the CAISO's emergency instructions. *Id.* In response to a request from the CAISO, the Commission issued an order on December 8, 2000 that granted the CAISO the ability to assess penalties against generators that failed to comply with emergency instructions.⁵⁵

⁵⁵ See 93 FERC ¶ 61,239. (December 8, 2000). This order was limited to dispatch instructions issued during System Emergencies and not, as the CPUC erroneously implies, for any dispatch instructions that were declined. See Supplemental
(continued...)

Staff asked the CAISO for specific information relating to the generators' alleged refusals to follow emergency instructions. In response, the CAISO provided data regarding assessment of penalties. Pursuant to the penalty provision in effect at the relevant time,⁵⁶ a generator was assessed a monetary penalty for each megawatt per hour of the dispatch instruction with which the generator did not comply.⁵⁷ A generator was not subject to penalties if the generator could demonstrate that it failed to comply with the dispatch instruction either because (1) the generating unit was physically incapable of responding in accordance with the instruction **if** the generator notified the CAISO in advance that the unit was unavailable or derated,⁵⁸ or (2) compliance with the dispatch instructions would have resulted in a violation of an applicable state or federal law.

Two points are most noteworthy from staff's review of the CAISO data on penalties. First, the number of declines by the five generators was primarily for relatively small amounts of power (almost 90 percent of the declines were for less than 25 megawatts and the average amount declined was 12 megawatts). *See* Appendix E for a chart reflecting the aggregate of the five generators' declines for emergency dispatch instructions on January 15-23, March 17-22, and May 5-10, 2001. The largest hourly sum of all five generators for which dispatch instructions were declined on these dates occurred during the 5:00 p.m. hour on January 18, when ten generating units declined a total of 110 megawatts or one percent of the total available capacity from the given generators for that hour. Notably, this was after the peak load and after power was restored from firm service interruptions that day and would not have prevented the 1000 megawatts interrupted earlier that day.

Second, because penalties were assessed regardless of the reason for the decline if the generator failed to notify the CAISO within the operating hour that it could not provide the power and the reason, staff could not determine if the decline was (1) due to economic

⁵⁵(...continued)
Report 10-11.

⁵⁶ The CAISO's authority to assess penalties for failure to deliver energy during system emergencies was revoked effective June 20, 2001, following the time period that is the subject of the Report. See 95 FERC ¶ 61,418 (June 19, 2001).

⁵⁷ CAISO Tariff § 5.6.3.1.

⁵⁸ More specifically, Section 5.6.3.2 of the CAISO Tariff required the generator to notify the CAISO operations staff of its reason for failing to comply with the dispatch instruction *within the operating hour* that the instruction was issued and then verify the reason the generator failed to comply within 72 hours from the time the instruction was issued.

reasons, or (2) due to a physical limitation on the plant, but the generator failed to timely notify the CAISO of the limitation.

On the other hand, despite the relative small number of megawatts declined under emergency dispatch instructions and the generators' contrary protestations in their responses to the Select Committee, staff is aware that there were some instances during the time period studied by the CPUC that generators refused to follow the CAISO emergency dispatch instructions. The details of these declines, which staff learned during the course of an earlier nonpublic investigation, occurred in the first week of December 2000. In general, however, the generators disputed the CAISO's efforts to use its emergency dispatch authority under the conditions existing at the time.⁵⁹ In most cases, the generators agreed to follow the disputed instruction after the CAISO agreed to pay the price requested by the generator. As a result, in at least some instances, the CAISO operators asked for power without invoking the emergency dispatch authority and accepted the price offered by the generator as an out of market transaction rather than debate the price or the authority to issue the emergency instruction, in an effort to keep the grid running.

Still another aspect of the CAISO's emergency authority to dispatch available power that must be taken into account is the practical limits and constraints under which the CAISO was operating when it attempted to issue emergency instructions. The CAISO informed staff that, as a practical matter, the CAISO could not call 1300 individual generating units on its system to locate available power during the system emergencies that occurred in late 2000 and early 2001. Rather, it needed supplemental energy bids from the generators in order to effectively dispatch pursuant to its emergency authority. Thus, as soon as the CAISO knew from its forecasts that system problems were likely, it began issuing alerts and warnings to the generators by email that requested any available energy be bid into the CAISO's electronic system. An example of one of the CAISO's warnings was included in its Commentary to the Select Committee:

[T]he ISO is predicting deficiencies in Operating Reserve The ISO is issuing a "Warning" notice and is *requesting* additional Supplemental Energy bids during this period.

⁵⁹ Reliant filed a complaint with the Commission (Docket No. EL01-57-000), arguing that the CAISO's emergency dispatch authority should not apply in circumstances in which economic conditions caused the emergency. The issue of when the CAISO may appropriately use its emergency dispatch power is not relevant today because of the existence of the "must offer" requirement effective on May 29, 2001, which mandates that all generation be provided to the CAISO unless the CAISO grants a waiver.

CAISO Commentary 8, n. 7 (emphasis added). Although the CAISO operations personnel who spoke to staff said that they believed the generators had an obligation upon receiving such warnings and requests for bids to submit bids for any available power, the CAISO tariff only required the generators to comply with emergency dispatch instructions, not with requests to submit bids.⁶⁰

Absent supplemental energy bids from the generators, the CAISO's dispatch personnel could only review telemetered data from generators on the CAISO's Energy Management System (EMS) data to determine whether a generating unit had some apparent available power and then call the scheduling coordinator or unit to instruct that the power be supplied. Although this was an ad hoc and chaotic process undertaken in stressful circumstances, the operations personnel maintain that there were no material amounts of power that were not bid or not called upon by the CAISO through its emergency authority—a position that is confirmed by the staff's analysis for the firm service interruptions.

Nonetheless, in any future emergencies the "must offer" requirement that was implemented in late May 2001 alleviates many of the problems experienced during the emergencies in late 2000 and early 2001. Should a system-wide emergency present itself again, the CAISO should not have a lack of bids from which to issue its emergency dispatch instructions since all generating units within California must bid in their available power absent a waiver from the CAISO.

F. Intrazonal Transmission Constraints Do Not Appear To Have Affected The Firm Service Interruptions

The Report only discussed transmission constraints on Path 15 and did not consider whether local or intrazonal transmission constraints (as opposed to interzonal constraints that can result due to congestion on Path 15) were a contributing factor in some generating units not being fully dispatched.⁶¹ The CAISO pointed out in its Commentary to the Select

⁶⁰ Similarly, in its Supplemental Report, the CPUC maintains that the CAISO's emergency authority did not relieve the generators of their failure to bid all available power into the market. Supplemental Report 11.

⁶¹ With respect to Path 15, the transmission path between central and southern California that is often constrained, the CPUC calculated the Path 15 unused capacity as the applicable rating (north to south or south to north) minus the Path 15 maximum flow during the hour, minus a 200 megawatts safety margin. Report 18-19. The CPUC's analysis also included sensitivity studies wherein safety margins of 600 megawatts and 50

(continued...)

Committee that a factor not mentioned in the Report that is relevant to the issue of calculating available capacity is whether any power that was bid was not dispatched because of intrazonal transmission constraints. CAISO Commentary 5. However, in order to determine whether intrazonal congestion and local transmission constraints would have prevented additional power from being dispatched had it been made available, it is essential to have snapshots of then-current system conditions and grid topology for the time periods during which the service interruptions occurred. Such system snapshots would allow power flow representations of system conditions to be prepared and permit re-creation of system conditions during the service interruption periods.

The CAISO did not maintain snapshots of system conditions during the service interruption periods. Nor does the CAISO have a complete record of local and intrazonal transmission constraints during the periods studied. All that the CAISO has available from the relevant time period are power flow models typically used for seasonal operations planning studies. Such models are not sufficient to effectively recreate system conditions during the service interruptions with the necessary parameters and accuracy.

Staff reviewed SLIC log entries in an attempt to identify instances when intrazonal congestion may have limited a unit's output, but found no notations by system operators to that effect. In addition, staff inquired of a number of the CAISO operations personnel whether they had knowledge of any intrazonal congestion that limited a unit's output during the periods of service interruptions. As a result, staff was unable to find any solid evidence that any intrazonal congestion was present during the days on which there were firm service interruptions. Nonetheless, without the system snapshots that the CAISO does not have, it is impossible to know what effect any additional power might have had on the grid. For instance, at a given hour on one of the days with service interruptions, if some of the lines were near their capacity and another 25 megawatts was supplied by one of the generators, it is theoretically possible that the result might have been intrazonal congestion such that additional power could not have been dispatched. Thus, neither the CAISO, the CPUC, nor

⁶¹(...continued)

megawatts were tested. The Report stated that the results did not vary with changes in these assumptions. *Id.* at 19, n.23. Staff was able to replicate the CPUC's calculation of available Path 15 capacity using Path 15 rating and flow data provided by the CAISO and by shifting the CPUC hourly availability figures by one hour, but staff cannot explain this one-hour difference. However, the above-stated assumptions by the CPUC regarding Path 15 congestion during firm load interruption hours are consistent with the CAISO SLIC log entries relating to generation dispatch instructions for interzonal congestion mitigation.

staff can determine with absolute certainty whether additional power by the generators would have prevented the service interruptions.

G. The CPUC's Report Must Be Viewed In The Appropriate Context

It is important to place the CPUC's study in perspective in terms of the entire electricity market as it existed in California during late 2000 and early 2001. The CPUC chose to focus on the five largest non-utility generators' conduct during the service interruptions.⁶² The CPUC omitted any mention of other generators. Owners of QFs, for example, which in the aggregate have over 5000 megawatts of generation, began shutting their facilities down in late 2000 and early 2001 when they were not assured of getting paid due to the financial troubles of the largest utilities. During some days in March 2001, for example, generation from QFs was down over 2000 megawatts.⁶³

Further, as the CAISO noted in its emergency response reports issued contemporaneous with the service interruptions, the CAISO operating personnel were unable to make accurate predictions of the amount of power they would have available because they could not obtain commitments in the forward markets "due to the financial concerns by generator owners, both in *and out of state*." (May 8, 2002 email from CAISO Emergency Response Coordinator)(emphasis added). Similarly, in referring to the large amount of generation out of service on one of the days when there was a firm service interruption (12,517 megawatts), the CAISO emergency coordinator noted that the large number of outages included two of four nuclear units that were out for maintenance.⁶⁴ *Id.*

The question of whether merchant generators helped to cause the service interruptions must be viewed in a larger context. A combination of events and policies gave rise to the California electricity crisis. Volumes has been written on this issue and it need not be repeated here. However, the California Public Policy Institute of California's report aptly noted:

⁶² During the relevant time, the CAISO had approximately 45,000 megawatts of generation capacity in its control area, of which the five generators held approximately 17,000 megawatts.

⁶³ On March 19, 2001, a CAISO news release stated that "half of the state's Qualifying Facilities (QFs) are not operating because of reported financial concerns, low wind, or an inability to purchase natural gas to run the plants."

⁶⁴ The maintenance on the two nuclear units represented 1148 unavailable megawatts.

Any search for simple answers . . . risks misperceiving the intricacies of the systemic failure of California's electricity sector. A satisfactory explanation for the severity of the crisis and its consequences cannot be composed based on any single factor. Rather a number of factors must be considered. These include:

- A shortage of generating capacity,
- Bottlenecks in related markets,
- Wholesale generator market power,
- Regulatory missteps, and
- Faulty market design.

No single factor can fully account for the crisis. . . .

Because California's experience was unique and because a number of factors were simultaneously at play, it is not possible to disentangle fully how each distinctly contributed to the blackouts, major financial crisis, and the systemic breakdown of market institutions. . . .

Christopher Weare, *The California Electricity Crisis: Causes and Policy Options* 2003.

VII. CONCLUSIONS

The service interruptions that California experienced in late 2000 and early 2001 have been, and will continue to be, studied. Such studies can be useful in attempts to avoid the problems and circumstances that contributed to the electricity crisis in California. The CPUC was right to study the amount of alleged Available Power Not Generated by merchant generators. But the means by which to conduct such a study were complex and onerous given the databases and record-keeping systems of the CAISO, causing the CPUC to fall short of its goal.

The CPUC's conclusion, that the 38 specific service interruptions could have been avoided had the five generators produced all of their available power is not supported by the evidence. Staff has demonstrably proven to the contrary for the six days of firm service interruptions. This does not mean, however, that there was no withholding by the generators during the 2000 and 2001 time frame, something which the Commission is still investigating.

The CPUC's calculation of Available Power Not Generated was incomplete. The CPUC failed to review all of the available CAISO data to determine if the power was in fact available. Close scrutiny of all the CAISO's relevant data reveals that the CPUC greatly overstated the amount of available power that was not generated by Duke, Dynegy, Mirant, Reliant, and Williams during the firm service interruptions. Indeed, most of the generation

that the CPUC claimed was available and could have averted the firm service interruptions was unavailable. Staff concludes that 87 percent of the available generation that the CPUC claimed was withheld during the firm service interruptions was either:

- (1) unavailable due to an outage erroneously recorded in one of the CAISO's databases;
- (2) unavailable because the generating unit was on AGC and under the control of the CAISO;
- (3) unavailable because the generating unit was starting up from having been off-line due to a repair or having tripped;
- (4) unavailable because the generating unit was located south of an overloaded transmission path that prevented the transmission of energy to the area suffering from firm service interruptions; or
- (5) unavailable because the generating unit was under some other internal or external physical constraint that prevented it from producing at full capacity.

The actual amount of available power that was not generated by Duke, Dynegy, Mirant, Reliant, and Williams during the firm service interruptions was not enough to have averted those service interruptions. Moreover, the Available Power Not Generated was widely dispersed in relatively small amounts among 66 separate generating units, so it is more likely that the differences reflect rounding or reporting errors than deliberate physical withholding on those days. Staff has disproven the CPUC's claim that but for the physical withholding by the five merchant generators, the firm service interruptions on the six days between January 17, 2001 and May 8, 2001 could have been avoided.

Similarly, the CPUC's study of the amount of available Power Not Bid by the five generators during the service interruptions was incomplete. The CPUC did not appropriately account for all of the variables that are relevant to the generators' bidding activity. Omitted from the CPUC's analysis of bids were all non-electronic bids, certain bilateral contracts with the CAISO and CDWR, environmental restrictions, and start-up limitations. By failing to take these factors into account, the CPUC overstated the amount of available power that Duke, Dynegy, Mirant, Reliant, and Williams did not bid into the California markets during the service interruptions.

Based on staff's review and analysis of the CAISO's data collection systems that were in place in 2000 and 2001, staff urges the CAISO to continue to review and improve upon its information databases. The CAISO's data collection systems were apparently designed as primarily forward looking planning tools which, for purposes of running the grid alone, may be appropriate. However, the CAISO's databases are not adequate for accurate and complete

reconstruction of events. Moreover, maintaining multiple databases, as was the case with outages and PMAX limitations, is fraught with potential problems and likely to cause errors in trying to recreate events. Accordingly, staff recommends that the CAISO review and improve its record-keeping protocols with regard to all aspects of its communications with the generators and that if there are any remaining multiple databases purporting to contain the same information, that sufficient checks and balances be implemented to assure consistency and data quality among all databases. Similarly, to the extent information is available on the CAISO's web site, it should not vary, in substance, from the underlying source database.

In addition, and critical in order to reconstruct events to fully understand in any future service interruptions, the CAISO should develop and implement a state estimator system sufficient to take periodic snapshots of the system conditions and preserve them.⁶⁵ Such data is needed, for example as discussed earlier, in order to determine whether intrazonal congestion and local transmission constraints would have prevented additional power from being dispatched had it been made available.

Finally, while we conclude that no further investigation is warranted at this time regarding the Report's narrow conclusions for the 38 days of service interruptions, staff continues to look at other areas of potential misconduct during the 2000 and 2001 time frame, including whether physical and economic withholding occurred, questionable outages, exercises of market power, and improper trading strategies.

⁶⁵ It is noteworthy that the CAISO operations personnel advised staff that due to additional generation that has become available since 2001, intrazonal congestion relating to dispatching units has become an increasing problem.

APPENDIX

APPENDIX A

Firm service interruptions occurred in California on January 17, 18, 21, March 19, 20, May 7, 8 2001. To investigate whether those interruptions could have been avoided by the largest five merchant generators, as the CPUC claims, staff requested that the CAISO provide the following information on an hourly basis for January 15, 16, 17, 18, 19, 20, 21, 22, 23, 2001; March 17, 18, 19, 20, 21, 22, 2001; and May 5, 6, 7, 8, 9, 10, 2001, for each plant operated by each of the five generators:

PMAX at the Time (the maximum generation capacity of the unit at that hour, assuming no outages, de-rates and environmental restrictions)

MW Scheduled Outage (the amount of megawatts from the unit unavailable during the hour due to a partial or total outage scheduled and approved by the ISO)

MW Forced Outage (the amount of megawatts from the unit unavailable during the hour due to a partial or total forced outage)

MW Emissions Constraints (the amount of megawatts from the unit unavailable during the hour due to air emissions constraints)

MW Other Environmental Constraints (the amount of megawatts from the unit unavailable during the hour due to environmental constraints other than air emissions--*e.g.*, water temperature)

MW Other Non-Environmental Constraints (the amount of megawatts from the unit unavailable during the hour due to all constraints other than emissions constraints and environmental constraints)

MW Unavailable Due to Unit Start-up Limitations (the amount of megawatts from the unit unavailable during the hour due to the time required to bring a unit on-line--*e.g.*, to "warm-up" the unit)

MW Available Generation (the maximum amount of megawatts the unit can produce after all outages, constraints, and limitations are accounted for)

MW Bid Into the Market (the amount of megawatts from the unit bid into the Day-Ahead and Hour-Ahead Markets for energy and ancillary services as those terms are defined in the CAISO Tariff)

MW Bid Accepted (the amount of megawatts bid in and accepted in the Day-Ahead and Hour-Ahead Markets for energy and ancillary services as those terms are defined in the CAISO Tariff)

MW Bid Not Accepted Due to Transmission Constraints (the amount of megawatts bid in by a generating unit that would have been accepted in the Day-Ahead and Hour-Ahead Markets for energy and ancillary had it not been for transmission constraints.)

MW Out-of-Market (the amount of megawatts for which the CAISO entered into an out-of-market agreement for that hour with the scheduling coordinator for the unit)

MW for Bilateral Contracts (the amount of megawatts from the unit that were not bid into the Markets because they were committed and sold under bilateral contracts)

MW Final Schedule (the amount of megawatts from the unit that are scheduled pursuant to the "Final Schedule" as that term is defined in the CAISO Tariff)

MW Generated (the energy delivered from a unit during the hour)

MW Not Dispatched for Congestion Management (the amount of energy from a unit not dispatched in real-time because of transmission constraints)

MW for Reserve Margin (the amount of megawatts for the unit that the ISO did not dispatch for purposes of maintaining an adequate reserve margin for that hour)

Flexible Generation (whether the unit is capable of, and has agreed to, adjust operating levels in response to real time market price or CAISO control signals)

Max Ramp Rate (the maximum rate (in MW/min) at which the unit is normally capable of ramping up or down)

Unit Under AGC (whether the unit was under the CAISO's operational control through AGC during the hour)

MW Dispatched with AGC (the amount of megawatts the CAISO dispatched during the hour using AGC)

Could be Used RMR (whether a local reliability problem existed during the hour for which the unit could have been called upon to run by the CAISO under a RMR contract)

Ordered by CAISO RMR (whether the CAISO ordered the unit to run during the hour pursuant to an RMR contract)

MW Ordered RMR (the amount of megawatts that the CAISO dispatched from a unit during the hour pursuant to an RMR contract, if applicable)

MW Ordered Sec. 5 Tariff (the amount of megawatts that the ISO dispatched from a unit during the hour pursuant to the ISO's emergency dispatch power under section 5.6.2 of the CAISO's tariff at that time)

MW Declined by Generator (the amount of megawatts that the generator declined to provide pursuant to an ISO dispatch instruction for the unit during the hour)

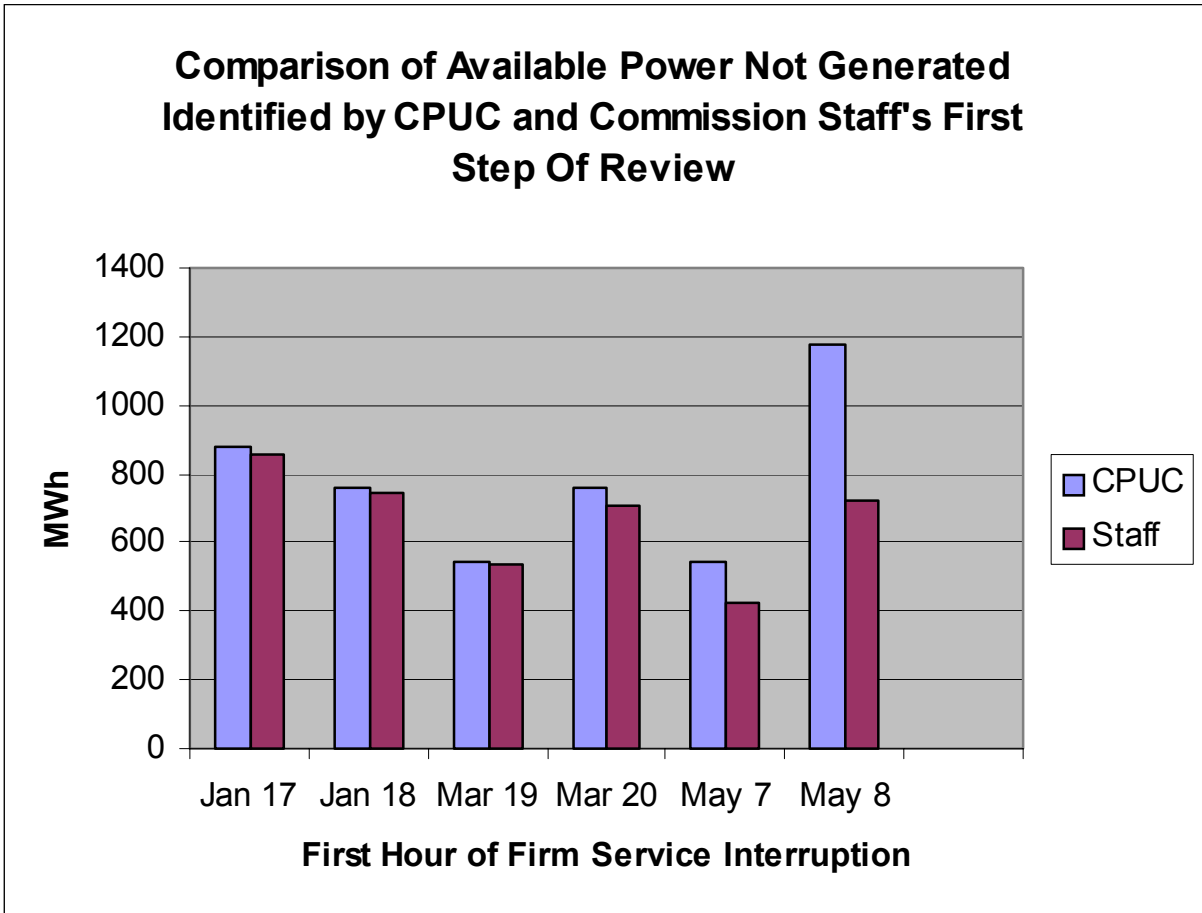
Generating Unit High Operating Limit (the maximum dispatch limit that must be observed due to generating unit limitations or system conditions)

Generating Unit Low Operating Limit (the minimum dispatch limit that must be observed due to the generating unit limitations or system conditions)

Total MW_{BOH} (the total power of the unit at the beginning of the hour)

Total MW_{EOH} (the total power of the unit at the end of the hour; only necessary if the unit's power was different at the end of the hour than the unit's power level at the beginning of the hour)

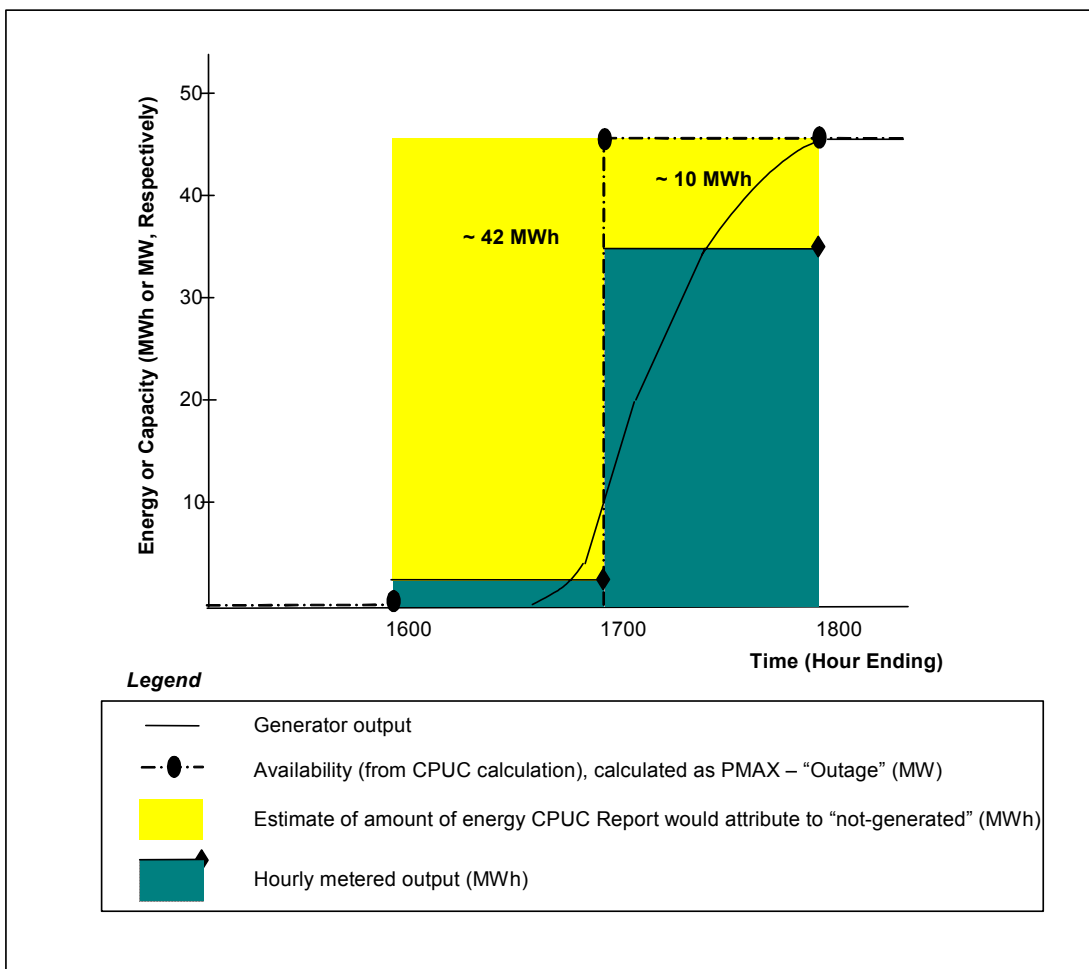
APPENDIX B



Appendix C

Sample Reconstruction of the CPUC Report's Treatment of Unit Outage Data in Relation to a Unit Start-Up: Encina Unit 2 Start-Up On May 7, 2001

The following figure depicts data representative of that upon which staff believes the CPUC relied to calculate amounts of Available Power Not Generated over the course of the period covered by the CPUC Report. The data in this figure was developed from information staff compiled as summarized below.



Staff reviewed CAISO SLIC logs which indicated that Encina Unit 2 tripped at approximately 1255 on May 7, 2001 when experiencing problems associated with the unit's "FD fan." At approximately 1640, CAISO recorded the unit was paralleled and ramping up in power (SLIC log number 557663). As discussed in Section IV.B. of staff's

Report, the CPUC's calculation of Available Power Not Generated is equal to unit capacity less the sum of "outages," generation, and reserves:

$$\text{Available Power Not Generated} = \text{Capacity} - \text{Outages} - \text{Generation} - \text{Reserves}$$

For the Hour Ending (HE) 1500 and HE 1600, CAISO data for "outages" is equal to the unit's maximum capacity of 104 megawatts. Then, at HE 1700 and HE 1800, the outage data is recorded as 59.5 megawatts.

Next, one needs to account for the fact that unit ramp rate limitations restrict how fast the unit's power output can be increased. According to information supplied by Dynegy to the CAISO, Encina Unit 2's ramp rate limit is equal to approximately 2 megawatts per minute.

If the Encina Unit 2 was capable of immediately and continuously increasing power at its maximum ramp rate upon paralleling, then the following would represent the maximum theoretical power levels for HE 1600 and HE 1700:

- Given that the unit was paralleled to the grid approximately 20 minutes before 1700, and given the above ramp rate limit, the maximum output that might theoretically be achievable at the beginning and end of the first full hour after parallel are estimated to be 40 megawatts at 1700 and 45 megawatts at 1800.⁶⁶
- The unit may not be expected to approach 45 megawatts – the unit's availability for HE 1800 – at 2 megawatts per minute (i.e., the ramp might be slowed slightly before reaching maximum availability).
- The corresponding hourly metered output levels for these hours would theoretically be a maximum of 7 megawatt hours in HE 1700 and an amount less than 44 megawatt hours in HE 1800.

Referring to the figure above, the 42 megawatt hours of Available Power Not Generated in HE 1600 should reasonably be expected to be near zero megawatt hours (or not more than 4 megawatt hours from the simplified, theoretical instantaneous-ramp-rate framework)

⁶⁶ Full availability is 45 megawatts for Encina Unit 2 in Hour Ending 1800. Also, it is doubtful that a unit of this vintage is capable of achieving its maximum ramp rate immediately upon parallel. Upon startup for older steam turbine units such as Encina Unit 2, ramps below a minimum production level (e.g., below Pmin) are likely to include some time for such operations as starting equipment thus making integrated power rise equivalent to a slower ramp for a portion of the lower power levels.

and, in HE 1800, the 10 megawatt hours of Available Power Not Generated should be a maximum of 9 megawatt hours (= 45 megawatt hours less the sum of 35 megawatt hours and an unlikely, but theoretical estimate of at least 1 megawatt hour for the ramp from 40 to 45 megawatts).

APPENDIX D

Review of Available Power Not Generated in Relation to Power Not Bid

The CPUC asserted that the amounts of Power Not Bid largely explained the quantities of Available Power Not Generated.⁶⁷ To determine the extent of any relationship between the quantities of Available Power Not Generated and Power Not Bid, staff reviewed the CAISO data on an individual generating unit basis. Based on its review, staff found that there may be only a limited and much smaller relationship between these quantities.

General Approach Staff Used to Review the Data

Staff analyzed the quantities of Power Not Bid and Available Power Not Generated (the “two quantities” associated with each generating unit) using the equations described in Sections V.B. and VI.C. of staff's report. From the two quantities, staff removed the amounts of megawatts that were found to be in fact not available as discussed in Section VI.A.

Next, to determine the extent of relationship between the two quantities, staff tabulated the remaining data by generating unit across all firm service interruption hours. Staff then identified and compared (1) the relative size and distribution of Power Not Bid and Available Power Not Generated quantities, and (2) the values of the two quantities for each generating unit. The detailed analytical methods used and the results are described below.

Relative Size and Distribution of the Two Quantities: Power Not Bid and Available Power Not Generated

Summarizing the individual generating unit data across all firm service interruption hours, staff plotted the two quantities on histograms. Each of the three figures below was prepared by dividing the range of the generating unit energy not generated or not bid into separate bins defined by ranges of energy. Then, for each bin, the number of points (a point is a generating unit in one hour) that fell into each bin was counted. That is, the plots show:

⁶⁷ In its report, the CPUC stated that the five generators "did not generate all available power on those days in significant part because they did not bid all available power into the ISO real-time market on those days" (CPUC Report 29).

- Vertical axis: Frequency (*i.e.*, counts for each bin); and
- Horizontal axis: Range of hourly energy quantities (megawatt hours) in each bin.

The bins for each Power Not Bid and Available Power Not Generated are as follows:

- $0 \text{ MWh} < \text{Hourly Energy} \leq 1 \text{ MWh}$
- $1 \text{ MWh} < \text{Hourly Energy} \leq 2 \text{ MWh}$
- $2 \text{ MWh} < \text{Hourly Energy} \leq 5 \text{ MWh}$
- $5 \text{ MWh} < \text{Hourly Energy} \leq 10 \text{ MWh}$
- $10 \text{ MWh} < \text{Hourly Energy} \leq 25 \text{ MWh}$
- $25 \text{ MWh} < \text{Hourly Energy} \leq 50 \text{ MWh}$
- $50 \text{ MWh} < \text{Hourly Energy} \leq 100 \text{ MWh}$
- $\text{Hourly Energy} > 100 \text{ MWh}$

Figures 1 and 2 below separately plot histograms of the quantities associated with generating units that had amounts of Power Not Bid and Available Power Not Generated. These two histograms are plotted without consideration of any relationship between the Power Not Bid and Available Power Not Generated. Figure 3 is a histogram of the intersection of the two quantities (where the two quantities coincided in the same generating unit).

Figure 1

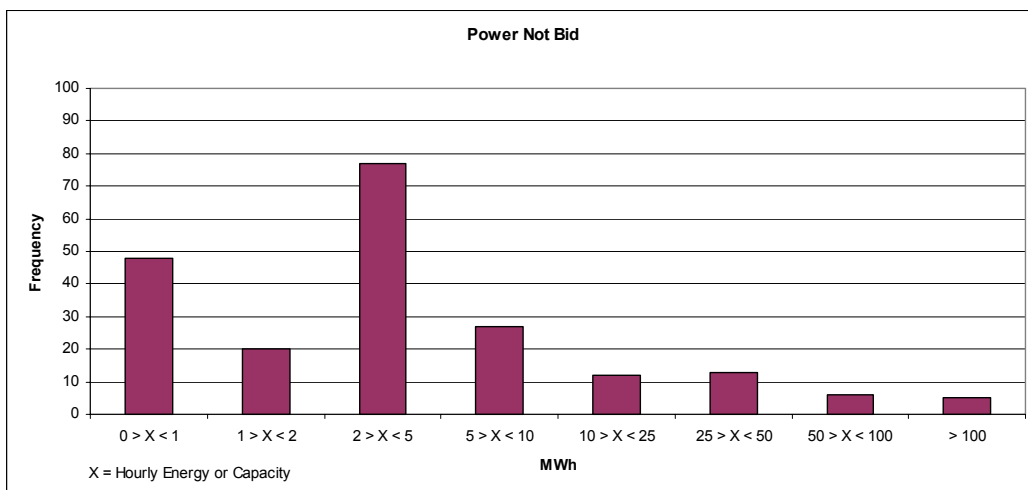


Figure 2

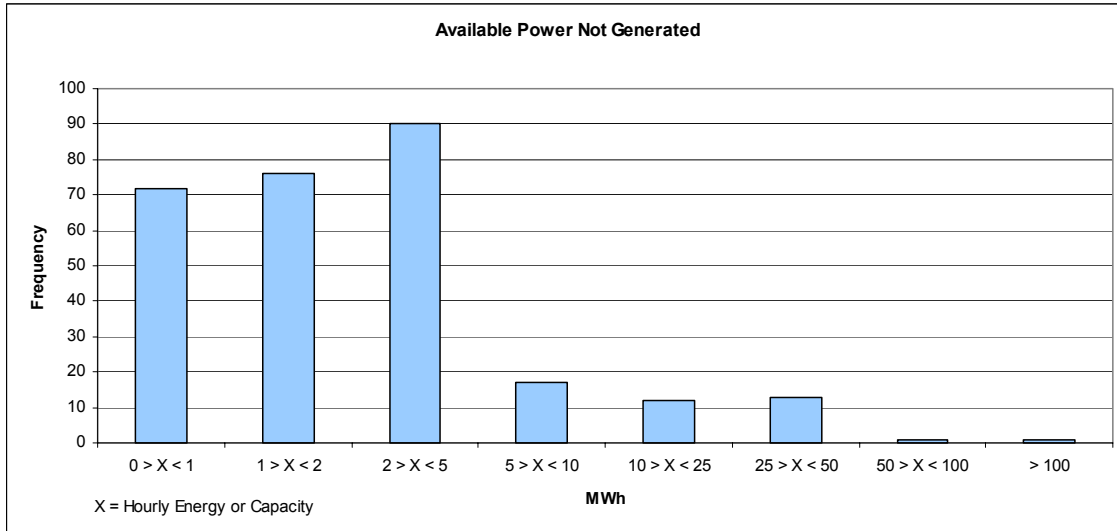
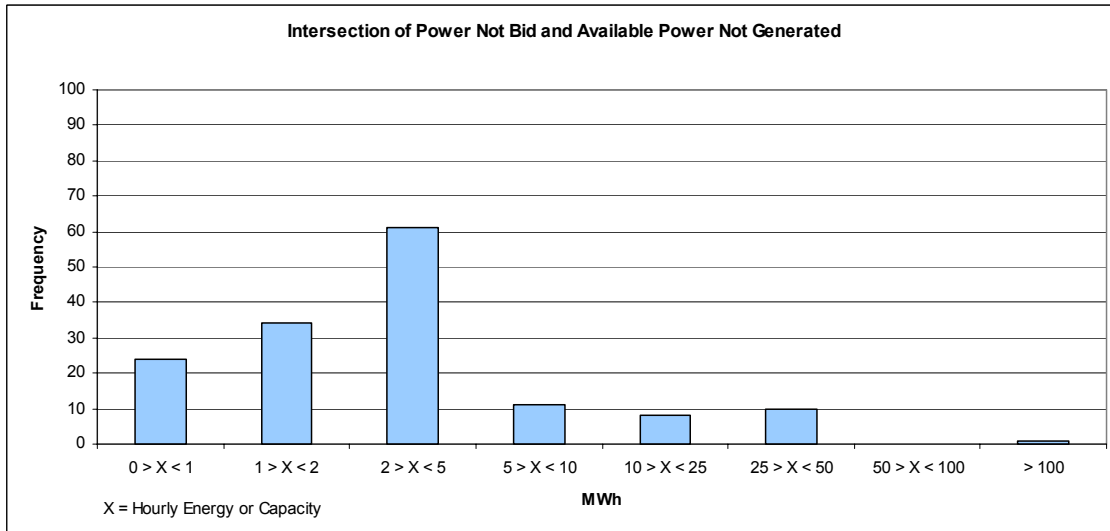


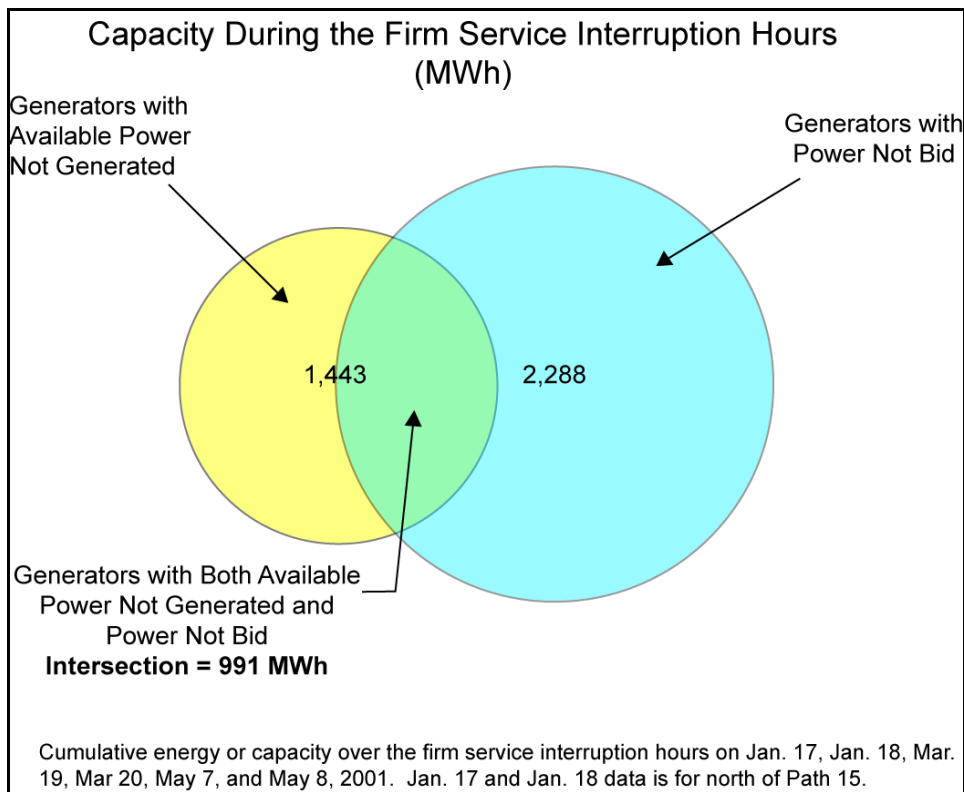
Figure 3



As can be seen in the above figures, the quantities of Power Not Bid and Available Power Not Generated were predominantly in the lower ranges (bins). That is, when a generating unit did have a quantity that was either not bid or not generated, the amounts were relatively small – *e.g.*, less than or equal to five megawatt hours. The amount of hourly energy within the most frequently occurring energy range in Figure 3 (hourly energy greater than two megawatt hours and less than or equal to five megawatt hours) is approximately 0.2 % of the available capacity from the five generating units during any one of the firm load interruption hours.

Relatively few generating units were found to have appreciable hourly energy quantities of both Power Not Bid and Available Power Not Generated (*i.e.*, generating units found in the intersection of both not bid and not generated as opposed to the hourly energy that was both in the intersection of the two categories as well as those instances without any intersection or overlap). Figure 4 below illustrates the intersection of generating units with Power Not Bid and Available Power Not Generated.

Figure 4



Note, however, a total of 19 instances⁶⁸ occurred with generating units that had Available Power Not Generated greater than 25 megawatt hours while those same units had *some* amount of Available Power Not Bid. What Figures 1 through 4 omit is the amount of Available Power Not Generated in relation to the amount of Power Not Bid. The next section addresses the description of the intersection of amounts not generated with amounts not bid with respect to the same generating unit.

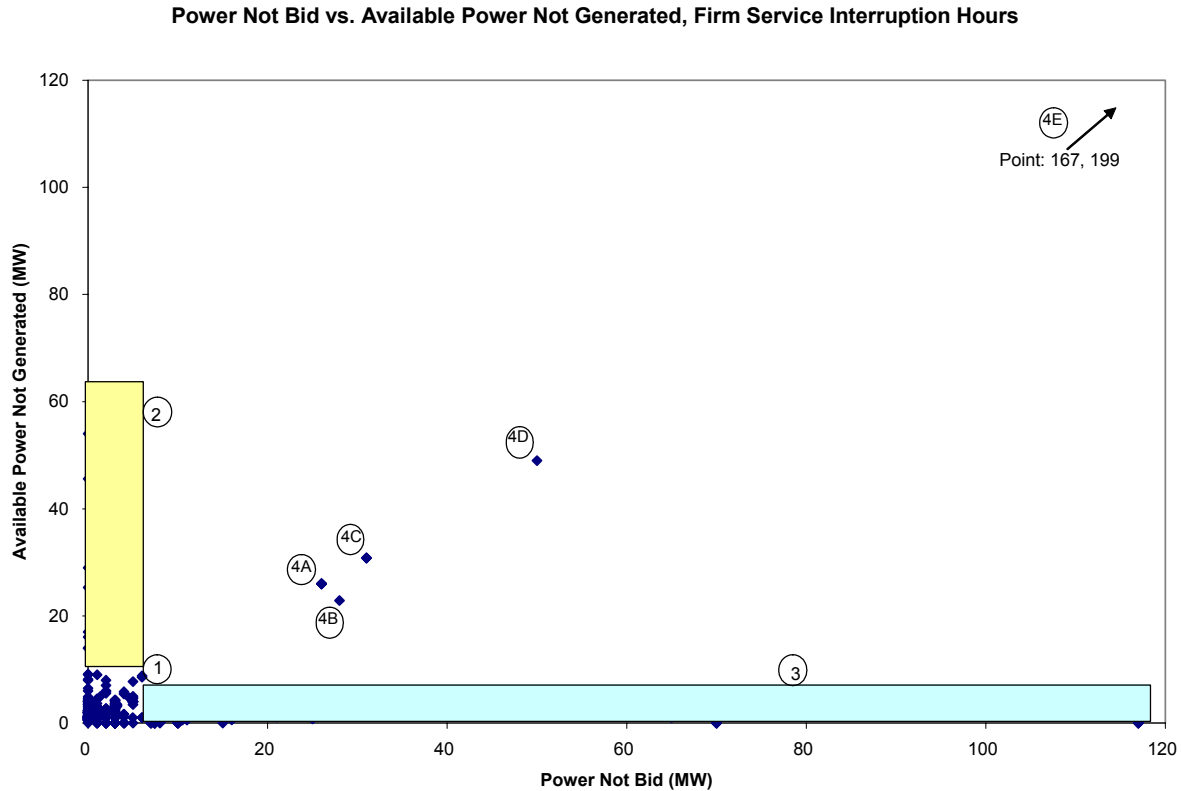
Relationship of the Two Quantities, Power Not Bid and Available Power Not Generated, at the Individual Generating Unit Level

Staff summarized the individual generating unit data across all firm service interruption hours by plotting the two quantities against each other on the same diagram. The purpose of this plot is to highlight the extent to which the Power Not Bid quantities might explain the Available Power Not Generated quantities.

Figure 5 plots the set of calculated Power Not Bid and Available Power Not Generated quantities for each generating unit with a positive amount in either or both categories. Specifically, the selection criteria used was to plot a generating unit if it had a value, in at least one of the two quantities, of one megawatt hour or greater.

⁶⁸ An instance is a single count (*i.e.*, a frequency index equal to one) of a generating unit that had either or both a quantity of Power Not Bid or Available Power Not Generated during one hour.

Figure 5



Case 1: Where the two quantities coincided with a single generating unit (*i.e.*, a matching set of data that is associated with one generating unit), the preponderance of individual generators (78% of all instances) have very small quantities in both categories.

Case 2: The units (7% of all instances) scheduled and/or bid in essentially all of their capacity while they had some amount not generated during the hour (*see* box 2 on Figure 5).

Case 3: The units (11% of all instances) had apparent quantities not bid as recorded in the CAISO electronic database while they generated at essentially full available capacity during the hour (*see* box 3 on Figure 5).

Case 4: A small number of individual generating units – 3 units over 11 separate

hours⁶⁹ (11 unit-hours is 3% of all instances observed) – had coincident amounts of Available Power Not Bid and Available Power Not Generated.⁷⁰

In Case 1, the magnitude of the not bid and not generated quantities are generally not appreciable – *i.e.*, the magnitudes of each quantity appear to be within levels of uncertainty that would be framed by such items as small differences between availability and actual output or between availability and quantities schedule and bid.⁷¹

In Case 2, these generating units have some amounts of Available Power Not Generated, however, they have scheduled or bid in all of their capacity.

In Case 3, it is possible that the bids for these generating units may not have been recorded (bids or offers to other potential buyers or the bids may have been made via telephone or facsimile and not recorded in the CAISO electronic databases). Irrespective of the recordation of the bids, the fact is that these units did operate at or very close to full availability for the hours noted.

In Case 4, staff's preliminary review of the SLIC log data available for the unit with the largest quantities indicates there was an operational issue that could explain some or all the resultant Power Not Bid and Available Power Not Generated.⁷² Further analysis would be necessary to resolve if data may be found explaining the quantities associated

⁶⁹ Two of the data points are common values for three and five 5 hours for two different generating units, respectively.

⁷⁰ One unit was operating on AGC over five hours where there appeared to be 26 megawatts of additional capacity that could have been dispatched if the unit's base operating point on AGC was adjusted to a level that was 26 megawatts higher. However, staff is not aware of any requirements that a unit operate at a base level for AGC that would place the unit in a situation where it may be dispatched to its full power level. In this case, the CAISO would have needed to alter this unit's scheduled energy by entering into an OOM transaction. No information was found in the SLIC logs to indicate that this such an OOM transaction was attempted.

⁷¹ Small differences between availability and actual output or schedule and bids could result from such items as thermal/ambient deratings (*e.g.*, from elevated cooling water injection temperatures or condenser fouling), fluctuations in unit output due to equipment problems, uninstructed deviations, and/or possible metering or recording errors.

⁷² The unit had to ramp up to full load after completing equipment repairs in the previous hour, but the ramp rate was at less than maximum ramp rate, possibly indicating other complications not recorded in the SLIC log.

with the generating units' Power Not Bid and Available Power Not Generated.⁷³

Summary

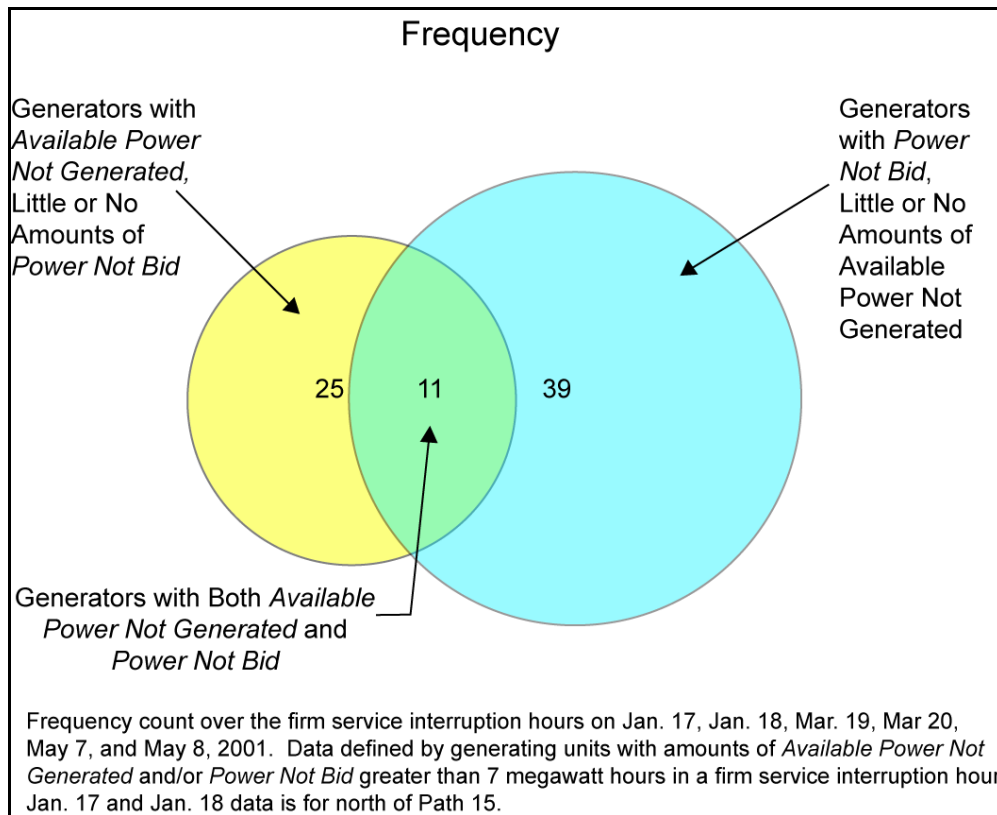
The distribution of the quantities, Power Not Bid and Available Power Not Generated, summed across all firm service interruption hours were concentrated in many units with either small amounts of Power Not Bid or small amounts of Available Power Not Generated. Further, the detailed review of individual generating unit data for all units with any amount of Power Not Bid or Available Power Not Generated (after removing the amounts of megawatts that was found to be in fact not available as discussed in Section VI.A. of staff's report) shows that:

- Most (78%) generating units had no appreciable quantities of both Power Not Bid and Available Power Not Generated;
- Eleven percent of the generating units had appreciable Power Not Bid quantities but had little or no Available Power Not Generated quantities;
- Seven percent of the generating units had appreciable Available Power Not Generated quantities but had little or no Power Not Bid quantities; and
- Three percent of the generating units had both appreciable Power Not Bid quantities and appreciable Available Power Not Generated quantities.

Thus, it does not follow that the amounts of Power Not Bid largely explain the quantities of Available Power Not Generated. After removing from the data those generating units with small amounts in both quantities, the Power Not Bid and Available Power Not Generated quantities coincided with the same generating unit in only limited cases, as summarized in the following figure:

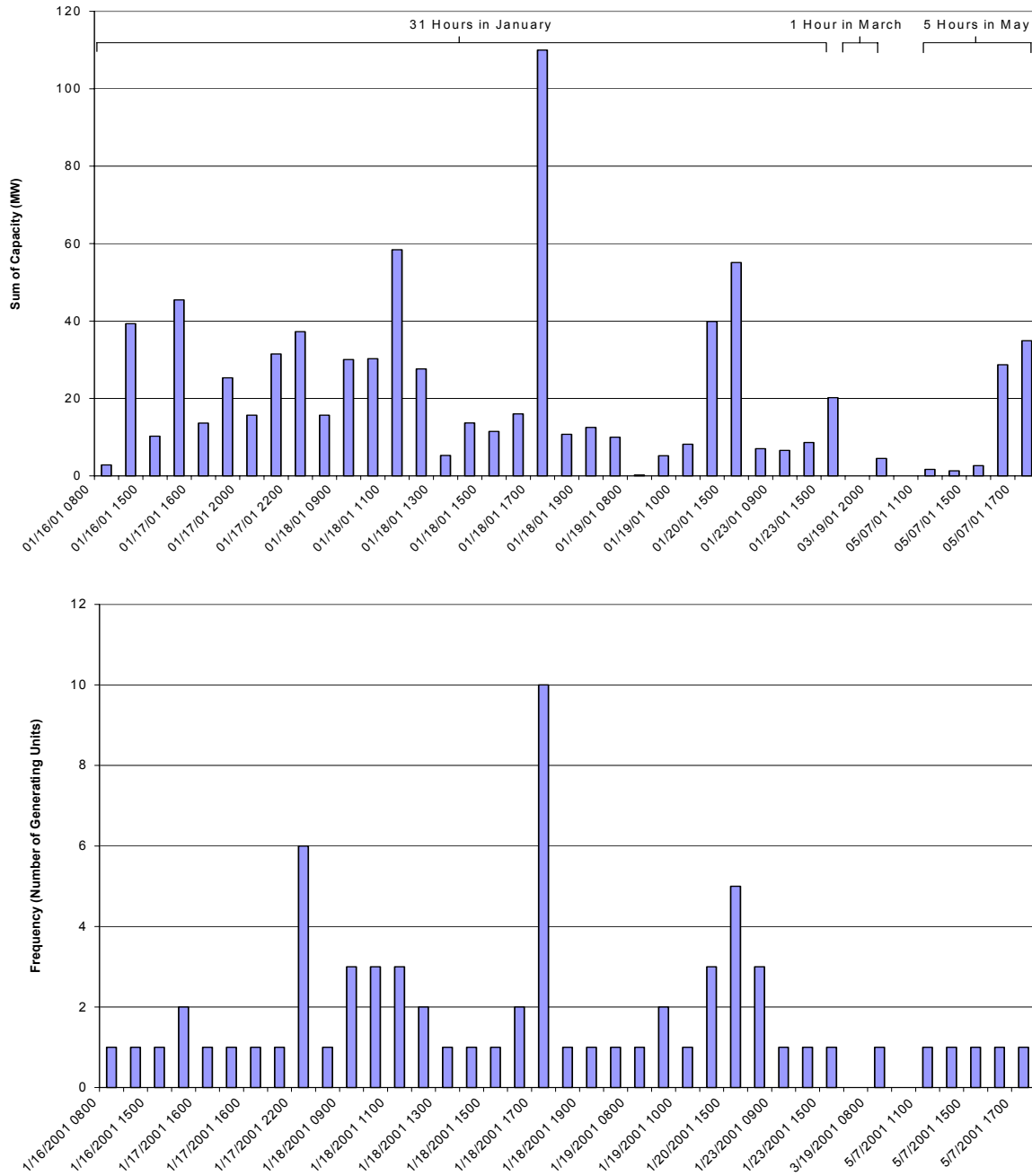
⁷³ In seven out of eleven cases, it appears there are likely explanations for these units. See notes 4 and 5.

Figure 6



APPENDIX E

Emergency Dispatch Instructions Declined By All Five Generators On January 15-23, March 17-22, and May 5-10, 2001⁷⁴



⁷⁴ The instances of declined dispatches in the above figure are for on-peak hours, between 8:00 a.m. and 10:00 p.m. Of the declines that occurred in January, all but one occurred by generating units south of Path 15 and would not likely have mitigated the firm load interruptions that occurred north of Path 15, as discussed in Section VA.