

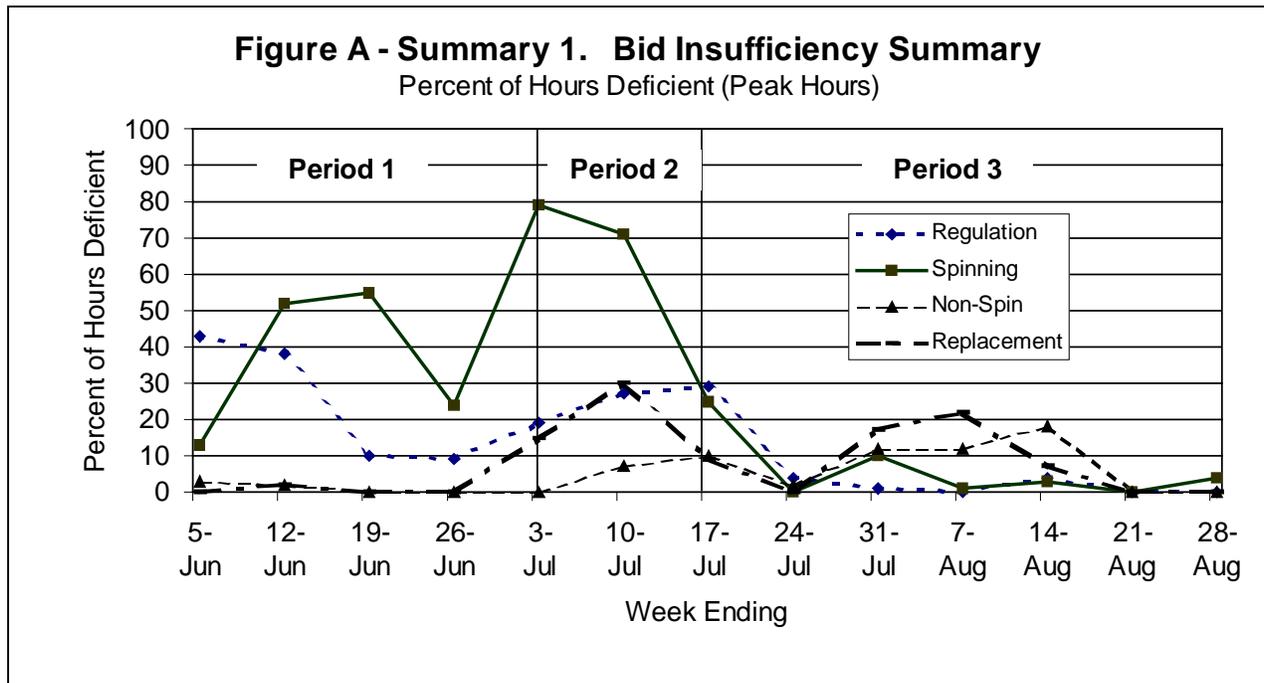
## APPENDIX A Ancillary Services Market Performance

### Summary

Figures A-Summary 1 through 4 shown below provide:

- an overall summary of bid insufficiency,
- A/S cost as a percent of daily scheduled energy costs,
- the pattern of A/S daily prices in the California market for the three time periods (May 30-June 30, July 1-13, July 14- current) requested by FERC, and
- the amount of A/S supply in each market compared to ISO requirements.

Figure A-Summary 1 plots the weekly average bid insufficiency in the A/S markets. It shows that the number of hours of bid insufficiency was reduced dramatically after the FERC approved the Regulation Energy Payment (REPA) on June 24, 1998. This had the effect of raising the low cost-based caps on all market participants, thereby increasing supply. The figure also shows that the ISO's damage control caps, implemented in Period 3, did not reduce the supply of bids into the ancillary service markets. Improvements in supply continued, as shown below, with a decline in bid insufficiency during period three.



In Figure A-Summary 2, daily A/S costs are shown as a percent of daily scheduled energy costs. The daily scheduled energy cost is the PX clearing price times the hourly volume for each hour of the day. The ancillary service costs have averaged 10 % over the three periods. In period 1, all suppliers were subject to cost-based caps with A/S costs averaging 10%. In period 2, some

suppliers received market-based rate authority and the FERC declared replacement reserves were not subject to cost-based caps. Ancillary service costs in period 2 averaged 24% of daily energy costs. In period 3, the ISO placed a \$250/MW/Hr damage control cap and prices of ancillary services dropped, averaging 8% of daily energy costs.

Figure A-Summary 3 shows the trend of A/S prices for regulation, spin, non-spin, and replacement reserves. Prices were low in period 1 because all generators were subject to low cost-based rates. In period 2 some generators were granted market-based rates. There were insufficient bids to meet requirements in several markets and several participants with market-based rate authority were able to set dramatically higher prices for replacement reserve (\$5,000/MW on some hours on July 9, 1998 and \$10,000/MW on for some hours on July 13. Note that the graph depicts average daily prices). These prices moderated when the damage control cap was put in place in period 3 and supply increased in response to the higher prices . It should be noted that, although a bid sufficiency statistic of 100% means we are receiving sufficient bids to meet our requirements, that number of bids is not enough to make a competitive market in A/S. Robust competition is more likely to occur when bid sufficiencies are in the 200% range, and the market demonstrates that no one player can be pivotal in setting the market price by strategically withholding supply from that market.

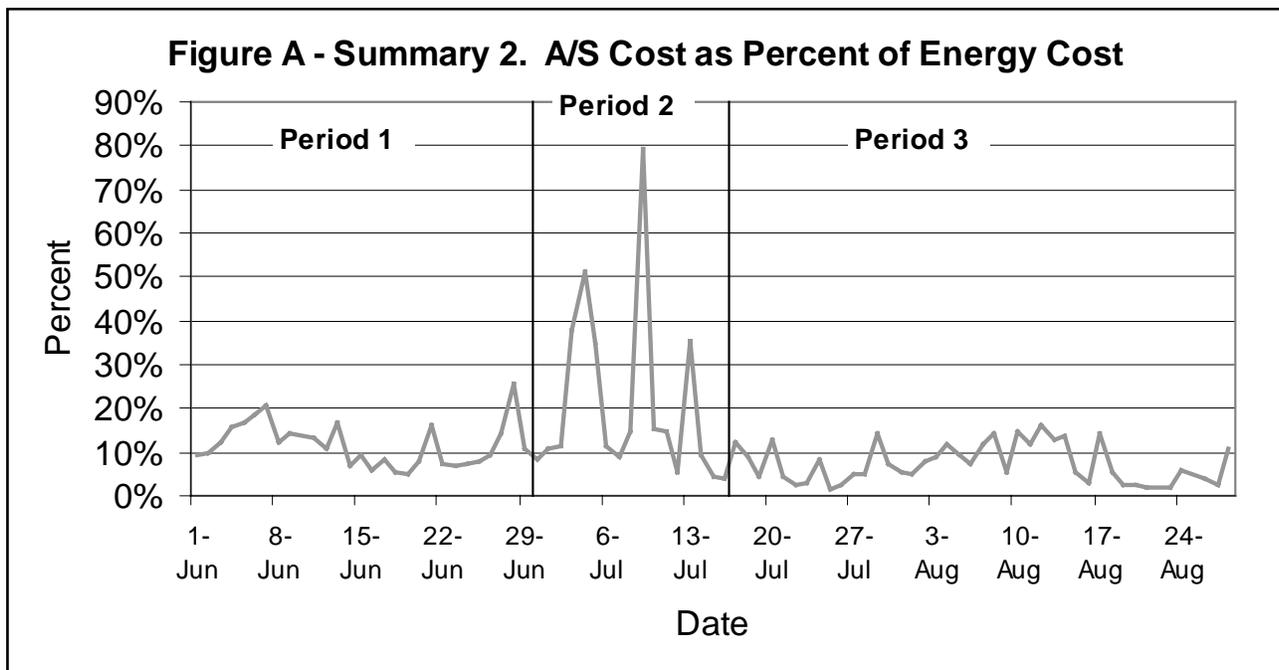


Figure A – Summary 3.

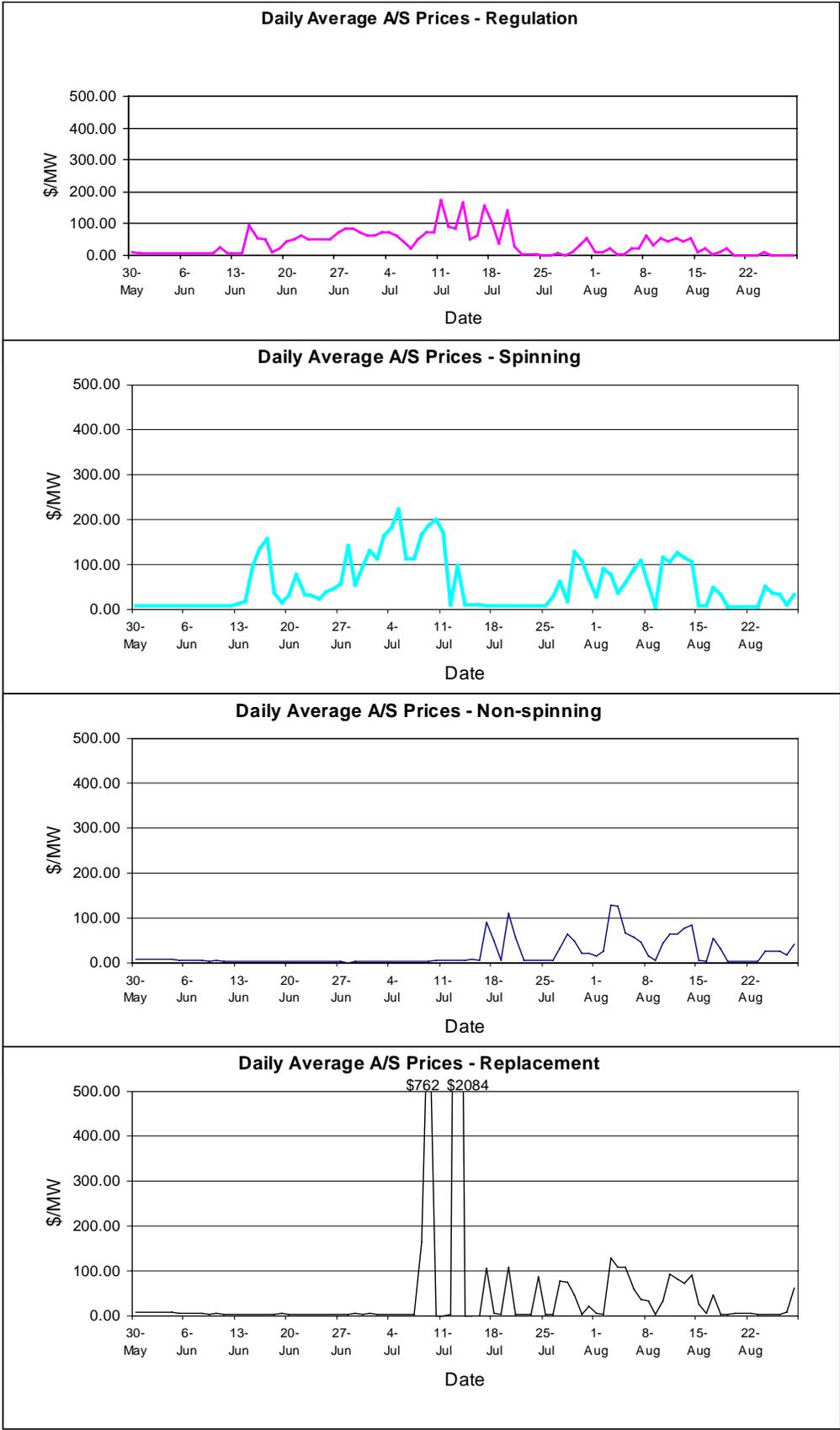


Figure A – Summary 4.

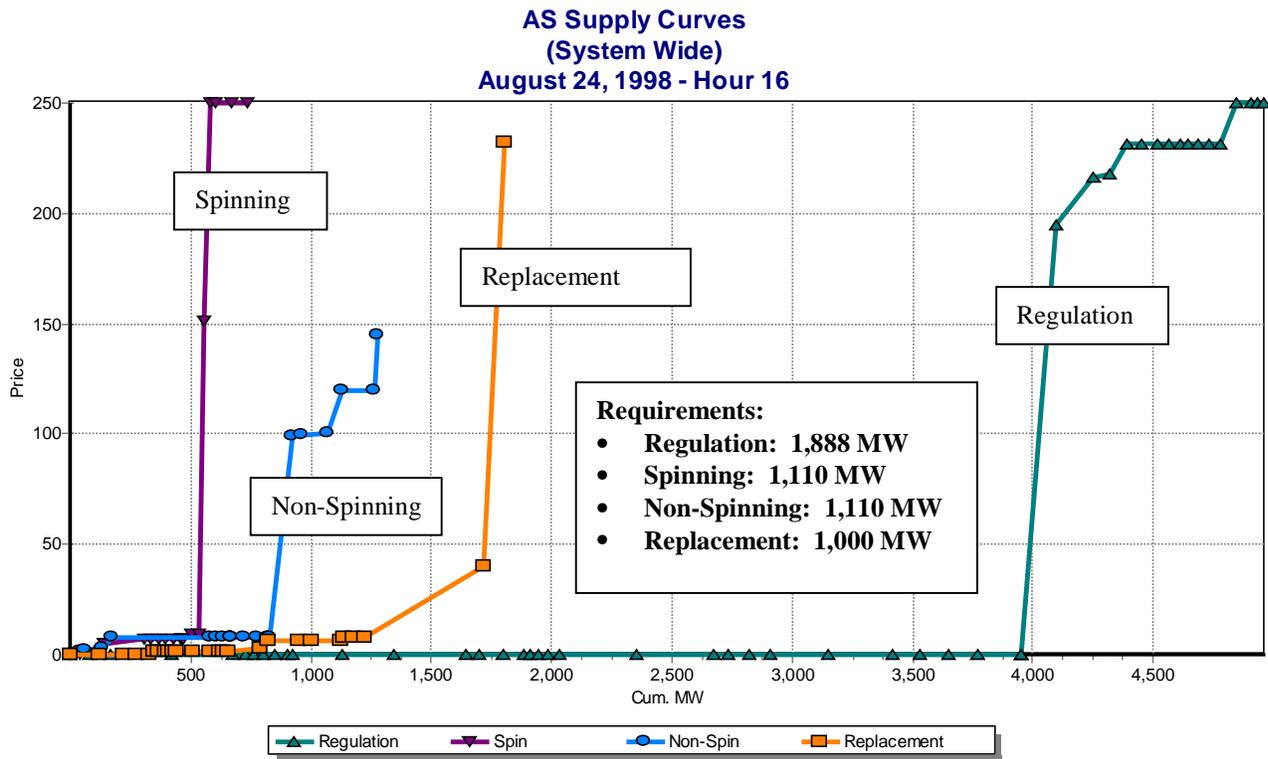


Figure A-Summary 4 shows the amount of each ancillary service supplied for one hour at price levels from \$0 to the \$250/MWh price cap. Spinning, non-spinning and replacement reserve show rapid increases in cost at volumes much less than that of regulation. Since regulation is a substitute for the other three services, and an excess amount is available above requirements, a “rational buyer” would choose to buy as much regulation as possible rather than paying higher prices for the other services. The current ISO Tariff and Protocols do not provide for this “rational buyer” approach.

## Study of Market Performance by Period

*Period 1: (May 30-June30)***Bid Sufficiency:**

Tables 1 and 2 provide various measures of the sufficiency of bids in the ISO's day ahead ancillary service capacity markets for "Peak" and "Off-Peak" periods, respectively. Bid sufficiencies are calculated by expressing the total bids available in each hour as a percentage of the ISO requirement. For each ancillary service type there are four indices, "% Hours deficient", "Avg. % of Requirement", "Min. % of Requirement", and "Max. % of Requirement". The first index, "% Hours deficient", measures the percent of hours in each time period that bid sufficiencies fall below 100%. The other three indices, measure the average, min, and max values of bid sufficiencies for the specified time period. Taken together, the four indices provide a fairly comprehensive picture of the "thinness/thickness" of the ISO's ancillary service markets.

**Table A-1: Ancillary Service DA Market Bid Sufficiency Peak Hours (7-22)**

<b>Ancillary Service Type</b>	<b>5/30-6/5</b>	<b>6/6-6/12</b>	<b>6/13-6/19</b>	<b>6/20-6/26</b>	<b>6/27-7/3</b>
<b>Regulation</b>					
<b>% Hours deficient</b>	43%	38%	10%	9%	19%
<b>Avg. % of Requirement</b>	102%	132%	176%	189%	150%
<b>Min. % of Requirement</b>	28%	44%	59%	69%	63%
<b>Max. % of Requirement</b>	183%	202%	260%	253%	229%
<b>Spin</b>					
<b>% Hours deficient</b>	13%	52%	55%	24%	79%
<b>Avg. % of Requirement</b>	114%	80%	96%	120%	90%
<b>Min. % of Requirement</b>	75%	44%	31%	58%	55%
<b>Max. % of Requirement</b>	232%	149%	220%	195%	174%
<b>Non-Spin</b>					
<b>% Hours deficient</b>	3%	2%	0%	0%	0%
<b>Avg. % of Requirement</b>	228%	235%	219%	223%	222%
<b>Min. % of Requirement</b>	3%	52%	102%	122%	113%
<b>Max. % of Requirement</b>	434%	353%	404%	386%	356%
<b>Replacement</b>					
<b>% Hours deficient</b>	0%	2%	0%	0%	15%
<b>Avg. % of Requirement</b>	280%	228%	215%	238%	204%
<b>Min. % of Requirement</b>	129%	31%	126%	161%	73%
<b>Max. % of Requirement</b>	407%	353%	454%	427%	372%

Regulation and spinning reserve markets were particularly thin during peak hours in June. During the first two weeks of June, regulation bids were deficient approximately 40% of the time and in at least one hour available regulation bids only met 28% of the ISO's requirement (Table A-1). Bid sufficiencies improved in the mid to later part of June, mainly in response to a new payment

incentive in the regulation market (REPA)<sup>1</sup>. The available bids in the spinning reserve market consistently fell short of requirements during peak hours for the month of June. During the middle part of June, bid sufficiency fell as low as 44% and 31%. Though occasionally deficient, non-spinning and replacement reserve market tended to be more robust, with average bid sufficiencies of over 200%. This was mainly due to moderate load conditions and availability of uncommitted generation.

**Table A-2: Ancillary Service DA Market Bid Sufficiency Off-Peak Hours (1-6,23,24)**

<b>Ancillary Service Type</b>	<b>5/30-6/5</b>	<b>6/6-6/12</b>	<b>6/13-6/19</b>	<b>6/20-6/26</b>	<b>6/27-7/3</b>
<b>Regulation</b>					
<b>% Hours deficient</b>	64%	54%	32%	36%	52%
<b>Avg. % of Requirement</b>	93%	108%	123%	130%	115%
<b>Min. % of Requirement</b>	25%	52%	63%	69%	56%
<b>Max. % of Requirement</b>	174%	190%	218%	217%	206%
<b>Spin</b>					
<b>% Hours deficient</b>	0%	4%	18%	16%	39%
<b>Avg. % of Requirement</b>	165%	150%	162%	134%	105%
<b>Min. % of Requirement</b>	104%	88%	65%	89%	48%
<b>Max. % of Requirement</b>	300%	264%	236%	184%	168%
<b>Non-Spin</b>					
<b>% Hours deficient</b>	2%	0%	0%	0%	0%
<b>Avg. % of Requirement</b>	333%	335%	349%	356%	287%
<b>Min. % of Requirement</b>	11%	111%	187%	195%	169%
<b>Max. % of Requirement</b>	469%	471%	449%	452%	414%
<b>Replacement</b>					
<b>% Hours deficient</b>	0%	12%	0%	0%	0%
<b>Avg. % of Requirement</b>	404%	352%	373%	371%	348%
<b>Min. % of Requirement</b>	213%	62%	169%	176%	165%
<b>Max. % of Requirement</b>	524%	491%	474%	476%	429%

With the exception of regulation, bid sufficiencies were generally higher during off-peak periods in June. Depending on the week, bids in regulation were deficient during 30% to 60% of the off-peak hours and in some hours bid sufficiencies were as low as 25%. As was the case during peak hours, bid sufficiencies during off-peak hours improved towards the mid to later part of the month. In the spinning reserve market, bid sufficiencies in the off-peak hours were significantly better than peak hours. Still, in the mid to latter part of June, spinning reserve bids fell short of requirements about 16-39% of the time. Non-Spinning and Replacement reserve bids were very abundant often exceeding 300% on average.

<sup>1</sup> Though, the ISO implemented REPA on May 21, it had not yet been approved by FERC and many participants chose not to bid additional resources into regulation until FERC approval (June 24, 1998).

**Price Spikes:**

During the month of June, the ISO did not have a damage control price cap for ancillary services. During this period, most participants were subject to individual cost-based bid caps that were under \$10/MW. However, during this period one QF was participating in these markets that was not subject to FERC caps and another participant (El Segundo Power, LLC) was granted cost-based rates based on the rates for ancillary services contained in their Must-Run Agreement with the California ISO. El Segundo's reliability payment rate for units 1 and 2 is equal to \$244.70/MWh. Table 3 shows the number of times each day prices for each ancillary service exceeded \$200/MW.

**Table A-3: Number of Hours Ancillary Service Capacity Prices exceeded \$200/MW  
(5/30/98-6/30/98)**

OPR_DT	Regulation	Spinning	Non-Spinning	Replacement	Total <sup>2</sup>
6/1/98	0	0	0	0	0
6/2/98	0	0	0	0	0
6/3/98	0	0	0	0	0
6/4/98	0	0	0	0	0
6/5/98	0	0	0	0	0
6/6/98	0	0	0	0	0
6/7/98	0	0	0	0	0
6/8/98	0	0	0	0	0
6/9/98	0	0	0	0	0
6/10/98	0	0	0	0	0
6/11/98	2	0	0	0	2
6/12/98	0	0	0	0	0
6/13/98	0	0	0	0	0
6/14/98	0	0	0	0	0
6/15/98	9	9	0	0	18
6/16/98	5	13	0	0	18
6/17/98	5	15	0	0	19
6/18/98	1	3	0	0	4
6/19/98	2	1	0	0	2
6/20/98	4	2	0	0	6
6/21/98	5	7	0	0	12
6/22/98	6	3	0	0	7
6/23/98	5	3	0	0	6
6/24/98	5	2	0	0	6
6/25/98	5	3	0	0	6
6/26/98	5	4	0	0	6
6/27/98	7	6	0	0	8
6/28/98	8	14	0	0	19
6/29/98	8	5	0	0	9
6/30/98	7	9	0	0	13
Avg <sup>3</sup>	3	3	0	0	5

<sup>2</sup> Totals are the sum of the hours that the price in at least one of the four markets exceeded \$200/MW.

<sup>3</sup> The average # of hours per day prices exceeded \$200/MW.

For the month of June, AS prices did not exceed \$200 until June 11<sup>th</sup>, the trading day after FERC issued an order granting El Segundo Power, LLC cost-based rates based on the rates for ancillary services contained in El Segundo's Must-Run Agreement with the California ISO (June 10). During June, all of the price spikes (i.e. prices > \$200/MW) occurred in the regulation and spinning reserve markets. As discussed above, bids in these two markets often fell short of the ISO's requirements whereas non-spinning and replacement reserve markets were generally very "thick". Given these supply conditions, it is not surprising to see price spikes limited to regulation and spinning reserve.

## Ancillary Service Costs:

Table A-4: Ancillary Service Daily Cost Summaries (6/1/98 – 6/30/98)

Date	Regulat. (\$)	Spin (\$)	Non-Spin (\$)	Replac. (\$)	AS MW Totals <sup>4</sup>	Est. Anc. Cost Totals <sup>5</sup> (\$)	Total Energy Cost <sup>6</sup> (\$)	AS Cost % of Total <sup>7</sup>
6/1/98	197,569	103,378	68,422	188,959	78,514	651,902	6,836,652	10%
6/2/98	215,624	109,023	67,747	188,140	82,200	627,151	6,336,167	10%
6/3/98	217,698	111,207	59,011	179,780	82,924	603,811	4,900,661	12%
6/4/98	216,832	109,979	59,041	174,840	82,060	605,215	3,859,499	16%
6/5/98	204,879	109,438	48,735	136,200	81,519	537,067	3,258,493	16%
6/6/98	187,417	72,936	33,982	105,210	73,676	460,260	2,461,855	19%
6/7/98	188,332	85,435	32,661	102,540	76,275	450,691	2,180,624	21%
6/8/98	216,560	99,469	41,464	113,760	85,982	500,114	4,022,399	12%
6/9/98	211,601	92,955	36,030	85,370	84,184	447,727	3,143,131	14%
6/11/98	231,621	100,578	33,514	64,320	86,108	446,215	3,352,138	13%
6/12/98	183,305	93,744	29,611	47,300	85,377	366,658	3,434,142	11%
6/13/98	110,785	82,935	25,364	43,410	79,708	289,483	1,735,913	17%
6/14/98	107,229	92,466	24,387	43,260	78,632	300,721	4,491,511	7%
6/15/98	345,180	196,277	28,075	42,240	87,915	674,872	7,132,930	9%
6/16/98	217,729	242,219	37,013	44,640	88,710	575,267	9,493,536	6%
6/17/98	174,187	428,619	35,915	51,936	87,056	831,592	9,737,408	9%
6/18/98	131,839	256,122	25,778	86,352	91,877	524,178	9,568,732	5%
6/19/98	134,463	154,719	22,806	92,540	92,478	415,674	8,462,245	5%
6/20/98	138,578	236,949	19,835	87,975	87,361	513,477	6,458,171	8%
6/21/98	162,605	498,506	19,356	81,888	83,396	869,328	5,434,928	16%
6/22/98	214,820	252,006	20,634	54,878	91,820	605,184	8,108,882	7%
6/23/98	204,370	240,580	20,440	41,137	94,055	538,672	7,735,627	7%
6/24/98	233,112	203,292	21,805	40,918	93,562	541,298	7,474,297	7%
6/25/98	233,965	299,453	18,038	39,271	92,867	665,419	8,231,185	8%
6/26/98	243,532	334,243	19,202	37,378	94,312	714,590	7,634,339	9%
6/27/98	276,178	367,156	17,889	86,570	90,782	841,959	5,965,183	14%
6/28/98	280,044	844,826	17,224	87,739	86,981	1,387,055	5,422,107	26%
6/29/98	309,626	343,596	22,457	93,030	93,534	888,118	8,277,976	11%
6/30/98	285,694	573,611	23,051	90,530	95,157	1,074,477	12,669,607	8%
<b>Total</b>	<b>6,075,377</b>	<b>6,735,715</b>	<b>929,488</b>	<b>2,532,111</b>	<b>2,509,021</b>	<b>17,948,175</b>	<b>177,820,338</b>	<b>10%</b>

Table A-4 summarizes the cost of procuring ancillary service capacity for June. Under current ISO procedures all winning participants who are subject to FERC cost-based price caps for ancillary services are paid their bid price rather than the market clearing price. During June, the total cost of

<sup>4</sup> This is the sum of the capacities won in all four markets.

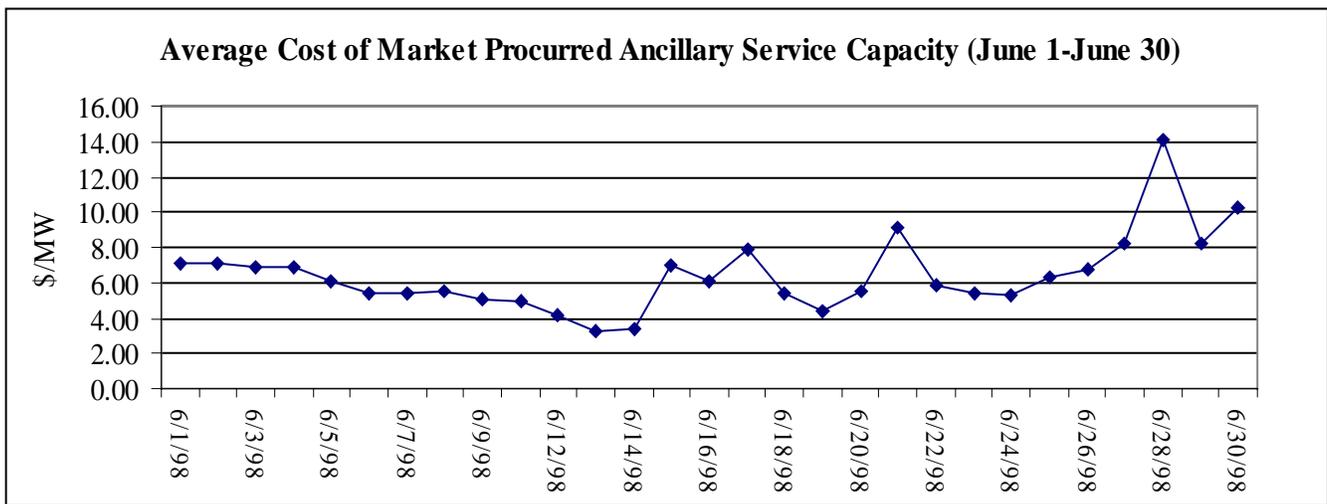
<sup>5</sup> The daily costs are computed for the total ancillary service requirements by multiplying the computed average cost of the total ancillary services for each hour by the total hourly requirements and then summing over all 24 hours (i.e. ancillary service market rate for quantities supplied by RMR units).

<sup>6</sup> Total energy costs are calculated by summing total hour ahead scheduled load times the PX unconstrained price over 24 hours.

<sup>7</sup> Estimated ancillary service costs expressed as a percentage of total energy costs.

ancillary service capacity procured in the day ahead market averaged about \$500,000 per day. However, in the last week of June, the total daily cost of ancillary service capacity began to increase significantly. Figure A-1 shows the average cost of ancillary service capacity for the month of June. As can be seen from the graph, the average cost was declining in a very smooth and consistent manner during the first two weeks of June but began increasing in a very volatile manner during the last two weeks of June. This change in pattern coincides with occurrence of large price spikes in the regulation and spinning reserve markets suggesting that the payments on high ancillary service bids significantly increased the average cost of ancillary service.

**Figure A-1: Average Cost of Procuring Ancillary Service Capacity (June 1-30)**



**Period 2: (July 1-July 13)**

During this period, several changes occurred in the market. First, some generator owners began bidding under market based rate authority for ancillary services (June 30<sup>th</sup> for AES, and July 10<sup>th</sup> for Destec and Houston Industries). Second, in its June 30<sup>th</sup> response to AES's request for market based rates, FERC stated that replacement reserves were not an ancillary service and thus, not subject to cost-based caps. Third, in an effort to mitigate the threat of real-time congestion, the ISO began procuring ancillary service capacity on a zonal basis. Finally, loads in the first two weeks of July were higher than the loads experienced in June. The combination of these conditions had a very negative impact on the performance of the ancillary service markets.

Tables A-5 and A-6 examine bid sufficiencies during this period.

**Table A-5: Ancillary Service Day Ahead Market Bid Sufficiency Peak Hours (7-22)**

<b>Ancillary Service Type</b>	<b>7/4-7/10</b>	<b>7/11-7/17</b>
<b>Regulation</b>		
<b>% Hours deficient</b>	27%	29%
<b>Avg. % of Requirement</b>	114%	130%
<b>Min. % of Requirement</b>	58%	40%
<b>Max. % of Requirement</b>	154%	205%
<b>Spin</b>		
<b>% Hours deficient</b>	71%	25%
<b>Avg. % of Requirement</b>	82%	142%
<b>Min. % of Requirement</b>	37%	47%
<b>Max. % of Requirement</b>	158%	306%
<b>Non-Spin</b>		
<b>% Hours deficient</b>	7%	10%
<b>Avg. % of Requirement</b>	158%	190%
<b>Min. % of Requirement</b>	62%	42%
<b>Max. % of Requirement</b>	309%	359%
<b>Replacement<sup>8</sup></b>		
<b>% Hours deficient</b>	30%	9%
<b>Avg. % of Requirement</b>	25,814%	77,115%
<b>Min. % of Requirement</b>	19%	26%
<b>Max. % of Requirement</b>	415,821%	622,655%

Though regulation supply showed improvements in the latter part of June, during the first two weeks of July, bid availability deteriorated (Table A-5). During peak hours, bids were deficient over 25% of the time and averaged only slightly higher than 25%. The spinning reserve market

<sup>8</sup> The very large percentages shown for replacement reserve are due to the fact that in some hours replacement reserve requirements are zero. The program used to calculate bid sufficiencies sets zero requirements to 1 MW. Thus, if the ISO's replacement requirement was zero in a particular hour and there was 5,000 MW of available bids, the program would calculate a bid sufficiency of 500,000%.

continued to be problematic with bids being deficient for over 70% of the peak hours in week ending 7/10 and 25% of the time in week ending 7/17. Non-spinning reserve bid sufficiencies also dropped significantly during this period. During the first week of July, Replacement reserves were deficient about 30% of the peak hours. Replacement reserve bid sufficiencies improved dramatically for the second week of July as participants learned that this was now an “uncapped” market and were either seeking to earn high prices or bid in low priced capacity to protect their loads from exorbitant ancillary service costs.

**Table A-6: Ancillary Service DA Market Bid Sufficiency Off-Peak Hours (1-6,23,24)**

<b>Ancillary Service Type</b>	<b>7/4-7/10</b>	<b>7/11-7/17</b>
<b>Regulation</b>		
<b>% Hours deficient</b>	52%	48%
<b>Avg. % of Requirement</b>	111%	117%
<b>Min. % of Requirement</b>	61%	38%
<b>Max. % of Requirement</b>	190%	238%
<b>Spin</b>		
<b>% Hours deficient</b>	48%	4%
<b>Avg. % of Requirement</b>	113%	240%
<b>Min. % of Requirement</b>	61%	48%
<b>Max. % of Requirement</b>	203%	460%
<b>Non-Spin</b>		
<b>% Hours deficient</b>	0%	0%
<b>Avg. % of Requirement</b>	231%	273%
<b>Min. % of Requirement</b>	146%	127%
<b>Max. % of Requirement</b>	287%	490%
<b>Replacement<sup>9</sup></b>		
<b>% Hours deficient</b>	0%	0%
<b>Avg. % of Requirement</b>	68,414%	122,209%
<b>Min. % of Requirement</b>	112%	630%
<b>Max. % of Requirement</b>	603,601%	688,086%

Regulation bids were also frequently deficient during off-peak hours with requirements being met only about 50% of the time (Table A-6). Off-peak bid sufficiencies for spinning reserve improved in the second week of July and ample bids continued to be supplied to the non-spinning and replacement reserve market during off-peak hours.

<sup>9</sup> The very large percentages shown for replacement reserve are due to the fact that in some hours replacement reserve requirements are zero. The program used to calculate bid sufficiencies sets zero requirements to 1 MW. Thus, if the ISO’s replacement requirement was zero in a particular hour and there was 5,000 MW of available bids, the program would calculate a bid sufficiency of 500,000%.

**Price Spikes:**

This table shows the number of times each day prices for each ancillary service exceeded \$200/MW.

**Table A-7: Number of Hours Ancillary Service Capacity Prices exceeded \$200/MW (7/01/98-7/13/98)**

<b>OPR_DT</b>	<b>Regulation</b>	<b>Spinning</b>	<b>Non-Spinning</b>	<b>Replacement</b>	<b>Total<sup>10</sup></b>
<b>7/1/98</b>	6	5	0	0	7
<b>7/2/98</b>	6	4	0	0	7
<b>7/3/98</b>	7	4	0	0	8
<b>7/4/98</b>	7	2	0	0	8
<b>7/5/98</b>	6	18	0	0	19
<b>7/6/98</b>	4	6	0	0	7
<b>7/7/98</b>	2	6	0	0	7
<b>7/8/98</b>	5	6	0	16	20
<b>7/9/98</b>	7	6	0	5	14
<b>7/10/98</b>	7	16	0	0	20
<b>7/11/98</b>	17	13	0	0	23
<b>7/12/98</b>	9	0	0	0	9
<b>7/13/98</b>	8	7	0	5	16
<b>Avg.<sup>11</sup></b>	<b>7</b>	<b>7</b>	<b>0</b>	<b>2</b>	<b>13</b>

Compared to price spike frequency in the second half of June, the frequency of price spikes increased significantly for the first two weeks of July (Table A-7). All of these price spikes occurred in SP15. Recall that during this period the ISO was procuring ancillary services on a zonal basis. Most of the price spikes occurred in the regulation and spinning reserve markets, the two markets showing the most “thinness”. However, the replacement reserve market experienced the most dramatic price spikes. These occurred during several peak hours on July 9<sup>th</sup> and July 13. On July 9<sup>th</sup> replacement reserve prices in SP15 reached \$5,000/MW in three hours and prices of \$750/MW and \$2,500/MW in two other hours and on July 14, replacement reserve prices in SP15 reached \$9,999/MW in five hours.

<sup>10</sup> Totals are the sum of the hours that the price in at least one of the four markets exceeded \$200/MW.

<sup>11</sup> The average # of hours per day exceeded \$200/MW.

**Ancillary Service Costs:****Table A-8: Ancillary Service Daily Cost Summaries (7/1/98-7/13/98)**

<b>Date</b>	<b>Regul. (\$)</b>	<b>Spin . (\$)</b>	<b>Non-Spin (\$)</b>	<b>Replac. (\$)</b>	<b>AS MW Totals<sup>12</sup></b>	<b>AS Cost Totals<sup>13</sup> (\$)</b>	<b>Total Energy Cost<sup>14</sup> (\$)</b>	<b>AS % of Total<sup>15</sup></b>
7/1/98	255,118	677,500	44,925	74,024	97,144	1,325,710	12,143,092	11%
7/2/98	269,189	600,710	77,959	120,671	101,073	1,255,893	10,981,247	11%
7/3/98	258,243	847,693	87,847	136,270	101,553	1,475,001	3,903,152	38%
7/4/98	349,191	930,128	71,917	134,916	95,289	1,693,907	3,305,980	51%
7/5/98	285,084	1,164,993	83,400	131,231	98,537	1,894,683	5,463,895	35%
7/6/98	293,814	726,337	83,099	107,334	102,324	1,436,794	12,579,034	11%
7/7/98	245,671	672,760	82,972	103,170	102,143	1,309,378	15,126,175	9%
7/8/98	295,612	851,709	88,464	991,367	90,300	3,095,525	21,332,521	15%
7/9/98	305,004	1,314,561	75,860	9,136,923	100,494	14,265,702	18,062,366	79%
7/10/98	526,706	1,476,105	107,558	0	79,607	2,794,255	18,122,645	15%
7/11/98	880,340	1,292,366	96,181	23,740	77,875	3,011,371	20,090,483	15%
7/12/98	547,876	180,970	98,006	33,998	82,309	1,051,148	19,204,177	5%
7/13/98	521,538	860,637	89,107	5,603,030	86,912	9,301,864	26,233,070	35%
<b>Total</b>	<b>5,033,386</b>	<b>11,596,469</b>	<b>1,087,295</b>	<b>16,596,674</b>	<b>1,215,560</b>	<b>43,911,231</b>	<b>186,547,837</b>	<b>24%</b>

In the first week of July, ancillary service costs averaged around \$1.6 million per day (Table A-8). These costs increased dramatically in the second week of July due largely to the extremely high prices for replacement reserve. Average costs followed a similar trend, averaging between \$10-\$20/MW during the first week of July and then jumping to \$108/MW on July 9<sup>th</sup>, the day replacement reserve prices reached \$5,000/MW for several hours.

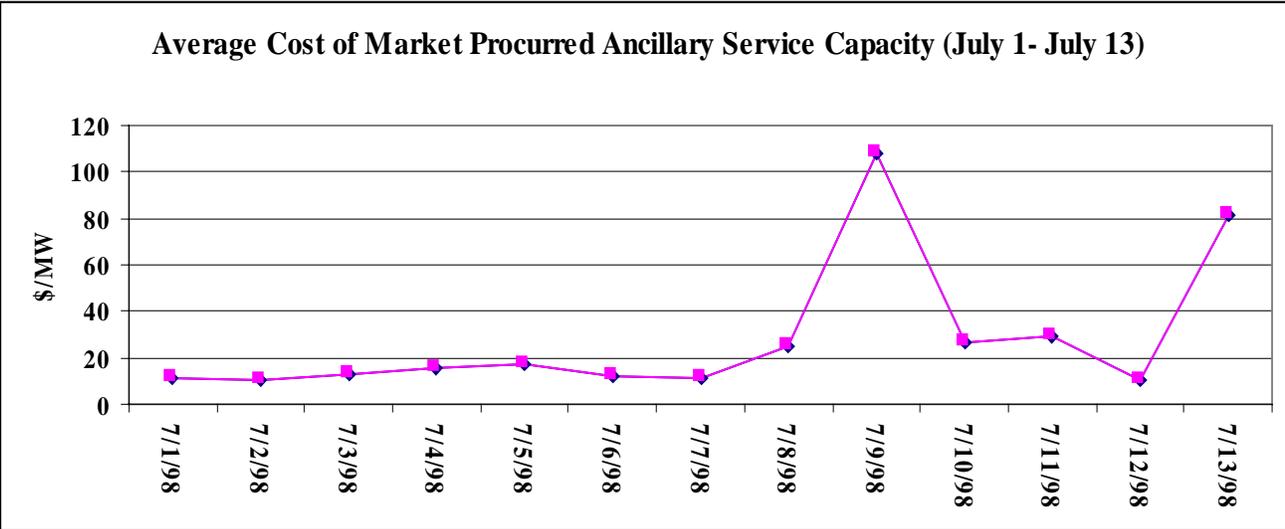
<sup>12</sup> This is the sum of the capacities won in all four markets.

<sup>13</sup> The daily costs are computed for the total ancillary service requirements by multiplying the computed average cost of the total ancillary services for each hour by the total hourly requirements and then summing over all 24 hours (i.e. ancillary service market rate for quantities supplied by RMR units).

<sup>14</sup> Total energy costs are calculated by summing total hour ahead scheduled load times the PX unconstrained price over 24 hours.

<sup>15</sup> Estimated ancillary service costs expressed as a percentage of total energy costs.

Figure A-2: Average Cost of Procuring Ancillary Service Capacity (July 1-13)



**Period 3: (July 14-present)**

During this period, the ISO implemented damage control price caps in its ancillary service capacity markets. The price cap was initially set at \$500/MW (July 14-25) and later changed to \$250/MW (July 26 to present). Another important change during this period is that the ISO stopped procuring ancillary services zonally except in those hours having day ahead congestion on Path 15.

**Table A-9: Ancillary Service DA Market Bid Sufficiency Peak Hours (7-22)**

<b>Ancillary Service Type</b>	<b>7/18-7/24</b>	<b>7/25-7/31</b>	<b>8/1-8/7</b>	<b>8/8-8/14</b>	<b>8/15-8/21</b>	<b>8/22-8/28</b>
<b>Regulation</b>						
<b>% Hours deficient</b>	4%	1%	0%	4%	0%	0%
<b>Avg. % of Requirement</b>	184%	188%	207%	185%	269%	289%
<b>Min. % of Requirement</b>	73%	92%	113%	75%	120%	128%
<b>Max. % of Requirement</b>	331%	275%	298%	248%	365%	405%
<b>Spin</b>						
<b>% Hours deficient</b>	0%	10%	1%	3%	0%	4%
<b>Avg. % of Requirement</b>	209%	152%	168%	182%	233%	223%
<b>Min. % of Requirement</b>	122%	35%	71%	97%	114%	66%
<b>Max. % of Requirement</b>	357%	320%	287%	353%	532%	522%
<b>Non-Spin</b>						
<b>% Hours deficient</b>	2%	12%	12%	18%	0%	0%
<b>Avg. % of Requirement</b>	251%	212%	205%	246%	336%	284%
<b>Min. % of Requirement</b>	96%	69%	73%	65%	103%	115%
<b>Max. % of Requirement</b>	496%	450%	415%	474%	740%	585%
<b>Replacement<sup>16</sup></b>						
<b>% Hours deficient</b>	0%	17%	22%	7%	0%	0%
<b>Avg. % of Requirement</b>	622%	17669%	295%	321%	382%	343%
<b>Min. % of Requirement</b>	106%	32%	49%	69%	131%	105%
<b>Max. % of Requirement</b>	1,454%	496,149%	1,054%	803%	776%	709%

The most notable change in bid sufficiencies during this period occurred in the regulation market (Table A-9). During the first two periods, regulation had frequently been deficient during peak hours, regulation bid sufficiencies were averaging 130-140%, and in many weeks, minimum bid sufficiencies for regulation were under 60%. During this period, regulation bids were seldom deficient (less than 5% of the time), weekly bid sufficiency averages were over 180% and the lowest bid sufficiency in any hour was 73%. Bid sufficiencies in spinning reserve also showed significant improvement. Though bid sufficiencies for non-spinning and replacement reserve were generally higher than in the previous two periods, they frequently (more than 12% of the time) fell below 100% during the middle part of this period.

<sup>16</sup> The very large percentages shown for replacement reserve are due to the fact that in some hours replacement reserve requirements are zero. The program used to calculate bid sufficiencies sets zero requirements to 1 MW. Thus, if the ISO's replacement requirement was zero in a particular hour and there was 5,000 MW of available bids, the program would calculate a bid sufficiency of 500,000%.

**Table A-10: Ancillary Service DA Market Bid Sufficiency Off-Peak Hours (1-6,23,24)**

<b>Ancillary Service Type</b>	<b>7/18-7/24</b>	<b>7/25-7/31</b>	<b>8/1-8/7</b>	<b>8/8-8/14</b>	<b>8/15-8/21</b>	<b>8/22-8/28</b>
<b>Regulation</b>						
<b>% Hours deficient</b>	7%	0%	0%	2%	0%	0%
<b>Avg. % of Requirement</b>	184%	173%	193%	183%	224%	230%
<b>Min. % of Requirement</b>	90%	121%	123%	91%	135%	134%
<b>Max. % of Requirement</b>	319%	324%	303%	332%	358%	371%
<b>Spin</b>						
<b>% Hours deficient</b>	0%	2%	0%	0%	0%	0%
<b>Avg. % of Requirement</b>	328%	288%	297%	349%	446%	474%
<b>Min. % of Requirement</b>	147%	99%	156%	134%	206%	290%
<b>Max. % of Requirement</b>	493%	513%	452%	512%	691%	717%
<b>Non-Spin</b>						
<b>% Hours deficient</b>	0%	0%	0%	0%	0%	0%
<b>Avg. % of Requirement</b>	383%	379%	373%	405%	515%	610%
<b>Min. % of Requirement</b>	168%	156%	146%	192%	250%	392%
<b>Max. % of Requirement</b>	556%	575%	520%	658%	749%	1012%
<b>Replacement<sup>17</sup></b>						
<b>% Hours deficient</b>	0%	0%	0%	0%	0%	0%
<b>Avg. % of Requirement</b>	1,313%	49,157%	812%	718%	752%	761%
<b>Min. % of Requirement</b>	586%	143%	217%	384%	470%	497%
<b>Max. % of Requirement</b>	1,729%	740,576%	1,529%	953%	938%	982%

Bid sufficiency improved even more dramatically during the off-peak periods. With the exception of a few incidents in regulation and spinning reserve, bid sufficiency were above 100% for the entire 6 week period (Table A-10).

Daily totals of price spikes for this period (whether measures as cap hits or prices > \$200/MW) were at levels similar to the previous period. However, during this period, they tended to be more spread out over the four ancillary services (Table A-11). In the last two weeks of this period the number of price spikes dropped significantly. This could be partly attributed to moderate load levels for these two weeks which leaves more capacity available for the ancillary service market

<sup>17</sup> The very large percentages shown for replacement reserve are due to the fact that in some hours replacement reserve requirements are zero. The program used to calculate bid sufficiencies sets zero requirements to 1 MW. Thus, if the ISO's replacement requirement was zero in a particular hour and there was 5,000 MW of available bids, the program would calculate a bid sufficiency of 500,000%.

## Price Spikes:

**Table A-11: Number of Hours Ancillary Service Capacity Prices exceeded \$200/MW or Hit the Price Cap (7/14/98-8/28/98)**

OPR_DT	CAP	Regulation		Spinning		Non-Spinning		Replacement		Total <sup>18</sup>	
		HIT CAP	> \$200	HIT CAP	> \$200	HIT CAP	> \$200	HIT CAP	> \$200	HIT CAP	> \$200
7/14/98	500	8	8	0	0	0	0	0	0	8	8
7/15/98	500	1	3	0	0	0	0	0	0	1	3
7/16/98	500	1	4	0	0	0	0	0	0	1	4
7/17/98	500	5	8	0	0	4	4	5	5	10	13
7/18/98	500	3	7	0	0	0	4	0	0	3	11
7/19/98	500	0	2	0	0	0	0	0	0	0	2
7/20/98	500	4	7	0	0	5	5	5	5	9	12
7/21/98	500	0	2	0	0	0	3	0	0	0	5
7/22/98	500	0	0	0	0	0	0	0	0	0	0
7/23/98	500	0	0	0	0	0	0	0	0	0	0
7/24/98	500	0	0	0	0	0	0	1	4	1	4
7/25/98	500	0	0	0	0	0	0	0	0	0	0
7/26/98	250	0	0	2	2	0	0	0	0	2	2
7/27/98	250	0	0	0	2	1	1	1	9	1	11
7/28/98	250	0	0	1	1	5	6	6	6	7	7
7/29/98	250	1	1	11	12	4	4	3	3	14	15
7/30/98	250	3	3	1	2	0	0	0	0	3	3
7/31/98	250	5	5	1	1	0	0	0	0	5	5
8/1/98	250	1	1	2	2	1	1	0	0	2	2
8/2/98	250	0	1	8	8	2	2	0	0	8	8
8/3/98	250	2	2	1	4	12	12	12	12	16	16
8/4/98	250	0	0	0	2	7	12	9	10	11	14
8/5/98	250	0	0	5	5	6	6	10	10	12	12
8/6/98	250	2	2	8	8	4	5	5	5	10	10
8/7/98	250	0	2	2	10	3	4	3	3	6	10
8/8/98	250	2	5	0	4	0	1	0	3	2	9
8/9/98	250	2	3	0	0	0	0	0	0	2	3
8/10/98	250	4	5	2	11	1	4	0	3	6	14
8/11/98	250	1	4	5	10	5	6	2	9	7	14
8/12/98	250	2	5	3	12	5	6	0	8	7	15
8/13/98	250	1	4	6	11	7	7	0	7	8	14
8/14/98	250	0	5	6	10	6	8	0	9	6	14
8/15/98	250	0	1	0	0	0	0	0	0	0	1
8/16/98	250	0	2	0	0	0	0	0	0	0	2
8/17/98	250	0	0	2	4	3	5	0	2	3	6
8/18/98	250	0	1	0	3	0	3	0	0	0	4
8/19/98	250	0	2	0	0	0	0	0	0	0	2
8/20/98	250	0	0	0	0	0	0	0	0	0	0
8/21/98	250	0	0	0	0	0	0	0	0	0	0
8/22/98	250	0	0	0	0	0	0	0	0	0	0
8/23/98	250	0	0	0	0	0	0	0	0	0	0
8/24/98	250	0	1	4	4	0	0	0	0	4	5
8/25/98	250	0	0	0	3	0	0	0	0	0	3
8/26/98	250	0	0	0	0	0	0	0	0	0	0
8/27/98	250	0	0	0	0	0	0	0	0	0	0
8/28/98	250	0	0	0	1	0	0	5	5	5	6
Average <sup>19</sup>		1	2	2	3	2	2	1	3	4	6

<sup>18</sup> Totals are the sum of the hours that the price in at least one of the four markets exceeded \$200/MW.<sup>19</sup> The average # of hours per day prices hit the cap or exceeded \$200/MW.

## Ancillary Service Costs:

Table A-12: Ancillary Service Daily Cost Summaries (7/14/98-8/28/98)

Date	Regul. (\$)	Spin (\$)	Non-Spin (\$)	Repl. (\$)	AS MW Totals <sup>20</sup>	Est. AS Cost Totals <sup>21</sup> (\$)	Total Energy Cost <sup>22</sup> (\$)	AS Cost as a % of Total <sup>23</sup>
7/14/98	1,408,121	192,561	95,491	0	80,870	2,111,429	22,573,935	9%
7/15/98	458,083	196,542	110,197	50,573	96,610	934,818	21,460,623	4%
7/16/98	550,384	180,187	97,555	43,977	95,306	1,026,932	26,616,139	4%
7/17/98	1,882,478	190,034	773,018	952,910	105,618	3,971,713	32,264,714	12%
7/18/98	1,494,280	172,573	535,424	47,684	103,665	2,382,195	26,515,447	9%
7/19/98	460,583	160,648	82,715	35,857	101,738	753,219	17,988,062	4%
7/20/98	2,185,017	186,949	1,092,414	1,292,135	109,969	4,932,744	38,581,326	13%
7/21/98	513,049	170,466	508,944	43,485	105,691	1,253,537	27,907,300	4%
7/22/98	180,102	164,928	66,476	29,578	102,101	444,150	19,085,343	2%
7/23/98	175,106	158,408	64,471	36,255	100,592	434,302	15,167,060	3%
7/24/98	51,634	159,181	67,114	1,044,052	98,577	1,323,404	15,740,135	8%
7/25/98	3,973	141,671	55,698	24,109	94,422	233,500	14,000,834	2%
7/26/98	14,916	260,868	57,297	36,104	93,623	386,019	15,524,798	2%
7/27/98	58,126	496,219	286,144	656,240	104,117	1,658,702	35,025,255	5%
7/28/98	21,665	324,619	898,929	897,993	106,550	2,202,806	45,339,391	5%
7/29/98	208,436	1,486,990	516,012	1,715,933	107,981	4,817,708	34,149,743	14%
7/30/98	308,939	868,558	98,425	40,700	99,021	1,857,664	24,637,523	8%
7/31/98	341,152	438,411	154,253	182,074	97,093	1,150,875	20,409,091	6%
8/1/98	92,629	433,460	164,114	50,261	96,548	763,118	16,161,009	5%
8/2/98	72,940	1,006,361	255,610	53,725	103,111	1,416,996	18,040,970	8%
8/3/98	361,050	649,608	1,398,884	2,304,672	123,351	5,217,269	57,690,549	9%
8/4/98	120,424	385,972	1,236,424	2,282,355	120,469	4,124,714	34,700,788	12%
8/5/98	115,733	792,614	927,104	2,104,245	121,961	4,168,516	43,559,813	10%
8/6/98	225,477	926,672	657,959	1,261,920	116,016	3,188,844	43,114,614	7%
8/7/98	145,993	1,480,912	405,588	746,400	118,091	2,832,698	23,734,678	12%
8/8/98	516,948	723,442	191,139	819,030	117,893	2,305,428	16,346,653	14%
8/9/98	340,369	124,327	79,345	51,950	110,231	641,561	11,916,515	5%
8/10/98	710,711	1,790,993	531,969	519,867	115,728	4,107,591	27,853,065	15%
8/11/98	495,033	1,794,294	1,175,011	1,897,868	123,103	5,639,973	47,052,545	12%
8/12/98	849,867	2,227,302	862,556	1,682,229	121,396	5,947,874	36,706,962	16%
8/13/98	630,598	2,053,637	1,346,507	1,723,727	125,581	6,102,299	47,547,083	13%
8/14/98	626,574	1,973,771	1,562,383	2,161,948	123,599	6,761,296	48,329,127	14%
8/15/98	197,894	153,355	99,349	570,213	115,735	1,049,820	19,649,870	5%
8/16/98	190,989	114,828	60,735	105,769	108,040	480,282	15,515,631	3%
8/17/98	81,726	779,333	882,082	1,084,480	117,681	2,877,024	20,131,123	14%
8/18/98	100,647	268,374	486,934	85,207	112,534	975,797	18,704,107	5%
8/19/98	152,973	127,362	66,100	67,797	106,209	433,717	16,262,134	3%
8/20/98	56,417	126,882	55,547	124,353	109,850	364,396	15,454,484	2%
8/21/98	40,897	128,128	62,380	99,322	110,896	335,846	16,769,108	2%
8/22/98	20,258	117,803	62,665	72,701	108,598	292,293	14,730,866	2%
8/23/98	23,984	101,279	47,335	79,181	104,054	259,689	13,446,494	2%
8/24/98	267,028	567,366	246,268	51,665	113,768	1,255,432	20,770,230	6%
8/26/98	0	557,444	334,979	53,520	114,232	1,041,068	27,476,585	4%
8/27/98	0	218,859	162,777	166,640	118,689	554,237	21,032,104	3%
8/28/98	0	613,746	793,176	1,370,067	121,775	2,808,932	25,927,218	11%
<b>Total</b>	<b>16,753,203</b>	<b>26,187,937</b>	<b>19,715,497</b>	<b>28,720,771</b>	<b>4,902,683</b>	<b>97,822,427</b>	<b>1,171,611,044</b>	<b>8%</b>

<sup>20</sup> This is the sum of the capacities won in all four markets.

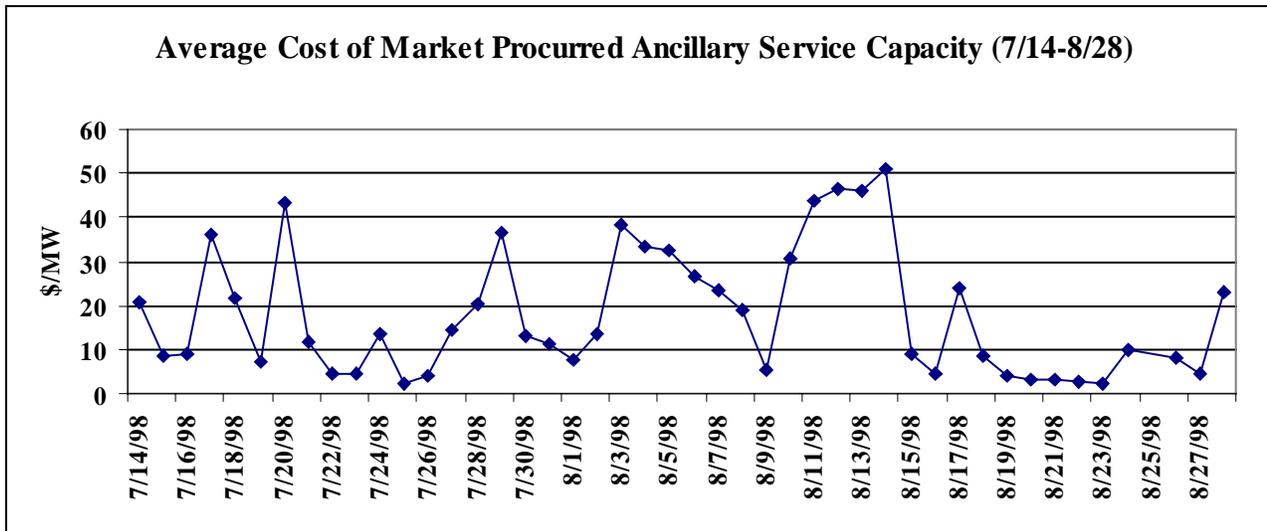
<sup>21</sup> The daily costs are computed for the total ancillary service requirements by multiplying the computed average cost of the total ancillary services for each hour by the total hourly requirements and then summing over all 24 hours (i.e. ancillary service market rate for quantities supplied by RMR units).

<sup>22</sup> Total energy costs are calculated by summing total hour ahead scheduled load times the PX unconstrained price over 24 hours.

<sup>23</sup> Estimated ancillary service costs expressed as a percentage of total energy costs.

Total daily costs of ancillary services varied considerably during this period ranging from \$250,000 to over \$6 million. This large variability is due to both changes in the daily quantities of reserve procured and price volatility. The average cost of ancillary service capacity also exhibited extreme volatility ranging from under \$5/MW to over \$50/MW. This high degree of variability is primarily due to price volatility

**Figure A-3: Average Cost of Procuring Ancillary Service Capacity (July 14-Aug 28)**



**Concluding Remark:**

The comparison of bid sufficiency and ancillary service costs for the three periods of concern to FERC studied above shows that during the third period where ISO price caps were in effect, the cost of ancillary services as a percentage of energy cost (8%) was the lowest compared to the other two periods, and the bid sufficiency was the highest. This observation indicates that the level of ISO price caps presently in use does not put too much constraint on the market (bid sufficiency) nor an excessive toll on the consumers (A/S cost as a percentage of energy cost).