

BPA Dispatcher Standing Order 216 and Wind Integration Rate: What's it all about?

UWIG Spring Technical Workshop

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Bart McManus, BPA



BPA DSO 216 and Wind Integration Rate

- Background
 - Wind and reserve
 - Wind in queue/what is real estimate for integration
 - Studies
- How the risk can be mitigated
 - Hold more reserve
 - Use less reserve (improve schedules)
 - DSO 216
- DSO 216 events

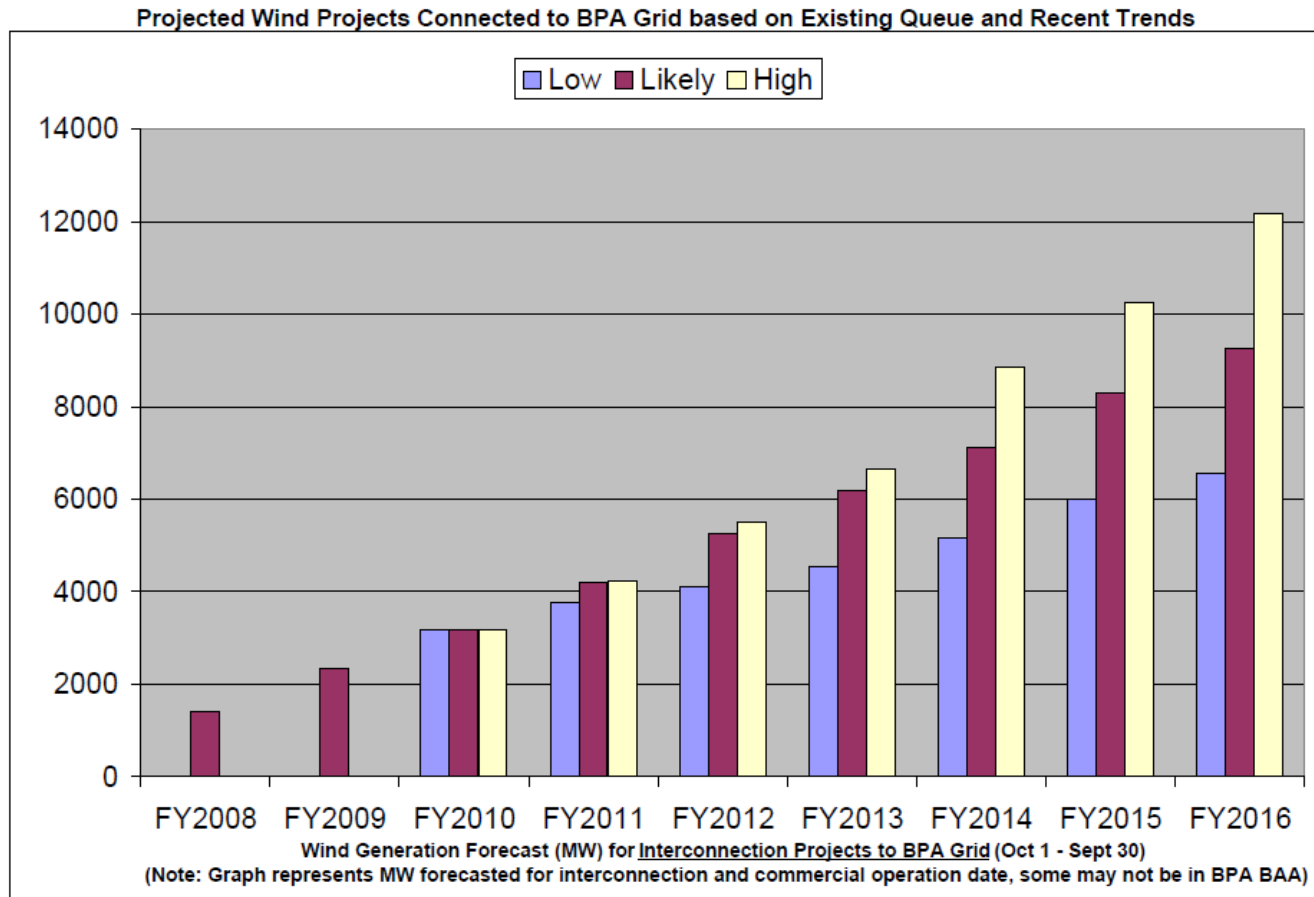
Background: Wind and reserve

- Until a certain penetration level is reached, wind does not have much affect on reserve.
- Once that level has been reached, it will ratchet up quickly, depending on diversity of wind resources
- BPA reached the level of wind integration where the reserve use could be seen in the second half of calendar year 2008
- By October of 2009, wind reserve needs surpassed reserve needs for load in BPA.

Background/Wind in Queue, Estimate on what will actually be built

- Over 20 GW of wind in the queue, maybe half will be built
- BPA uses all data available to get the best estimate on what will be built over the years rather than just relying on the queue
- Next graph shows the results.

Background/Wind in Queue, Estimate on what will actually be built



NOTES:

S. Enyeart/C. Randall - As of: 3/10/2010

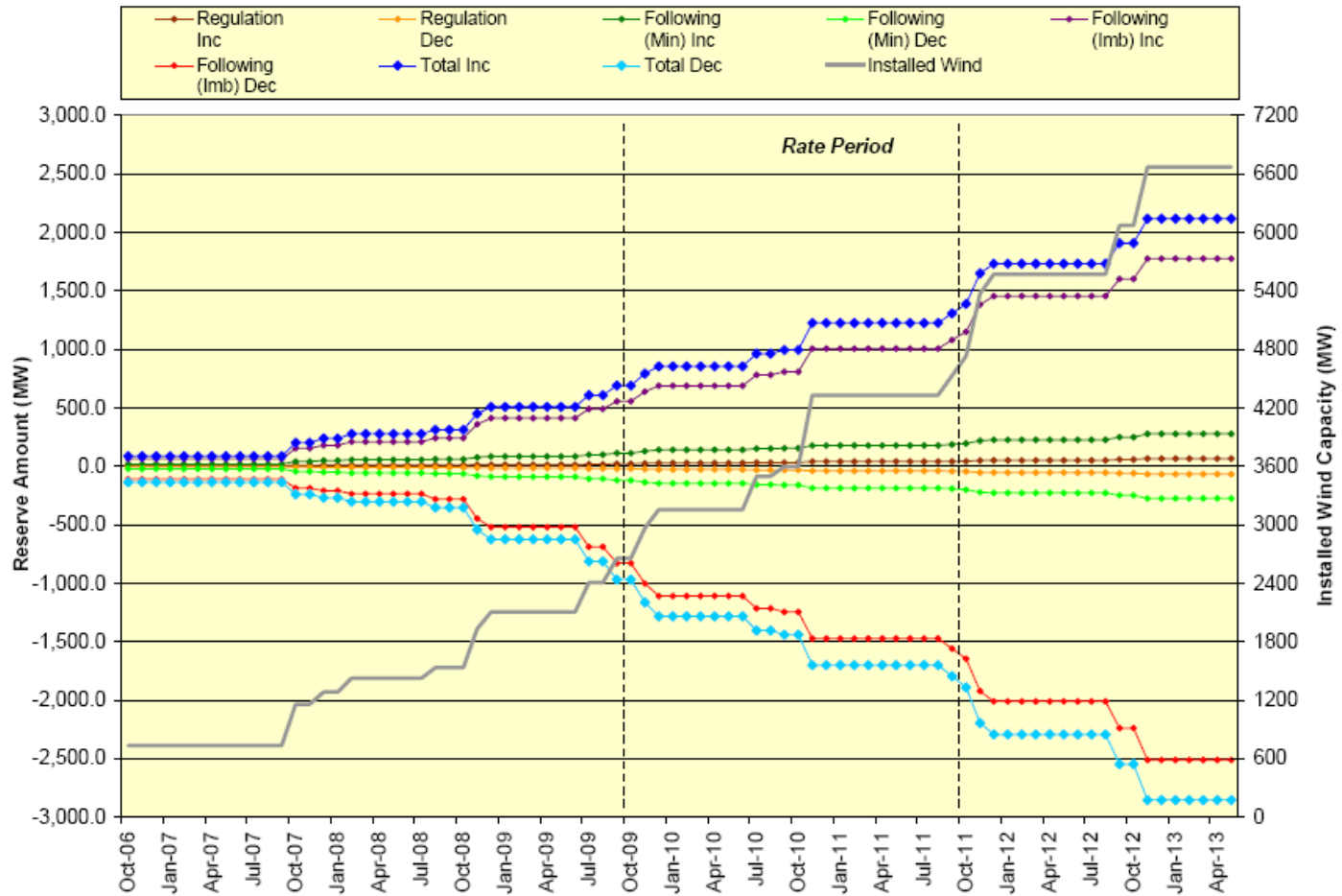
1. Projections beyond FY10 may be impacted or delayed due to a need for Transmission system expansion.
2. Projected totals based on previous experience and present growth factors including Production Tax Credits and RPS Demand.
3. Total Wind Projects / GI Study Requests: **20,739** Megawatts
4. Wind generation shown is interconnected to BPA-T; amount within BPA Balancing Authority Area is not estimated.
5. Graph FY assumption based on estimate of commercial operation of wind projects.

Background: Studies

- Calculated reserve requirements for wind for FY 2009 for mini-rate case
- Did not include scheduling errors in this case, Generation Imbalance was not part of it
- Did include schedules in the rate case for FY 2010 and 2011
- The amount of reserve needed increased by 4x the amount calculated for FY 2009
- Other change, in 2009 the wind was given an incremental reserve amount (studied load alone, then studied load net wind, wind got the delta) but for 2010-2011 rates, gave each different component the amount of reserve required based on its volatility rather than an incremental amount.

Background: Study results

2010 Rate Case Wind Reserve Requirement
(using statistical allocation method)



Total Reserve Needs

Table 2.4																						
Total Reserve Requirement (Load Net Wind)																						
30-MINUTE PERSISTENCE WIND SCHEDULING ACCURACY																						
1	A	B	C		D		E		F		G		H		I		J		K		L	
2	Date	Installed Capacity	Inc	Dec	Inc	Dec	Inc	Dec	Inc	Dec	Inc	Dec	Inc	Dec	Inc	Dec	Inc	Dec	Inc	Dec	Inc	Dec
3	Oct-09	2111 MW	94.2	-98.8	251.0	-268.2	571.6	-703.2	320.6	-435.0	665.9	-802.1										
4	Nov-09	2111 MW	94.2	-98.8	251.0	-268.2	571.6	-703.2	320.6	-435.0	665.9	-802.1										
5	Dec-09	2111 MW	94.2	-98.8	251.0	-268.2	571.6	-703.2	320.6	-435.0	665.9	-802.1										
6	Jan-10	2211 MW	95.5	-100.0	256.3	-273.7	598.5	-740.2	342.1	-466.5	693.9	-840.2										
7	Feb-10	2402 MW	97.8	-102.1	266.5	-284.3	649.7	-810.9	383.2	-526.7	747.5	-913.1										
8	Mar-10	2402 MW	97.8	-102.1	266.5	-284.3	649.7	-810.9	383.2	-526.7	747.5	-913.1										
9	Apr-10	2515 MW	99.2	-103.4	272.5	-290.5	680.1	-852.7	407.6	-562.3	779.2	-956.2										
10	May-10	2515 MW	99.2	-103.4	272.5	-290.5	680.1	-852.7	407.6	-562.3	779.2	-956.2										
11	Jun-10	2515 MW	99.2	-103.4	272.5	-290.5	680.1	-852.7	407.6	-562.3	779.2	-956.2										
12	Jul-10	2515 MW	99.2	-103.4	272.5	-290.5	680.1	-852.7	407.6	-562.3	779.2	-956.2										
13	Aug-10	3198 MW	105.7	-110.1	305.5	-326.7	833.2	-1,086.3	527.7	-759.7	938.9	-1,196.4										
14	Sep-10	3198 MW	105.7	-110.1	305.5	-326.7	833.2	-1,086.3	527.7	-759.7	938.9	-1,196.4										
15	Oct-10	3515 MW	108.8	-113.1	320.8	-343.5	904.2	-1,194.8	583.4	-851.3	1,013.0	-1,307.9										
16	Nov-10	3515 MW	108.8	-113.1	320.8	-343.5	904.2	-1,194.8	583.4	-851.3	1,013.0	-1,307.9										
17	Dec-10	3593 MW	109.5	-113.9	324.6	-347.6	921.7	-1,221.5	597.1	-873.8	1,031.2	-1,335.4										
18	Jan-11	3593 MW	109.5	-113.9	324.6	-347.6	921.7	-1,221.5	597.1	-873.8	1,031.2	-1,335.4										
19	Feb-11	3593 MW	109.5	-113.9	324.6	-347.6	921.7	-1,221.5	597.1	-873.8	1,031.2	-1,335.4										
20	Mar-11	3593 MW	109.5	-113.9	324.6	-347.6	921.7	-1,221.5	597.1	-873.8	1,031.2	-1,335.4										
21	Apr-11	3593 MW	109.5	-113.9	324.6	-347.6	921.7	-1,221.5	597.1	-873.8	1,031.2	-1,335.4										
22	May-11	3593 MW	109.5	-113.9	324.6	-347.6	921.7	-1,221.5	597.1	-873.8	1,031.2	-1,335.4										
23	Jun-11	3593 MW	109.5	-113.9	324.6	-347.6	921.7	-1,221.5	597.1	-873.8	1,031.2	-1,335.4										
24	Jul-11	3593 MW	109.5	-113.9	324.6	-347.6	921.7	-1,221.5	597.1	-873.8	1,031.2	-1,335.4										
25	Aug-11	3843 MW	112.1	-116.5	341.2	-360.5	977.1	-1,297.6	635.9	-937.1	1,089.2	-1,414.0										
26	Sep-11	3843 MW	112.1	-116.5	341.2	-360.5	977.1	-1,297.6	635.9	-937.1	1,089.2	-1,414.0										
27	Rate Period Average	3053 MW	104.2	-108.5	298.5	-318.8	797.3	-1,033.8	498.8	-715.0	901.5	-1,142.4										

- PS – based on a perfect schedule (hourly average ramped in over 20 minutes)
 - ES – based on an estimated schedule (30 minute persistence forecast for wind; scaled historical estimates for load)
 - lmb – the delta, i.e. the increase in following due to imbalance (ES – PS)

Wind Reserve Needs

Table 2.5												
Wind Reserve												
30-MINUTE PERSISTENCE WIND SCHEDULING ACCURACY												
1	A	B	C	D	E	F	G	H	I	J	K	L
			Regulation		Following (PS)		Following (ES)		Following (Imb)		Total (Reg + ES)	
2	<u>Date</u>	<u>Installed Capacity</u>	<u>Inc</u>	<u>Dec</u>	<u>Inc</u>	<u>Dec</u>	<u>Inc</u>	<u>Dec</u>	<u>Inc</u>	<u>Dec</u>	<u>Inc</u>	<u>Dec</u>
3	Oct-09	2111 MW	11.0	-10.4	67.6	-66.5	319.0	-467.9	251.4	-401.5	330.0	-478.3
4	Nov-09	2111 MW	11.0	-10.4	67.6	-66.5	319.0	-467.9	251.4	-401.5	330.0	-478.3
5	Dec-09	2111 MW	11.0	-10.4	67.6	-66.5	319.0	-467.9	251.4	-401.5	330.0	-478.3
6	Jan-10	2211 MW	11.9	-11.3	72.7	-72.3	348.6	-507.7	275.9	-435.4	360.6	-518.9
7	Feb-10	2402 MW	13.7	-13.0	82.4	-83.4	405.2	-583.5	322.8	-500.1	419.0	-596.5
8	Mar-10	2402 MW	13.7	-13.0	82.4	-83.4	405.2	-583.5	322.8	-500.1	419.0	-596.5
9	Apr-10	2515 MW	14.8	-14.0	88.1	-89.9	438.7	-628.4	350.6	-538.4	453.5	-642.4
10	May-10	2515 MW	14.8	-14.0	88.1	-89.9	438.7	-628.4	350.6	-538.4	453.5	-642.4
11	Jun-10	2515 MW	14.8	-14.0	88.1	-89.9	438.7	-628.4	350.6	-538.4	453.5	-642.4
12	Jul-10	2515 MW	14.8	-14.0	88.1	-89.9	438.7	-628.4	350.6	-538.4	453.5	-642.4
13	Aug-10	3198 MW	22.2	-21.3	119.9	-128.0	602.7	-872.4	482.9	-744.4	624.9	-893.7
14	Sep-10	3198 MW	22.2	-21.3	119.9	-128.0	602.7	-872.4	482.9	-744.4	624.9	-893.7
15	Oct-10	3515 MW	25.6	-24.7	134.6	-145.6	678.9	-985.7	544.3	-840.0	704.4	-1,010.4
16	Nov-10	3515 MW	25.6	-24.7	134.6	-145.6	678.9	-985.7	544.3	-840.0	704.4	-1,010.4
17	Dec-10	3593 MW	26.4	-25.6	138.2	-150.0	697.6	-1,013.5	559.4	-863.6	724.0	-1,039.1
18	Jan-11	3593 MW	26.4	-25.6	138.2	-150.0	697.6	-1,013.5	559.4	-863.6	724.0	-1,039.1
19	Feb-11	3593 MW	26.4	-25.6	138.2	-150.0	697.6	-1,013.5	559.4	-863.6	724.0	-1,039.1
20	Mar-11	3593 MW	26.4	-25.6	138.2	-150.0	697.6	-1,013.5	559.4	-863.6	724.0	-1,039.1
21	Apr-11	3593 MW	26.4	-25.6	138.2	-150.0	697.6	-1,013.5	559.4	-863.6	724.0	-1,039.1
22	May-11	3593 MW	26.4	-25.6	138.2	-150.0	697.6	-1,013.5	559.4	-863.6	724.0	-1,039.1
23	Jun-11	3593 MW	26.4	-25.6	138.2	-150.0	697.6	-1,013.5	559.4	-863.6	724.0	-1,039.1
24	Jul-11	3593 MW	26.4	-25.6	138.2	-150.0	697.6	-1,013.5	559.4	-863.6	724.0	-1,039.1
25	Aug-11	3843 MW	30.0	-28.7	151.5	-160.0	760.8	-1,102.5	609.3	-942.5	790.8	-1,131.2
26	Sep-11	3843 MW	30.0	-28.7	151.5	-160.0	760.8	-1,102.5	609.3	-942.5	790.8	-1,131.2
27	Rate Period Average	3053 MW	20.8	-19.9	112.9	-119.4	564.0	-817.6	451.1	-698.2	584.8	-837.5

- PS – based on a perfect schedule (hourly average ramped in over 20 minutes)
- ES – based on an estimated schedule (30 minute persistence forecast for wind; scaled historical estimates for load)
- Imb – the delta, i.e. the increase in following due to imbalance (ES – PS)

Load Reserve Needs

	A	B	C	D	E	F	G	H	I	J	K	L
1			Regulation		Following (PS)		Following (ES)		Following (lmb)		Total (Reg + ES)	
2	<u>Date</u>	<u>Installed Capacity</u>	<u>Inc</u>	<u>Dec</u>	<u>Inc</u>	<u>Dec</u>	<u>Inc</u>	<u>Dec</u>	<u>Inc</u>	<u>Dec</u>	<u>Inc</u>	<u>Dec</u>
3	Oct-09	2111 MW	83.3	-88.5	183.4	-201.8	252.6	-235.3	69.2	-33.5	335.9	-323.7
4	Nov-09	2111 MW	83.3	-88.5	183.4	-201.8	252.6	-235.3	69.2	-33.5	335.9	-323.7
5	Dec-09	2111 MW	83.3	-88.5	183.4	-201.8	252.6	-235.3	69.2	-33.5	335.9	-323.7
6	Jan-10	2211 MW	83.5	-88.7	183.7	-201.5	249.8	-232.6	66.2	-31.1	333.4	-321.3
7	Feb-10	2402 MW	84.0	-89.1	184.1	-200.9	244.5	-227.4	60.4	-26.5	328.6	-316.5
8	Mar-10	2402 MW	84.0	-89.1	184.1	-200.9	244.5	-227.4	60.4	-26.5	328.6	-316.5
9	Apr-10	2515 MW	84.3	-89.4	184.4	-200.5	241.4	-224.4	57.0	-23.8	325.7	-313.8
10	May-10	2515 MW	84.3	-89.4	184.4	-200.5	241.4	-224.4	57.0	-23.8	325.7	-313.8
11	Jun-10	2515 MW	84.3	-89.4	184.4	-200.5	241.4	-224.4	57.0	-23.8	325.7	-313.8
12	Jul-10	2515 MW	84.3	-89.4	184.4	-200.5	241.4	-224.4	57.0	-23.8	325.7	-313.8
13	Aug-10	3198 MW	83.6	-88.7	185.6	-198.7	230.4	-213.9	44.8	-15.2	314.0	-302.7
14	Sep-10	3198 MW	83.6	-88.7	185.6	-198.7	230.4	-213.9	44.8	-15.2	314.0	-302.7
15	Oct-10	3515 MW	83.2	-88.4	186.2	-197.9	225.3	-209.1	39.2	-11.2	308.6	-297.5
16	Nov-10	3515 MW	83.2	-88.4	186.2	-197.9	225.3	-209.1	39.2	-11.2	308.6	-297.5
17	Dec-10	3593 MW	83.1	-88.3	186.3	-197.7	224.1	-207.9	37.8	-10.3	307.2	-296.3
18	Jan-11	3593 MW	83.1	-88.3	186.3	-197.7	224.1	-207.9	37.8	-10.3	307.2	-296.3
19	Feb-11	3593 MW	83.1	-88.3	186.3	-197.7	224.1	-207.9	37.8	-10.3	307.2	-296.3
20	Mar-11	3593 MW	83.1	-88.3	186.3	-197.7	224.1	-207.9	37.8	-10.3	307.2	-296.3
21	Apr-11	3593 MW	83.1	-88.3	186.3	-197.7	224.1	-207.9	37.8	-10.3	307.2	-296.3
22	May-11	3593 MW	83.1	-88.3	186.3	-197.7	224.1	-207.9	37.8	-10.3	307.2	-296.3
23	Jun-11	3593 MW	83.1	-88.3	186.3	-197.7	224.1	-207.9	37.8	-10.3	307.2	-296.3
24	Jul-11	3593 MW	83.1	-88.3	186.3	-197.7	224.1	-207.9	37.8	-10.3	307.2	-296.3
25	Aug-11	3843 MW	82.1	-87.8	189.7	-200.6	216.3	-195.1	26.6	5.5	298.4	-282.8
26	Sep-11	3843 MW	82.1	-87.8	189.7	-200.6	216.3	-195.1	26.6	5.5	298.4	-282.8
27	Rate Period Average	3053 MW	83.4	-88.6	185.5	-199.4	233.3	-216.3	47.7	-16.8	316.7	-304.9

· PS – based on a perfect schedule (hourly average ramped in over 20 minutes)
 · ES – based on an estimated schedule (30 minute persistence forecast for wind; scaled historical estimates for load)
 · lmb – the delta, i.e. the increase in following due to imbalance (ES – PS)

Background: Study Results and Response

- With the amount of wind likely to be integrated and the amount of reserve needed, BPA saw that it would be unable to provide the balancing needs for the wind in the near future
 - Halted new integration until solutions could be found
 - BPA knew that limiting the output of wind generation could be done for overgeneration conditions, undergeneration was more of an issue
 - BPA decided to curtail tags when undergeneration caused the reserve to be over deployed

Mitigating the Risk

- One method for mitigating the risk would be to purchase more reserve in order to cover all events
- The wind owners/operators mitigated some of the risk by increasing their scheduling accuracy
- BPA decided to insure there were enough in-hour balancing reserve by limiting the amount of reserve deployed with the measures set out in DSO 216

DSO 216

- Dispatcher Standing Order 216 lays out how the wind facilities will be limited during overgeneration events and how the tags for the wind facilities will be curtailed during undergeneration events
 - When total reserve deployed reaches 85% of the amount set aside, a warning is issued
 - When total reserve deployed reaches 90% of the amount set aside, the wind output is limited to schedule plus reserve allocation or the wind tags are curtailed to actual plus reserve allocation, depending on if it is an over-generation or under-generation event (Level 1).
 - If, in the same hour of a Level 1 event, the reserve deployed reaches 100% of the reserve set aside, wind is limited to schedule or wind tags are curtailed to actual, depending on if it is an over-generation or under-generation event (Level 2).

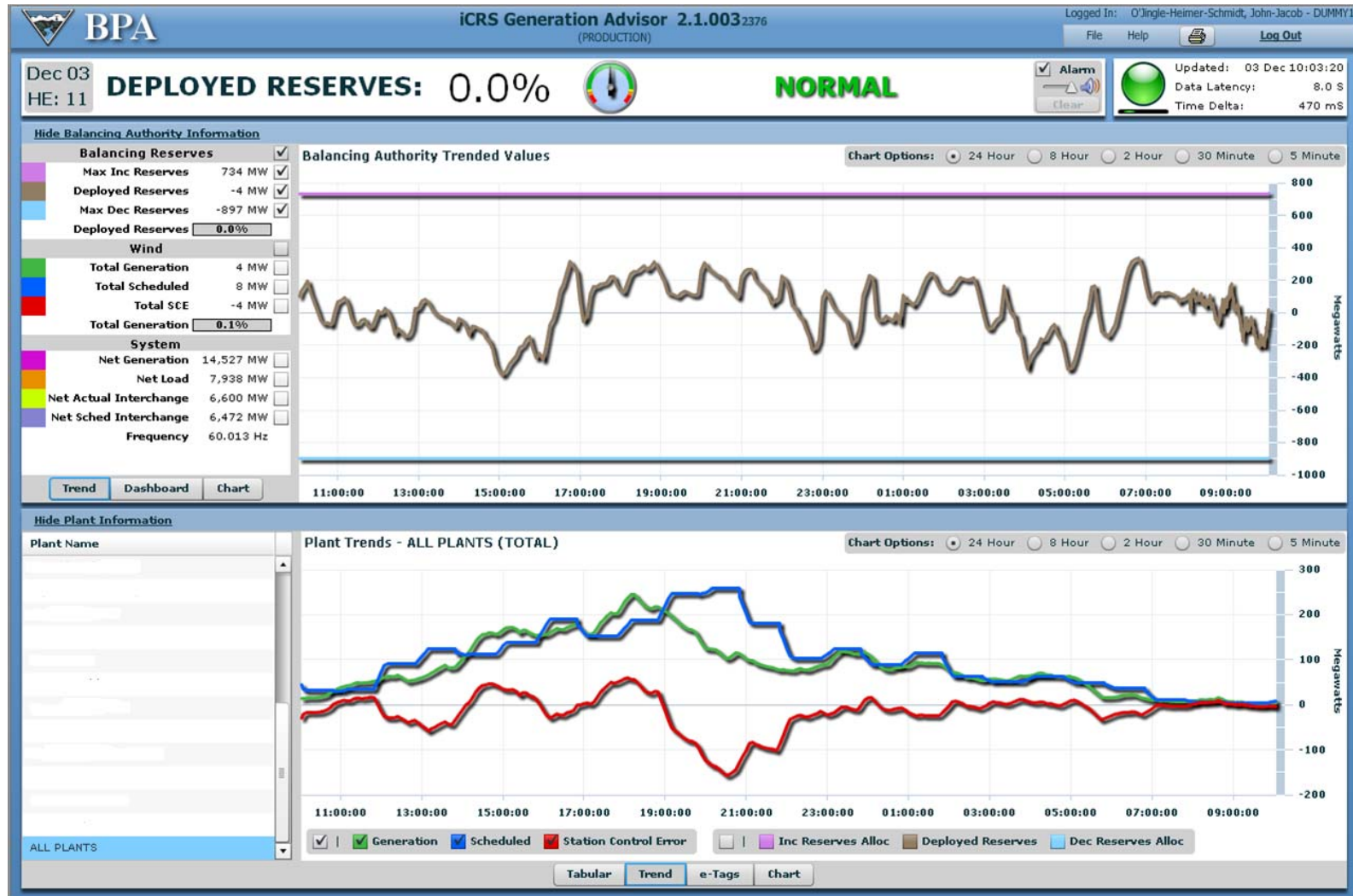
DSO 216

- This has given BPA the certainty that the amount of reserve being held is sufficient at all times for load-resource balance
- This also gives the owners and operators of wind facilities the ability to reduce risk by increasing the accuracy of their schedules.

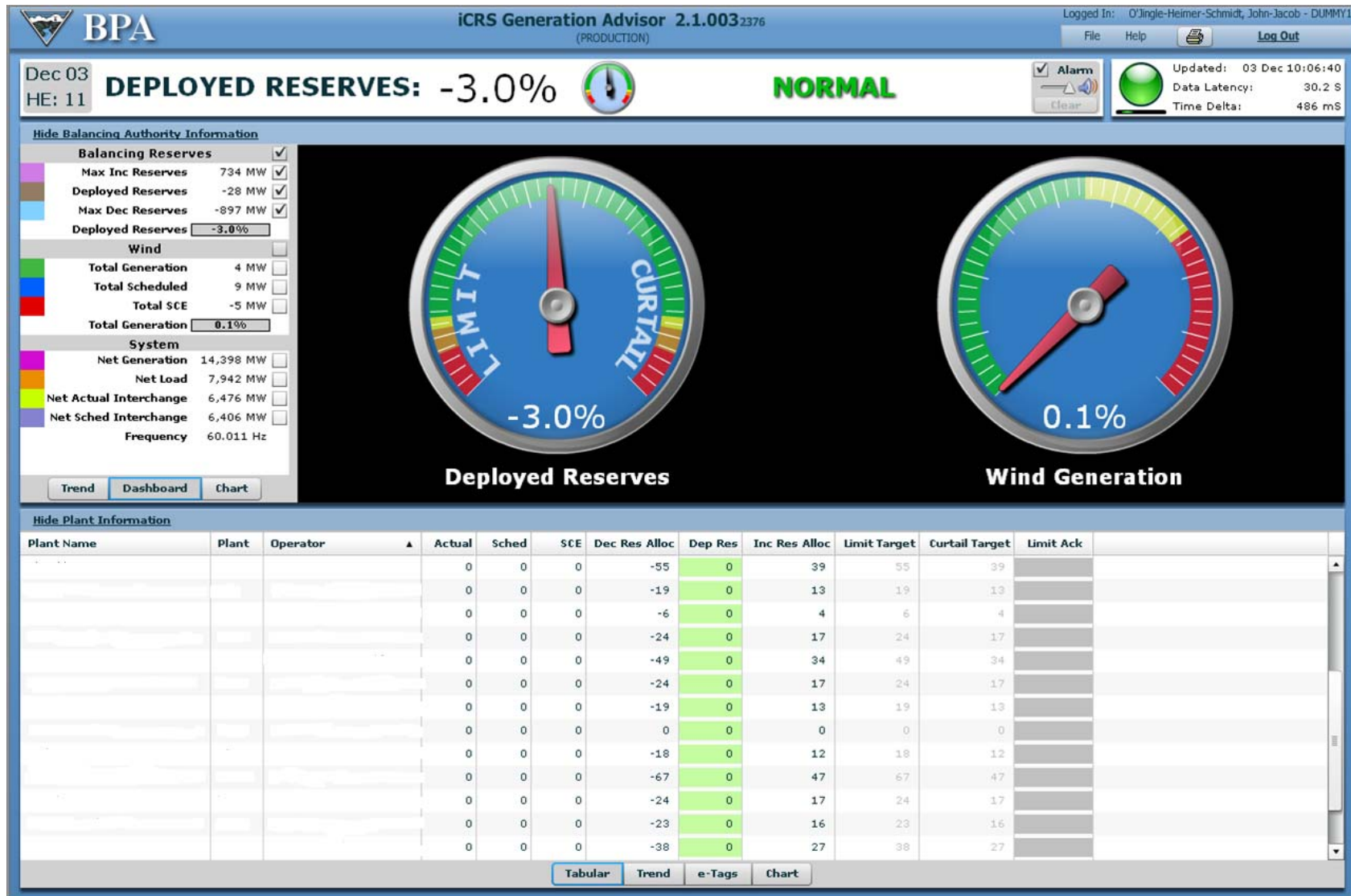
Implementing DSO 216

- First needed to calculate the total reserve deployed
 - All BAs know how much reserve is available
 - Few BAs know how much reserve has been deployed at any given time
- Second, needed a customer interface in order to notify when an event is occurring
 - SCADA RTUs
 - ICCP
 - Web (Generation Advisor)

Generation Advisor



Generation Advisor



Information on BPA Website

- BPA has added numerous charts on website showing the state of the system
- All can be accessed from:

<http://www.transmission.bpa.gov/Business/Operations/Wind/default.aspx>

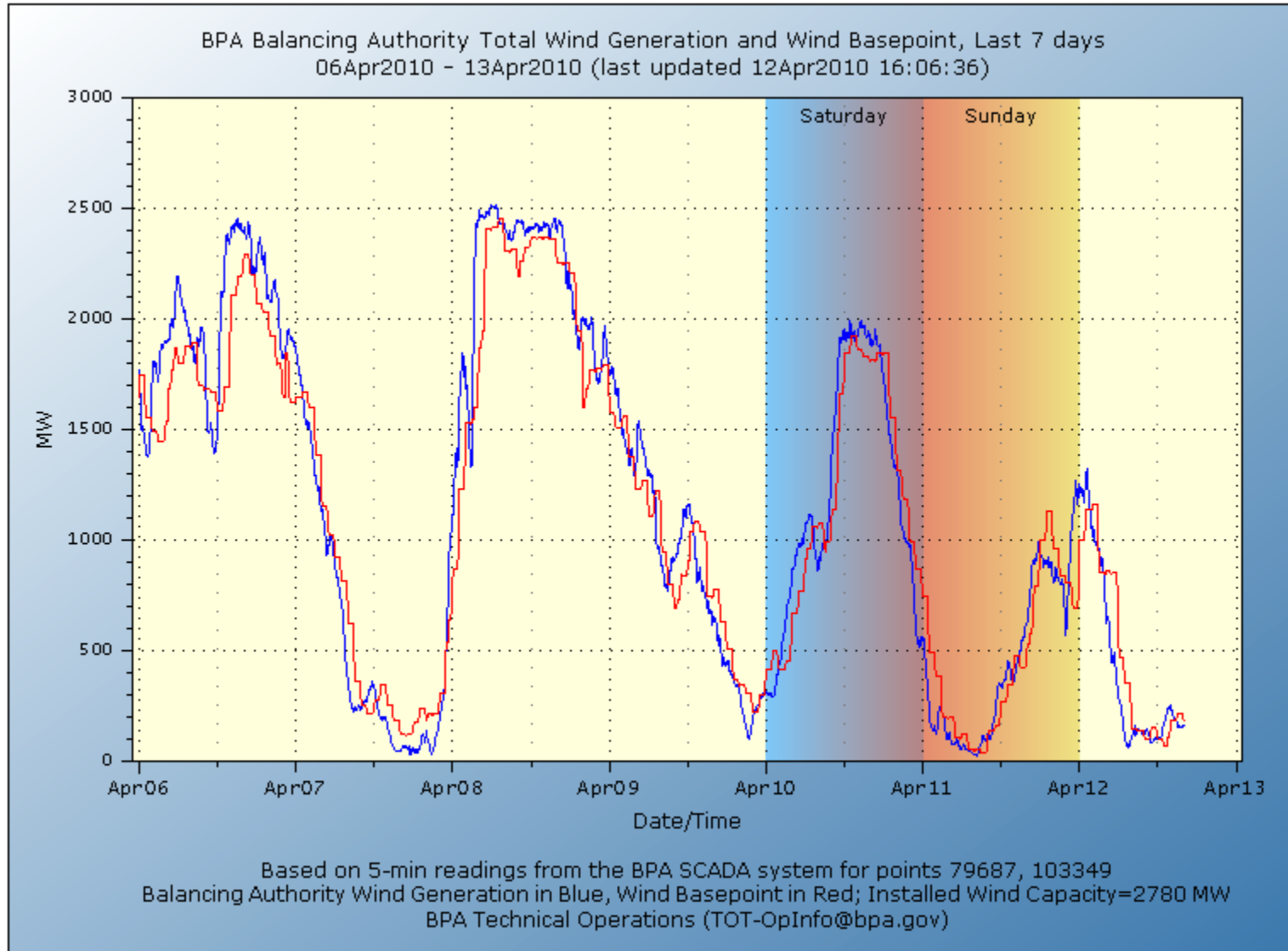
Events

http://www.transmission.bpa.gov/wind/op_controls/default.cfm?page=DSO216

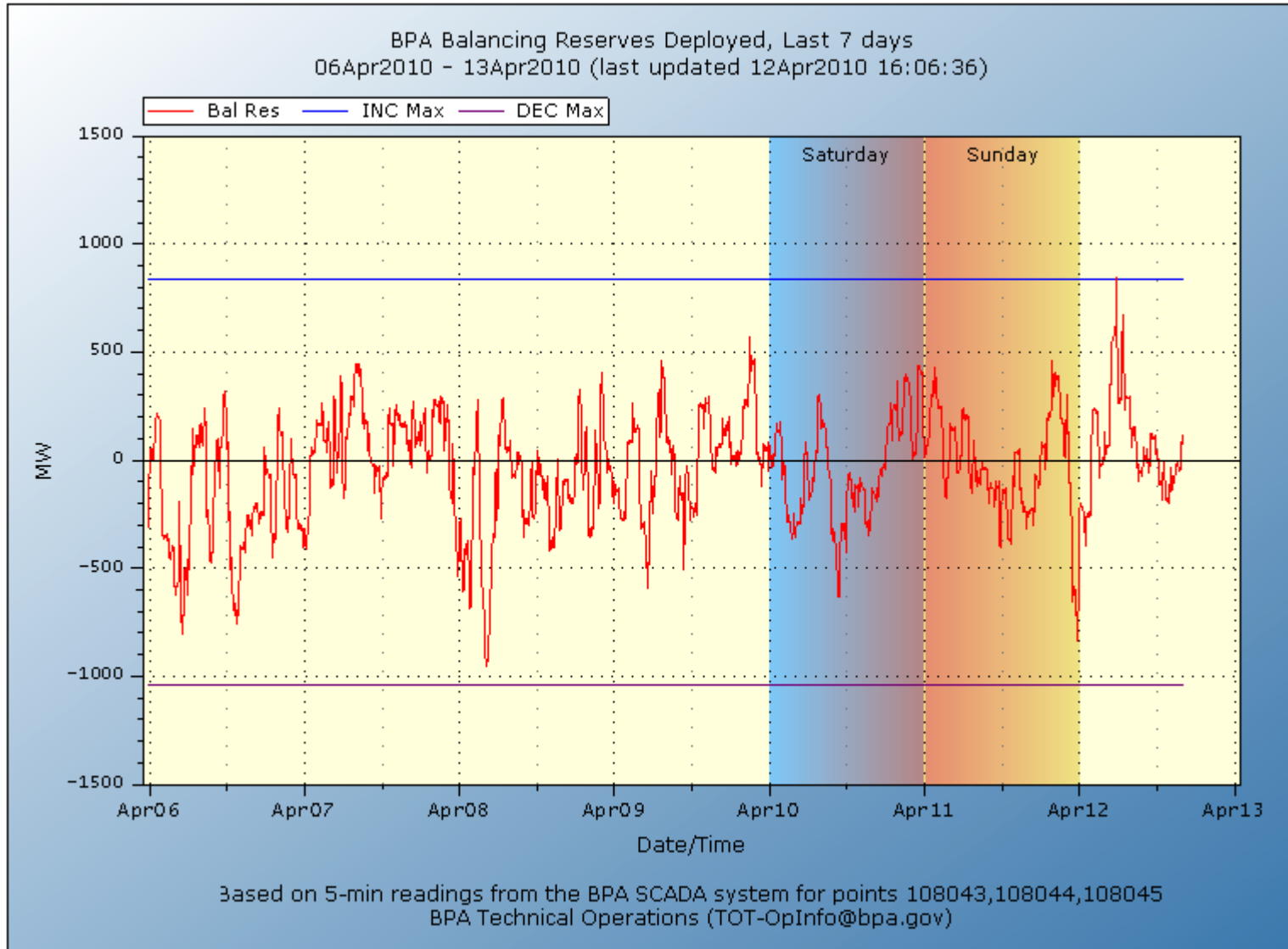
Limit (DEC) Events	October	November	December	January	February	March	Total
	Act	Act	Act	Act	Act	Act	Act
Level 1	2	2	1	1	0	4	10
MW per L1 Event	379	305	534	214	0	194	289
L1 MW per Month	758	610	534	214	0	776	2892
Average Number of Sources	12	9	13	13	0	7	11
Average MW by Source	33	36	41	16	0	28	32
Curtailment (INC) Events	October	November	December	January	February	March	Total
	Act	Act	Act	Act	Act	Act	Act
Level 1	2	5	2	1	1	2	13
MW per L1 Event	151	327	233	329	179	550	308
L1 MW per Month	302	1633	466	329	179	1100	4009
Average Number of Sources	5	12	9	13	11	14	10
Average Number of PODs	6	12	8	10	6	11	9
Average MW by Source	30	27	26	25	16	50	29

Installed Capacity (as of the end of each month)	October	November	December	January	February	March	Median
		2284	2517	2680	2780	2780	2780

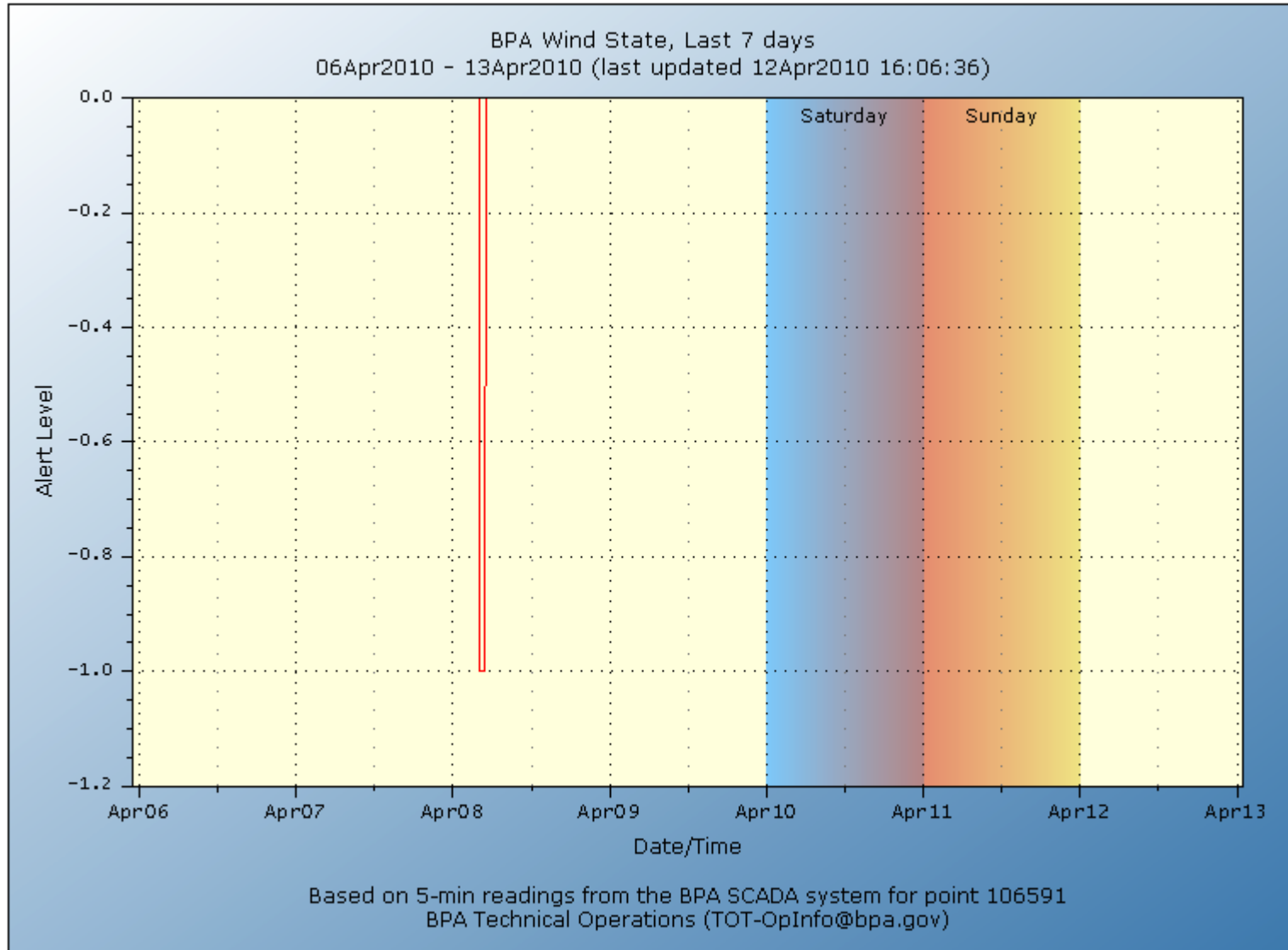
Total Wind Actual and Schedule



Total Reserve Deployed



Wind State

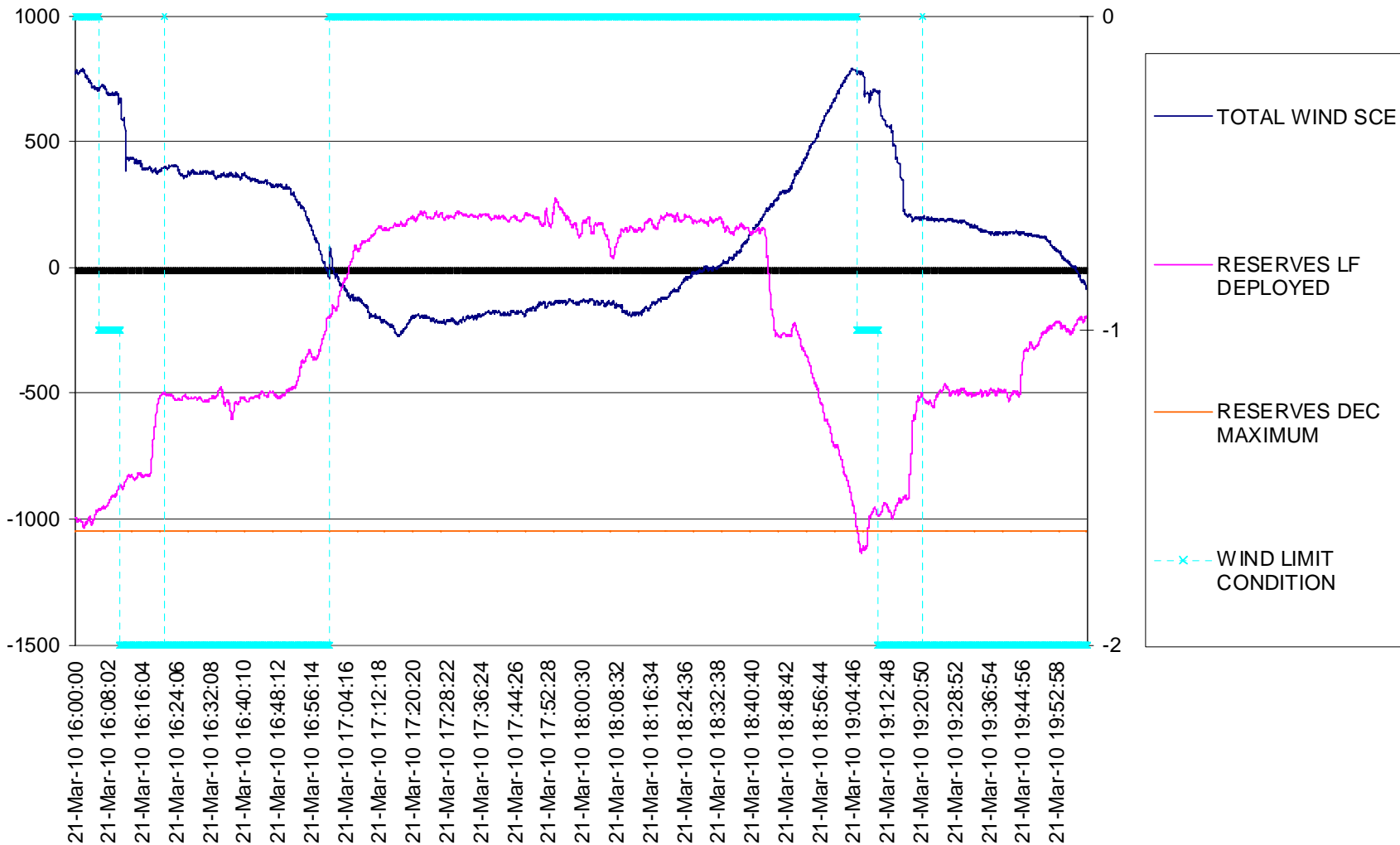


3/21/2010 limitations

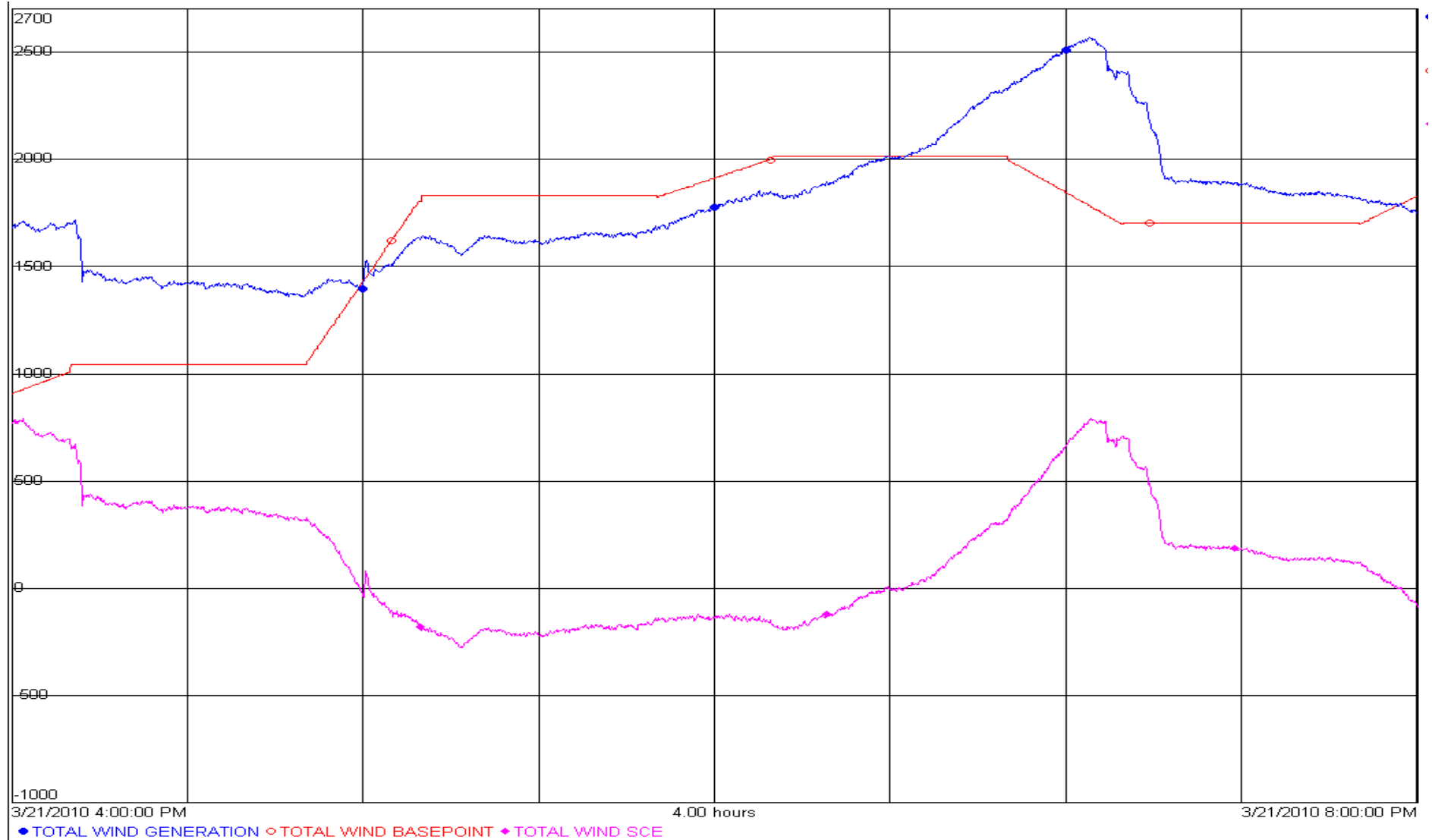
- Next slide shows BPA total wind control error, total reserve deployed, reserve decrement maximum and the wind state
- There were two limitation events on this day as the wind was quite volatile
- The slide following shows the total wind generation and schedule for same time period.

Two limitations on 3/21/2010

Total Reserve



Total wind output, schedule and error



Conclusion

- DSO 216 has proven to work for BPA, giving us the capability to limit the amount of reserve set aside for balancing and keeping the deployed reserve within the bounds
- Continuing to work with other Balancing Authorities
- The wind providers have increased scheduling accuracy a lot from prior to the first reserve study presented in August 2008.