



Market Pricing Working Group

Market Evolution Program

Introduction to Reserve Demand Curves

Meeting #12

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Public

Introduction to Reserve Demand Curves

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Market Pricing Working Group

DRAFT: For Discussion Purposes Only
Toronto, Ontario

AGENDA

Today's presentation will include:

- A discussion of the development of reserve demand curves in the New York market using materials presented to their MSWG and BIC:
 - 2 A brief history of reserve provision
 - 2 Reserve demand curve concepts
 - 2 Deriving the reserve demand curves
- Other jurisdictions
- Control Action operating reserve
- Questions

The scheduling and pricing functions in SCUC and BME have always included reserve demand curves. The reserve demand curves are analogous to the penalty function costs included in the objective function that allow the reserve constraints to be violated in order to obtain feasible solutions when not enough of a particular reserve is available.

BME on numerous occasions has calculated energy prices and reserve shadow prices well in excess of \$1,000 because of reserve constraint violations. However, these BME prices are not used to settle the energy or reserves scheduled in BME.

SCD does not solve (or value) these reserve constraints, but rather receives the reserve schedules from BME and calculates LMPs that do not include the full shortage or scarcity value of the reserves.

The fundamental goal of including demand curves in the RTS/SMD2 software calculation of reserves is to recognize the shortage or scarcity value of reserves, thereby implementing a more robust and tightly integrated method of pricing reserves and energy during scarcity conditions relative to the current interim approach in today's legacy system.

The demand curves need to reflect appropriate scarcity values while maintaining consistency with operational practice and reserve scheduling requirements (i.e., maintain scheduling objectives such that it has a negligible effect on the number of times or the magnitude by which reserve requirements might be violated without impacting system reliability).

The demand curves do not limit the actions that can be taken by operations staff to create or procure additional reserves if those reserves that are necessary to meet the requirements are available but not scheduled.

There are two distinct types of reserve constraints modeled in today's SCUC and BME.

- There are those that are based on reserve requirements that correspond to specific reliability rules, e.g., NYCA spinning reserve, NYCA 10-minute total reserve, NYCA 30-minute total reserve, Eastern 10-minute total reserve and the Long Island 30-minute total reserve.
- There are other reserve constraints in SCUC and BME that are based on guidelines that the NYISO is not required to maintain, e.g., Long Island spinning reserve, Long Island 10-minute total reserve, Eastern spinning reserve, Eastern 30-minute total reserve.

SCUC and BME currently do not distinguish between these two types of reserve constraints and all of these constraints are modeled using very high violation costs.

The implementation of the reserve demand curves will allow the reserve guidelines (as opposed to requirements) to be treated in a manner more consistent with the manner in which real-time operation would treat these reserve constraints.

The same reserve demand curves will be applied in SCUC, RTC (the replacement for BME) and RTD (the replacement for SCD).

DEVELOPMENT OF THE DEMAND CURVES

Many issues were considered during the process of developing the demand curves including:

- Analysis of reserve shadow prices from SCUC and BME for the period of time following the implementation of the Export as Reserves mechanism.
 - ² In how many hours would demand curves have triggered below the historical reserve shadow prices – a 0.05% benchmark was used to inform the initial demand curve definitions
 - ² The pattern and magnitude of the reserve shadow prices in the historical hours with very high prices
 - ² Review of market conditions causing extreme prices in the historical data

DEVELOPMENT OF THE DEMAND CURVES

Issues in developing the demand curves, cont'd.:

- Do the demand curves make sense relative to the current definition and MW quantity for each locational reserve requirement?
- Do the demand curves make sense relative to the \$500 EDRP cost and the existing \$1,000 10-minute reserve shortage costs?
- What are the additive impacts of the reserve demand curves?

DEVELOPMENT OF THE DEMAND CURVES

Issues in developing the demand curves, cont'd.:

- Are the curves consistent with how operations would actually operate the system?
- Importance of the NYCA spinning reserve and Eastern 10-minute total reserve constraints;
- Relative importance of the individual location and reserve product quality constraints;
- How does the regulation demand curve relate to the reserve demand curves?

RESERVE DEMAND CURVES

Summary

The table below summarizes the regulation demand curve and the nine operating reserve demand curves that have been proposed and discussed with the Market Structure Working Group.

	NYCA	East	LI
Spin	\$500	\$25	\$25
10-Total	\$150	\$500	\$25
30-Total	200 MW @ \$50, 200 MW @ \$100 and remainder @ \$200	\$25	\$300
Regulation	25 MW @ \$250 and remainder @ \$300		

Min		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Max		\$ 7,102.41	\$ -	\$ -	\$ 143.23	\$ 3,986.74	\$ 831.72	\$ 552.51	\$ 100.00	\$ 4,019.54	\$ 8,008.80	6.00	\$ -	
Ave		\$ 2.04	\$ -	\$ -	\$ 0.40	\$ 5.54	\$ 5.04	\$ 0.45	\$ 0.36	\$ 7.32	\$ 21.14	1.91	\$ 15.27	
StdDev		\$ 82.60	\$ -	\$ -	\$ 5.32	\$ 58.69	\$ 17.67	\$ 8.01	\$ 4.15	\$ 46.82	\$ 133.53	1.50	\$ 50.73	

Date	Hour	EAST 10	EAST 30	EAST SPIN	LI 10	LI 30	LI SPIN	NYPP 10	NYPP 30	NYPP SPIN	SUM	Non-zero SPs	NYPP REGUL
9/3/02	20	\$ 1	\$ -	\$ -	\$ -	\$ 3,987	\$ -	\$ -	\$ 1	\$ 4,020	\$ 8,009	5	4023
7/23/02	18	\$ 7,102	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 553	\$ -	\$ -	\$ 7,655	3	1090
3/10/03	14	\$ 3	\$ -	\$ -	\$ -	\$ 3,017	\$ -	\$ -	\$ -	\$ -	\$ 3,019	3	0
6/26/02	15	\$ 2,336	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 2,336	2	0
8/2/02	15	\$ 21	\$ -	\$ -	\$ -	\$ 889	\$ -	\$ -	\$ 50	\$ -	\$ 961	4	50
8/2/02	16	\$ 48	\$ -	\$ -	\$ -	\$ -	\$ 832	\$ 2	\$ 56	\$ -	\$ 937	5	56
7/3/02	16	\$ 571	\$ -	\$ -	\$ 3	\$ -	\$ -	\$ 49	\$ -	\$ -	\$ 623	4	49
2/17/03	21	\$ 563	\$ -	\$ -	\$ -	\$ 33	\$ -	\$ -	\$ 23	\$ -	\$ 619	4	67
2/18/03	16	\$ 1	\$ -	\$ -	\$ -	\$ 325	\$ -	\$ -	\$ 1	\$ 266	\$ 594	5	341
1/2/03	18	\$ 1	\$ -	\$ -	\$ -	\$ 511	\$ -	\$ -	\$ 1	\$ 7	\$ 520	5	15
2/17/03	15	\$ -	\$ -	\$ -	\$ -	\$ 253	\$ -	\$ -	\$ 50	\$ 211	\$ 514	4	229
2/17/03	11	\$ 82	\$ -	\$ -	\$ -	\$ 203	\$ -	\$ 137	\$ 89	\$ -	\$ 510	5	226
2/17/03	10	\$ 81	\$ -	\$ -	\$ -	\$ 207	\$ -	\$ 155	\$ 3	\$ -	\$ 446	5	158
2/17/03	7	\$ -	\$ -	\$ -	\$ -	\$ 1	\$ -	\$ -	\$ 3	\$ 382	\$ 386	4	393
2/17/03	16	\$ -	\$ -	\$ -	\$ -	\$ 156	\$ -	\$ -	\$ 50	\$ 127	\$ 333	4	214
2/17/03	9	\$ -	\$ -	\$ -	\$ -	\$ 156	\$ -	\$ -	\$ 3	\$ 174	\$ 332	4	195
2/17/03	17	\$ -	\$ -	\$ -	\$ -	\$ 143	\$ -	\$ 122	\$ 50	\$ -	\$ 316	4	177
2/17/03	12	\$ -	\$ -	\$ -	\$ -	\$ 168	\$ -	\$ -	\$ 3	\$ 133	\$ 304	4	117
2/17/03	14	\$ -	\$ -	\$ -	\$ -	\$ 166	\$ -	\$ -	\$ 3	\$ 123	\$ 292	4	107
1/27/03	18	\$ 29	\$ -	\$ -	\$ -	\$ 151	\$ -	\$ 96	\$ 1	\$ -	\$ 278	5	131
2/18/03	17	\$ -	\$ -	\$ -	\$ -	\$ 162	\$ -	\$ -	\$ 3	\$ 112	\$ 277	4	47
2/17/03	18	\$ 23	\$ -	\$ -	\$ -	\$ 134	\$ -	\$ 78	\$ 33	\$ -	\$ 267	5	147
7/30/02	8	\$ 244	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 244	2	8
6/26/02	16	\$ 243	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 243	2	0
4/17/03	11	\$ 23	\$ -	\$ -	\$ -	\$ 1	\$ -	\$ 206	\$ 3	\$ -	\$ 233	5	209
9/20/02	13	\$ -	\$ -	\$ -	\$ -	\$ 1	\$ -	\$ -	\$ 3	\$ 228	\$ 231	4	185
2/17/03	8	\$ -	\$ -	\$ -	\$ -	\$ 97	\$ -	\$ -	\$ 3	\$ 121	\$ 221	4	155
4/8/03	10	\$ 0	\$ -	\$ -	\$ -	\$ 116	\$ -	\$ -	\$ 2	\$ 92	\$ 211	5	3
8/12/02	17	\$ -	\$ -	\$ -	\$ -	\$ 48	\$ -	\$ -	\$ 100	\$ 62	\$ 210	4	177
2/18/03	20	\$ -	\$ -	\$ -	\$ -	\$ 123	\$ -	\$ -	\$ -	\$ 86	\$ 209	3	165
1/28/03	18	\$ -	\$ -	\$ -	\$ -	\$ 159	\$ -	\$ -	\$ 3	\$ 47	\$ 209	4	61
2/17/03	19	\$ -	\$ -	\$ -	\$ -	\$ 129	\$ -	\$ 76	\$ 3	\$ -	\$ 208	4	114
8/13/02	17	\$ 53	\$ -	\$ -	\$ -	\$ 53	\$ -	\$ -	\$ 100	\$ -	\$ 207	4	153
8/1/02	17	\$ 80	\$ -	\$ -	\$ -	\$ -	\$ 1	\$ 26	\$ 100	\$ -	\$ 206	5	206
8/14/02	15	\$ 24	\$ -	\$ -	\$ -	\$ 79	\$ -	\$ -	\$ 100	\$ -	\$ 203	4	100

Min		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Max		\$ 500.00	\$ -	\$ -	\$ 25.00	\$ 300.00	\$ 25.00	\$ 150.00	\$ 100.00	\$ 500.00	\$ 802.52	6.00	\$ 250.00	
Ave		\$ 1.01	\$ -	\$ -	\$ 0.17	\$ 4.68	\$ 2.96	\$ 0.40	\$ 0.36	\$ 6.90	\$ 16.47	1.91	\$ 14.68	
StdDev		\$ 12.96	\$ -	\$ -	\$ 1.97	\$ 19.31	\$ 7.26	\$ 5.28	\$ 4.15	\$ 17.06	\$ 34.77	1.50	\$ 22.36	

Date	Hour	EAST 10	EAST 30	EAST SPIN	LI 10	LI 30	LI SPIN	NYPP 10	NYPP 30	NYPP SPIN	SUM	Non-zero SPs	
												NYPP REGU	
9/3/02	20	\$ 1	\$ -	\$ -	\$ -	\$ 300	\$ -	\$ -	\$ 1	\$ 500	\$ 803	5	\$ 250
7/23/02	18	\$ 500	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 150	\$ -	\$ -	\$ 650	3	\$ 250
3/10/03	14	\$ 3	\$ -	\$ -	\$ -	\$ 300	\$ -	\$ -	\$ -	\$ -	\$ 303	3	\$ -
6/26/02	15	\$ 500	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 500	2	\$ -
8/2/02	15	\$ 21	\$ -	\$ -	\$ -	\$ 300	\$ -	\$ -	\$ 50	\$ -	\$ 371	4	\$ 50
8/2/02	16	\$ 48	\$ -	\$ -	\$ -	\$ -	\$ 25	\$ 2	\$ 56	\$ -	\$ 131	5	\$ 56
7/3/02	16	\$ 500	\$ -	\$ -	\$ 3	\$ -	\$ -	\$ 49	\$ -	\$ -	\$ 552	4	\$ 49
2/17/03	21	\$ 500	\$ -	\$ -	\$ -	\$ 33	\$ -	\$ -	\$ 23	\$ -	\$ 556	4	\$ 67
2/18/03	16	\$ 1	\$ -	\$ -	\$ -	\$ 300	\$ -	\$ -	\$ 1	\$ 266	\$ 569	5	\$ 250
1/2/03	18	\$ 1	\$ -	\$ -	\$ -	\$ 300	\$ -	\$ -	\$ 1	\$ 7	\$ 310	5	\$ 15
2/17/03	15	\$ -	\$ -	\$ -	\$ -	\$ 253	\$ -	\$ -	\$ 50	\$ 211	\$ 514	4	\$ 229
2/17/03	11	\$ 82	\$ -	\$ -	\$ -	\$ 203	\$ -	\$ 137	\$ 89	\$ -	\$ 510	5	\$ 226
2/17/03	10	\$ 81	\$ -	\$ -	\$ -	\$ 207	\$ -	\$ 150	\$ 3	\$ -	\$ 442	5	\$ 158
2/17/03	7	\$ -	\$ -	\$ -	\$ -	\$ 1	\$ -	\$ -	\$ 3	\$ 382	\$ 386	4	\$ 250
2/17/03	16	\$ -	\$ -	\$ -	\$ -	\$ 156	\$ -	\$ -	\$ 50	\$ 127	\$ 333	4	\$ 214
2/17/03	9	\$ -	\$ -	\$ -	\$ -	\$ 156	\$ -	\$ -	\$ 3	\$ 174	\$ 332	4	\$ 195
2/17/03	17	\$ -	\$ -	\$ -	\$ -	\$ 143	\$ -	\$ 122	\$ 50	\$ -	\$ 316	4	\$ 177
2/17/03	12	\$ -	\$ -	\$ -	\$ -	\$ 168	\$ -	\$ -	\$ 3	\$ 133	\$ 304	4	\$ 117
2/17/03	14	\$ -	\$ -	\$ -	\$ -	\$ 166	\$ -	\$ -	\$ 3	\$ 123	\$ 292	4	\$ 107
1/27/03	18	\$ 29	\$ -	\$ -	\$ -	\$ 151	\$ -	\$ 96	\$ 1	\$ -	\$ 278	5	\$ 131
2/18/03	17	\$ -	\$ -	\$ -	\$ -	\$ 162	\$ -	\$ -	\$ 3	\$ 112	\$ 277	4	\$ 47
2/17/03	18	\$ 23	\$ -	\$ -	\$ -	\$ 134	\$ -	\$ 78	\$ 33	\$ -	\$ 267	5	\$ 147
7/30/02	8	\$ 244	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 244	2	\$ 8
6/26/02	16	\$ 243	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 243	2	\$ -
4/17/03	11	\$ 23	\$ -	\$ -	\$ -	\$ 1	\$ -	\$ 150	\$ 3	\$ -	\$ 177	5	\$ 209
9/20/02	13	\$ -	\$ -	\$ -	\$ -	\$ 1	\$ -	\$ -	\$ 3	\$ 228	\$ 231	4	\$ 185
2/17/03	8	\$ -	\$ -	\$ -	\$ -	\$ 97	\$ -	\$ -	\$ 3	\$ 121	\$ 221	4	\$ 155
4/8/03	10	\$ 0	\$ -	\$ -	\$ -	\$ 116	\$ -	\$ -	\$ 2	\$ 92	\$ 211	5	\$ 3
8/12/02	17	\$ -	\$ -	\$ -	\$ -	\$ 48	\$ -	\$ -	\$ 100	\$ 62	\$ 210	4	\$ 177
2/18/03	20	\$ -	\$ -	\$ -	\$ -	\$ 123	\$ -	\$ -	\$ -	\$ 86	\$ 209	3	\$ 165
1/28/03	18	\$ -	\$ -	\$ -	\$ -	\$ 159	\$ -	\$ -	\$ 3	\$ 47	\$ 209	4	\$ 61
2/17/03	19	\$ -	\$ -	\$ -	\$ -	\$ 129	\$ -	\$ 76	\$ 3	\$ -	\$ 208	4	\$ 114
8/13/02	17	\$ 53	\$ -	\$ -	\$ -	\$ 53	\$ -	\$ -	\$ 100	\$ -	\$ 207	4	\$ 153
8/1/02	17	\$ 80	\$ -	\$ -	\$ -	\$ -	\$ 1	\$ 26	\$ 100	\$ -	\$ 206	5	\$ 206
8/14/02	15	\$ 24	\$ -	\$ -	\$ -	\$ 79	\$ -	\$ -	\$ 100	\$ -	\$ 203	4	\$ 100

RESERVE DEMAND CURVES

Summary

The table below shows the cascaded sum of the reserve demand curves by product and location where LI spinning reserve is calculated as the sum of all the demand curve values.

The \$1,750 value is very high. However, when historical shadow prices in extreme hours (slide 10) are capped at the shadow prices defined by the demand curves (slide 9) the modified observed aggregate shadow prices (slide 11) never reach this level. It is very unusual for more than 3 or 4 of the reserve requirements to be violated at any one time and a \$1,750 value would require a violation of all 9 locational reserve requirements .

	NYCA	East	LI
Spin	\$850	\$1,400	\$1,750
10-Total	\$350	\$875	\$1,200
30-Total	\$200	\$225	\$525

MODIFICATION OF THE DEMAND CURVES

If the demand curves result in reserves not being scheduled when those reserves are available, operations may take action to create those reserves. When this occurs the NYISO tariff requires the following steps to be taken:

- NYISO will review the market conditions that resulted in the reserve shortage and the implied cost of the reserves that were available but not scheduled and may recommend a set of modifications to the demand curves;
- The changes to the demand curves will be noticed to the market and will be applied by the NYISO after a prescribed notice period has expired;
- The NYISO will also commit to make an exigent circumstances 205 filing containing the modified demand curves and seek ratification of the modified demand curves from the Management Committee.

OTHER JURISDICTIONS

New York has led the way in terms of other jurisdictions:

- PJM does not have reserve demand curves and allows the actual scheduled quantity of reserves to fall below the target levels without scheduling expensive imports;
- It is not yet clear where MISO will end up on reserve demand curves and pricing during scarcity conditions;
- New England included forms of demand curves in their CMS/MSS submissions to FERC but these were never implemented as the current SMD development took its place.

CONTROL ACTION OPERATING RESERVES

The current IMO market includes 400MW of control action operating reserves priced at \$30 which reflects voltage reductions that can be taken in real time if contingencies actually occur.

Are these reserve demand curves?

- In many ways these are demand curves for operating reserves
- The operating reserve is not physically present i.e., is not explicitly scheduled on Ontario generating resources
- The price at which CAOR included in the OR stack reflects the value or willingness to count of Control Action as operating reserves
- NY keeps voltage reduction and ability to count export transactions as 30 minutes reserves as NERC qualifying reserve and allows the scarcity pricing of the demand curves to reflect prices for energy and operating reserves relative to actual levels of physically present operating reserve

CONTROL ACTION OPERATING RESERVES

Are market participants prepared to accept that the hour-ahead (and the day-ahead) scheduling process may choose to not schedule imports or not commit an internal resource to create reserves because those choices are more expensive than the cost of counting control action operating reserve?

- 2 If no, then it suggests that the value of operating reserves is higher than the modeled cost of the control action operating reserve and energy and operating reserve prices should reflect that value in times of scarcity
- 2 Scheduling and pricing of the operating reserve should be consistent across all timeframes (day-ahead, hour-ahead and in real-time)
- 2 If operator actions are inconsistent with scheduling and pricing results it again suggests the demand curve prices are not set at the correct levels