Reserve Demand Curve Issues

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This presentation attempts to answer a number of questions that have been posed related to reserve demand curves including:

- What elements factored into the demand curve definitions specifically the modification of the curves between August 27th and September 9th that resulted in the increase of two demand curves from $300 to $500.
- What would the system look like immediately following a reserve pickup?
- How is a load pick up different from a reserve pickup?
- What would the system look like during a period of sustained $1,000 prices?
- How could the system get to a $1,700 energy price?
- How might the periodic review result in reductions to the reserve demand curves?

The reserve demand curve design is important from a number of respects:

- Allows energy and reserves to be co-optimized in real-time facilitating a two-settlement system for reserves;
- Promotes pricing consistency according to system conditions and the ability to respond to the next event on the system;
- Allows us to maintain the reserve requirements during reserve pickups. Maintaining reserve requirements during reserve pick ups eliminates the current counter-intuitive reductions we see in LBMPs during reserve pick-ups;
- Provides consistency in the pricing from interval to interval;

Reserve Targets (MW)	NYCA	East	LI
Ten-Minute Spinning Reserve	600	300	60
Ten Minute Total Reserve	1,200	1,000	120
Thirty-Minute Total Reserve	1,800	1,000	270 to 540

Highest Value on Demand Curves ($/MW)	NYCA	East	LI
Ten-Minute Spinning Reserve	$ 500	$ 25	$ 25
Ten Minute Total Reserve	$ 150	$ 500	$ 25
Thirty-Minute Total Reserve	$ 200	$ 25	$ 300

Additive Values ($/MW)	NYCA	East	LI
Ten-Minute Spinning Reserve	$ 850	$ 1,400	$ 1,750
Ten Minute Total Reserve	$ 350	$ 875	$ 1,200
Thirty-Minute Total Reserve	$ 200	$ 225	$ 525

The internal development and review of the demand curves has included operations staff, SMD 2.0 project staff, LECG, MMU and David Patton.

A detailed description of the derivation of the demand curves was presented to the Market Structures Working Group on August 27th, 2003. A revised set of demand curves, and a discussion of the modifications to the demand curves, was presented to the Market Structures Working Group on September 5th, 2003 and to the Business Issues Committee on September 9th.

BACKGROUND

The NYISO considered the following when developing the Demand Curves :

- Analysis of reserve shadow prices from SCUC and BME for the period of time following the implementation of the Export as Reserves mechanism.
  - ✧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
  - ✧The pattern and magnitude of the reserve shadow prices in the historical hours with very high prices
  - ✧Review of market conditions causing extreme prices in the historical data

Background, cont'd.:

- Consistency with the current definition and MW quantity for each locational reserve requirement;
- Review of the additive impacts of the reserve demand curves;
- Consistency with how operations would actually operate the system;
- Relative importance of the individual location and reserve product quality constraints;
- How does the regulation demand curve relate to the reserve demand curves?
- Consistency in the scheduling and pricing of energy and reserves.
- Relative importance of the individual location and reserve product quality constraints

Factors Leading to Revision in the Demand Curve Prices

- Importance to the Operations Department of the NYCA spinning reserve and Eastern 10-minute total reserve constraints.
- Consistency with the $500 EDRP cost and the existing $1,000 10-minute reserve shortage costs. It was this analysis that led to the increase in the NYCA spinning reserve and Eastern 10-minute total reserve demand curves from $300 to $500. (See example to follow)
- With a $300 RDC price for shortages of NYCA spinning reserve and Eastern 10-minute total it became apparent that when we were is shortage conditions akin to those that would have caused us to administratively set a $1,000 price under today's tariff, we were not getting $1,000 prices. Operators would go outside the market to acquire the reserves to the extent that they were available.

What would the system look like immediately following a reserve pickup?

The answer to this question greatly depends on that state of the system at the time the reserve pickup is called. The elements of the system conditions that are important are included in the appendix to this presentation

What actions is this RTD-CAM run likely to take in a reserve pickup?

- Dispatch economic regulation capacity as energy as the regulation market is suspended in large event reserve pickups;
  - ✧If Central East is not binding the full 200 to 275 MW of the regulation can be converted into energy if it is economic
  - ✧Very likely to happen
- Dispatch any synchronized 30-minute operating reserves or latent capacity on units that may not have been scheduled as 30-minute reserves (i.e. if the clearing price for 30-minute reserves had been $0) potentially leading to transient 30-minute operating reserve shortages;
  - ✧Very likely to happen;

What actions is this RTD-CAM run likely to take in a reserve pickup? (cont'd)

- Commit and dispatch any unscheduled quick start units or at least schedule as 10-minute reserves so that quick start units previously scheduled as reserves can be started or in the case of excess 10-minute spinning reserves converted to energy
  - ✧Quite likely to happen;
- Commit and dispatch quick start units scheduled as 10-minute reserves before the system event potentially leading to transient 10-minute operating reserve shortages
  - ✧Possible, but in many instances the previously described actions will be sufficient;
- If there is a combined ramp and capacity shortage RTD-CAM will choose to convert 10-minute spinning reserve into energy potentially leading to transient 10-minute spinning reserve shortages
  - ✧Possible but much less likely as in many instances the previously described actions will be sufficient;

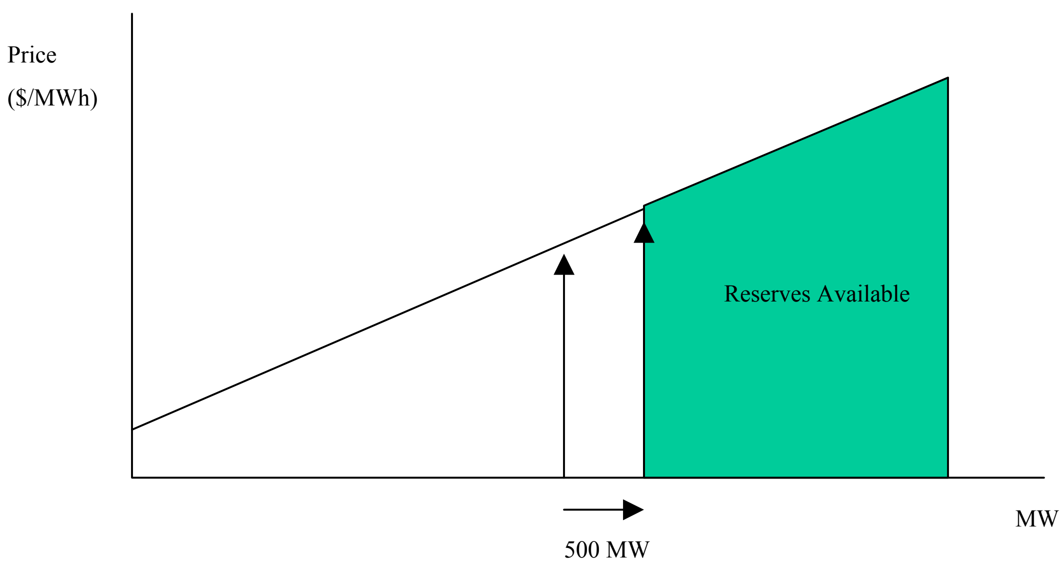
What might prices actually look like in a reserve pickup?

The range of potential outcomes is a continuum of solutions. It is not possible to determine exactly what prices will be set in any given scenario without understanding: i) the entire supply curve available to the dispatch software; ii) the dispatch solution and system immediately prior to the system event; and iii) the magnitude of the system event.

The next few slides illustrate various points along the continuum of the solutions that are possible for a hypothetical 500 MW generator outage.

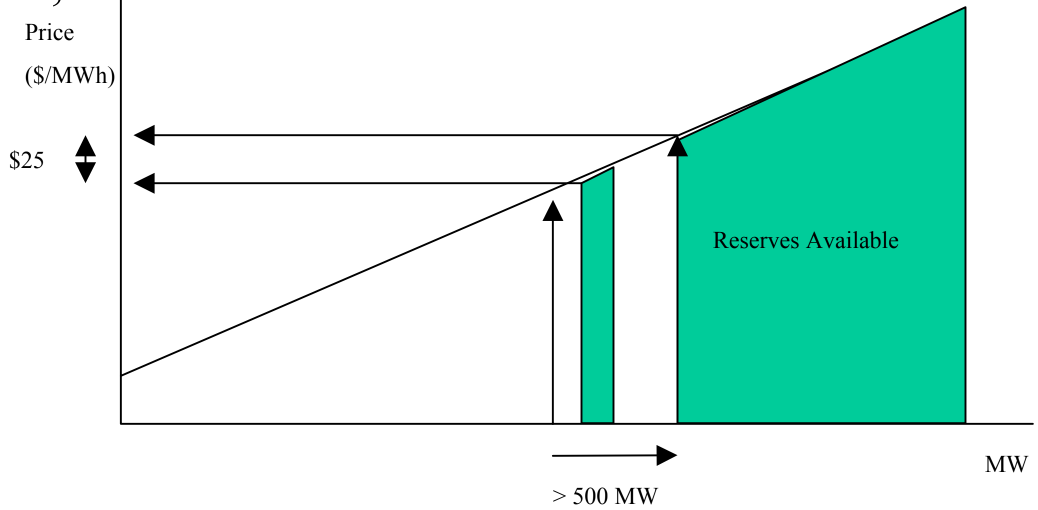
Sufficient latent reserve at $0

A combination of regulation capacity and dispatchable online capacity can be moved without causing any activation of the demand curves with a result shift in the RT LBMP corresponding to moving 500 MW up the energy supply curve with reserve prices still at or near $0 levels. This will occur if there is sufficient rampable capacity to cover the 500 MW generator outage and sufficient total capacity above that to meet the reserve requirements with undispatched higher priced energy;



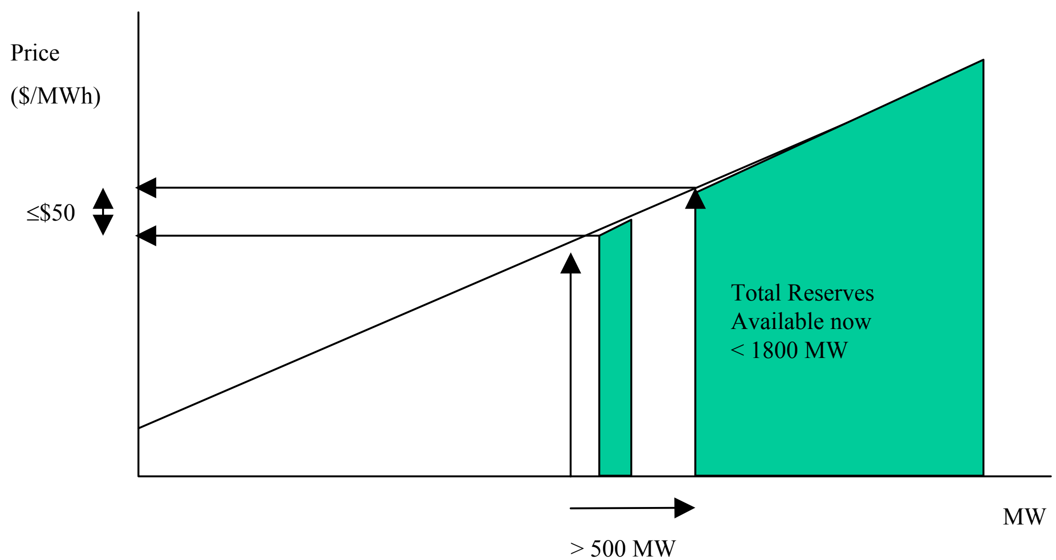
Reserve clearing price reflects Lost Opportunity Cost

A combination of regulation capacity and dispatchable online capacity that can be moved without causing any activation of the demand curves with a resulting shift in the RT LBMP corresponding to moving more than 500 MW up the energy supply curve with reserve prices at $25, still below demand curve levels. Because of tradeoffs with capacity and ramp limits it may be necessary to not dispatch the cheapest energy so that 10 and 30-minute synchronized reserves can be carried with opportunity costs. This is why the LBMP increase will correspond to somewhat more than a 500 MW move along the energy supply curve. The reserve shadow prices will all be less than the corresponding demand curve prices;



30-Minute Demand Curve sets the price

A combination of regulation capacity and dispatchable online capacity some of which is being converted from 30-minute synchronized reserves resulting in a “scheduling” shortage of 30 minute total reserves, a reserve clearing price of $50 for 30-minute reserves and most likely an energy clearing price set by the bid of the lowest energy cost capacity scheduled for 30-minute synchronized reserves plus $50. The demand curve will occur when the lost opportunity cost associated with the next MW of 30-minute synchronized reserves that could be converted to energy reaches $50 for the first 200 MW. Note that the progression from $0 to $25 to $50 is not a step function but rather a continuum.



Transient 10-Minute Reserve Shortage sets reserve clearing price

If it is still not possible to meet load after converting all the economic regulation capacity and all synchronized 30-minute operating reserves RTD-CAM will look to convert 10-minute reserves, either offline quick-start GTs or any surplus 10-minute spinning reserves to energy leading to transient shortage of 10-minute operating reserves.

Note that this transient shortage reflects the very limited availability of reserves to respond to the next system event and sends a price signal to the market consistent with the reliability conditions faced on the system.

The reserve clearing prices will incorporate the shortage cost of any demand curve that is violated. The energy clearing price will reflect the energy bid of the least expensive MW backed down to provide reserves plus the applicable reserve demand curve shortage costs.

Transient Spinning reserve shortage sets the reserve clearing price

- The last case in the continuum of solutions is a case where it is still not possible to meet load after accounting the combined effect of regulation capacity, synchronized 30-minute reserves, conversion of 10-minute non-synchronized reserves and excess 10-minute spinning reserves. RTD-CAM must convert spinning reserves necessary to meet the spinning reserve operating requirement to energy triggering the one or more of the spinning reserve demand curves.
- Note that this transient shortage reflects the extremely limited availability of reserves to respond to the next system event and sends a price signal to the market consistent with the extreme reliability conditions faced on the system.
- The reserve clearing prices will incorporate the shortage cost of any demand curve that is violated. The energy clearing price will reflect the energy bid of the least expensive MW backed down to provide reserves plus the applicable reserve demand curve shortage costs.
- It is very unlikely that the outage of a 500 MW unit would cause this level response from the market. An event causing this level of response from the market will likely trigger other emergency procedures in addition to the actions taken by RTD-CAM.

How is a load pickup different from a reserve pickup?

- The continuum of solutions for a load pickup is very similar to those illustrated for a reserve pickup with the exception that RTC has 15 minute scheduling that allows imports, exports and 10 and 30-minute offline resource schedules to be moved in anticipation of load pickup without ever having to re-dispatch the reserves otherwise held to meet the reserve requirements.
- To the extent that the load pickup is unanticipated the continuum of solutions available to RTD is still similar to those solved by RTD-CAM with the exception that RTD does not have the capability to start 10-minute turbines or dispatch the capacity otherwise held back to provide regulation, short of activating the regulation demand curve.
- However, if the operators felt that 10-minute resources were necessary they could initiate a non reserve pickup activation of RTD-CAM with commitment that would solve for energy, regulation and reserves whilst allowing additional quick-start gas turbines to be committed for energy in response to the unanticipated load pickup.

What would the system look like during a period of sustained $1,000 prices?

During a sustained period of $1,000 prices the following situation is likely:

- Little or no 30-minute reserves will be scheduled meaning that the NYCA and Eastern 30 minute reserve constraints will be violated. RTC will choose to violate the 30-minute reserve constraints before violating any of the more expensive constraints by converting 30-minute reserves to energy;
- RTC will schedule expensive imports to maintain the 10-minute spinning and 10-minute total reserves;
- At some point in the path up to $1,000 prices the SCR/EDRP programs will have been notified and activated due to a forecasted shortage of 30-minute operating reserves;
- Steam units backed down to provide 10-minute spinning reserves in the East will likely be on the margin for the Eastern 10-minute total reserves perhaps at an energy price in the $150-$250 range;

What would the system look like during a period of sustained $1,000 prices? (cont'd)

During a sustained period of $1,000 prices the following situation is likely:

- The NYCA 10-minute total reserve constraint may or may not be short depending on the relationship of the 600 MW and 300 MW NYCA and Eastern spin requirements relative to the 1200 to 1000 MW NYCA and Eastern 10-minute total requirements:
- If the NYCA 10-minute total reserve constraint is not violated then the price will be in the $875 to $975 range (200 + 25 + 500 + energy dispatch cost);
- If the NYCA 10-minute total reserve constraint is violated then the price will be in the $1025 to $1125 range (200 + 25 + 150 + 500 + energy dispatch cost);
- This is likely to be a case where around 1000 MW of reserves are available on the system.

How could the system get to $1,700 energy prices?

If we assume that the energy price of a unit of Eastern spinning reserve is on the margin for reserves with an energy bid of $300, it would take all six NYCA and Eastern reserve demand curves to be activated with an aggregate value of $1,400 to reach $1,700/MWh. This implies there is likely less than 300 MW of reserves available on the system.

Before this point is reached it seems likely that:

- All actions in the $1,000 pricing example would have been taken including the notification and activation of SCR/EDRP load reductions;
- The NYISO would be operating in a major emergency mode;
- In the BME analysis that was performed we never saw all six NYCA and Eastern constraints binding at the same time and substituting demand curve values whenever the observed shadow prices exceeded the demand curves value resulted in a maximum aggregate shadow price of around $800/MWh well below the $1,400 aggregate shown above.

How might the periodic review result in reductions to the reserve demand curves?

- Never activating or reaching a demand curve does not necessarily indicate that the demand curve is set too high
  - ✧ If a demand curve was never activated it means the dispatch solution was always able to find reserves to schedule;
  - ✧ The reserve price would have been consistent with the availability bid (to the extent that they were allowed) and other redispatch costs incorporated into the reserve products shadow price;
  - ✧ The reserve price would also be consistent with the energy price.

How might the periodic review result in reductions to the reserve demand curves? (cont’d)

- Identify occasions where no additional reserves of a particular quality and location could have been scheduled at a time where the demand curve for that quality and location of reserves was activated:
  - ✧ Identify the lowest price at which all the reserve scheduled to meet the reserve requirement would still have been purchased?
  - ✧ Would this price have been consistent with all the shadow prices where sufficient reserves were available?
  - ✧ What were the system conditions? Are there other mitigating circumstances? Seasonality?

APPENDIX

System conditions defining what the system would look like when the reserve pickup is called.

- Is Central-East Binding?
  - This affects the extent to which Western reserves and regulation can be converted to energy and may cause the Eastern rather than NYCA reserve demand curves to activate;
- How much of the systems thirty-minute reserves are carried on synchronized resources?
  - The 30-minute synchronized reserves are the only 30-minute reserves that can be immediately accessed by RTD-CAM;

System Conditions, Cont'd.:

- How much of the ten minute reserves carried on the system are synchronized?
  - This affects the extent to which 10-minute spinning reserves can be converted to energy without violating any of the 10-minute spinning reserve requirements;
- How many of the units currently carrying synchronized reserves or regulation are capacity constrained?
  - A capacity constrained unit has less ability to move in response to the system event. A non-capacity constrained unit can be moved at its ramp rate for energy in addition to being scheduled for 10 and 30-minute synchronized reserves.
- What is the shape of the supply curve and what point on the supply curve is the dispatch solving around?