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MEMORANDUM

DATE: August 11, 2004; Revised September 19, 2005

TO: Robert Thompson

FROM: Scott M. Harvey

RE: Reserve Optimization Cost Savings

At present the NYISO schedules spinning and 10 minute reserves to satisfy locational reserve requirements for eastern New York as well as the overall NYISO requirements. [1] These locational requirements are ultimately attributable to transmission constraints across the NYISO that could potentially prevent the dispatch of western reserves to restore the system following generation or transmission contingencies in the east. In principle, therefore the requirement for eastern reserves is related to the level of transmission congestion on the NYISO transmission system. If transmission constraints are not binding across New York, the NYISO should in principle be able to satisfy its reserve requirements by purchasing more reserves west of Central East without adversely impacting the deliverability of those reserves. At present, however, these locational reserve requirements are treated as fixed in the day-ahead market and all west to east transfer capability is available to support the transfer of energy and none is used to support the procurement of additional western reserves and reduce procurement of eastern reserves.

While a broader optimization of the use of the transmission system would in principle be efficient and reduce the cost of meeting load, there would be material costs associated with both designing and implementing such changes. It is therefore desirable to assess the magnitude of the potential cost savings from implementing improved optimization of the scheduling of the transmission system between reserves and energy.

The historic difference in reserve shadow prices between eastern and western New York places an upper bound on the potential production cost savings from using western reserves to meet the eastern reserve requirements in the bid load dispatch of SCUC. The potential cost savings in the day-ahead market from optimizing reserves between east and west estimated on this basis were

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[1] The NYISO schedules 600MW of spinning reserve, 300MW of which must be east of Central East. The NYISO schedules 1200MW of 10 minute reserves, 1000MW of which must be east of Central East.

$914,310 for spinning reserves over the six-month period February 1, 2005 through July 31, 2005, which projects to $1,844,199 on an annual basis.[2] This is considerably higher than the potential cost savings of $53,445 estimated for the year August 2003-July 2004, or $155,763 for the period August 2002-July 2003. The cost difference for the same six-month period in 2003 was $61,059 and $18,693 for 2004.

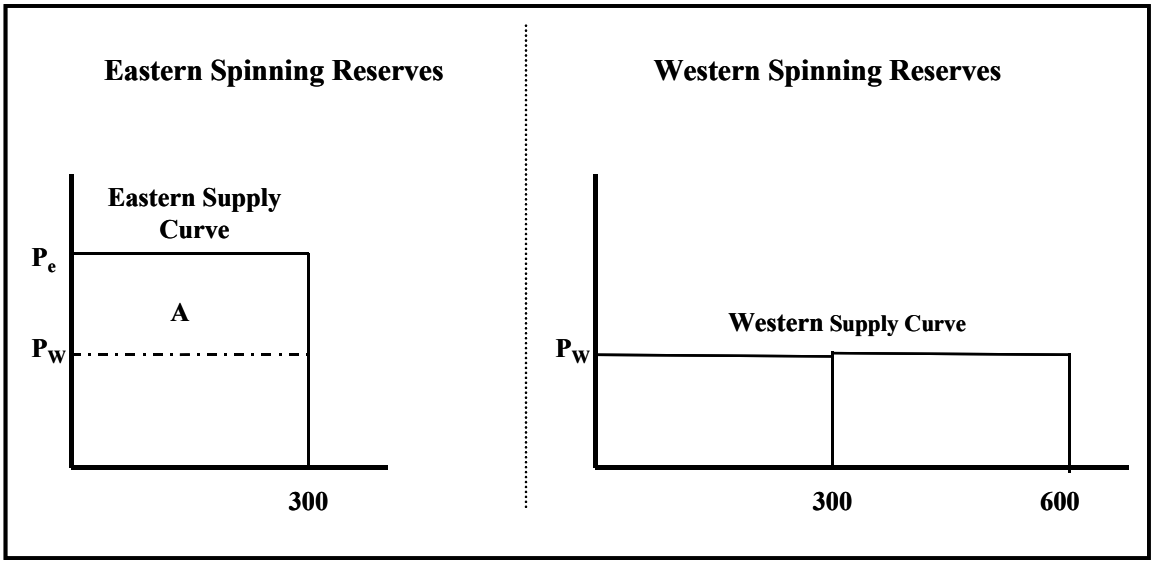
Similarly, the estimated upper bound on the potential production cost savings from using Western 10 minute reserves to displace eastern 10-minute reserves is $879,662 for the period February 1- August 31, 2005, which projects to $1,774,312 on an annual basis. [3] The corresponding potential production costs savings for 10-minute reserves was $109,802 for the period August 2003- July 2004 and $363,447 for the period August 2002-July 2003. The cost difference for the same six-month period in 2003 was $142,471 and $43,617 in 2004. The reason for the larger potential cost savings is that the eastern reserve constraints have been binding more often in 2005 than in the past and western reserve prices have been lower than eastern prices as a result.

[2] This projection to an annual basis is not necessary representative of values over an actual year. The estimate assumes that an additional 300MW of spinning reserves would have been acquired in the west in every hour in which the eastern spin price exceeded the western spin price. This assumption is discussed below.

[3] The estimate assumes than an additional 700MW of 10 minute reserves would have been acquired in the west in every hour in which the eastern 10 minute reserve price exceeded the western price.

These figures are upper bounds on the cost savings in the SCUC dispatch and the actual cost savings would be less for two reasons. First, the upper bound calculation assumes a flat supply curve for spinning and 10-minute reserves in both the East and the West, as illustrated in Figure 1. If the supply curves were flat, the potential production cost savings would be the entire Region A.

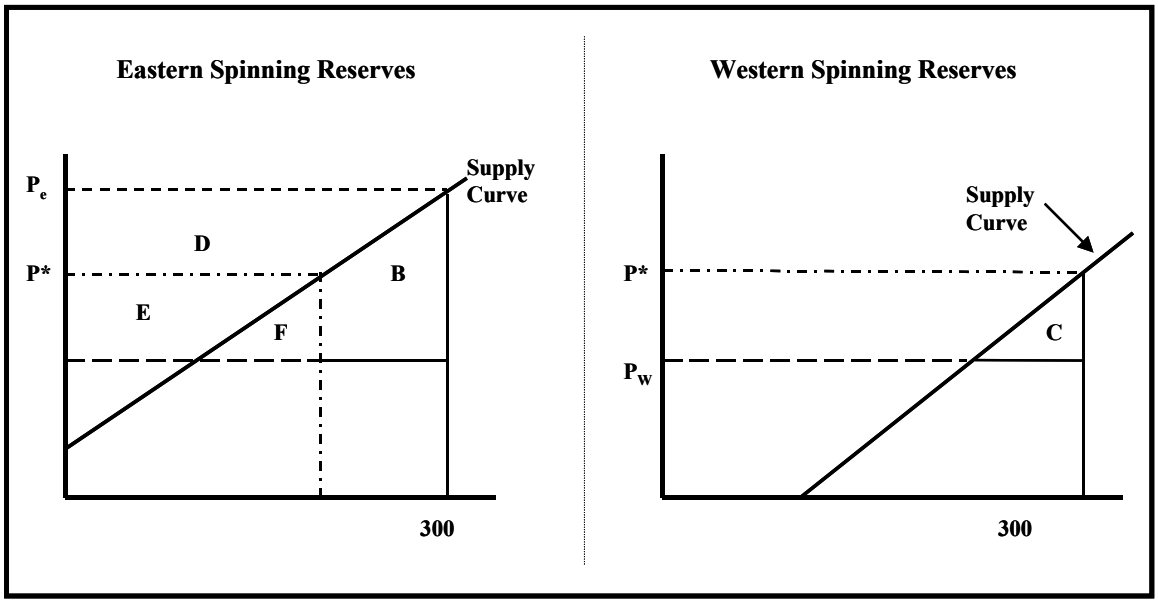
Figure 1



This assumption places an upper bound on the calculated potential cost savings but overstates the actual potential cost savings. The shadow price of eastern spin in SCUC is the cost of the last MW of spinning reserves scheduled. We know from NYISO bidding data that the inframarginal reserve MW are lower cost than the marginal MW as illustrated in Figure 2, so the benefits of replacing eastern reserves with western reserves would decrease as more and more eastern reserves were replaced.

Similarly, the shadow price of western reserves in SCUC is also the cost of the marginal MW of reserves and this cost would rise as more and more MW of reserves are shifted from East to West. This is also illustrated in Figure 2.

Figure 2



In the example portrayed in Figure 2, the price of reserves in both regions would be P* and the potential production cost savings would be Region B minus Region C, which obviously could be much, much smaller than Region A in Figure 1 (Region A in Figure 1 corresponds to regions B + D + E + F in Figure 2. The magnitude of the actual costs savings from improved optimization therefore depends on the shape of various reserve supply curves. Developing a more accurate estimate of the potential benefits would require analysis of the supply curves, not merely constraint shadow prices.

A second reason that the difference in reserve shadow prices provides only an upper bound on the potential reduction in production costs from providing additional reserves from western generation is that when the price of energy in the East exceeds the price of energy in the West, the difference in reserve shadow prices can be positive, yet shifting reserves to the west could increase production costs if the western generation that would provide reserves is still

cheaper than the eastern generation that would be dispatched up. Such offsetting costs in the energy market are likely if Central East is constrained in the day-ahead market and scheduling additional western reserves would require some unloading of Central East.[4]

A rough calculation to gauge the potential importance of these offsetting energy costs is to calculate the difference in reserve costs during the hours in which Central East was not constrained in the DAM and thus there would have been little or no cost at the margin in the energy market from shifting reserves from the east to the west. During the six month period in 2005 for which the production cost savings were estimated, Central East constraints were binding relatively infrequently in the day-ahead market (747 out of 4343 hours), so most of the potential cost savings occurred during hours in which Central East was not constrained.[5] Thus, the potential cost savings for spinning reserves were $723,762 over the six month period in the hours in which Central East constraints were not binding, which projects to $1,459,856 on an annual basis. Similarly, the potential cost savings for 10 minute reserves were $799,815 over the six month period in the hours in which Central East constraints were not binding, which projects to $1,603,173 on an annual basis.[6]

These estimates are only upper bounds on the potential benefits even in the unconstrained hours as the DAM congestion data only indicate that Central East was not constrained at the margin. The actual production cost savings from reserve optimization would depend on how much reserves could be shifted from East to West before energy redispatch would be required. Such a more complete analysis of the magnitude of the potential gains would require knowledge of the criteria the NYISO would establish for maintaining transmission margin on Central East in order to accommodate eastern reserves and application of these criteria to the historical data to assess the magnitude of the potential for reoptimization.

The shadow price based benefit calculations discussed above place an upper bound on the production cost savings from relaxing the reserve constraint in the dispatch step of SCUC but do not necessarily reflect the benefits of relaxing the constraint in the unit commitment step.

If western units were committed to displace in-city units providing reserves that then would be committed anyway in the LRR pass, relaxing the reserve constraint in the UC might actually raise production costs and uplift, so accounting for unit commitment costs could reduce the potential production cost benefits.

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[4] The estimated potential benefits during hours in which Central East is binding in the day-ahead market cannot be adjusted to take account of the energy market impacts until it is known what criteria the NYISO would establish for unloading Central East in order to accommodate reserves in the west.

[5] For the purpose of this analysis, Central East-VC PTID 2330 and 23313 and Pleasant Valley – Leeds for the Athens Pleasant Valley contingency were taken into account as Central East constraints.

Alternatively, if greater use of reserves on western units avoided the need to commit eastern units outside the city in SCUC, the reduction in production costs could be greater than implied by the shadow price calculation.

Changing the modeling of reserves in the SCUC commitment process would be more complex from an implementation standpoint than simply changing it in the dispatch step. Given the interaction with the LRR commitment, it would likely be difficult to implement improvements in reserve optimization in the unit commitment process without first improving optimization in the LRR unit commitment process.

An intermediate step might be to optimize use of the transmission system between reserves and energy in the dispatch step of SCUC, but not in the unit commitment and LRR steps. More accurate analysis of the potential production cost savings from such an enhancement could be developed by rerunning the SCUC dispatch step for a sample of days, allowing comparison between the upper bound estimates and detailed SCUC based estimates of the potential cost savings on these days. This analysis has not been undertaken. A necessary precondition would be specification of the criteria the NYISO would use to reserve transmission across Central East to support the activation of incremental western reserves. Absent transmission optimization logic in SCUC, developing the estimates of production costs savings might also require multiple reruns of SCUC per day studied in order to iterate to the optimum (or at least near the optimum) without developing new optimization routines.