MARS Emergency Assistance Modeling Findings, Conclusions and Recommendations

Background

Historically one of the primary reasons driving electric power systems to interconnect was the ability to share capacity resources especially during emergency conditions. This allows the interconnecting entities to reduce their installed generating capacity below what may otherwise would have been necessary without interconnections to meet its generation reliability requirements. NYSRC IRM studies utilize the GE-MARS Monte Carlo simulation model for determining the minimum level of installed resources to meet the NYSRC resource adequacy criterion. This model includes the neighboring control areas and their interconnection capability primarily for reflecting the availability of emergency assistance (EA) to assist the NYCA in meeting its resource adequacy criterion. The MARS representation of the neighboring control areas consists of four interconnected external control areas which are contiguous with the NYCA. They include PJM and the NPCC members ISO New England, Ontario IESO, and Quebec.

The New York State Reliability Council (NYSRC) Policy 5 states: "The primary consideration for developing the final load and capacity models for the external Control Areas is to avoid overdependence on the external Control Areas for emergency capacity support. Over the last five years (2012 - 2016 Studies), the EA reserve benefit has averaged 8.5%. This compares to average EA reserve benefits of 5.8% and 1.7% for New England and the PJM RTO, respectively, for the same time. In consideration of these ranges of EA reserve benefits and the concern as to whether NYSRC studies presently overstate EA reserve benefits, the Executive Committee has requested ICS to conduct an analysis to determine whether the EA levels presently relied upon in NYCA IRM studies may be excessive, considering operating conditions or other system considerations that may not be recognized in the present GE-MARS model, and to recommend an IRM study modeling change if appropriate[1].

The MARS model does have the capability to impose a limit(s) on the overall level of EA that can be counted on by the NYCA in meeting the NYSRC resource adequacy criterion. This capability to limit EA has not been utilized in the past. To address the EA concerns raised by the NYSRC Executive Committee, the ICS approved a scope work at its MAY 4, 2016 meeting entitled: "MODELING OF EMERGENCY ASSISTANCE TO THE NEW YORK CONTROL AREA IN NYSRC IRM STUDIES". This scope of work directed the NYISO to analyze the maximum amount of EA that NYCA can reliably depend upon from our neighbors for application in IRM studies, considering the above-referenced EA modeling issues and other NYISO operating constraints and considerations not presently considered in the GE-MARS model. The NYISO completed its

[1] Source: ICS Study scope entitled: "MODELING OF EMERGENCY ASSISTANCE TO THE NEW YORK CONTROL AREA IN NYSRC IRM STUDIES" which was approved at the May 4, 2016 ICS meeting.

review and reported its finding to the ICS in a paper entitled:" MODELING OF EMERGENCY ASSISTANCE FOR THE NEW YORK CONTROL AREA IN NYSRC IRM STUDIES" dated July 26, 2016.

The NYISO work was followed by a second scope of work entitled:" EMERGENCY ASSISTANCE STUDY SCOPE" and approved by the ICS at its November 2, 2016 meeting. This scope of work directed that an appropriate EA capacity limit be developed based on a statistical analysis of historical excess 10-minute reserves carried by NYCA's neighboring systems during high load periods. The data to be utilized is the excess 10-minute reserve MWs reported by the neighboring control areas and is data supplied by the NYISO. The purpose of the balance of this document is to report on the findings, conclusions and recommendations resulting from the work and analysis conducted as result of the above scopes.

Findings

The overall findings can be broken down into two categories. One set of findings based on a data consisting primarily of 10-minute synchronized and non-synchronized excess reserves which included all reserves available in ISONE, IESO of Ontario, Hydro Quebec's non-ICAP HVDC tie capability but only the excess reserves that were available in Mid-Atlantic and Dominion (MAD) Regions of PJM. The second data set is the same as previously but includes the available excess reserves available in the entire PJM RTO. For this analysis, excess reserves are defined as the total level of 10-minute reserves that are available minus the required level of 10-minute reserve. For this analysis, the 10-minute reserves are utilized because they are resources that can be available very quickly in the event of a system emergency. However, it is recognized that some resource shortage events would have longer lead times but MARS does not consider such lead time issues. It primarily looks at what areas are short and what areas are long in each hour and can the excess available in the long areas be delivered with available transmission capability to those areas that are deficient resources.

The NYISO findings conducted under initial scope of work, which was based on an analysis of excess reserve data that included only the MAD region of PJM, concluded that that the levels of EA within the GE MARS model were excessive. This was based on looking at the overall average of available excess reserves, the max and min levels and concluding that the NYCA EA limit should be set at the NYCA operating reserve requirement of 2620 MW. An IRM sensitivity based on this limit against the 2016 base case resulted in a 1.4% increase in the IRM. The analysis also noted that the max MARS EA level of 4,900 MW found in the MARS modeling results exceeded the max of 4,200 MW observed in the data as available from our neighbors.

The analysis conducted under the second scope of work was conducted by NYSRC Consultant J Adams utilizing excess reserve data provided by the NYISO. The starting point for this analysis was the data set which included just the MAD region excess reserve data for PJM. The overall results of that analysis were presented at the April 5, 2017 ICS meeting – http://www.nysrc.org/pdf/MeetingMaterial/ICSMeetingMaterial/ICS_Agenda%20194/Emergency%20Assistance%20Model%20Status%20Report%2004_05_2017.pdf . The primary finding from this analysis was that the level of excess reserves appeared to decline with increasing load level. The result seemed feasible. This suggested a model where the EA limit would vary by load level which MARS can accommodate. However, it was subsequently determined that this finding was primarily the result of major difference in the level of excess reserves and trend by load level in the MAD region versus the rest of PJM RTO.

One of the issue raised regarding the NYISO initial analysis was that only a part of PJM RTO was modeled while the MARS model includes the entire PJM RTO. This difference of using an EA limit based on data that includes just the PJM MAD region could account for the significant increase in the IRM versus the base case result. PJM data that includes the full PJM RTO as well as a breakdown of the MAD Region and the rest of PJM was provided by NYISO to the NYSRC consultant. A plot of the PJM MAD region and the balance of the PJM RTO is presented in Appendix A as well as a plot of the full PJM excess reserves by load level. This data clearly demonstrates that most of the excess reserves in PJM generally exist within the rest of PJM footprint with excess reserves for the top 5 LFU load bins averaging 891 MW in the rest of the PJM RTO and 81.4 MW in the MAD region.

The initial results for the data that included the excess reserves for the full PJM RTO was presented at the April 5, 2017 ICS meeting – see link bottom of page 2. The data indicated that there was no significant trend in excess reserve levels by load level in the neighboring control areas in total. This indicates the best approach would be to use a straight average of the excess reserve data. This resulted in an initial EA limit of 3318 using the full data set that included the entire PJM RTO. This limit on EA resulted in 18.2% IRM which is 0.1% higher than the base case.

At the March 1, 2016 ICS meeting NYISO staff presented a presentation entitled: "Distribution of Loss of Load Events in 2017 PBM" see - http://www.nysrc.org/pdf/MeetingMaterial/ICSMeetingMaterial/ICS_Agenda%20193/ICS_20170301_Event_Distribution_FINAL%20v4%20(002).pdf.
This presentation showed that measurable LOL events only occur in LFU bins 1-5 with LFU bins 2 and 3 having the highest numbers of LOL events. This would suggest that EA limit should be based on the excess reserve observed in those bins. This results in an estimated EA limit of 3457 MW. An EA limit of 3450 still results in an IRM sensitivity of 18.2%.

Appendix B presents a histogram of frequency distribution of excess reserves in neighboring regions grouped into intervals that are 500 MW wide except for the tail intervals for observations occurring in LFU bins 1-5. The excess reserve levels in the interval are represented by the midpoint of the interval. The mode, which represents the most frequently occurring value, is the value where the histogram reaches its peak. For this data, the mode occurs at a midpoint value of 3,500 MW. The modal value was tested as a EA limit sensitivity. The sensitivity resulted in the following values:

Sensitivity of Total EA Limit for NYCA	IRM	LCR (J)	LCR (K)	LCR (G-J)
3500 MW	18.1%	81.6%	103.5%	91.6%

Except for the G-J LCR, these sensitivity results match the 2017 base case result for the NYCA IRM and the J and K LCRs.

Conclusions

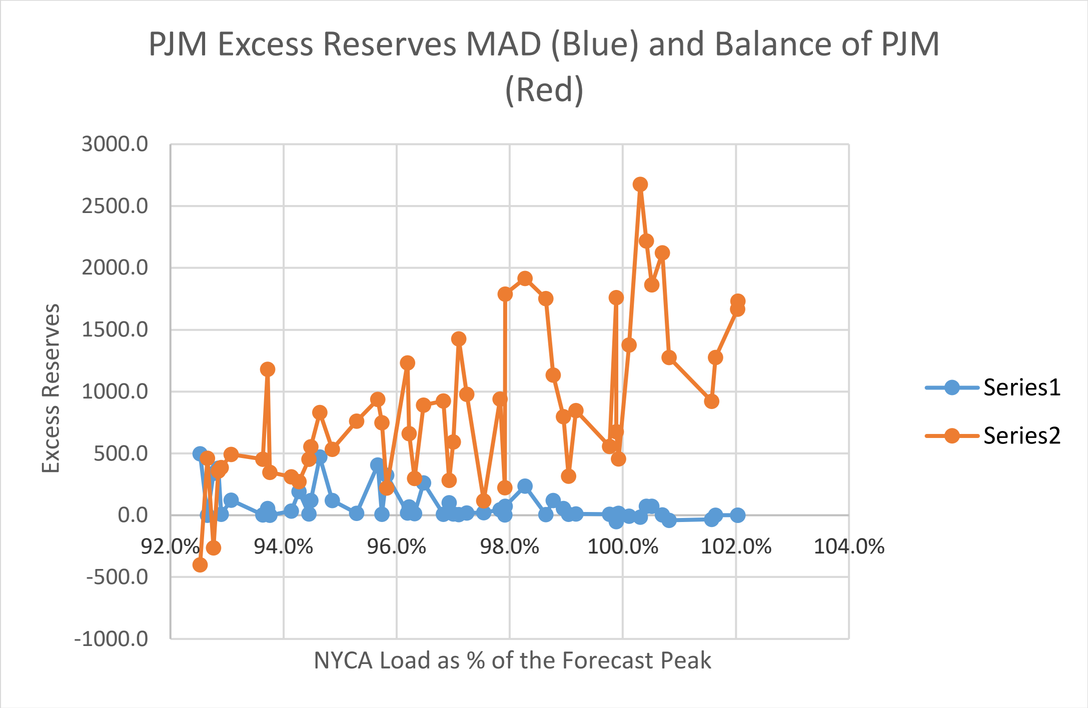
The primary conclusion is that the IRM base case overall implied expected level of EA utilized in determining the NYCA IRM appears to be reasonable based on the analysis of the availability of 10-minute reserves in neighboring control areas. However, specific draws which are on the order of 4,000 MW or higher could be excessive. This ties to the question as to what is the maximum simultaneous import capability of the NYCA across all interfaces with neighboring control areas. As has been stated in the past by NYISO staff this is not an easy question to answer. It is highly dependent on systems condition not only in the NYCA but in the neighboring control areas as well. There would be numerous system states that would need to be enumerated and evaluated. It would be a major undertaking if even feasible. Also, the EA flows would be on top of any external ICAP transactions that were occurring. Therefore, it does seem reasonable to impose a limit on EA flows in the MARS simulations.

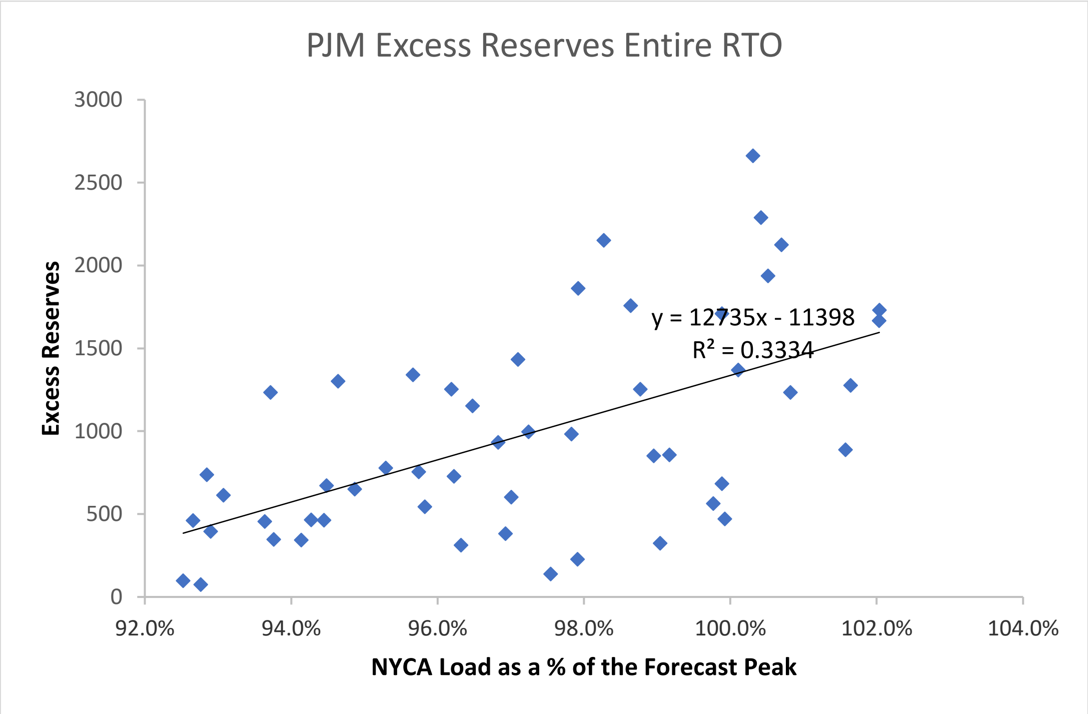
Recommendations

The first recommendation is that an EA limit be implemented for the base case. The value of the limit should be 3,500 MW which represents the modal value for LFU bins 1-5 where LOL events have been observed to occur in the MARS simulation. It is also the value that maintains the implied level of EA observed in the 2017 IRM base case which has been determined to be an overall reasonable level of EA.

The second recommendation is if the EA limit is adopted as a base case assumption then a sensitivity with no EA limit be run. Likewise, if the EA limit is not adopted as a base case assumption it should be run as a sensitivity.

Appendix A
Plots of PJM Excess Reserves by Region and Total





Appendix B
Histogram of Excess Reserves in Neighboring Control Areas