Attachment XIV

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

New York Independent System Operator, Inc.   Docket No. ER13-___-000

AFFIDAVIT OF HENRY CHAO, Ph.D. AND JOHN M. ADAMS

Dr. Henry Chao and Mr. John Adams each declare:

1. I have personal knowledge of the facts and opinions herein and if called to testify could and would testify competently hereto.

I. Purpose of this Affidavit

2. The purpose of this Affidavit is to explain the process the NYISO followed to determine the boundary for the New Capacity Zone[1] ("NCZ") that it has proposed in this proceeding and to determine the Indicative NCZ Locational Minimum Installed Capacity Requirement ("Indicative NCZ LCR"). This Affidavit also discusses the results of the analyses performed in those processes.

II. Qualifications

A. Dr. Henry Chao

3. My name is Henry Chao. I am the Vice President of System and Resource Planning for the NYISO. My business address is 10 Krey Boulevard, Rensselaer, NY 12144.

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[1] Terms with initial capitalization not defined herein have the meaning set forth in the Market Administration and Control Area Services Tariff ("Services Tariff") and if not defined therein, then in filing in which this Affidavit is incorporated.

4. My responsibilities include performing reliability and economic studies of supply (including demand side resources) and transmission facilities in New York State in accordance with the objectives and procedures of the NYISO. This includes performing planning studies and functions of resource adequacy and transmission security, load forecasting, and interconnection studies. I also lead the NYISO's participation, either directly or through overseeing NYISO personnel, various stakeholder committees, Federal Energy Regulatory Commission (the "Commission") proceedings, New York State Reliability Council ("NYSRC") matters, and Northeast Power Coordinating Council ("NPCC") and North American Electric Reliability Corporation ("NERC") committees dealing with bulk power system reliability and economics. I have been actively engaged in the NYISO's analyses for and development of the NCZ, including the determination of the proposed NCZ boundary and the Indicative NCZ LCR.

5. I have thirty years of experience in all aspects of electric system planning and operations. I have held my current position at the NYISO since April 2008. Prior to holding my current position, I was the NYISO's Director of System & Resource Planning. Before joining the NYISO in 2007, I served as Group Vice President of Utility Partner, and Director of Business Development, Electric Systems Consulting, for ABB Ltd. At ABB, my primary responsibility was to direct model development and consulting leveraging ABB's technologies, which were built to analyze bulk power markets, relieve transmission congestion, and foster improved understanding of the competitive forces underlying the changes in the electric power sector.

6. I have worked extensively with electric utilities, Independent System Operators and Regional Transmission Organizations, regulators, generation and energy trading companies, investment banks, and hedge funds. I have been a frequent participant as speaker or panel chair in industry and government sponsored industry forums and technical seminars and have authored over fifty papers for Institute of Electrical and Electronics Engineers ("IEEE"), CIGRE (the International Council on Large Electric Systems,) and other industry conferences. I have briefed the Commission and U.S. Department of Energy staff on transmission congestion and grid technology issues.

7. I hold a Ph.D. in Electrical Engineering from Georgia Institute of Technology.

B. John Adams

8. My name is John Adams. I am a Principal Electric System Planner for the NYISO. I have held my current position since 2006. My business address is 10 Krey Boulevard, Rensselaer, NY 12144.

9. I have forty years of experience in the electric utility industry primarily in electric system planning and operations. My current responsibilities include managing special studies such as the NYISO's study of the system integration of wind generation, providing support to the annual New York Control Area ("NYCA") Installed Capacity Requirements study, serving as one of the NYISO observers to the NYSRC since its creation as part of electric restructuring in New York State in 1999. I am a member of NERC's Integration of Variable Generation Task Force and Chaired the task force that produced the report for "task 1.4" entitled:

"Flexibility Requirements and Metrics for Variable Generation: Implications for System Planning Studies." I am the NYISO representative to the NPCCs Task Force on the Coordination of Planning ("TFCP") and was the New York Power Pool ("NYPP") representative on TFCP prior to electric restructuring. I have been actively engaged in the NYISO's analyses for and the development of the NCZ, including the determination of the proposed NCZ boundary and the Indicative NCZ LCR.

10. I was previously Director of Planning for the New York Power Pool ("NYPP") and became Director of Planning and Analysis at the NYISO when it succeeded the NYPP. During electricity restructuring, I directed a staff of over twenty professionals with the primary objective of transitioning NYPP processes that were directed by vertically integrated utilities to open unbundled competitive market processes while maintaining the NYPP's culture of a strong commitment to reliability. I had major roles in: 1) converting the NYPP installed capacity requirement or BP-4 requirement to a market based Installed Capacity ("ICAP") requirement and auction process; 2) directing the implementation of the NYISO Transmission Congestion Contract market; 3) directing the implementation and development of the NYISO generator and merchant transmission interconnection process; 4) directing the implementation of a "state-of-the-art" real time load forecasting capability; 5) directing the development of the NYISO demand response programs; 6) directing the development and implementation of a comprehensive electric systems reliability planning process for the New York Control Area, including being the primary author of the NYISO's first and second

Reliability Needs Assessments and Comprehensive Reliability Plans; and 7) initiating the NYISO's publication of its annual "Load and Capacity Data Report" or "Gold Book." I am a Life Member of the IEEE and have coauthored several papers and articles. I have appeared before the New York State Public Service Commission as an expert witness in both electric rate and long range planning proceedings.

11. I hold a Bachelor of Science Degree in Electrical Engineering from Rensselaer Polytechnic Institute ("RPI") and a Master of Science Degree in the Management of Technology from RPI.

III. Determination of the NCZ Boundary

12. Section 5.16 of the Services Tariff states that the NYISO shall conduct the NCZ Study on or before January 15 in each ICAP Demand Curve Reset Filing Year. If the NCZ Study determines that there is a constrained Highway interface into one or more Load Zones, the NYISO must establish an NCZ. The NYISO is also required to determine the NCZ's boundary by considering "the extent to which incremental Capacity in individual constrained Load Zones could impact the reliability and security of constrained Load Zones, taking into account interface capability between constrained Load Zones."[2] The Services Tariff provides that the boundary of the NCZ may encompass a single constrained Load Zone or group of Load Zones including one or more constrained Load Zones on the constrained side of the Highway interface.

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[2] Services Tariff Section 5.16.2.

13. In addition, the NYISO must determine an Indicative NCZ LCR each ICAP Demand Curve Reset Filing Year. The Indicative NCZ LCR is used solely for establishing the ICAP Demand Curve for the NCZ in accordance with Section 5.14.1.2 of the Services Tariff.[3]

14. As described in the Affidavit of Mr. Steven Corey, the NCZ Study determined that the UPNY-SENY Highway interface is bottling 849.2 MW of generation from Load Zones A through F to one or more of Load Zones Load Zones G through K.[4] The NCZ Study therefore triggered the tariff requirement to create, and to define the boundary of, one or more New Capacity Zones.

15. Currently, Load Zones J and K are defined as separate Localities and each has its own Locational Minimum Installed Capacity Requirement ("LCR"). They are the only two Localities in the NYCA. Load Zones G, H, and I ("GHI") are located on the constrained side of the UPNY-SENY Highway interface and, therefore, clearly had to be included in the NCZ. A principal question was whether Load Zones GHI should be combined with one or both of the existing Localities.

16. The Services Tariff requires that in determining the boundary, the NYISO consider the extent to which incremental capacity in individual constrained Load Zones could impact the reliability and security of constrained Load Zones while taking into account interface capability between Load Zones. Power system reliability consists of adequacy and security. Adequacy, which encompasses both capacity

[3] *Id.*

[4] The NYCA Load Zones are depicted on the map that is Attachment IX to the filing.

resources and transmission adequacy, refers to the ability of the bulk power system to supply the aggregate requirements of electricity to consumers at all times, accounting for scheduled and unscheduled outages of system components. Security refers to the ability of the bulk power system to withstand disturbances such as electric short circuits or unanticipated loss of system components.

17. The NYISO's determination of which of the Load Zones located on the constrained side of UPNY/SENY interface should be included in the NCZ began with the application of resource adequacy techniques. Because Load Zones J and K are defined as Localities with their own LCRs, the NYISO sought to determine how fungible capacity in Load Zones GHI is with capacity in Load Zones J and with capacity in Load Zone K. This was done by running simulations in which capacity was removed from Load Zones GHI and added to Load Zones J and K while monitoring whether compliance with the NYSRC rule of a loss-of-load event of not more than once in ten years (or a loss-of-load expectation ("LOLE") evaluated probabilistically of not more 0.1 days per year) would be maintained.[5] The degree to which capacity in Load Zones J and K could substitute for capacity on a reliability basis in GHI would measure how fungible GHI capacity was with capacity in Load Zones J and K and, thus provide guidance on which Load Zones should be included in the NCZ.

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[5] *See* NYSRC Reliability Rule A-R1, *Statewide Installed Reserve Margin Requirements* <*http://www.nysrc.org/pdf/Reliability%20Rules%20Manuals/RR%20Manual%20V32%20Final%201-11-13%20.pdf*>, ("The NYSRC shall establish the IRM requirement for the NYCA such that the probability (or risk) of disconnecting any firm load due to resource deficiencies shall be, on average, not more than once in ten years. Compliance with this criterion shall be evaluated probabilistically, such that the loss of load expectation (LOLE) of disconnecting firm load due to resource deficiencies shall be, on average, no more than 0.1 day per year.")

18. The analysis was conducted using General Electric's Multi-Area Reliability Simulation Model (the "MARS" model). This MARS model has been used by the NYSRC to establish the statewide installed reserve margin ("IRM") since 2000, which was the first full year of operation for the NYISO-administered markets. The MARS model also accounts for the emergency transfer criteria for the key transmission interface between Load Zones.[6] It is intended that the NYS Bulk Power System be operated within normal transfer criteria at all times insofar as possible. However, in the event that adequate facilities are not available to supply firm load within normal transfer criteria, emergency transfer criteria may be invoked. Under emergency transfer criteria, transfers may be increased up to, but not to exceed, emergency ratings and limits. When running the MARS simulations, the NYISO used the base case in setting the 2013/2014 IRM approved by the NYSRC Executive Committee, as adjusted by the NYISO in its determination of the 2013/2014 LCRs for the J and K Localities.

19. Because the MARS model accounts for the ability of the transmission system to transfer power, the distribution of resources relative to the capability of the transmission system and load can result in multiple sets of statewide IRM and LCRs for Localities J and K that meet the LOLE criterion. In recognition of this, a process known as the "unified methodology" was developed so that the selection of the IRM and corresponding LCRs set to establish LSE capacity requirements would be selected consistently from year-to-year. The unified methodology is also the

[6] This is consistent with NYSRC Reliability Rule A-R1, which requires, among other things, that IRM analyses make "due allowance" for emergency transfer capability.

process used by the NYISO to set the LCRs and thus it is internally consistent with the process used by the NYSRC to set the statewide IRM.

20. The unified methodology establishes a graphical relationship or curve between statewide IRM and the LCRs. The shape of the curve tends to be convex with higher LCRs at lower IRMs and lower LCRs at higher IRMs. Beyond the inflection point of the curve, which also known as the "Tan 45" point (*i.e.*, the point where the tangent measures 45 degrees), is the point where the curve tends to flatten out. At that point, higher IRMs result in minimal reduction in LCRs.

21. In the first step of the NCZ boundary analysis, the MARS simulations in conjunction with the unified methodology indicated that close to 6,000 MW of capacity could be relocated from Load Zones GHI to Load Zone J before the LOLE criterion for the NYCA would be violated. In the case of Load Zone K, the MARS simulation and unified methodology indicated that only approximately 300 MW of capacity could be transferred from Load Zones GHI to Load Zone K without a violation. This much lower number is attributable to the limited transmission export capability from Load Zone K to Load Zones GHI.

22. Thus, capacity in Load Zones GHI is much less fungible with capacity in Load Zone K. The result shows that from the resource adequacy perspective, Load Zone K capacity provides limited support and value to Load Zones GHI, especially in comparison to the support that Load Zone J provides.

23. In the second step of the NCZ boundary analysis, the NYISO conducted resource adequacy simulations that added capacity to Load Zones J and K separately to

determine how capacity additions in them would impact the LOLE for Load Zones GHI. This approach begins with the NYISO system at LOLE criterion and adds capacity. In general, adding incremental capacity to any location in the system, either NYCA Load Zones or neighboring systems, will show an improved LOLE to some extent. Even adding capacity to a location where the capacity is bottled (*i.e.*, constrained) can result in some improvement although when such improvements occur they will usually be smaller. The LOLE ordinarily declines rapidly towards zero in an asymptotic manner until the point of diminishing returns is reached or the LOLE has dropped to essentially zero. For the case where the capacity additions become bottled, the LOLE will stop improving at a certain point.

24. Adding capacity to Load Zones J or K would affect reliability in two ways. First, it would result in a lower LOLE because the number of loss-of-load events in those zones would be reduced and there would be more capacity available to share with other Load Zones subject to transmission constraints. Second, more of the capacity that is able to flow across the UPNY-SENY constrained Highway interface would be available to provide greater support to Load Zones GHI, and to Load Zone J or K, depending on where the capacity was added. For example, if capacity is added to Load Zone J, the proportion of capacity flowing over the UPNY-SENY interface that is available to support Load Zones G, H, I, and K will increase.

25. The NYISO examined cases where large amounts of capacity (*e.g.*, 3,500 MW) were added to Load Zones J and K. When 3,500 MW was added to Load Zone J, the LOLE in Load Zones GHI dropped from 0.1 days per year to essentially zero (0.001 days per year) because this amount of capacity increased the IRM by more

than 10%, to above 27% while the Load Zone J capacity margin increased by over 33%. These changes were so substantial because the 3,500 MW would not be bottled in Load Zone J.

26. By contrast, when 3,500 MW was added to Load Zone K it results in an even greater increase in the Load Zone K capacity margin, *i.e.,* 57%. The LOLE in Load Zones GHI LOLE fell to only 0.012 and stayed at this level without any further improvement. In fact, the NYISO increased the capacity additions in Zone K beyond 3,500 MW and there was no further improvement in the LOLE for Load Zones GHI or the NYCA LOLE. This is because the 3,500 MW of incremental capacity additions in Load Zone K become bottled there at some point while no such bottling occurred in Load Zone J. This result means that, unlike Load Zone J, adding more capacity to Load Zone K provides considerably less reliability benefit because the capacity additions become bottled.

27. Thus, the second step of the analysis demonstrates that adding capacity to Load Zone J provides greater LOLE benefits per MW in Load Zones GHI and in the NYCA than adding equivalent capacity to Load Zone K. The conclusion for the case of large capacity additions is that capacity in Load Zones GHI and Load Zone J is fungible but large capacity additions in Load Zones GHI and Load Zone K are not because incremental capacity becomes bottled in Load Zone K. The second step also shows that Load Zones GHI combined with Load Zone J ("Load Zones GHIJ") are a superior location for incremental capacity than Load Zone K given that the objective is to send a price signal for incremental capacity additions in locations that provide the greatest reliability benefit and support for maintaining the

system at least at criterion. These results are consistent with and reinforce the findings from the first step.

28. In the third step of the NCZ boundary analysis, the NYISO conducted a transmission security analysis. Such analyses are conducted deterministically through the enumeration of multiple system facility outage events. Transmission security analysis is often referred to as "N-1" analysis. The LOLE results and capacity transfer capability resulting from the MARS simulations described above are probability weighted values. The transmission system topology and its limits used in the MARS model are derived from the N-1 analysis based on emergency transfer criteria (*i.e.*, with system facilities operating at 15 minute short term emergency ratings). That is, they aggregate a set of simulated system conditions which are probability weighted loss of load occurrences that reflect various system outages, extreme weather/load conditions, *etc*. The transmission security analysis provides the deterministic perspective and information about specific operation conditions. This provides a different view of real-time system operation conditions when compared to the probability weighted measures provided by the MARS analysis.

29. Under system operation conditions, the transfer capability based on normal transfer criteria (with system facilities operating at four-hour long term emergency ratings) from Load Zone K to Load Zone I results in less transfer capacity than the probability weighted results from the MARS simulations. The NYISO's N-1 analysis found that the maximum power that can be transferred out of Load Zone K to the rest of NYCA under normal conditions is 233 MW; and under emergency

conditions it is 344 MW. The normal and emergency transfer capacities are sensitive to the load and the generation dispatch under various facility outage conditions on the 138 kV and 69 kV transmission systems in western Load Zone K.

30. An "N-1-1" transmission security analysis was also conducted for the Load Zones on the constrained side of the UPNY/SENY interface. In an N-1-1 security analysis, individual N-1 cases are created by removing critical generator, transmission circuit, transformer, series or shunt compensating device, or HVDC pole, from the base case. Next, a set of corrective actions is developed to restore the system to normal condition for each of the first N-1 contingency cases and to be ready for the second N-1 contingency (commonly referred to "N-1-1").

31. With the Zone K export capability at 233MW, for the next ten years, an N-1-1 transmission security analysis for the Load Zones located on the constrained side of the UPNY-SENY interface demonstrated that SENY Load Zones must seek capacity from regions other than Load Zone K. Resource shortages due to generation outages/retirements in the Load Zones on the constrained side of the interface cannot be met by the addition of incremental generation capacity to Load Zone K. This conclusion is consistent with and reinforces those found in the first two steps described above.

32. Finally, the NYISO considered the fact that Load Zone J is electrically more integrated with the transmission system in Load Zones GHI than it is with Load Zone K. In general, this is a result of the fact that the Transmission Owner, and largest LSE serving Load Zone J, also has substantial operations in Load Zones GHI and, prior to deregulation also owned a substantial amount of generation

capacity in GHI that were built to serve load in GHI as well as Zone J. As a result, much of the transmission in GHI was designed to deliver energy generated in Load Zones GHI to Load Zone J. Further, it should be noted, that the backbone transmission system serving Load Zones GHIJ is a more robust 345 kV system while the backbone transmission system serving Load Zone K is a 138 kV except for its external ties to Load Zone I.

33. In conclusion, the Service Tariff requires the NYISO to determine the NCZ's boundary and that it consider "the extent to which incremental Capacity in individual constrained Load Zones could impact the reliability and security of constrained Load Zones, taking into account interface capability between constrained Load Zones."[7] Further the Services Tariff provides that the boundary of the NCZ may encompass a single constrained Load Zone or group of Load Zones including one or more constrained Load Zones on the constrained side of the Highway. The analyses, described above, clearly shows that the capacity needs attributable to generation retirements cannot be fully met by adding generation in Load Zone K on a one-to-one basis. It is axiomatic that sound market design should promote economic efficiency. An NCZ should send price signals that promote reliability in an economically efficient manner. Establishing an NCZ that included Load Zone K would be inconsistent with these principles because it would incent capacity additions in Load Zone K even though such additions would

[7] Services Tariff Section 5.16.2.

provide considerably less reliability value to the other Load Zones located on the constrained side of the UPNY-SENY interface and to the NYCA as a whole.

34. NYISO's proposed NCZ encompassing Load Zones GHIJ is more consistent with these tariff requirements than any other potential NCZ configuration, including a combination with Load Zone K. Taken together, the factors described above cause the NYISO to recommend that the NCZ created in response to the constraint identified in the NCZ Study should encompass Load Zones GHIJ, and should not include Load Zone K.

IV. Determination of the Indicative NCZ LCR

35. As stated above and in the transmittal letter, the Indicative NCZ LCR will be utilized in the determination of the ICAP Demand Curve for the NCZ. Therefore, a description of how it was calculated is provided here.

36. The NYISO calculated the Indicative NCZ LCR using the MARS model which, as described earlier, is the same tool that is used to perform the analysis determining the NYCA IRM and the LCRs.

37. As discussed above, the transmission constraints that are modeled in the MARS simulations can result in multiple sets of IRM and LCR "pairs." The "unified" or "Tan 45" methodology, was developed to determine the IRM and the LCR for Zones J and K all paired so that a balance is struck between the statewide (NYCA) IRM and the LCRs. The unified methodology has been in use since 2005 and has provided balanced levels of IRM and LCRs between upstate and downstate over time.

38. Under the unified methodology, a curve is developed that relates the statewide IRM and the LCRs. The anchor point on the curve is selected by applying a tangent of 45 degrees ("Tan 45") at the bend (or "knee") of the curve.[8]

39. To determine the Indicative NCZ LCR, the NYISO began by using the unified methodology to find the Tan 45 point for the statewide IRM and the 2013/2014 LCRs for Load Zones J and K. It then "layered" the proposed G-J Locality on top of load zones GHI and J at the Tan 45 point.

40. The NYISO ran simulations that shifted capacity from the Load Zones GHIJ to Load Zones A, C, and D until the LOLE criterion was satisfied. The NYISO performed that analysis because under the unified methodology, capacity from Load Zones J and K is shifted to Load Zones A, C, and D or to the Load Zones with excess and Load Zones that fully utilize the transmission system. It is at that point, where the collective capacity to Load ratio for Load Zones G-J became the Indicative NCZ LCR.

41. The application of this method resulted in a LCR for Load Zone K of 105% and a LCR of 86% for Load Zone J. The application of the methodology for NYISO's proposed G-J Locality resulted in an Indicative NCZ LCR of 88%.

42. This concludes this affidavit.

[8] *See* NYSRC Policy 5 Attachment A and B.

ATTESTATION

I am Henry Chao, a witness identified in the foregoing Affidavit of Henry Chao and John M. Adams dated April 30, 2013 (the "Affidavit"). I have read the Affidavit and am familiar with its contents. The facts set forth therein are true to the best of my knowledge, information, and belief.

Henry Chao

Henry Chao, Ph.D.
Vice President of System and Resource Planning
New York Independent System Operator, Inc.

April 30, 2013

Subscribed and sworn to before me
this 30th day of April 2013.

Thomasine DeShaw

Notary Public

My commission expires: 5/31/15

THOMASINE DeSHAW
Notary Public, State of New York
Qualified in Rensselaer County
Commission Expires 5/31/15

ATTESTATION

I am John M. Adams, a witness identified in the foregoing Affidavit of Henry Chao and John M. Adams dated April 30, 2013 (the "Affidavit"). I have read the Affidavit and am familiar with its contents. The facts set forth therein are true to the best of my knowledge, information, and belief.

John Adams
Principal Electric System Planner
New York Independent System Operator, Inc

April 30, 2013

Subscribed and sworn to before me
this 30th day of April 2013.

Thomasine DeShaw

Notary Public

My commission expires: 5/31/15

THOMASINE DeSHAW
Notary Public, State of New York
Qualified in Rensselaer County
Commission Expires 5/31/15