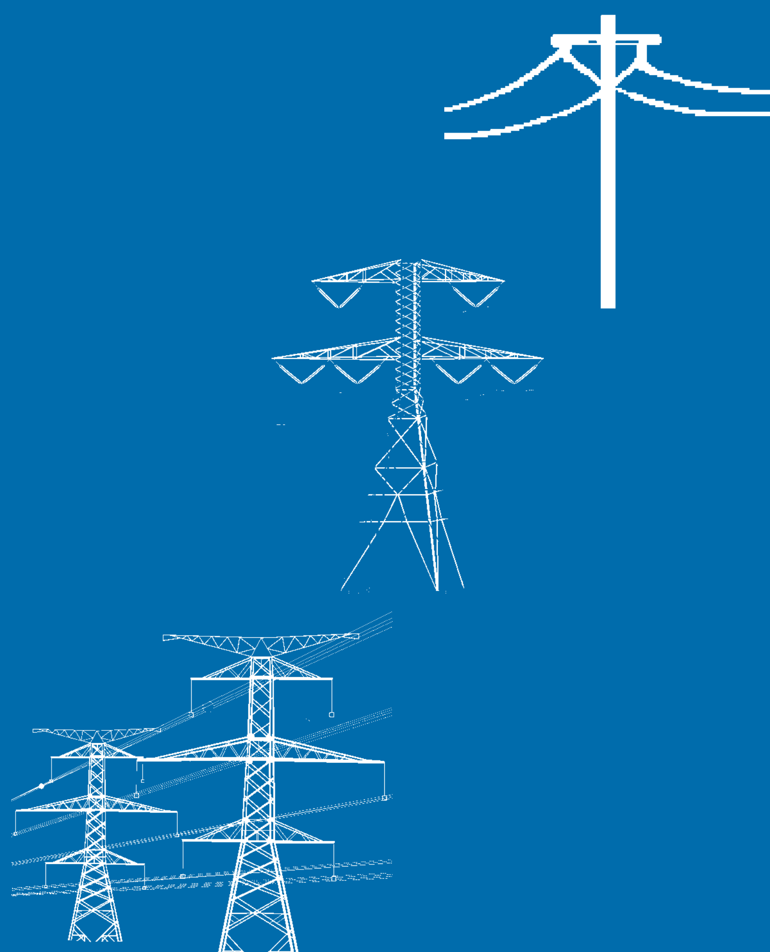
Report on the Reliability of New York's Electric Transmission and Distribution Systems

November 2000

George E. Pataki, Governor



New York State Energy Planning Board

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Report of the New York State Energy Planning Board
on the
Reliability of New York State's Electric Transmission and Distribution Systems

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EXECUTIVE SUMMARY

The New York State Energy Planning Board (EPB) was directed by statute (Chapter 636 of the Laws of 1999) to study the reliability of New York's electric transmission and distribution systems. The statute required the EPB to examine how the reliability of the transmission and distribution systems would be affected by several factors now and in the future. The statute authorized the New York Power Authority (NYPA) and the Long Island Power Authority (LIPA) to each provide a voluntary contribution to the EPB to contract with an independent consultant to assist the EPB in analyzing the existing and future reliability of New York's transmission and distribution systems. Finally, the EPB was directed to submit its report on the current and projected reliability of New York's electric transmission and distribution systems with findings and recommendations to the Governor and the Legislature by December 1, 2000.

The reliability study was overseen by an interagency study team. The interagency study team, through the New York State Energy Research and Development Authority (NYSERDA), selected General Electric Power Systems Energy Consulting competitively to provide consulting services. The contractor's study of the existing and future reliability of New York's transmission and distribution system is available upon request. To help the staff of the EPB member agencies frame and analyze the issues surrounding the current and future reliability of New York's electricity system, the EPB established a Reliability Study Advisory Group.[1] The Group was made up of a variety of stakeholder organizations and technical experts, including utilities, large industrial corporations, the Legislature, the New York transmission system operator, reliability experts, New York City, power generators, and environmental and consumer representatives.

The New York State Energy Planning Board's major findings and recommendations follow.

The Importance of the Electric System

As the Legislature recognized in calling for this study, the reliability of the electric system is critical to the safety and well-being of New Yorkers, and to continuing the State's economic resurgence. There have been serious challenges to maintaining the historically high levels of transmission and distribution system reliability in New York. The 1998 ice storm required a virtual reconstruction of lines in affected areas in Northern New York State. Last year's heat wave threatened the network systems in New York City, and caused an extended disruption in the Washington Heights area of Manhattan. Hudson Valley customers were without power for several days in the aftermath of Hurricane Floyd.

Beyond these weather-related events, the restructuring of the electric industry has also caused concern over the integrity of the electric system. In addition, increased power consumption

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[1] The members of the Reliability Study Advisory Group are listed in Appendix A.

associated with the rise of economic activity and the increased use of computers and other appliances threatens to outstrip the capacity of existing generation to provide adequate supply.

Given these factors, those entities charged with designing, building, operating, maintaining, expanding, and regulating the electric system in New York have placed a high priority on maintaining system reliability. In pursuit of high reliability, numerous programs and policies have been developed to ensure that outages are not the result of negligence or carelessness, and that when outages do occur, service is restored as quickly and safely as possible. State policymakers, regulators, and utilities cannot be content, however, to simply maintain the status quo, but must continually seek new programs and policies to enhance the reliability of this critical component of New York's infrastructure.

Current and Future Reliability

New York's electricity transmission and distribution systems, by all objective measures and compared to other states and regions, currently are very reliable. The very high level of reliability is the result of strict adherence by the New York Independent System Operator (NYISO) and transmission and distribution companies, to well-developed procedures specifically designed to maintain the security of the electric infrastructure, as well as close oversight by the New York State Public Service Commission (PSC). Continued compliance with existing reliability standards is a key component to ensuring the future reliability of New York's interconnected electricity system.

Recent events, including the growth in demand for electricity, have increased the utilization of New York's bulk power transmission system in moving electricity to New York's downstate electric load center. Furthermore, there appears to be a need to better coordinate and plan for the evolution of New York's electricity system as it transforms from a highly regulated system with few participants to a highly competitive system with many participants. The challenge facing New York over the next several years is to preserve the high reliability of the State's electric transmission and distribution systems while allowing for a more competitive electricity market to emerge. Several steps should be taken now to ensure continued reliability. The EPB finds that with the adoption of the recommendations outlined in this Report, the basic principles and institutions will be in place to preserve the high electric system reliability that the citizens, businesses and industries of New York expect now and in the future.

Causes of Interruptions

The primary causes of electric service interruptions have been, and will continue to be, weather (storms, lightning, wind, ice), equipment failure, tree contact and accidents.[2] New York's transmission and distribution system owners have and will continue to restore electricity service expeditiously and cost-effectively in response to such interruptions.

[2] Accidents refer to physical contacts or intrusions into the electric system, not operator error.

Generation is Needed

New electricity generation is needed, particularly in the New York City metropolitan area, to provide adequate supply to, and preserve the reliability of, New York's electricity system. Energy conservation and efficiency, load control and peak shaving measures, in tandem with new electricity generation, can assist in maintaining adequate supply to New York's transmission and distribution systems.

One additional way to help meet the need for new capacity is through price-responsive load programs which allow consumers to control their demand for electricity in response to higher electricity prices. Allowing price-responsive load to compete in the wholesale electricity markets will benefit system reliability through lower use of electricity when the demand on the system is the greatest. Such programs will also help make the electricity markets more competitive, and provide better and more stable prices to consumers.

Transmission Planning

Currently there is a lack of coordinated bulk electricity transmission system planning for enhancements and new facilities. The Federal Energy Regulatory Commission's (FERC) Order 2000 requires electricity system operators to develop and implement a coordinated and comprehensive bulk transmission planning process. In response to this FERC mandate, the NYISO is actively seeking to develop such a process. The ability to finance and fairly allocate costs for bulk transmission enhancements is an unresolved issue that will need to be addressed before bulk transmission enhancements and new transmission facilities are pursued.

Recommendations

The EPB makes the following recommendations to ensure that New York's transmission and distribution systems continue to meet a high standard of reliability in the future.

Need for New Generation and Load Reduction

- Support initiatives to improve the efficiency of the Article X siting process.

- Provide interim solutions to meet the need for increased generation by the Summer of 2001, including supporting NYPA's efforts to place 11 new gas turbines in the New York City and Long Island area.

- Continue and enhance efforts to reduce demand (*e.g.*, the present and future System Benefits Charge (SBC) funded programs, and New York Power Authority and Long Island Power Authority initiatives), especially during peak periods of electricity use.

Role of Price-Responsive Load

- Develop NYISO protocols that allow for price-responsive load to be bid in both the day-ahead and real time electricity markets. Such measures will reduce stress on the bulk transmission and distribution systems and will provide a more competitive electric market.

- Develop technologies and approaches (*e.g.*, remote load control of residential appliances, innovative real time pricing programs, time of use metering, and load aggregation) that support current and evolving NYISO dispatch programs. Load aggregation allows small consumers to play a larger role in price-responsive load programs, enhancing competition in the marketplace.

- Pursue public education efforts to help inform consumers of the benefits of participating in price-responsive load programs.

Transmission Monitoring, Planning and Enhancements

- Research requirements for the development of a broadly applicable system for monitoring and documenting the reliability of transmission systems, including data requirements, index design, tracking method, responsibility for implementation and frequency of reporting. To be most helpful, efforts to track transmission reliability should be performed on a regional and national basis, since the systems are interconnected and events in one system can affect the operation of adjoining systems.

- Initiate an integrated, coordinated approach to bulk power system planning that includes transmission resources as well as new generating sources. Such approach should seek to ensure that the State's electric system reliability needs are met and that the economic benefits of the system are maximized. Recently, the NYISO stated that it intends to develop a comprehensive "Transmission Planning Process" in cooperation with New York's market participants and relevant State agencies. The NYISO, consistent with the objectives of FERC Order 2000, is the suitable entity to perform this function.

- Develop effective financial mechanisms to support increases in transmission capability, especially those increases which have a material effect on improving system reliability. TCCs do not, necessarily, by themselves, provide adequate incentive to stimulate market-based transmission enhancements. Incentives to support economically desirable transmission enhancements, to the extent possible, should be offered through the marketplace .

Importance of Reliability Standards

- Support national efforts for mandatory, enforceable, minimum reliability standards that allow for more stringent regional, state or local reliability standards.

- Encourage national, regional and State organizations with authority to set and enforce system reliability standards to assess monetary penalties and sanctions for violations by market participants which jeopardize reliability. The level of penalties and sanctions should be large enough to clearly discourage parties from realizing benefits through non-compliance with reliability standards.

Role and Impact of Distributed Generation

- Support policies which facilitate the development and implementation of environmentally and economically sound distributed generation technologies.

- Support the development and implementation of distributed generation through research and regulatory initiatives aimed at making distributed generation technologies compatible with the State's electric system infrastructure and more accessible to consumers, including interconnection standards to accommodate appropriately-sized DG units with proven technologies.

Energy Conservation, Efficiency, Load Control and Peak-Shaving

- Support energy conservation, efficiency, load control and peak-shaving programs in New York State by removing barriers to the provision of such services by energy service companies. Support such programs as delivered by NYSERDA, NYPA, and LIPA.

ACKNOWLEDGMENTS

In addition to the Study Advisory Group (see Appendix A), the Energy Planning Board would like to acknowledge the efforts of the following individuals in preparing this report:

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INTRODUCTION

Statutory Requirements

The New York State Energy Planning Board (EPB) was established by the New York State Legislature pursuant to Article 6 of the New York State Energy Law in 1992. The EPB consists of the Chair of the Public Service Commission (PSC), the Commissioner of the Department of Environmental Conservation (DEC), the Commissioner of the Department of Economic Development, the Commissioner of the Department of Transportation (DOT), and the President of the New York State Energy Research and Development Authority (NYSERDA), who serves as Chair of the EPB.

The EPB was required by Chapter 636 of the Laws of 1999 to study the overall reliability of New York's electric transmission and distribution systems. The EPB was also directed to prepare a report on both its findings and recommendations and transmit the report to the Governor, the Speaker of the Assembly, the Temporary President of the Senate, the Chairman of the Assembly Energy Committee, and the Chairman of the Senate Energy and Telecommunication Committee.

The study is to include, at a minimum, an assessment of:

> (a) the current and projected reliability of the electric power system over the term of the planning period, with specific focus on transmission and distribution systems within the State, and should examine: (i) investment in infrastructure, including capital improvements, expansions, and maintenance; and (ii) workforce utilization;
>
> (b) the potential impact on distribution system reliability and on each factor enumerated in paragraph (a) of: (i) distributed electric generation, especially generation using renewable or innovative energy resources; (ii) energy conservation and efficiency; (iii) load control and peak shaving measures; (iv) corporate reorganization of electric utilities; (v) performance ratemaking, multi-year rate agreements, and other departures from traditional regulatory mechanisms; and (vi) large scale industrial development; and
>
> (c) the potential impact on transmission system reliability of: (i) each factor enumerated in paragraph (b); (ii) changes in protocols for electricity dispatched through the New York power pool or its successor or successors; (iii) accommodation of proposed new electric generation facilities or repowering or life extension of existing facilities; and (iv) the market-driven nature of decisions to build, size, and locate such facilities.

In conducting the study, the statute requires the EPB to consult with entities that have resources and expertise to assist in such investigation.

Energy Law Section 6-108 also authorized the EPB to contract with an independent and competitively selected contractor to undertake the study and authorized the New York Power Authority (NYPA) and the Long Island Power Authority (LIPA) to each provide a voluntary contribution to the EPB for this purpose. On January 26, 2000, the Board of Trustees of NYPA authorized a donation of $250,000, and on February 3, 2000, the Board of Trustees of LIPA authorized a donation of $250,000, to support this legislatively mandated effort.

Implementation

Interagency Study Team. In response to the legislation, the EPB formed an interagency study team (Study Team), including staff from the New York State Department of Public Service (DPS), Empire State Development (ESD), DEC, NYSERDA, NYPA and LIPA, to oversee the study.

Study Advisory Group. A Study Advisory Group of diverse public and private stakeholders was organized to assist the EPB in the preparation of the study. The Study Advisory Group met five times for the purposes of:

- providing input on the content of the proposed study including identifying the issues to be addressed;
- meeting with the competitively selected contractor to discuss and provide guidance on the study approach;
- reviewing and commenting on the proposed methodologies for determining reliability of the transmission and distribution systems and all other drafts and aspects of the study; and
- meeting to discuss the policy implications to be inferred from the results of the study.

In addition, an ad hoc technical working subgroup was formed. This subgroup participated in three roundtable discussions with the Study Team and the contractor to provide direction, assistance, and input into the technical areas covered by the study.

Outside of the formal meetings, the Study Advisory Group members provided detailed and timely documentation pertinent to the research efforts, advised the interagency Study Team on utility processes and procedures, and provided site visits and presentations on the workings of the electric system to the Study Team. The Study Advisory Group members were a major source of information and were a significant factor in the successful completion of the study. A listing of the Study Advisory Group is attached as Appendix A.

Finally, it should be noted that the Advisory Group was not asked to review and approve this report and no such approval should be inferred.

Technical Contractor. The interagency Study Team, through NYSERDA, issued a Request for Proposals (RFP) for conducting the study in March 2000. A Technical Review Group (TRG) consisting of staff from NYSERDA, DPS, ESD, LIPA, NYPA, and Paul Torpey, past Executive

Director of the Empire State Electric Energy Research Corporation, convened in April 2000 and reviewed the four proposals that were submitted in response to the RFP. The TRG recommended that GE Power Systems Energy Consulting (GE) be selected to perform the study. A contract was executed with GE in May 2000.

Study Approach. The first stage of the study involved identifying and obtaining data and developing methodologies to assess transmission and distribution systems reliability. Standardized sources of information on the reliability of the distribution systems were available from customer interruption data collected by the PSC, together with other standardized reliability measures. There were no similar standardized reliability measures for the transmission system, therefore reliability assessment measures were developed based on information from several sources including the New York Independent System Operator (NYISO), Federal Energy Regulatory Commission (FERC), and industry publications.

The second stage of the study involved assessing the "current" reliability of New York's transmission and distribution systems. Distribution system reliability was assessed using actual PSC customer interruption data including system average interruption frequency indices and customer average interruption duration indices, among other factors. Baseline transmission system reliability was assessed by reviewing historical data, such as previous transmission system stress and the duration of such stress on major New York transmission facilities, and major transmission emergencies experienced within New York and in North America. Baseline transmission reliability was also assessed by analyzing New York's exposure to potential risks of failure, including the past effects of extreme contingencies on international, national, and Statewide transmission systems, as well as the potential exposure of the New York system to those potential causes of failure in the future.

The third stage of the study assessed the effects that the nine specific industry trends could have on the future reliability of New York's electric system in both the near term and over the long term. Energy Law Section 6-108 required that reliability be assessed over the term of the planning period, which is defined under Energy Law Section 6-104 to be 20 years. A near-term period of five years was deemed within the horizon of utility and other company's current planning horizon for capital investment in generation and transmission facilities.

General Electric Study: The final report of General Electric's *New York State Electric System Reliability Study*, dated November 30, 2000, is available from NYSERDA on request.

OVERVIEW OF NEW YORK STATE ELECTRIC POWER SYSTEM

System Description

The electric power system in New York is a combination of power plants producing electricity (*i.e.*, generation), high-voltage power lines transporting bulk electricity around and through the State (*i.e.*, transmission system) and low-voltage lines delivering electric service to individual customers (*i.e.*, distribution systems). Before deregulation of the electric industry, generation, transmission and distribution were provided by a number of regulated monopolies, with mutually exclusive geographical service areas. These companies, commonly referred to as "vertically integrated utilities" were physically interconnected so that they could mutually support each other and provide a seamless Statewide system. In addition, New York's interconnected system is physically connected with neighboring systems so that electric power can be imported and exported across State lines as appropriate. The New York bulk transmission system was operated by the New York Power Pool which was a cooperative venture of the utilities, NYPA and LIPA.

Over the past three years, as part of the restructuring of the New York State electric system, utilities have sold most of their power plants and now purchase electricity through a competitive wholesale market operated by the New York Independent System Operator (NYISO).[3] NYISO functions in accordance with a series of agreements with New York electric system participants, including but not limited to power suppliers, transmission owners and the New York State Reliability Council (NYSRC).[4] These agreements were approved and continue to be overseen by the Federal Energy Regulatory Commission (FERC).

Generation. The NYISO reports there are currently more than 700 operational electric generating units in New York State representing approximately 34,400 Megawatts of summer capacity. In addition, certain municipal electric utilities and large corporations possess generation resources which further contribute to existing in-State electric generation resources. According to the NYISO's Transmission and Interconnection Study Queue (Updated: 10/04/2000), there are 59 generating projects seeking approval for interconnection with the State's transmission system which, if ultimately available would add another 23,700 megawatts

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[3]The NYISO is a not-for-profit organization formed in 1998 as part of the restructuring of New York State's electric power industry. Its mission is to ensure the reliable, safe and efficient operation of the State's major transmission system and to administer an open, competitive and nondiscriminatory wholesale market for electricity in New York State.

[4]The NYSRC is a not-for-profit entity, organized as a Delaware limited liability company, whose mission is to promote and preserve the reliability of electric service on the New York State Power System by developing, maintaining, and, from time-to-time, updating the Reliability Rules which shall be complied with by the NYISO and all entities engaging in electric transmission, ancillary services, energy and power transactions on the New York State Power System.

of electric generation capacity.   The last significant new generating facility was added to the system in 1994.[5]

The NYSRC has established an installed reserve margin requirement of 18% for the New York State electric system. The reserve margin is the amount of electric generating capacity that exceeds projected peak customer demand for electricity.   The reserve margin is a reliability standard that is designed to ensure that capacity to meet peak load will be present in the event of an unexpected higher demand and scheduled or unplanned generation outages.   During the early to mid-1990s, New York had a surplus of generation capacity in excess of required reserve margins. This surplus has eroded, however, as a result of increased demand spurred by economic growth and the lack of new generation additions.

The NYISO filed information on July 1, 2000 with the Energy Planning Board indicating that existing in-State capacity and known purchases from neighboring electric systems would provide sufficient capacity to meet the 18% reserve margin requirement through the end of this calendar year. However, current load growth projections exceed the high range estimate developed for the 1998 New York State Energy Plan. These estimates of projected peak electricity demand suggest that the State will be unable to meet the installed capacity reserve requirements as soon as the summer of 2001.

Additionally, two areas of the State are required to meet locational generating capacity requirements. The New York City area is required to obtain 80% of its peak demand from electricity generating facilities located within the City; and the entire Long Island area is required to obtain 93% of its peak demand from electricity generating facilities located on Long Island.

Transmission. The transmission system includes more than 10,700 miles of high voltage (generally in excess of 115,000 volts) lines of which about 600 miles are underground.

The New York power system consists of many diverse locations of load centers and electricity supply sources connected by transmission facilities. At times, customer demand, generation supply and transmission facilities interact to impede the free flow of power. This condition is frequently referred to as congestion and is a prominent feature of the New York power system. Historic records indicate that New York has congestion levels which divide the State into 11 transmission zones. The borderline between transmission zones is called an "interface" and is frequently defined by a set of transmission facilities that separate the two zones. Three critical interfaces are displayed in the following figure.

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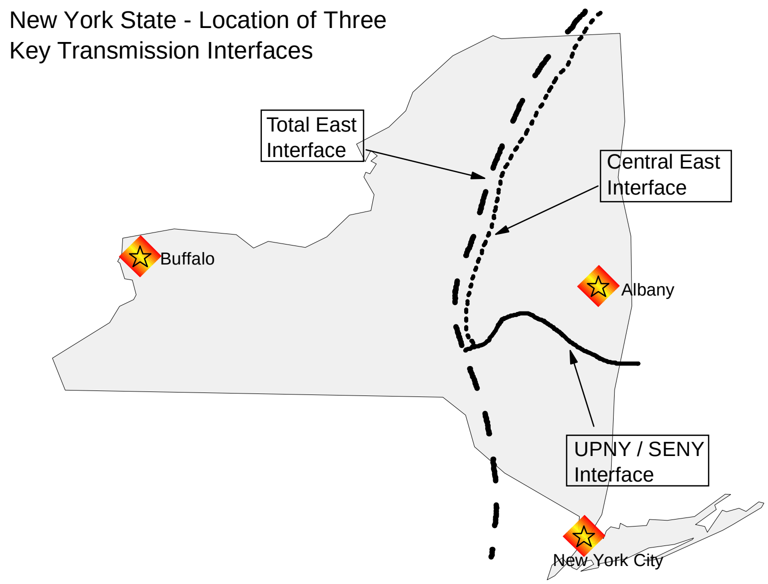
[5]Sithe Energy's 1000 megawatt Independence Station in Oswego came on line in November 1994.



The NYISO conducts transmission system operations in coordination with the eight transmission owners in New York State. The eight transmission owners include six investor-owned utilities and the State's two power authorities, which are not-for-profit, public-benefit corporations.

<u>**Investor-Owned Utilities**</u>

Central Hudson Gas & Electric Corporation
Consolidated Edison Company of New York, Inc.
New York State Electric & Gas Corporation
Niagara Mohawk Power Corporation
Orange and Rockland Utilities, Inc.
Rochester Gas and Electric Corporation

<u>**Power Authorities**</u>

Long Island Power Authority
New York Power Authority

The NYISO also performs studies in support of planning for the New York State transmission system, and to evaluate the impact of proposed interconnections of new generation, transmission and load facilities on the transmission system.

Distribution. New York State's investor-owned utilities continue to distribute electricity and are regulated by the New York State Public Service Commission. They are also responsible for operating and maintaining their respective electric service distribution systems. They respond to customers' requests for service and maintenance, and usually serve as the electric service billing agent. On Long Island, the Long Island Power Authority operates and maintains the electric distribution system.

Distribution systems are designed as either radial or network systems. Radial distribution systems consist of a number of primary circuits extending radially from a substation connected to the bulk power transmission system. Each circuit serves customers within a particular area and failure of a circuit would normally mean a loss of electric service to the customers on that circuit.

A network system is most frequently found in high-load-density metropolitan areas. The advantage of such a dense population of customers is that it affords the economical design and installation of redundant parallel lower voltage feeder cables, network transformers, and protective relays. If a primary circuit or a network transformer fails, protective devices will automatically operate to isolate the failed component. With multiple feeds on the network system, most customers would not be affected by such a failure.

The radial system is principally an overhead system and subject to interruptions caused by tree contact, accidents and lightning. Network systems are underground and are essentially unaffected by those causes of interruption, although they can be affected by construction activities.

By their nature, the network systems are more reliable than the radial system. In network systems, service interruptions generally occur only when there is a failure within the connection to the customer, or when the substation supplying the network suffers a complete collapse in its ability to serve the load. Otherwise, the network system possesses sufficient robustness in design to withstand most problems that would result in interruptions for radial distribution circuits.

<u>Defining Reliability</u>

The North American Electric Reliability Council (NERC) is an industry organization that provides voluntary reliability standards for bulk transmission systems across the nation.   NERC defines reliability as the degree to which the performance of the system results in electricity being delivered to customers within accepted standards and in the desired amount. Reliability may be measured by the frequency, duration and magnitude of adverse effects on the electric supply. NERC further defines reliability in terms of “adequacy”and “security”. Adequacy is defined as the ability of the bulk electric system to supply the aggregate electric demand and energy requirements of the consumer at all times, taking into account scheduled and unscheduled outages of system components. Security is defined as the ability of the bulk electric system to withstand sudden disturbances such as electric short circuits or unanticipated loss of system components.

For most consumers, reliability means the continuous supply of electricity (*i.e.,* the lights come on when the switch is flipped).   For other consumers, reliability also translates into the quality of the electric service. For example, correct and consistent voltage and consistent frequency of alternating current are important for certain industries, such as computer chip manufacturers among others.

Maintaining Reliability

NERC establishes overall reliability standards for transmission system design and operation, which are administered by 10 regional councils as shown below. NERC also works cooperatively with the Federal Energy Regulatory Commission (FERC) to collect operating data and monitor performance. New York is part of the Northeast Power Coordinating Council (NPCC) which is comprised of New York, New England States and the Provinces of Ontario, Quebec and the Maritimes.

NERC Regional Councils

NPCC is a voluntary, non-profit organization which was formed shortly after the 1965 Northeast blackout. Its purpose is to promote the reliability and efficiency of the interconnected power systems throughout the Northeast geographic area by establishing reliability criteria, coordinating system planning, design and operations, and assessing compliance with these criteria.

In addition to NERC and NPCC, the NYSRC also monitors reliability. NYSRC is a not-for-profit entity whose goal is to promote and preserve the reliability of electric service on New York's bulk power system. NYSRC's mission is achieved by: establishing and maintaining reliability rules for use by NYISO and all entities engaging in electric power transactions on the bulk power system; and, along with NPCC and NYISO, monitoring compliance with regional and State reliability rules.

New York's investor-owned electric distribution companies are regulated by the PSC. The PSC establishes specific performance, maintenance, and outage restoration objectives for individual regions within the service territories of the distribution companies and requires daily, monthly, and annual reporting of performance data. The PSC thus monitors reliability and can impose monetary penalties on utilities that fail to meet minimum performance criteria.

ASSESSING THE CURRENT RELIABILITY OF THE NEW YORK ELECTRIC POWER SYSTEM

The EPB, pursuant to Section 6-108 of the Energy Law, was directed to assess the current reliability of the electric power system, with specific focus on transmission and distribution systems within the State. The statute also required that the assessment should examine: (i) investment in infrastructure, including capital improvements, expansions, and maintenance; and (ii) workforce utilization. This "current" reliability assessment provides a baseline or reference point for evaluating how industry trends may affect the future reliability of the New York State electric system.

The current reliability of the distribution system was assessed using PSC customer interruption data, including system average interruption frequency indices and customer average interruption duration indices, among other factors.

The current transmission system reliability was assessed by reviewing historical data, such as previous transmission system stress and the duration of such stress on major State transmission facilities and major transmission emergencies experienced within New York and in North America. Baseline transmission reliability was also assessed by analyzing New York's exposure to potential risks of failure. This included evaluating consequences of extreme contingencies (*i.e.*, events beyond the system design criteria) and New York State's potential exposure to major failures (*i.e.*, probability of occurrence and consequences of potential major disturbances on the New York State transmission system).

Utility and transmission facility owner financial data filed with PSC and FERC was evaluated for insights into investment and capital expenditure trends. In addition, several utilities provided workforce data and information on existing and emerging workforce use practices. This data was assessed for possible implications on system reliability.

The following three sections summarize the results of this assessment.

Assessing the Current Reliability of the New York Transmission System

New York's transmission system is part of an interconnected grid built and operated with intended redundancy to tolerate a reasonable level of disturbance without loss of customer service. Interruption of customer service due to transmission failure is uncommon. However, when the transmission system fails, the effect can be widespread.

The rules for the design and operation of the New York State transmission system include reliability criteria from NERC and NPCC as well as special rules and procedures unique to the State's transmission system. Customized New York State rules are devised and maintained by the NYSRC and are strictly followed by the NYISO and transmission owners.

The centerpiece of transmission system reliability for *both* design and operation is the N-1 criterion. This criterion specifies that a system consisting of N critical components must operate reliably following the loss of any one critical component. The N-1 criterion serves as a design specification for the construction of and additions to the transmission system. The design provides that the system be able to suffer the loss of the most critical transmission component and operate normally.[6] The N-1 criterion is also observed in the operation of the transmission system and accounts for the major reason why certain critical interfaces are operated below their absolute maximum loading levels so that the system will survive events that meet the N-1 objective.[7]

Different methods of assessing transmission system reliability in New York show consistently that New York's transmission system is highly reliable and that this high reliability is improving and there is a low risk of major failure. Specific indicators of this trend include:

- Over the past six years, New York experienced an average of seven hours per year in the Major Emergency State.[8] Further, only slightly more than three of those hours were due to transmission causes.

- The amount of time that the New York transmission system spent in reported emergency states annually has declined compared to the rest of North America. Furthermore, the

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[6] After the loss of a critical element, the system must maintain normal frequency, voltages must be within specified bounds, and power flows must be within established limits. The design must allow for rapid restoration of normal conditions to the power system.

[7] Power system disturbances are felt within a few seconds and leave little time for system operators to respond with corrective actions to maintain system stability. Reserve interface capability provides resources to survive system upset events.

[8] The term "Major Emergency State" refers to a declared condition of the New York power system made by the NYISO when conditions exist that require immediate corrective action in order to prevent damage to the power system and/or avoid the loss of firm customer load.

number of reported transmission-related events has remained relatively constant over the past 16 years, averaging 1.7 events per year.

- The power flows on major upstate transmission interfaces,[9] including Central East, trended downward between 1995 and 1998.

- Power flows into New York City on one major interface, UPNY/SENY, increased in 1998, but remained within operating limits about 98% of the time.

- Comparison of Extreme Contingency Analysis (ECA)[10] assessments conducted in 1994 and 2000 indicate that situations that can result in loss of service to customers have decreased. The trend is toward a more robust transmission system.

The transmission assessment found that, unlike local distribution systems, the bulk power transmission system does not have standard reliability measurement indices. The assessment, therefore, relied on a combination of historical records and risk exposure studies. The historical records included the number, duration and causes of high system loadings, and failures and disturbances in the New York State transmission system. More specifically, this research effort was directed at:

- Examining loading levels on major New York State transmission facilities over the 1995 to 1998 period based on reports by the former NYPP;[11]

- Reviewing major emergencies in New York as documented by the NYISO and the NYPP over the 1994 through early 2000 period;

- Reviewing major disturbances as recorded by the Disturbance Analysis Working Group (DAWG) of NERC to compare the New York system to other electric power systems throughout North America.

- Reviewing ECA assessments conducted by the NYISO and other control area operators to obtain an indication of system strength for extreme events beyond design and operation criteria. ECA is intended to show conditions under which power systems fail, with the

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[9] An interface is a defined set of transmission facilities that separate electricity load zones in New York State. There are currently 11 load zones within New York State. Interfaces also define the boundaries with neighboring electricity systems.

[10] ECA is an analysis of potential system disturbances or events that are more severe than the transmission system design criteria. As specified by the NYSRC, ECA is intended "... to obtain an indication of system strength, or to determine the extent of a widespread system disturbance, even though extreme contingencies do have low probabilities of occurrence."

[11] *New York Power Pool 1998 Transmission Performance Report*, prepared by Operations Engineering of the NYPP, (March 1999).

most serious potential result being widespread cascading failure of the transmission system (*e.g.,* blackout); and

- Examining major failures in other domestic and foreign electric power systems to evaluate the potential for such events to occur in New York.

In addition to the findings noted above, the assessment led to the following observations:

- The number of times the transmission system exceeded operational limits and initiated Major Emergency States peaked in 1996 at 22, but has declined sharply since (10 in 1997, 3 in 1998, and 6 in 1999);

- Transient stability limit violations (*i.e.,* the inability within a prescribed period of time to reach a state of equilibrium following a large disturbance) on the Central East and Total East transmission interfaces account for almost one-half of the total transmission violations. Voltage stability violations on the Central East Interface are a recurring problem. In some cases, the violations are results of disturbances or events in neighboring electric systems beyond the control of the NYISO;

- A review of the DAWG database of reportable disturbances for bulk transmission systems indicates an increase in events for NPCC and North America in the late 1980's and early 1990's. However, this trend reversed during the middle and late 1990's. New York State had a consistently low rate of transmission disturbances throughout the reporting period. The annual cumulative duration of reported disturbances in New York State increased during the late 1980's and early 1990's and was driven by two exceptional events: a substation fire in New York City in 1990 and a severe ice storm in Western New York in 1991. However, even with these events included, the overall trend for New York State transmission system performance is improving relative to NPCC and North America;

- The evaluation of historical records for loading levels on New York State transmission facilities, reflecting data available through the close of calender year 1998, showed an increasing transfer margin (*i.e.,* the cushion between actual loads and load limits increased). Data now available for 1999[12] indicate, on an annual average basis, a similar result. However, over the last six months of 1999, transmission system use has been increasing while transfer margins have been decreasing. This could be an early indicator of a possible reversal in the observed trend and should continue to be monitored closely;

- On a national level, the DAWG data indicates that human error, as a cause for transmission system disturbances, has increased over the 16-year reporting period.

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[12] "New York Independent System Operator 1999 Transmission Performance Report," prepared by NYISO Operations Engineering, July 2000.

However, in New York State, there was only one report of human error causing a major disturbance during this period; and

- The ECA study results suggest that the most severe vulnerabilities are for substation and generating station outages, and that loss of right-of-way and circuit breaker failures are not as severe. The geographical distribution of the worst cases from the ECA testing does not reveal any regional trends within New York State.

All the analyses performed lead to the conclusion that New York State's transmission system has operated in a highly reliable manner. Further, New York's bulk transmission system is improving in its ability to withstand severe disturbances.

Assessing the Current Reliability of New York State's Distribution Systems

New York State is served by two general types of distribution systems—radial and network systems (see "Overview of the New York State Electric Power System - System Description" for a description). For the most part, network systems are located underground and are confined to the New York City Metropolitan area and in sections of the larger upstate cities. Radial systems serve the remainder of the State and are comprised of both overhead and underground facilities. The entirely underground network systems are, by design, redundant in nature and, therefore, highly reliable. However, network systems tend to be practical only in densely populated urban areas because of the high cost to build and maintain them.

The reliability of New York's distribution systems is measured by sustained interruptions (longer than 5 minutes) as defined by the following indices:

- **SAIFI –** System Average Interruption Frequency Index. SAIFI provides information about the frequency of interruptions per customer and is represented by the following ratio:

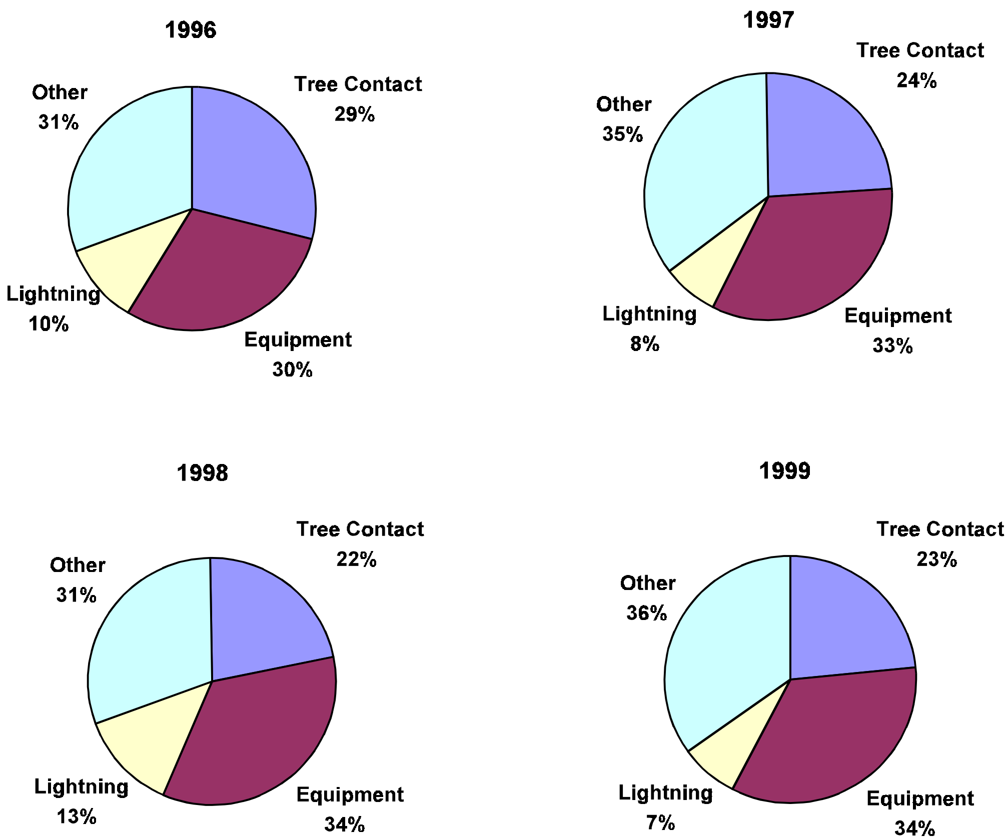
$$\frac{\textbf{Total Number of Customer Interruptions}}{\textbf{Total Number of Customers Served}}$$

- **CAIDI –** Customer Average Interruption Duration Index. CAIDI represents the average time required to restore service to the average customer per interruption, and is represented by the following ratio:

$$\frac{\textbf{Total Customer Interruption Durations}}{\textbf{Total Number of Customer Interruptions}}$$

For both SAIFI and CAIDI, a lower number indicates better performance. The PSC manages reliability by assigning "minimum" and "objective" SAIFI and CAIDI targets for each operating region in the State under its jurisdiction. The data finds that the performance of the vast majority of distribution circuits exceed minimum and objective SAIFI targets, indicating that the distribution system is extremely reliable with few interruptions. A smaller majority also meet minimum and objective CAIDI targets, also indicating that the system is very reliable. This reliability evaluation was based primarily on the reports provided by each utility for the years 1996 through 1999, although additional data were included in some reports that extended back to 1992. The reliability reports of each utility include individual circuit reliability data for each operating region or district. The circuit data include the number of customers, customer interruptions, as well as the total time duration of the customer interruptions.

Overall, the dominant causes of distribution failure in New York are tree contacts, lightning, and equipment failures. Together, these factors account for 85% of distribution system interruptions. Equipment failure, related to both aging and utilization at maximum rated capacity, increased slightly over the four-year period observed. Tree contact has shown a slight decline, and lightning-caused interruptions have been essentially constant over the measurement period. The Statewide contributors to CAIDI over the four years are shown in the following figures. For example, in 1999, considering all interruptions of five minutes in duration or longer, equipment failure accounted for 34% of the total time that distribution systems were interrupted.



Causes of Distribution System Interruptions in New York State in terms of Duration of Interruption

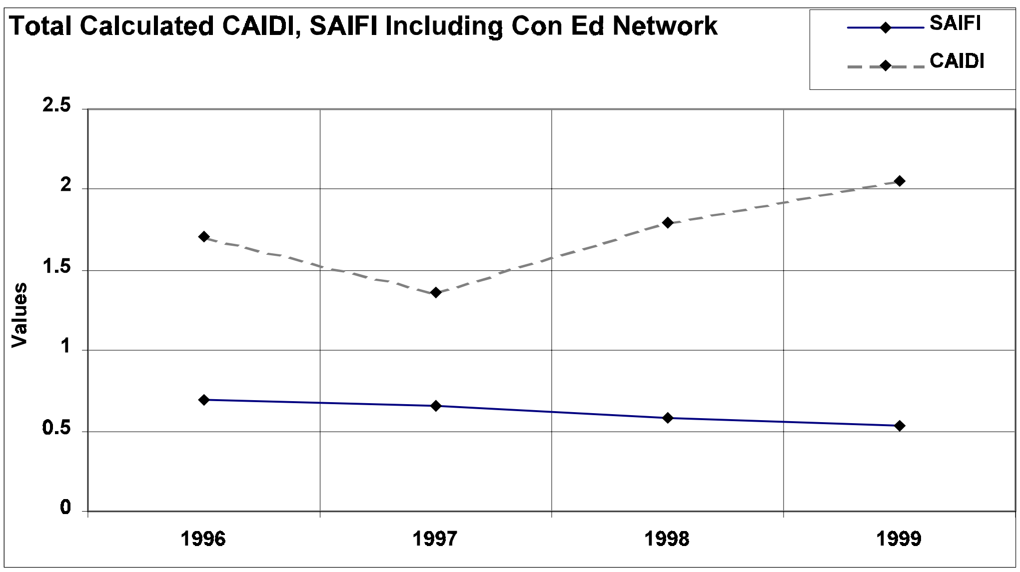
Regional Considerations

This reliability evaluation also examined and compared regional groupings of SAIFI and CAIDI data, including New York's upstate utilities for the years 1992-1999, the downstate utilities for the years 1996-1999, and the entire State for the years 1996-1999. The evaluation considered circuit and region performance data contained in the annual reports each utility provides to the PSC.

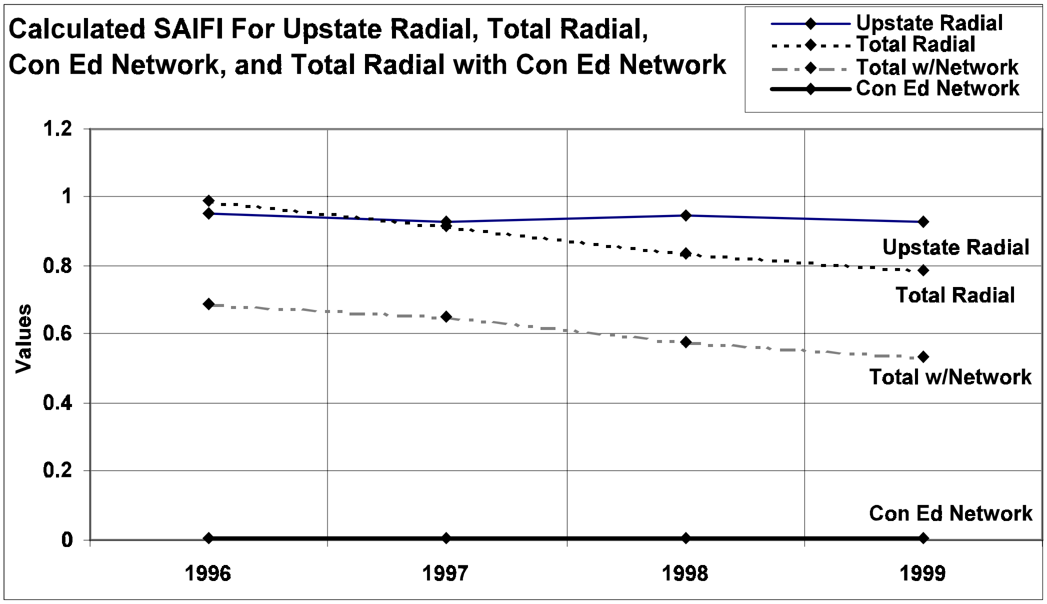
The Statewide number of customer interruptions is trending downward and indicates that the overall reliability of New York's distribution systems is improving. Utility emphasis on distribution line maintenance activities, such as tree trimming, will control tree contacts as a cause of interruption and will help manage the number of customer interruptions and hours of interruption. Also, continuous utility attention to regional circuits that perform below minimum SAIFI and CAIDI levels helps to maintain the overall system reliability.

The primary benchmarks used in the overall reliability assessment were the minimum and objective SAIFI and CAIDI indices that establish the performance of each circuit in a region, and, collectively, the individual region's performance. The New York data for the period examined indicate that the SAIFI index is declining (improving) but the CAIDI index has experienced an upward trend. This is depicted in the graph below.

In general, a system with a decreasing SAIFI may very easily result in increasing CAIDI. For example, as the frequency of interruptions declines, the average duration, which is calculated by dividing the resulting smaller number of interruptions into the total duration, could increase. The increasing CAIDI, especially when accompanied by a decreasing SAIFI, does not necessarily indicate decreased reliability; rather it may indicate that utilities have made more progress in eliminating the short duration interruptions.



It is also instructive to examine and compare the SAIFI performance of the State's radial and network systems over the four-year period, as shown in the next figure.



The downward trend in the number of customer interruptions indicates that the reliability of the distribution systems is improving. This improvement in reliability can be attributed to any number of corrective and application considerations, such as strategically locating sectionalizing and switching devices throughout the distribution system. As more automated capability is added to the system, SAIFI should continue to decrease. As shown at the bottom of the chart, Con Ed's network SAIFI performance curve is flat and significantly lower compared to the rest of the State. The high level of reliability of the network system in New York City is very apparent from its SAIFI data, and especially when its SAIFI data are aggregated with data for the entire State (the "Total w/Network" line).

The SAIFI and CAIDI performance indices, as reported by utilities and monitored by the PSC, are extremely valuable tools. The data suggest that the utilities have been responsive to this PSC oversight and have developed a record of reliable service.

Capital Investment, O&M Expenditure, and Workforce Utilization

Energy Law Section 6-108 directed the EPB, in performing the Reliability Study, to examine investment in infrastructure, including capital improvements, expansions, and maintenance, and workforce utilization.

Financial data for New York State transmission system owners filed with FERC and PSC were reviewed. The data included both capital and operating expenditures for the transmission system from 1988 to 1998. These expenditures were adjusted for inflation, converting all amounts to equivalent 1998 dollars. The data were then analyzed to look for indications of trends.

Annual financial data filed by the State's utilities, with FERC and PSC, regarding distribution system capital investments and operation and maintenance (O&M) expenditures for the years 1988-1998 were also reviewed.

As shown in the table below, transmission-related operating and maintenance expenditures have remained relatively constant over the past 10 years. Although capital investment in transmission infrastructure has declined, transmission system reliability has improved. This suggests that transmission system expenditures are being used more effectively, or that these factors have less of an impact on actual reliability than other factors.

New York Transmission System
(in millions of constant 1998 dollars)

Year	Capital Investment	O&M Expenditures
1988	$304.4	$307.7
1989	$180.8	$344.6
1990	$316.6	$326.2
1991	$307.6	$350.6
1992	$167.5	$378.0
1993	$164.1	$368.2
1994	$116.3	$349.1
1995	$131.4	$339.9
1996	$104.6	$329.9
1997	$97.2	$336.1
1998	$90.0	$298.3

As shown in the following table, capital investments in New York's distribution systems were relatively constant from 1988 to 1993, but declined from 1994 to 1998. However, because such investments tend to be associated more with new construction, this trend likely reflects a decline in housing starts.[13] O&M expenditures on distribution systems have been relatively constant from 1994 to 1998.

New York Distribution Systems
(in millions of constant 1998 dollars)

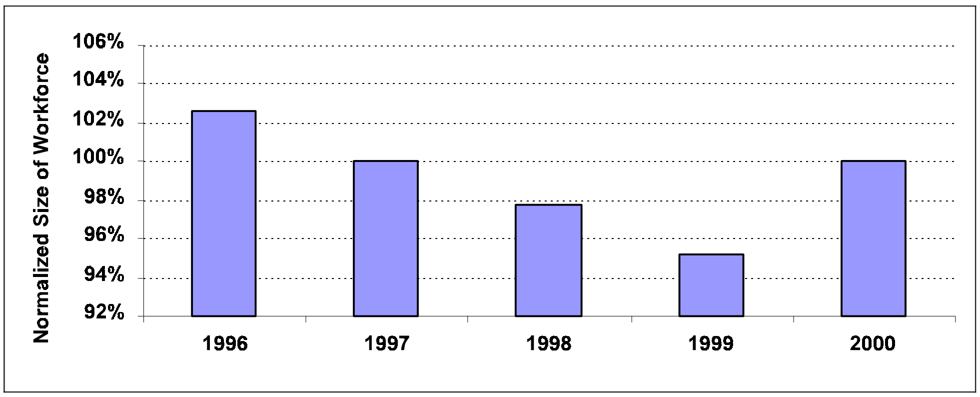
Year	Capital Investment	O&M Expenditures
1988	$772.8	$713.1
1989	$874.2	$713.3
1990	$838.0	$724.8
1991	$780.8	$720.6
1992	$807.1	$717.2
1993	$795.6	$704.7
1994	$742.6	$666.2
1995	$747.7	$672.3
1996	$706.8	$645.7
1997	$627.7	$624.0
1998	$537.2	$658.3

One of the organizations that participated in the Reliability Study Advisory Group, the Energy Association of New York State, in a letter to the Chairman of the Energy Planning Board, stated that, in a competitive environment, New York's utilities will not be reimbursed fully for relocating distribution facilities as a result of public projects, most notably highway or street improvement projects. State Highway Law restricts the ability of the New York State Department of Transportation to reimburse the utilities for the expense of moving and/or supporting these facilities. These relocation projects affect utility budgets for transmission and distribution system maintenance and improvement projects. Consequently, there is a need to analyze how facilities relocation and protection costs are reimbursed in the future.

[13] Information published by Data Resource Inc. indicates that housing starts in NY State peaked at 42,000 in 1987, and then steadily declined to 19,500 in 1997. Housing starts have gradually increased since then, reaching 24,800 in 1999.

Workforce issues related to staffing levels, training, and measures intended to enhance the utilization or productivity of the workforce were also analyzed. More than half of the New York State utilities, as well as the International Brotherhood of Electrical Workers, provided information and data to support this analysis.

While overall employment in the transmission and distribution segment of the industry declined in New York over the past decade, the size of the workforce has been relatively stable from 1996 to 1999. At the same time, significant improvements have been reported in utilization of the workforce to achieve higher levels of productivity through cross training, automation and enhanced communications. More recent data indicate a slight increase in employment during 2000.



Normalized Transmission and Distribution Staffing Trends (1997 base year)

Utilities have reported that increases in workforce productivity have enabled them to serve increased load levels with the same level of reliability and staffing. In additional to cross-training and outsourcing (*i.e.*, use of contractor services), the utilities attribute increases in productivity to new system equipment, tools, and work procedures. Some specific examples include:

- Improved communication techniques provide information to the operators on loading and status of facilities that formerly had to be developed manually, reducing time spent gathering data.

- Improved monitoring allows prediction of loading and possible contingencies that identify pressing needs and enable efficient deployment of workforce to meet the needs.

- Newer transmission and distribution equipment has frequently proved to be more reliable than earlier designs, reducing maintenance requirements. Design revisions by manufacturers have resulted in more efficient operation and maintenance. Maintenance driven by diagnostic analyses rather than by time interval reduces the total applied time spent on maintenance.

- New types of line materials are easier and quicker to install than those formerly used. Improved tools and work practices have reduced the time required for certain procedures.

- Crew utilization has been improved by improved job site reporting and by anticipating needs based on weather forecasts.

<u>Recommendation</u>

- Examine utility reimbursement and other facility relocation issues as part of the next update of the State Energy Plan.

Power Quality

The reliability of the transmission and distribution systems in New York State is already among the highest in the world. Nevertheless, current trends and existing conditions bring power quality concerns to the forefront. The New York City metropolitan area is particularly dependent on and aware of power quality due to the impact of momentary disruptions and voltage reductions on electric motors used in transportation (by rail transit and elevators), and the dependency of financial markets on electronic communication. Residential and commercial customers throughout the State are increasingly aware of momentary disruptions because of their effect on the displays of electronic clocks, VCRS, and other devices, as well as their effect on computers. High-tech manufacturing customers demanding higher power quality currently pay for their own quality-enhancing facilities in combination with distribution company service.

Electric distribution reliability indices and standards are designed to reflect the needs of most, but not all, utility customers. Outages of less than five minutes duration, for example, are not reflected in these indices. Likewise, PSC-established voltage tolerance standards may not meet the needs of those customers with highly sensitive machinery and equipment.

The benefits of more stringent power tolerance standards (*e.g.*, voltage, frequency) to suit each and every customer may not warrant the anticipated higher costs to comply. Nevertheless, it is noteworthy that the increasing use of electronic control devices, robotics, adjustable-speed drives, data processing equipment, electronic telecommunications, and other such electrically-sensitive equipment has made “power quality” an important issue to a greater number of industrial and commercial customers, and to New York’s economy in general.

Momentary outages, voltage sags and swells, as well as such electric power phenomena as transients, “noise,” and harmonic distortion are all part of “power quality,” defined by IEEE as “the powering and grounding of sensitive electronic equipment in a manner that is suitable to the operation of that equipment.”[14] Power quality, in other words, is the measure of how usable electrical energy is when it reaches an application.

Power quality is frequently affected by how the electricity is used. Equipment such as variable frequency drives, switch mode power supplies, battery chargers, large motors during startup, light dimmers, electronic (or other) lighting ballasts, computers, arc devices, and certain medical equipment can cause and are susceptible to power quality problems. Rapid load reductions, overloaded circuits, and poor grounding can also degrade power quality.

Whether a power quality problem is caused by a customer’s load, or by utility equipment operating within regulated tolerance standards, rectifying the problem is generally the customer’s responsibility. A large variety of power quality monitoring and correcting equipment can be purchased or leased, and engineering consultants can help diagnose problems and recommend the

[14]IEEE is the Institute of Electrical and Electronics Engineers, Inc.

simplest and most economic solutions. It is anticipated that load serving entities will be providing power quality monitoring and enhancement as a value added service in the future.

ASSESSING THE FUTURE RELIABILITY OF THE NEW YORK ELECTRIC POWER SYSTEM

The Reliability Study statute (Section 6-108 of the Energy Law) directed the EPB to perform an assessment of the projected reliability of the State's electric power system over the term of the planning period (*i.e.,* 20 years), with specific focus on New York's transmission and distribution systems. In addition, the statute directed the EPB to assess the potential impact of the following nine factors on distribution and transmission system reliability:

- Distributed electric generation, especially generation using renewable or innovative energy resources;
- Energy conservation and efficiency;
- Load control and peak shaving measures;
- Corporate reorganization of electric utilities;
- Performance ratemaking, multi-year rate agreements, and other departures from traditional regulatory mechanisms;
- Large scale industrial development;
- Changes in protocols for electricity dispatched through the New York Power Pool or its successor or successors (transmission system only);
- Accommodation of proposed new electric generation facilities or repowering or life extension of existing facilities (transmission system only); and
- The market-driven nature of decisions to build, size, and locate electric generation facilities (transmission system only).

The assessment of the future reliability of New York's electricity transmission and distribution systems is, in most instances, qualitative. The factors identified by the legislation represent trends that will influence the electric power industry into the future. Each factor was considered in terms of its likely evolution and such evolution was evaluated in terms of the potential impact on the reliability of the State's electricity system. The results of this assessment are summarized in the sections that follow.

Historically, the primary causes of electric service interruptions have been tree contact, weather (storms, lightning, wind, ice), and equipment failure. This assessment of future reliability leads to the conclusion that these same factors will continue to be the dominant causes of system interruptions into the future.

In evaluating the future reliability of New York's electric system, the following important themes emerged:

- the need for new electricity generation resources and implementation of load reduction measures;
- the potential role of price sensitive load;
- the need for effective mechanisms for transmission system monitoring, planning and enhancements; and
- the importance of adherence to reliability standards.

The importance of each of these major issues is reviewed in the following sections.

MAJOR ISSUES

Need for New Generation and Load Reduction

The Need for New Electricity Resources and Demand Responses

New York's strong economic growth, especially in the greater New York City metropolitan area, has resulted in unexpectedly high growth in electricity demand. Current load growth projections exceed the high range estimate developed for the 1998 New York State Energy Plan. The State Energy Plan high-demand growth scenario projected an average annual peak demand growth rate of 1.7% over the 1996-2016 planning period. However, spurred by steady economic growth, peak electric demand is now projected to rise more than 2% annually over the next several years. Such estimates suggest that in-State electricity generation resources will be unable to meet the 18% installed capacity reserve requirements[15] as soon as next year. Recently, the PSC has advised that, in order to have a sufficient supply of electricity, at a minimum, a combined 750 megawatts of increased generation or reduced load will be needed for the summer of 2001, and an additional 600 megawatts will be needed for the summer of 2002. New electric generating facilities in the New York City metropolitan area, coupled with increased efforts to manage demand, are needed to ensure reliable electric service into the future.

Delays in adding new electric generation will put additional stress on the capability of the State's transmission system to meet the anticipated increased demand for electricity. In the short term, there may be surplus electricity in neighboring electricity systems which could be imported to meet New York's electricity needs. However, as electricity demand grows in those neighboring electricity systems, it is possible that this surplus power will eventually be required to meet host system demand as load growth continues in the region.

While most of the attention is on encouraging new capacity, it is important that existing capacity remain in service until replaced by new capacity. Capacity reserves can be critical during peak loads and times of high outage.

Addressing New York's Need for New Electricity Supplies

Market participants, such as generators, ESCOs, and utilities, are seeking to meet the increasing load in New York through new supply and demand options. In addition, the State, through its agencies and authorities, has taken a number of steps to meet increasing electricity consumption.

To assist in addressing the near term need for new electric generating facilities, NYPA has purchased eleven 47-megawatt gas turbines totaling more than 500 megawatts of new generating

[15] The New York State Reliability Council recently reduced New York's installed capacity reserve margin from 22% to 18%. The NYSRC's technical investigations found that power system conditions have materially changed since the last reserve margin analysis was conducted by the former NYPP, warranting a revision of the margin.

capacity. NYPA plans to have these facilities in service and operating by the Summer of 2001. Significant public sector efforts are also under way to reduce electricity demand through load management and energy conservation and efficiency programs (*e.g.*, NYSERDA's SBC-funded, and NYPA and LIPA energy conservation programs). The NYISO also initiated an effort to implement price-responsive load mechanisms in the New York market in time to assist with next summer's anticipated peak demand. The PSC staff, in its recent recommendation for renewal of the State's SBC program, calls on NYSERDA to place even greater emphasis on reducing peak demand in the transmission-constrained downstate area.

<u>Status of New Generation - Article X of the Public Service Law</u>

The increased rate in the growth of demand for electricity, driven by strong economic growth, together with deregulation and the resulting market-driven nature of decisions to build new plants, are spurring the development of new electric generating facilities in New York. There are currently 59 applications before the NYISO for new power plant interconnections. Many of these proposed facilities would be sited in the metropolitan New York City region where market prices have signaled the need to build new generating facilities to meet increased demand for electricity.

Any proposed new power plant with a capacity of 80 megawatts or greater is subject to the State's Article X electric generation siting process which was designed to consolidate the process and shorten the time required to obtain regulatory and environmental permits to build and operate new electric generating facilities. There are currently 19 projects, representing more than 12,000 megawatts of new generating capacity, seeking Article X approval. The first project to be approved under Article X was the 1080 megawatt Athens generating plant. The application for this plant was formally approved on June 13, 2000, 20 months after its acceptance for Article X review in October 1998. Construction of the plant has not yet begun because a required federal approval has not been obtained. Article X is an applicant-driven process, and does not lend itself readily to a relative consideration of plants and sites. Applications are addressed as they are received but proceed through the process independently.

The PSC recently established a specialized staff team to evaluate opportunities to improve the Article X process. The objective is to ensure that Article X applications are reviewed expeditiously, but thoroughly, leading to the timely siting of clean, efficient, environmentally sound electricity generating facilities. Specific team tasks include:

- Enhancing coordination and review with DEC and other State agencies;
- Streamlining the preliminary scoping statement process;
- Streamlining the review of Article X applications;
- Enhancing public outreach efforts; and
- Developing legislative proposals for consideration before Article X legislatively sunsets.

Recommendations

- Support initiatives to improve the efficiency of the Article X siting process.

- Provide interim solutions to meet the need for increased generation by the Summer of 2001, including supporting NYPA's efforts to place 11 new gas turbines in the New York City and Long Island area.

- Continue and enhance efforts to reduce demand (*e.g.*, present and future SBC-funded programs, and NYPA and LIPA initiatives), especially during peak periods of electricity use.

Role of Price-Responsive Load

With higher loads projected in the near term, there is a need to bring on new generation and/or transmission system improvements to meet this demand for electricity. An additional and complementary strategy to capacity additions is price-responsive load programs which allow consumers to control their demand for electricity in response to higher electricity prices.

Some programs used in neighboring electric systems during the Summer of 2000 were designed to reduce electricity demand by providing compensation for voluntary load shedding when the system approaches supply or reliability limits. A key characteristic of this type of program is that they are activated by the control area operator in response to emergency conditions as opposed to business conditions. These programs reduce reliance on emergency measures, such as voltage reductions, to meet electricity requirements.

Another form of price sensitive load programs would offer monetary rewards to participants who voluntarily reduce electricity usage in response to monetary incentives beyond the savings the consumer would realize by lowering electricity use. This program is activated by business conditions and is not dependent on operator intervention. Advocates for such an approach argue these demand-reduction programs have value in terms of displacing generation that would have been purchased absent such a price-responsive load program. NYPA's Peak Load Management Initiative offered its New York City customers $40 per kilowatt for electricity saved when called upon due to hot weather and high demand for power in the Summer of 2000.

Allowing price-responsive load to compete in the wholesale electricity markets also provides benefits beyond reliability, by making electricity markets more competitive. Creating a more elastic demand response to the price of electricity will provide benefits to all consumers. New York market participants, NYSERDA, the Public Service Commission and the NYISO are working cooperatively to establish price-responsive load programs in New York by the Summer of 2001.

Some members of the Reliability Study Advisory Group have stated that higher loads do not necessarily represent a significant threat to reliability and should not be a primary concern of the study. However, NERC's DAWG database reveals that violation of transmission system capability limits (thermal or voltage) is the dominant cause (41%) of reliability challenges to the New York transmission system. In about 75% of these events, the cause of the disruption is traced to high system demand due to unseasonable weather.

<u>Recommendations:</u>

- Develop NYISO protocols that allow for price-responsive load to be bid in both the day-ahead and real time electricity markets. Such measures will reduce stress on the bulk transmission and distribution systems and will provide a more competitive electric market.

- Develop technologies and approaches (*e.g.,* remote load control of residential appliances, innovative real time pricing programs, time of use metering, and load aggregation) that support current and evolving NYISO dispatch programs. Load aggregation allows small consumers to play a larger role in price-responsive load programs, enhancing competition in the marketplace.

- Pursue public education efforts to help inform consumers of the benefits to participating in price-responsive load programs.

Transmission Monitoring, Planning and Enhancements

The State's interconnected transmission system is highly reliable. Further, the reliability has been improving over the past several years due in great part to strict adherence to design and operational reliability standards, particularly the "N-1" criteria.

As discussed previously, this assessment is based on a review of several historical data sets[16] which requires that reliability measurements be inferred from the underlying data. For example, significant disturbances and unusual events on the national bulk electric system are reported to the "DAWG" system which is maintained by DOE and NERC. The DAWG reports are incident based and anecdotal in nature.[17] However, there are currently no generally accepted standards for monitoring and measuring the reliability of transmission systems. Furthermore, there are no State or federal requirements to report transmission system reliability on a periodic basis. Tracking transmission system reliability in a timely manner would provide a valuable tool for identifying trends in system performance and the need and focus for more in-depth assessment of system requirements.

Integrated generation and transmission planning has largely been eliminated as a corporate function as vertically-integrated utilities' transmission and distribution assets have been divested from utility-owned generation assets. In the future, new electricity generation will be proposed for locations driven by market decisions.

In assessing the future reliability of the New York transmission system, a computer-based operational simulation was performed to examine the loading levels on the transmission lines under various generation expansion and load growth scenarios. The primary indicators examined were the amount of time that key interfaces were loaded at or near their operating limits. The various scenarios examined showed that additional electricity generation and/or load reduction can have a significant impact on the loading of the system. Further, the "location" of new generation was shown to be a particularly significant factor. In general, the addition of more, low cost generation in the transmission-constrained downstate areas was shown to significantly reduce the loading on some of the key transmission interfaces. Adding new electricity generating plants only in upstate regions could actually increase congestion and loading on the transmission system more than not adding any new generating facilities.

Presently, there is no entity in New York State that is charged with preparing a comprehensive Statewide transmission plan. The NYISO is authorized to prepare a compilation of proposed projects by transmission owner and other market participants. However, the NYISO is not able to order a transmission owner to construct or modify existing transmission facilities. Currently,

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[16] The historical information reviewed generally covered times period where the electricity systems were still operated under significant regulatory control. Full utility deregulation and enhanced competition effects are not completely captured in the data sources at this time.

[17] At the time of this report, the DAWG data set extended through June, 1999.

there is an apparent gap in comprehensive transmission and generation planning that has not been filled by the NYISO or any of the individual market participants. To address this need, the NYISO has proposed to establish a process in the future that brings market participants, State agencies and other interested parties together to construct a comprehensive plan.

Full conformance with FERC Order 2000[18] may require the NYISO, or some alternative multi-state regional organization, to conduct transmission planning and provide a mechanism to implement needed transmission expansion or enhancements. Such efforts would need to include transmission upgrades required for reliability purposes as well as upgrades which might relieve economic congestion within the transmission system. The PSC has the authority to order transmission owners under its jurisdiction to build new transmission facilities. Both LIPA and NYPA have the ability to plan for and construct transmission facilities.

Capital investments in New York's transmission infrastructure have been declining. Such decline will likely continue unless developers and investors believe a dependable framework is established to recover and profit on their investment.

Presently, Transmission Congestion Contracts (TCCs)[19] are viewed as the means for encouraging increases in transmission capability. However, in the extreme, new transmission additions which relieve congestion could have the effect of de-valuing TCCs. Therefore, current holders of TCCs could oppose transmission improvements because such improvements could diminish the value of their assets.

The potential for merchant transmission projects in New York is beginning to be realized, but in a limited case with special circumstances. LIPA is supporting the first merchant transmission project to serve the New York system. TransEnergie U.S. Ltd., a division of Hydro Quebec, has been selected by LIPA to build, own and operate a $120 million, high-voltage direct current Cross-Sound Cable. The new 26-mile cable will run under Long Island Sound from New Haven, Connecticut to Shoreham, New York, providing access to New England's expanding power supply market. The project is intended to bring 300 megawatts of electricity to Long Island by May 2002. LIPA was the successful respondent to the "open season" conducted by TransEnergie U.S. for capacity on the cable and has negotiated an agreement with TransEnergie to purchase all

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[18] FERC issued its Order 2000 on December 20, 1999. The final rule requires all public utilities and existing ISOs that own, operate or control interstate electric transmission to file a proposal for a Regional Transmission Organization (RTO), or alternatively; a description of any efforts made by the utility to participate in an RTO, the reasons for not participating and any obstacles to participation, and any plans for further work toward participation. RTOs are asked to fulfill the minimum characteristics of Independence, Scope and Regional Configuration, Operational Authority, and Short-term Reliability. In addition, minimum functions that each RTO should be able to carry out are Tariff Administration and Design, Congestion Management, Parallel Path Flow, Ancillary Services, Transmission Capability Reporting, Market Monitoring, Transmission Planning and Expansion, and Interregional Coordination. The RTOs should be operational by December 15, 2001.

[19] A Transmission Congestion Contract (TCC) is a financial instrument that provides the holder with the right to collect or obligation to pay congestion rents associated with a single megawatt of transmission between a specified point-of-injection and point-of-withdrawal. TCCs enable the buyer and seller to hedge fluctuations in the price of transmission. TCCs do not provide the physical rights to transmit power between injection and withdrawal points.

of the transmission capacity. More recently, LIPA has announced that it is seeking additional proposals from entities who would construct, own, and operate one or more additional off-island cables in the 200 to 600 megawatt range. The stated purpose of the additional cables is to increase energy imports from New England, Upstate New York, and other parts of the country by the year 2003.

LIPA’s efforts underscore the emerging role of merchant transmission, but are aided by some unique characteristics. Long Island is an isolated load pocket where the need for new generation and/or transmission facilities provides very strong locational price signals. The siting, land acquisition, and environmental mitigation challenges which exist for most overland transmission projects are lessened in this case because it involves the laying of underwater cable across Long Island Sound.

NYPA has been the major provider of transmission system expansion since the mid-1980's with the construction of Marcy-South and the existing Long Island Sound cable crossing. In addition, NYPA is investing in new technologies to enhance the reliability of New York’s transmission system. NYPA is installing a convertible static compensator (CSC), an advanced transmission-control device, at the Marcy Substation located at NYPA’s Clark Energy Center in Oneida County. It is expected to increase the flow of electricity by as much as 240 megawatts. The CSC is the latest in a series of sophisticated transmission technologies known as FACTS (Flexible Alternating Current Transmission Systems). Its high-speed solid-state electronics will allow operators to control electricity flow on two circuits simultaneously and avoid bottlenecks by immediately transferring power from an overloaded to an underused line.

Recommendations:

- Research requirements for the development of a broadly applicable system for monitoring and documenting the reliability of transmission systems, including data requirements, index design, tracking method, responsibility for implementation and frequency of reporting. To be most helpful, efforts to track transmission reliability should be performed on a regional and national basis, since the systems are interconnected and events in one system can affect the operation of adjoining systems.

- Initiate an integrated, coordinated approach to bulk power system planning that includes transmission resources as well as new generating sources. Such approach should seek to ensure that the State’s electric system reliability needs are met and that the economic benefits of the system are maximized. Recently, the NYISO stated that it intends to develop a comprehensive “Transmission Planning Process” in cooperation with New York’s market participants and relevant State agencies. The NYISO, consistent with the objectives of FERC Order 2000, is the suitable entity to perform this function.

- Develop effective financial mechanisms to support increases in transmission capability, especially those increases which have a material effect on improving system reliability.

TCCs do not, necessarily, by themselves, provide adequate incentive to stimulate market-based transmission enhancements. Incentives to support economically desirable transmission enhancements, to the extent possible, should be offered through the marketplace .

Importance of Reliability Standards

Adhering to reliability standards has been the most critical element in establishing and maintaining a reliable electric system in New York State. As the electric industry restructures, many new participants are involved and the operation of the system is becoming more complex. Adhering to reliability standards will become even more important in the future as New York's electric system changes. It is critical that appropriate structures and authorities are in place to meet this challenge.

Several industry and government organizations play a role in promulgating or enforcing reliability standards, including: the North American Electric Reliability Council (NERC); the Northeast Power Coordinating Council (NPCC), the Federal Energy Regulatory Commission (FERC); the New York State Public Service Commission (PSC); the New York State Reliability Council (NYSRC); and the New York Independent System Operator (NYISO). The following describes the roles that each of these organizations play in helping to maintain electric system reliability.

> FERC is an independent Federal agency, that operates under the Federal Power Act (16 U.S.C., sections 792 through 825), and regulates the transmission and wholesale transaction of electricity in interstate commerce. FERC also licenses and inspects private, municipal and state hydroelectric projects and oversees related environmental matters, and administers accounting and financial reporting regulations for electric utilities, electric generators and transmission owners. FERC's regulations are found in Chapter 18 of the Code of Federal Regulations.
>
> NERC was formed in 1968 to promote the reliability of the electricity supply for North America following a major blackout in the Northeast US in 1965. Consisting of 10 regional reliability councils, NERC is operated as a voluntary organization, dependent on reciprocity and mutual self-interest in maintaining the reliability of the nation's interconnected electricity grid. Its role is to develop and promote standards for a reliable North American bulk electric system. It reviews past performance for lessons learned, monitors compliance with NERC standards and policies, and assesses issues affecting future reliability.
>
> NPCC is one of the 10 regional reliability councils in NERC. The NPCC region consists of New York State, New England, and the Canadian provinces of Ontario, Quebec and the Maritimes. It is a voluntary, non-profit organization, which was also formed shortly after the 1965 Northeast blackout. Its purpose is to promote the reliability and efficiency of the interconnected power systems within its geographic area by establishing criteria, coordinating system planning, design and operations, and assessing compliance with these criteria.

NYISO is a not-for-profit organization established in 1998 to reliably operate an open access transmission system and a power exchange in New York State. The NYISO replaced the former New York Power Pool. The NYISO functions in accordance with a series of agreements with New York electric system participants, including but not limited to power suppliers, transmission owners and the NYSRC. These agreements were approved and continue to be overseen by the FERC.

NYSRC is an organization established by agreement among the member systems of the former New York Power Pool to develop and maintain the reliability rules for operating New York's interconnected electricity system, and to monitor system operation.

PSC is New York's utility regulatory agency, with powers and duties defined in the State's Public Service Law. It specifically regulates investor-owned transmission and distribution companies which continue to provide monopoly electric distribution services. PSC establishes specific minimum performance criteria for individual regions within the service territories of the distribution companies and requires annual reporting of performance data on distribution system reliability. The PSC monitors distribution system reliability and can impose monetary penalties on utilities that fail to meet minimum performance criteria.

On September 10, 1999, the NYSRC issued the "Initial Reliability Rules for Planning and Operating the New York State Power System" (see http:/www.nysrc.org/pdf /nysrc_initialrules. pdf). This document includes the reliability criteria of NERC, NPCC, FERC, and the PSC, as well as more stringent requirements particular to New York, and includes local reliability rules of individual transmission owners.

Compliance with transmission reliability standards in the past has been, in part, voluntary. Pending federal legislation may result in a new entity (such as the North American Electric Reliability Organization, or NAERO) with national authority to adopt and enforce uniform reliability standards for transmission systems and to impose monetary penalties and sanctions for non-compliance. Broadly applicable and enforceable national and regional reliability standards are important because the New York system can be affected by events in neighboring systems. For example, the New York State transmission system was declared to be in a "major emergency state" 16 times over the past six years as a result of events occurring outside the State's borders. New York State depends on its neighbors' adherence to national and regional reliability standards to assist New York's electric system in meeting external challenges. National and regional standards do not currently preclude the adoption of more stringent regional and state standards.

Recommendations:

- Support national efforts for mandatory, enforceable, minimum reliability standards that allow for more stringent regional, State or local reliability standards.

- Encourage national, regional and state organizations with authority to set and enforce system reliability standards to assess monetary penalties and sanctions for violations by market participants which jeopardize reliability. The level of penalties and sanctions should be large enough to clearly discourage parties from realizing benefits through non-compliance with reliability standards.

FACTORS SPECIFIED BY THE RELIABILITY STUDY LEGISLATION

Role and Impact of Distributed Generation

Distributed generation (DG) refers to generating units that are located close to electric load, in size ranges that are typically smaller than central station powerplants. DG units range anywhere from 1 kilowatt (kW) to 100 megawatts in size, although the majority of current applications for DG are in the lower part of that range. DG units could be owned by generating companies, distribution companies, or other entities responsible for managing the transmission and distribution systems. In current applications, DG units are typically owned by large industrial customers, hospitals, commercial institutions, and by individuals.

DG represents a broad application of emerging renewable and innovative electric generation technologies (*e.g.*, photovoltaic, wind, biomass, gas-powered micro-turbines, and fuel cells among others), as well as conventional gasoline and diesel-powered reciprocating internal combustion engines. Many industries with DG are also adaptable to combined heat and power (CHP) applications. Nearly 20% of total industrial energy consumption escapes as waste heat that is economically recoverable with available CHP technologies. CHP systems can exceed 80% fuel-use efficiency and significantly reduce NOX and other air emissions.

DG can be applied as a totally independent source of electricity or interconnected with the electric system. DG is frequently used as an independent back-up source of electricity that can be used during service outages. DG is also receiving attention as a potential resource to be interconnected with the grid, providing localized service in load pockets, and as an alternative to larger, central station generation.

While DG technology is maturing, there are some potential near-term negative effects on the reliability of the State's distribution systems, and, to a much lesser degree, on the transmission system. DG fundamentally changes the design premise that electric power will always flow from the transmission system into the distribution substation, and then through the distribution circuits to consumers. This change presents new considerations and challenges for utility engineering and maintenance staff. In addition, when a DG unit suddenly shuts down, an unexpected load may be added to the system from the customers that were being served by that DG unit. Such unexpected loads are likely to be large relative to the rating of the affected distribution circuit (*i.e.*, industrial and large commercial DG, not individual residential DG). By contrast, such sudden additions to net load are likely to be small relative to the capacity of the transmission grid and the impact of switching the load on the bulk transmission system should not be significant.

DG's role in meeting large-scale generation needs depends on its ability to use innovative, environmentally-acceptable technologies. Environmentally-acceptable technology is crucial given the large number of DG units that could be located in industrial, commercial, and residential settings.

To address these issues, State, federal and industry efforts are underway to facilitate the application of DG by developing appropriate interconnection standards. In response to a request from the Chairman of the PSC, the DPS conducted a collaborative investigation for standardizing and streamlining interconnection requirements for small DG units. As a result of that effort, the PSC approved a new interconnection standard, focused primarily on safety and connection protocols with a host utility, that applies to such smaller units (300 Kilovolt-amperes, or less). The new rules also standardize interconnection contracts and the interconnection application process. DG advocates have recommended developing and adopting uniform interconnection standards for larger units, up to 10 megawatts, and for application anywhere in the State.

NYSERDA and NYPA are actively facilitating the development and implementation of DG and CHP. Among the topics being researched by NYSERDA are interconnection issues, exit fees, and backup charges. In addition, NYSERDA-sponsored research efforts, performed in cooperation with Underwriters' Laboratories, facilitated the application of the new PSC interconnection standard by testing inverters which allow the interconnection of DG units. This has been especially helpful to the interconnection and application of net metering to photovoltaic units. NYSERDA also plays an active role in the US DOE/States collaborative CHP program.

NYPA is actively demonstrating distributive generation systems such as fuel cells, solar photovoltaic systems and microturbines. NYPA's 200-kilowatt fuel cell power plant in Yonkers (Westchester County) was the world's first commercial fuel cell to run on the waste gas produced at a wastewater treatment plant. NYPA has also installed natural gas-powered fuel cells at the Central Park police precinct in Manhattan and North Central Bronx Hospital. NYPA's work on solar power includes photovoltaic systems at 19 schools and other public facilities, including a 300-kilowatt rooftop system at the New York City Transit Gun Hill Road Bus Depot in the Bronx. NYPA has installed a microturbine, fueled by natural gas, at its White Plains headquarters and is in the process of installing two microturbine generators that will run on the waste gas produced by the wastewater treatment facility in the Town of Lewiston (Niagara County).

Technically mature DG has the potential to enhance electric system reliability by providing a diffuse source of generation, and by reducing electric demand and associated loading on the transmission and distribution infrastructure. Computer simulations of the New York power system indicate that a 5% system load reduction can reduce transmission congestion levels. Moreover, system load reduction, in addition to new generation sources, provided greater reduction in transmission system congestion levels than generation additions alone.

Recommendations:

- Support policies which facilitate the development and implementation of environmentally and economically sound distributed generation technologies.

- Support the development and implementation of distributed generation through research and regulatory initiatives aimed at making distributed generation technologies compatible with the State's electric system infrastructure and more accessible to consumers, including interconnection standards to accommodate appropriately-sized DG units with proven technologies.

Energy Conservation, Efficiency, Load Control and Peak-Shaving

Energy conservation and efficiency programs reduce overall energy consumption by promoting efficient energy-using machinery and appliances, encouraging better insulation of buildings, and changing the patterns of energy consumption. These programs have a positive effect on reliability by reducing overall daily load curves and are applicable to residential, commercial, and industrial buildings and operations. The PSC recognized the importance of energy efficiency programs during the transition to greater competition in the electric industry by adopting a non-bypassable electric distribution system "wires charge" to fund public benefit programs (Systems Benefit Charge or SBC).[20] The PSC is also currently considering an increase in funding and extension of the SBC program for five years, including a change in emphasis over the next few years aimed at securing peak load reductions and electricity capacity additions. The operators of transmission and distribution systems can, and do, also institute energy efficiency improvements, such as higher efficiency substation and transformer components.

Electricity load control and peak shaving measures help control a customer's demand for electricity when the electricity system is experiencing its greatest electricity requirements, by removing selected loads, or using some form of previously stored on-site energy. Alternatively, but less desirable, load control can also be achieved by voltage reduction. Such actions have a positive effect on system reliability by curbing energy usage when transmission and distributions systems are the most strained. Examples of load control and peak shaving devices include remotely-controlled water heaters and HVAC equipment. Other programs targeted at efficiency improvements in space conditioning equipment can significantly reduce daily peak loads, thus improving distribution system reliability. An example of such a program is the SBC-funded "Keep Cool, New York", a program administered by NYSERDA to remove less-efficient room air conditioners. Also, as part of this effort, NYSERDA worked with large commercial and industrial customers to tune-up and optimize the use of existing HVAC systems.

Load control activities are expected to increase in the future as technologies such as real time pricing and price-responsive load aggregation are implemented. (See the section on Price-Responsive Load for a discussion of how peak loads can be reduced by making energy markets more competitive and beneficial to consumers.) On the other hand, some electricity distribution system operators have expressed concern that diminished load growth in some areas will reduce revenue and hence the funds available to invest in reliability-related distribution system improvements. Also, reduced loads may not have as positive an impact on reliability in some upstate areas where transmission and generation resources are relatively plentiful.

As noted earlier, computer simulations of the New York power system indicate that a 5% reduction in the loading on New York's transmission system can reduce transmission congestion levels. Energy conservation and efficiency can help achieve such a reduction.

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[20] PSC Case 94-E-0592: In the matter of Competitive Opportunities Regarding Electric Service - Opinion and Order 98-3 Concerning System Benefit Charge Issues, January 30, 1998.

Recommendation:

- Support energy conservation, efficiency, load control and peak-shaving programs in New York State by removing barriers to the provision of such services by energy service companies. Support such programs as delivered by NYSERDA, NYPA, and LIPA.

Corporate Reorganization of Electric Utilities

A surge of restructuring activities has followed the advent of electric industry deregulation. Two general outcomes have been seen in New York State: divestiture of generation by vertically integrated utilities; and mergers of energy companies.

FERC required traditional vertically integrated utility companies to separate electric power generation from the transmission and distribution of electricity. Most investor-owned utilities in New York have divested electric generation assets from their transmission and distribution assets as a result of PSC Orders issued to promote competitiveness and reduce electricity prices.

Adding new electric generating capacity to meet New York's future electricity requirements now depends on entities that are outside the immediate or direct responsibility of the utilities that deliver the electricity (*i.e.,* the load serving entities). Both the demand for new electric generating capacity, and New York's competitive wholesale electricity market, will provide the impetus to build new generation in the State. However, the historic linkages between load growth and forecasting of available resources that defined the requirements for new generation additions, the siting of these resources and the transmission expansion to optimally utilize the generation additions are now driven by market signals rather than by integrated planning processes . (See also discussions of Transmission Monitoring and Planning Enhancements; and Accommodation of Proposed New Generating Facilities or Repowering or Life Extension of Existing Facilities & Market Driven Nature of Decisions to Build, Size and Locate New Electric Generation.)

The number of mergers in the electric power industry has accelerated over the past several years. Examples of this trend in New York include the merger of Consolidated Edison Company and Orange and Rockland Utilities, the proposed merger of Consolidated Edison with Northeast Utilities in New England, the proposed purchase of Niagara Mohawk by the United Kingdom's National Grid Company, and the purchase by New York State Electric & Gas of electric generation assets in Maine that were previously owned by Central Maine Power Company.

Consolidation of electric industry firms may also occur under "holding companies". These holding companies may include firms that participate in different activities (for example, transmission companies and load serving entities) and include operations in multiple geographical areas. In addition, holding companies may include other firms that are not related to the traditional power industry (for example, telecommunications). The consolidation of these firms could result in internal competition for investment funds, and budgeting processes could lead holding companies to direct limited resources away from distribution companies with regulated earnings. However, because the PSC will continue to regulate New York's transmission and distribution companies, it will require that these regulated companies provide sufficient investments to achieve performance standards.

Corporate reorganization of electric utilities is not expected to affect the reliability of the transmission and distribution system significantly because of the continued application of existing regulatory oversight, NYISO compliance requirements, and reliability standards that remain in effect.

Departures From Traditional Regulatory Mechanisms

Public utility regulatory bodies, such as New York's PSC, have traditionally established rates as low as possible, yet sufficient to provide for safe and adequate service to customers while balancing the needs of utility shareholders to earn a fair rate of return on their investment. In this regulatory framework, electricity consumers have traditionally paid a "bundled" rate for generation, transmission, and distribution services. Deregulation has led to an "unbundling", or separation, of these charges because all three of these services may not necessarily be provided by the same entity. Generation services are now largely deregulated, and transmission services are undergoing transition that will allow participation by firms exempt from most traditional ratemaking regulations, while the distribution will remain fully regulated. Distribution systems are expected to remain regulated for the foreseeable future due to their natural monopolistic characteristics.

Ideally, under deregulation, transmission and generation companies should be able to compete in delivering services to customers. Such competition could lead to the construction of additional low-cost generation facilities or transmission system upgrades which reduce congestion on the transmission system. The result would be improved reliability and lower-cost electricity for consumers.

Distribution companies continue to own the wires, and circuits/ties to most customers and provide the bulk of the metering and billing services. A "cost-of-service" regulatory approach is used to fairly compensate utilities for operation, maintenance and capital costs. As certain functions that were traditionally provided only by utility companies (e.g. meter reading and billing services) are opened up to competition, several concerns arise. For example, cross-subsidization[21] or cost-shifting between customer classes[22] may lead to a reevaluation of these regulatory procedures.

Performance-based rates (PBRs), have been discussed as a preferred regulatory process, once wholesale and retail competition become more widespread. PBRs allow the regulator to reward superior service providers and/or penalize those providers delivering inferior service. PBR standards can be developed to address the increasing concern over power quality, clean power, and interruptible critical loads. For example, as the distribution infrastructure becomes more heavily loaded and demand for uninterruptible service continues to increase, new technologies (*e.g.*, automatic sectionalizing and application of intelligent electronic devices) may help meet higher consumer electricity requirements. A properly structured PBR could provide the necessary incentives to distribution companies willing to take the financial risks associated with developing these products. PBRs are also used as an incentive for distribution companies to

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[21] Cross-subsidization refers to selling one product at a loss, which is balanced by higher profits on another product or market area.

[22] This concept strives to insure that each customer class earns a sufficient rate of return and no customer class subsidizes another.

exceed minimum reliability standards (*e.g.*, SAIFI, CAIDI). Currently, the PSC can impose penalties for below standard performance. PBRs tied to such indices can have a positive impact on system reliability.

FERC Order 2000 encourages transmission owners to voluntarily form regional transmission organizations (RTOs). The order also suggests that applying PBRs to RTOs could encourage investors to participate in the transmission market. At this early stage, three possible RTO formations are likely: not-for-profit RTOs (*e.g.*, the NYISO), for-profit RTOs; or a hybrid model. All three RTO models offer opportunity to encourage investments in transmission infrastructure.

Another approach, multi-year rate agreements, has been discussed in response to wholesale and retail competition initiatives in different states. The PSC has used multi-year rate agreements to provide rate stability to electric consumers, particularly in the transition to full retail electric competition. At the wholesale level, suppliers view multi-year rate agreements as a method to retain customers for longer periods, while consumers can hedge energy price risk. Alternatively, multi-year rate agreements have been discussed in conjunction with future merchant transmission projects to encourage investment in transmission infrastructure. Unlike PBRs, multi-year rate agreements would likely have little impact on system reliability, although long-term contracts may provide a means of mitigating the risk inherent in transmission system investment.

The NYISO currently uses Transmission Congestion Contracts (TCCs) that allow market participants to hedge fluctuations in the price of electricity transmission. Some parties view the market creation of new TCCs as providing an alternative to traditional regulatory mechanisms for encouraging new transmission additions. TCCs are financial instruments which provide the holder with the right to collect the congestion rents between specified points of the transmission system. Congestion rents are approximately equal to the differences in energy prices, or LBMPs, between two locations on the transmission system. New TCCs can be awarded to investors in new transmission facilities and possibly provide a revenue stream of congestion rents to the contract holders. This process has its limitations, however, since transmission improvements may result in reduced congestion and the value of new and existing TCCs would diminish.

Large Scale Industrial Development

Large scale industrial development could translate into significant increases in electrical demand in New York State. To put this into perspective, the electricity consumption of a typical modern steel mini-mill exceeds the consumption of more than 8,000 single family households. A small paper mill consumes more electricity than 2,000 homes. Light industries are significant consumers of electricity too. For example, a small "e-business" that employs 25 office workers could consume 25 times the electric power used collectively in the homes in which those employees live.

Significant growth of industry in New York over the 20-year planning period horizon is likely to be in the form of "new industries," such as internet-based data processing and financial institutions. However, these loads could, individually and in aggregate, approach the magnitude of traditional heavy industry.

A firm considering locating in New York will evaluate the reliability of New York's transmission and distribution infrastructure as a potential cost of operation. The need to add back-up power equipment or power quality enhancements can add to a firm's cost for electricity. Therefore, the perception of transmission and distribution reliability is a factor that can determine whether industrial development occurs. As discussed previously, an integrated transmission expansion and planning process and adequate generation that will meet the needs of the State is paramount to meeting the electricity needs of new large scale industrial development in New York.

A heightened awareness of the reliability of New York's transmission and distribution infrastructure may be the second most likely consequence of industrial development, after an increase in load. As discussed previously, power quality has become critically important for many businesses, particularly high-tech manufacturers as well as data processing and communication dependent industries. Momentary disruptions and voltage irregularities, once considered minor nuisances, will have increasingly negative and costly effects on such industries. Fortunately, a large variety of power quality monitoring and correcting equipment can be purchased or leased, and engineering consultants can help diagnose problems and recommend the simplest and most economic solutions.

Industrial energy efficiency can play an important role in encouraging industrial development. For example, the goal of NYSERDA's Energy Efficiency Services Program is to provide increased energy efficiency and lower operating and maintenance costs for industrial, commercial, and institutional customers. That Program also provides the industrial sector guidance on improving economic competitiveness and productivity, while reducing pollution and controlling electricity demand.

Changes in NYISO Electricity Dispatch Protocols

A competitive wholesale market for electricity supply was established in November 1999, when the NYISO succeeded the NYPP. The NYISO administers the power system according to a set of market rules and with the objective of maintaining system security. The security and reliability objectives are the equivalent of those observed by the former NYPP, although the market participants, business objectives and business rules have changed significantly.

Under the NYPP, generation was committed and dispatched[23] to minimize production cost of supplying power, subject to meeting all security constraints. The dispatch protocol was based on sharing the operational savings between the members of the NYPP. Outage schedules were optimized for system reliability and the benefit of generating resources owned or controlled by utilities.

Under the NYISO, generation is committed and dispatched through supply-side competition and based on bid submissions from suppliers. Such bids are considered in day ahead and real time markets. Bids are also used to select providers of operating reserve and regulation energy.[24] Bids submitted by generators may or may not be based on the generators's cost of producing power. Bidding of supply sources to meet electricity requirements within New York is influenced by the business objectives of the owners. Other factors, such as run-time limits and start-up issues, that may qualify a bid, must be considered by the NYISO.[25] Importantly, more and new market participants (*e.g.*, suppliers, consumers, and other intermediaries) are now active compared to the number of participants that were members of the former NYPP. FERC requires the NYISO to provide fair, impartial and predictable treatment to all market participants in the commitment and dispatch of electricity generation resources in New York. The NYISO must also accommodate a large number of participants within a fixed set of commitment and dispatch protocols which significantly increases the complexity of the process compared to that experienced by the former NYPP. Increased complexity, unexpected conditions and frequent dispatch adjustments can provide greater opportunity for operator error.

Notwithstanding the significant change in dispatch protocols, the NYISO continues to ensure that all transactions conform to reliability rules and standards similar to those that applied to the

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[23] A generator is committed if it is placed in a condition that allows it to produce power if called upon by system operators. Various physical parameters in addition to financial objectives are considered in establishing a commitment list of generators. Dispatch refers to establishing the quantity of power that an individual unit is to produce at a specific time. Only committed units can be dispatched.

[24] "Regulation energy" refers to flexible energy resources that provide for following the moment-to-moment variations in the demand or supply.

[25] Other new market initiatives include an Installed Capacity Market (ICAP) where load serving entities secure commitments for capacity sufficient to meet expected yearly peak loads plus an allowance, or reserve, for meeting unexpected conditions. Additionally, bilateral contracts are allowed which provide for the prescheduling of capacity and energy between parties. Both ICAP and bilateral contracts play a very important reliability role for insuring generation adequacy.

former NYPP. The NYISO, in cooperation with market participants, continuously assesses the system security and reliability throughout the commitment and dispatch process.

Some market participants favor the formation of a northeastern regional transmission organization, comprising a combination of the NYISO with one or more neighboring ISOs, under guidelines established in FERC's Order 2000. The potential formation of such an organization is not likely to significantly change power flow patterns, nor lessen congested facilities within the New York transmission grid. In the longer term, a broad regional approach might improve incentives for building new transmission and generation facilities, thus improving overall transmission system reliability.

Accommodation of Proposed New Generating Facilities or Repowering or Life Extension of Existing Facilities

Market Driven Nature of Decisions to Build, Size and Locate New Electric Generation

The Decision to Build

Historically, New York's investor-owned utilities were required to maintain a generation reserve margin of 22% in order to maintain adequate levels of reliability. The utilities selected the type, size and location of new generation in order to meet the need for a balanced mix of base-load, intermediate and peaking generation, typically over a 20-year planning horizon. Utility decisions were reviewed and approved by the New York State Siting Board on Electric Generation and the Environment and the capital costs of adding generation and associated transmission and other system enhancements were added to the utility rate base and recovered through a PSC regulated rate of return. Energy costs were priced at an average cost to supply electricity, and although the electricity costs varied among the different companies' service territories, there was generally no locational variation within a particular company.

Deregulation of the electric utility industry has provided open access to the transmission system, unbundling of vertically integrated utilities, locational-based marginal pricing of energy, and merchant generation units and transmission lines. In contrast to the highly regulated, closed system of the past, today's electricity system is market driven and open to many more players than ever before.

Adding new electricity generation is now a marketplace function. There are 59 applications before the NYISO for new power plant interconnections studies, of which 19 projects, representing more than 12,000 megawatts of new generating capacity, are also seeking Article X siting approval. The type of plant, its fuel supply, size and location are determined by market conditions and the objectives of private developers. The NYISO's electricity pricing system, with locational-based market prices, is sending clear pricing signals that new generation is needed in Southeastern New York to meet load growth.

Accommodating New Electric Generation

All new power plant proposals must be submitted to the NYISO for evaluation and approval of the required interconnection with the bulk transmission system (power grid). The evaluation looks at the effect the new facility will have on system reliability, focusing primarily on the local effects created by proposed projects. This "minimum interconnection" standard does not consider the overall system impact of the facility, and may result in the system not being able to fully realize the economic and capacity benefits of new generation. For example, the system impact study performed by the NYISO for the recently approved Athens plant found that the plant could have a substantial adverse effect on certain transmission system transfer limits.

Consequently, the plant may be required to reduce power generation during times of severe system stress in order to maintain system reliability. As a result, New York's interconnected electric system may not realize the full benefit of the 1,080 MW of new generation capacity provided by this plant.

Requiring that proposed generation projects be subject to a full system impact analysis may hinder bringing on new capacity, if it is perceived that a new generating unit owner has to solve a preexisting problem. However, the current coordination of these studies under the NYISO should help to establish consistency and reasonableness across the State.

As discussed earlier, any proposed new power plant of 80 megawatts capacity or greater is subject to the State's Article X siting process which was designed to consolidate the process and shorten the time required to obtain the necessary approvals to 12 months. Of the 59 projects before the NYISO, 45 meet the 80 megawatts threshold and, as noted above, 19 projects, representing more than 12,000 megawatts of new generating capacity, are actively under Article X review. The Athens generating plant is the only project to receive Article X approval. The Athens application was accepted for review in October 1998 (pre-application - September 9, 1997) and formally approved on June 13, 2000, twenty months later. Construction of the plant has yet to begin, pending a required federal permit. Further, since Article X is a market (applicant) driven process, it does not lend itself readily to considering broader questions of overall system impact and desirability. Applications are addressed as they are received and proceed through the process independently.

Generation Planning

The lack of a centralized, coordinated, overall plan for the expansion of generation will likely result in short term "boom and bust" cycles as the market responds to over- and under-capacity situations in combination with long lead times to build new generation. The installed capacity requirements currently established by the NYSRC should help to mitigate any adverse consequences. In general, the market is expected to respond to the needs of the system properly and in a timely manner, as long as the appropriate economic signals occur.

In summary, the current market-driven process for generation addition is expected to have a positive impact on overall system reliability. The existence of locational-based energy and capacity prices will encourage proper siting of generation and development of transmission capacity. As long as the electric market remains stable, developers can build with confidence and electric system reliability will be supported.

APPENDIX A

Reliability Study Advisory Group Members

Organization/Advisory Group Member	Designee
CH Energy Group John E. Mack III Chairman of the Board	
Con Edison Eugene R. McGrath Chairman & Chief Executive Officer	 Bill Longhi* Terri Crowley
Distributed Power Coalition of America Ruben Brown, President, The E Cubed Co., LLC	 Peter Chamberlain John Smith*
The Energy Association of NYS Howard Shapiro Esq. President	 Stuart Silbergleit Bill Greenwald* Steve Hanse*
I.B.E.W. Local Union 503 Robert V. Citrolo Co-Chairman, NYS Industry Restructuring Committee	
IBM Corporation Robert J. Newhard Manager, IBM Site Operations	 Mary Ann McNulty
Independent Power Producers of New York Carol E. Murphy Executive Director	 Carolyn Brown
Long Island Power Authority Richard J. Bolbrock Vice President, Power Markets	 John Adragna Alan Elberfeld
NYC Economic Development Corporation Richard B. Miller Vice President, Energy Analysis	 Lester M. Stuzin*
New York Independent System Operator William J. Museler President and CEO	 Karl Tammar* John Adams

New York Power Authority Dan Berical V.P. for Policy & Gov. Affairs	John Hamor Gary Paslow
New York State Assembly Carol D. Taylor Senior Program Analyst	
New York State Consumer Protection Board Tariq Niazi Chief Economist	
New York State Reliability Council George C. Loehr* eLucem	
New York State Senate Bernard P. McGarry Principal Program Associate	
Niagara Mohawk William E. Davis Chairman of the Board and CEO	Edward J. Dienst Joe Hipius*
Pace Energy Project Edward A. Smeloff Executive Director	Laurence DeWitt*
Praxair, Inc. Jim Rouse Director, Energy Policy	

*Participated in the Ad Hoc Technical Working Subgroup meetings.

APPENDIX B

GLOSSARY OF TERMS

Term	Definition
Adequacy	The ability of the bulk electric system to supply the aggregate electrical demand and energy requirements of the customers at all times, taking into account scheduled and unscheduled outages of system components.
Alert State	The Alert (Operating) State is the second of four non-normal operating states observed by the NYISO The Alert State exists when conditions on the NYS Power System are more severe than in the Warning State. Immediate actions are required to return the NYS Power System to the Normal State.
Ancillary Services	Services necessary to support the transmission of Energy from Generators to Loads, while maintaining reliable operation of the NYS Power; Operating Reserve Service (including Spinning Reserve, 10-Minute Non-Synchronized Reserves and 30-Minute Reserves); and Black Start Capability.
Article X	"Certification of Major Electric Generating Facilities", New York State's process for permitting new power plants (See: http://www.dps.state.ny.us/articlex.htm)
CAIDI	Customer Average Interruption Duration Index. One standard index of distribution system reliability. It provides a measure of the average duration of each interruption that an average customer (in the measured area) endures.
Central station generation	Generation installed at a central location, typically connected at the transmission level in large increments, and at least monitored, if not dispatched, by the New York ISO. Central stations include merchant power plants, large industrial cogeneration, and legacy facilities predating disaggregation of the vertically integrated utilities, utilizing fossil fuel, nuclear and hydro energy sources.
Congestion	Conditions in which the free flow of power through the transmission system is constrained by thermal or other technical limits associated with the design or operation of the system.
Contingency	An actual or potential unexpected failure or outage of a system component, such as a generator, transmission line, circuit breaker, switch, or other electrical element. A contingency also may include multiple components, which are related by situations leading to simultaneous component outages.
DAWG	Disturbance Analysis Working Group is a technical committee responsible for analyzing major power system disturbances across North America. DAWG functions under the auspices of NERC and maintains a database of disturbance data reported by the regional reliability councils under mandate from DOE.
Developer	A commercial party that undertakes the design, specification, permitting, construction, and other activities to add new generating capacity.
Distributed generation, (DG)	Small generation facilities utilizing a range of technologies, including reciprocating engines, small and micro-turbines, fuel cells, photovoltaic

Term	Definition
	array, wind and other renewable energy sources. DG is usually connected to the distribution system.
Distribution system	The facilities that deliver power from the transmission system to the end users. Operating voltage is typically 34.5 kV and lower.
Downstate	The New York City and Long Island portions of the NY State electric system.
Efficiency	The ratio of useful energy provided by a process to the total energy put in. The efficiency of a power plant is the ratio of the electric power output to the thermal value of the fuel input.
Emergency	See "Major Emergency Operating State"
Energy service company, (ESCo)	Any of a variety of companies that provide energy related services. These services may involve power management, power purchasing, fuel procurement services, etc.
FERC	Federal Energy Regulatory Commission is an independent regulatory agency that regulates the transmission and sale for resale of natural gas in interstate commerce; regulates the transmission of oil by pipeline in interstate commerce; regulates the transmission and wholesale sales of electricity in interstate commerce; licenses and inspects private, municipal and state hydroelectric projects; oversees related environmental matters and administers accounting and financial reporting regulations and conducts of jurisdictional companies.
FERC 2000	18 CFR Part 35 [Docket No. RM99-2-000; Order No. 2000] "Regional Transmission Organizations", (Issued December 20, 1999). (see: http://www.ferc.fed.us/news1/rules/pages/order2000.htm
Gas turbine	Also a 'combustion turbine'. An engine which burns fossil fuel, usually natural gas, to provide rotating mechanical power to an electric generator. Gas turbines operate on the same physical principles as jet aircraft engines. Some gas turbines can be started and stopped very easily, and are used to meet operating reserve during load peaks or emergencies.
Generating station	An entire facility for generating electricity. A generating station will include one or more turbine-generators.
Grid backup DG	Use of the electric distribution system to supply power in the event that local generation supply (e.g. distributed generation) is unavailable. Grid backup implies that power supply is either local to the load or from the grid, but not both at once.
Installed capacity, (ICAP)	A generator or load facility that complies with the requirements in the reliability rules and is capable of supplying and/or reducing the demand for energy in the NYCA for the purpose of ensuring that sufficient energy and capacity are available to meet the reliability rules. The Installed Capacity requirement, established by the NYSRC, includes a margin of reserve in accordance with the reliability rules. (Source: NYISO)
Integrated system planning	Coordinated, simultaneous planning of both generation and transmission capacity.
Interface	A defined set of transmission facilities that separate load zones in New York State and that separate the NY City Area from adjacent control areas.

Term	Definition
Interruptible load	Customer loads with related contractual agreements allowing them to be disconnected from grid under emergency conditions. The opposite of firm load.
Interruption	As pertains to distribution system reliability indices: The complete loss of power supply to a customer for more than 5 minutes. Outages due to major storms are not normally included in this category.
Investor-owned utility, (IOU)	A publicly traded company that provides utility service. This may include traditional vertically integrated utilities (i.e. those that provide generation, transmission, and distribution) or companies that provide a subset of these services, but who remain subject to utility regulation under the PSC. Investor-owned utilities do not include public agencies such as NYPA or municipalities.
Load	The electric power consumed by customers.
Load shedding	The systematic reduction of system demand by temporarily decreasing Load in response to Transmission System or area Capacity shortages, system instability, or voltage control considerations under Part III of the OAT Tariff.
Load-serving entity, (LSE)	An entity, including a municipal electric system and an electric cooperative, authorized or required by law, regulatory authorization or requirement, agreement, or contractual obligation to supply energy, capacity and/or ancillary services to retail customers located within the NYCA, including an entity that takes service directly from the NYISO to supply its own load in the NYCA. (Source: NYISO)
Location-Based Marginal Pricing, (LBMP)	A pricing methodology under which the price of energy at each location in the NYS Transmission System is equivalent to the cost to supply the next increment of load at that location (i.e., the short-run marginal cost). The short-run marginal cost takes generation Bid Prices and the physical aspects of the NYS Transmission System into account. The short-run marginal cost also considers the impact of Out-of-Merit Generation (as measured by its bid price) resulting from the congestion and marginal losses occurring on the NYS Transmission System which are associated with supplying an increment of load. The term LBMP also means the price of energy bought or sold in the LBMP markets at a specific location. (Source: NYISO)
Major Emergency Operating State	One of four non-normal operating states observed by the NYISO. It exists when an emergency is accompanied by abnormal frequency, abnormal voltage and/or equipment overloads that create a serious risk to the reliability of the NYS transmission system.
Market Participants	An entity, excluding the NYISO, that produces, transmits, sells, and/or purchases for resale capacity, energy and ancillary services in the wholesale market. Market participants include: transmission customers under the ISO OATT, customers under the ISO Services Tariff, power exchanges, transmission owners, primary holders, LSEs, suppliers and their designated agents. Market participants also include entities buying or selling TCCs. (Source: NYISO)

Term	Definition
Merchant transmission	Transmission lines constructed by entities independent of the regulated transmission owner.
NAERO	North American Electric Reliability Organization. As successor to NERC, NAERO's mission will be to develop, promote, and enforce standards for a reliable North American bulk electric system. With the growth of competition and the structural changes taking place in the industry, NERC is to transform from a voluntary system of reliability management to NAERO, one that is mandatory, with the backing and support of U.S. and Canadian governments.
NERC	North American Electric Reliability Council. Formed in 1968 to promote the reliability of the electricity supply for North America following major blackouts in the northeast US in 1965 and 1967. Consisting of 10 regional reliability councils, NERC is operated as a voluntary organization - one dependent on reciprocity and mutual self-interest of all those involved.
Network distribution system	A power distribution system which relies on multiple connections to the transmission system and in which the distribution supply is 'meshed.' This arrangement is used in dense urban areas (i.e. New York City). (Compare with radial feeder).
New York Control Area (NYCA)	The portion of the NYS Power System that is under the control of the NYISO. It includes transmission facilities listed in the ISO/TO Agreement and generation located outside the NYS Power System that is subject to protocols (e.g., telemetry signal biasing) that allow the NYISO and other control area operator(s) to treat some or all of that generation as though it were part of the NYS Power System.
New York State Power System	All facilities of the NYS Transmission System, and all those generators located within the NYCA or outside the NYCA, some of which may from time-to-time be subject to operational control by the NYISO.
New York State Transmission System	The entire New York State electric transmission system, which includes: (1) the transmission facilities under ISO operational control; (2) the transmission facilities requiring ISO notification; and (3) all remaining transmission facilities within the NYCA.
NPCC	Northeast Power Coordinating Council is one of 10 regional reliability councils in NERC. The NPCC region consists of New York State, New England, and the Canadian provinces of Ontario and Quebec.
NYISO	New York Independent System Operator, a not-for-profit organization established in 1999 to operate an open access transmission system and a power exchange in New York State. The NYISO replaced the NYPP.
NYPP	New York Power Pool, predecessor to the NYISO, was formed in 1966 to coordinate the economic operation of the facilities owned by the seven investor-owned utilities in the State and the Power Authority of the State of New York.

Term	Definition
NYSRC	New York State Reliability Council, an organization established by agreement among the member systems of the NYPP to develop and maintain the reliability rules by which the NYPP would operate the New York State Power System
Operating Reserve	Generating capacity in excess of that required to satisfy load.
Outage	A device is in outage state if it is not connected to the electrical system or otherwise not in operation.
Peaking unit	A generating unit that is used to provide power at or near the peak system load. Peaking units may run only a small fraction of the total hours in a year.
Performance-based rates, (PBR)	A regulated rate structure through which entities may be either rewarded or penalized based on their performance relative to established standards. FERC 2000 notes that PBR may incorporate price/revenue caps, price incentives, or performance standards.
Photovoltaic, (PV)	Also "solar cells." Electric power generation by direct conversion of solar radiation into electricity using semiconductor technology.
Radial Circuit	A distribution circuit (typically overhead) extending radially from the distribution substation into the load area. The failure of any circuit component will generally result in customer interruption(s) that will require repair and/or the use of alternative system supply sources to restore service to the interrupted customer(s).
Reactive power	The product of voltage and the out-of-phase component of alternating current. Reactive Power, measured in vars or MVAr, plays a critical role in enabling the conversion of energy in alternating current power system devises such as generators, motors and transformers. Control of reactive power is provided by regulating voltage on transmission and distribution systems with generators and other devices (e.g. capacitors).
Real time pricing	A pricing mechanism for power sales to consumers that bases the price on the spot market price for power at the time of consumption. The "real-time" price may be set in the day-ahead market or the real-time market.
Regional Transmission Organization, (RTO)	The entity that is responsible for operation of a regional transmission system. The characteristics and functions of an RTO are defined in FERC 2000.
Reliability	Reliability, in a bulk electric system, is the degree to which the performance of the elements of that system results in electricity being delivered to customers within accepted standards and in the amount desired. The degree of reliability may be measured by the frequency, duration, and magnitude of adverse effects on the electric supply (or service to customers.) Bulk electric system reliability can be addressed by considering two basic and functional aspects of the bulk electric system - adequacy and security. (Source: NERC)

Term	Definition
Reserve margin	Installed generation capacity in excess of load, typically expressed as a percent of load. % Reserve = 100 * (Installed Capacity – Peak Load) / Peak Load.
SAIFI	System Average Interruption Frequency Index. One standard index of distribution system reliability. It provides a measure of the average number of interruptions that an average customer (in the measured area) endures.
Short circuit	An event in which an abnormal connection is created between conductors in the power system. Short circuits are the most destructive events that can affect a power system because they result in flow of extremely high magnitude currents and because they depress system voltage.
Stability	The ability of a power system to maintain a state of equilibrium between generators during normal and abnormal system conditions or disturbances.
System benefits charge, (SBC)	The SBC is designed to fund, during the transition to full retail electric access and possibly thereafter, the following public policy initiatives not expected to be adequately addressed by competitive electric retail markets: • energy efficiency programs, • research and development (R&D) projects, • environmental protection efforts, and • efforts on behalf of low-income utility customers. (see http://www.dps.state.ny.us/sbc.htm)
Thermal limit	The maximum loading of electrical equipment which can be sustained based on nominal ambient conditions and recognizing pre-loading conditions. The three commonly observed thermal limits are: Normal rated limits, long-term emergency limits (LTE) and short-term emergency (STE) limits.
Transient stability	The ability of a power system to return to a state of equilibrium following large disturbances such as faults and/or loss of vital facilities including lines, transformers or generation.
Transmission Congestion Contract, (TCC)	The right to collect or obligation to pay congestion rents associated with a single megawatt of transmission between a specified point of injection and point of withdrawal. TCCs are financial instruments that enable energy buyers and sellers to hedge fluctuations in the price of transmission. (Source: NYISO)
Transmission Owner (TO)	The public utility or authority (or its designated agent) that owns facilities used for the transmission of energy in interstate commerce and provides transmission service under the Open Access Transmission Tariff. (Source: NYISO)
Upstate	All of NY State electric system with the exception of New York City and Long Island.
Voltage collapse	The extreme deterioration of voltage on the system that, if allowed to continue unchecked, can result in load being lost due to their inherent behavior at low voltage (such as motors) or through the operation of protective devices.

Term	Definition
Voltage reduction	The deliberate lowering of voltage on the distribution system for the purpose of achieving load relief. A technique employed under conditions of unusually heavy load and high system stress.
Voltage stability limit	A maximum allowable power transfer (megawatts) that is observed to avoid potential voltage collapse conditions. Such limits are generally applied to the flows on transmission interfaces that have been shown in simulation studies to be at risk of voltage collapse under conditions of extreme loading.

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State of New York
George E. Pataki, Governor

New York State Energy Planning Board
F. William Valentino, Chairman

11/00