STATE OF CONNECTICUT
CONNECTICUT SITING COUNCIL

JOINT APPLICATION OF THE CONNECTICUT LIGHT AND POWER COMPANY AND THE UNITED ILLUMINATING COMPANY FOR A CERTIFICATE OF ENVIRONMENTAL COMPATIBILITY AND PUBLIC NEED FOR A 345-KV ELECTRIC TRANSMISSION LINE FACILITY AND ASSOCIATED FACILITIES BETWEEN SCOVILL ROCK SWITCHING STATION IN MIDDLETOWN AND NORWALK SUBSTATION IN NORWALK	DOCKET NO. 272 MARCH 9, 2004

PREFILED TESTIMONY OF ISO NEW ENGLAND INC. BY STEPHEN G. WHITLEY

I. WITNESS EXPERIENCE

Q. Please state your name, title and business address.

A. Stephen G. Whitley
Senior Vice President and Chief Operating Officer
ISO New England Inc.
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Q. What positions have you held at ISO and what have your responsibilities been?

A. As the Senior Vice President and Chief Operating Officer of ISO New England Inc. ("ISO"), I have overall responsibility for System Planning, System Operations, Market Operations, Settlements, and Customer Service & Training for the company. I manage a staff of approximately 200 people and oversee the Dispatch Control Center in Holyoke, Massachusetts. Prior to this position, from 2000-2001, I served as Vice-President for Systems Operations and oversaw that department. I presently serve as Chairman of the Electric Power Research Institute Grid Operations, Planning and Markets Working Group.

Q. What experience prior to ISO did you have that concerned transmission system planning?

A. As detailed in my attached biography[1], my entire career has been spent on matters concerning the operations and planning of transmission systems. Prior to joining ISO, from 1996-2000, I was responsible for control area operations, power supply, economic dispatch, system protection, transmission security and services, and dispatching for the 80,000 square mile Tennessee Valley Authority ("TVA") service territory, comprising five States. From 1991-1996, I was responsible for the planning, design, and construction of the TVA transmission system.

O. Have you previously testified before the Connecticut Siting Council?

A. Yes, I testified in Docket 217 regarding Northeast Utilities Service Company's application for a 345kV line from Plumtree Substation in Bethel to Norwalk.

Q. What has been your involvement in Connecticut Siting Council Docket 217?

A. As the Chief Operating Officer of ISO, I am responsible for operating the existing system and for overseeing and supervising the studies that ISO performed, as described in this testimony.

Q. Is the information presented in this testimony and in the responses to pre-hearing questions true and correct to the best of your knowledge and belief?

A. Yes.

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1 ISO Exhibit 1.

II. SUMMARY OF TESTIMONY

Q. Please summarize your testimony.

A. Based on studies to date, applicable regional reliability standards, and its own operating experience, ISO considers the electricity delivery system in the southwestern region of Connecticut to be unreliable. Given the present and predicted future composition of generating units and electric demand in that part of the state, transmission system reinforcements are required to enable consumers of electricity in that part of the state to receive reliable electricity service in accordance with regional reliability standards.

As part of its responsibility to assess and develop a long-range transmission expansion plan, ISO seeks to identify solutions to expected transmission system problems, and to identify solutions that will solve those problems while there is still time to permit, design and construct a solution. Pursuant to its obligation as the region's transmission system planner, ISO has identified a "full loop" 345-kV transmission line, located in the southwestern region of Connecticut, as a long-term response to its concerns about electricity service meeting NEPOOL Reliability Standards. A "full loop" would consist of the 345-kV transmission line which was the subject of the Siting Council's approval proceeding in Docket 217 and a 345-kV transmission line running from the Norwalk substation to the Scovill Rock Switching Station in Middletown, including related facilities. A combination overhead/underground 345 kV line from Norwalk to Middletown has been proposed by The Connecticut Light and Power Company ("CL&P") and The United Illuminating Company ("UI," together with CL&P sometimes jointly referred to as the "Applicants") in this proceeding.

A 345-kV transmission line between Middletown and Norwalk (the "M-N Line") is a vital part of a long range transmission upgrade plan that will comprehensively address present and future reliability problems in Connecticut, will complete the transmission loop connecting Southwestern Connecticut with the rest of New England's bulk power grid system, and will alleviate many of the reliability problems ISO has observed in this area. Completion of the full 345 kV loop is necessary to address the reliability problems in this area and addresses those problems more completely than other transmission or non-transmission alternatives studied by ISO.

III. ISO'S MISSION AND RESPONSIBILITIES

Q. Why was ISO established?

A. The "Independent System Operator" concept was developed by the Federal Energy Regulatory Commission ("FERC") as part of the framework to support competitive electricity markets. In 1996, FERC stated its principles for ISO operation and governance in FERC Order 888.[2] FERC identified key Independent System Operator principles as: providing independent, open and fair access to the region's transmission system; establishing a non-discriminatory governance

[2] Promoting Wholesale Competition Through Open Access, Non-Discriminatory Transmission Services by Public Utilities; Recovery of Stranded Costs by Public Utilities and Transmitting Utilities, Order No. 888, 75 FERC ¶ 31,036 (1996)(establishing principles for ISO's operation and governance).

structure; facilitating market based wholesale electricity rates; and ensuring the efficient management and reliable operation of the regional bulk power system. ISO was established to be the Independent System Operator of the New England bulk power grid on July 1, 1997, and it assumed certain operating and transmission reservation responsibilities which had previously been carried out by NEPOOL, which transferred staff and assets to ISO. Administrative Notice Exhibit 1.[3] In May, 1999, ISO commenced administration of the restructured wholesale electricity marketplace for the region.[4] In June, 2001, FERC conferred authority on ISO to be responsible for the regional transmission planning process.[5] In June 2003, FERC confirmed ISO's authority to approve planning for upgrades and changes to supply and demand-side resources.[6]

Q. *Does ISO make any profit from its role as the Independent System Operator?*

A. No. As the Independent System Operator, ISO complies with FERC Order No. 889.[7] 75 FERC 61,078. In this regard, ISO is an independent, private, non-profit, non-stock, company. ISO therefore has no shareholders, and its Directors, employees and consultants are barred from being employed by or owning shares

[3] New England Power Pool, Order Conditionally Authorizing Establishment of an Independent System Operator and Disposition of Control Over Jurisdictional Facilities, 79 FERC ¶ 61,374 (1997)(authorizing formation of ISO).

[4] New England Power Pool, Order Conditionally Accepting New and Revised Market Rules, 87 FERC ¶ 61,045 (1999)(authorizing ISO-NE to administer the restructured wholesale electricity marketplace).

[5] ISO New England Inc. & New England Power Pool, Order On Rehearing Requests and Compliance Filings, 95 FERC ¶ 61384 (2001)(authorizing ISO to oversee regional transmission planning).

[6] New England Power Pool & ISO New England Inc., 103 FERC ¶ 61,304 (2003) (accepting October 2001 compliance filing as to the directive regarding Sections 18.4 and 18.5 of the Restated NEPOOL Agreement, and stating that "[w]e are persuaded by ISO-NE's arguments that it is the appropriate authority to approve planning for transmission upgrades and changes to supply and demand-side resources.").

[7] Open Access Same-Time Information System Conduct, Order No. 889, 75 FERC ¶ 61,078 (1996)(rules establishing and governing Open Access Same-Time Information System).

in NEPOOL Market participants. Its budget is reviewed and approved annually by FERC, and ISO's Tariff only recoups its annual expenses. As a result, market activity covers ISO's expenses in monitoring and administering the system.

Q. What are ISO's mission and responsibilities?

A. ISO is responsible for managing the New England region's bulk electric power system, operating the wholesale electricity market, administering the region's Open Access Transmission Tariff, and conducting centralized system planning. More specifically, ISO's responsibilities include independently operating and maintaining a highly reliable bulk transmission system, promoting efficient wholesale electricity markets, and working collaboratively and proactively with state and federal regulators, NEPOOL Participants, and other stakeholders. NEPOOL Participants include generators, transmission owners, marketers, municipalities and "end users." Each of these types of entities make up a "NEPOOL Sector." Each sector has an equal vote in all NEPOOL matters, *i.e.*, a weighted vote of 20% per section. Connecticut NEPOOL Participants include both of the Applicants in this proceeding, as well as Connecticut Municipal Electric Energy Cooperative, Connecticut Energy Cooperative, Inc., Connecticut Resource Recovery Authority, and the Office of Consumer Counsel ("OCC").

Pursuant to this mission, ISO must maintain a level of system reliability that meets criteria established by NEPOOL, the Northeast Power Coordinating Council ("NPCC") and the North American Electric Reliability Council ("NERC"). Applicable reliability standards are discussed more fully below.

NEPOOL Reliability Standards, which are based on NERC Planning Standards, are found in NEPOOL Planning Procedure No. 3 (July 9, 1999).[8]

The massive outage which struck the North American electric power system on August 14, 2003, causing the loss of approximately 2,500 MW of load in New England, including much of Southwest Connecticut and portions of other areas in the state, has underscored the significance of ISO's mission and responsibilities. The event demonstrated the need for appropriate reliability standards, effective monitoring of compliance, and, most importantly, a reliable bulk power transmission system. A well-coordinated system plan and additional power system infrastructure are more essential than ever to ensure reliability of service to load, because without a well-planned system, there may not be operating decisions available to maintain uninterrupted service.

Q. What is ISO's role in operating the region's power grid system?

A. ISO operates the power grid for the six-state New England region, which includes approximately 350 generating facilities connected by approximately 8,000 miles of transmission lines. This regional network, originally established with the formation of NEPOOL in 1971, serves electricity in real time to more than 14 million New England residents and businesses. ISO's Control Center, which centrally dispatches this system based on the economic merit order of generating resources at any given time to match the region's electric load, is staffed around the clock by a team of experienced operators to ensure safe and reliable delivery

[8] NERC Planning Standards and NEPOOL Planning Procedure No. 3 are included in Volume 5 of the Application.

of electricity and transmission system reliability. If overloads are identified, a re-dispatch process occurs, if available.

Q. What is ISO's role in conducting regional transmission planning?

A. In June 2001, FERC conferred upon ISO responsibility for conducting long-term system planning for the New England region. The regional transmission plan ("RTEP") is developed through an open process and through participation of, and review by, interested parties, including state regulators and NEPOOL market participants. The RTEP is updated annually.

Each RTEP summarizes results from a yearlong regional planning effort that examines system needs throughout New England. The RTEP is a comprehensive electrical engineering assessment comprised of numerous studies and analyses of New England's bulk electric power system. By identifying problem areas, the RTEP is intended to provide appropriate information to the wholesale electricity marketplace on power system problems and the needs that may be addressed through investment in market solutions. Market responses might include investment in generation, merchant transmission facilities, distributed resources and demand response programs. If the market does not respond with adequate solutions to defined system needs, ISO is charged with providing a coordinated transmission plan that identifies appropriate upgrades for reliability and economic needs. The plan would be implemented only after market solutions have been considered. Thus, the RTEP is a planning process that responds to and integrates market responses with needed reliability and economic transmission upgrades in order to achieve a reliable system of generation, distributed resources, and transmission.

Q. *Does the RTEP study process focus on specific geographic areas?*

A. The RTEP study process included the development of "RTEP sub-areas" based on electrical interfaces in the system to evaluate region-wide reliability and economic indicators, including a Southwest Connecticut RTEP sub-area ("SWCT") covering more than 50 municipalities in South and Central Connecticut, a Norwalk-Stamford sub-area ("Nor-Stam") covering 14 municipalities in Fairfield County within the SWCT sub-area, and a Connecticut sub-area ("CT") covering the remaining northern and eastern portions of the state. For purposes of broad resource adequacy and economic modeling, these sub-areas simplistically assume no operating constraints within them, although in fact such constraints exist. As a result, they provide screening analyses. ISO then conducted more detailed studies of the operating constraints, embodied in various studies discussed herein, that provide more accurate pictures of the nature of the transmission system shortcomings in the SWCT and Nor-Stam sub-areas and the need transmission upgrades.

Q. *Who conducts the RTEP process?*

A. ISO conducts and directs the studies that comprise the RTEP with the advice of the Transmission Expansion Advisory Committee ("TEAC"). The TEAC is composed of a wide variety of regional stakeholders as may change from time to time, including NEPOOL Participants (such as generator owners, marketers, load serving entities and transmission owners), governmental representatives, state agencies (including those participating in the New England Conference of Public Utilities Commissioners), representatives of local communities, and consultants. The TEAC meets regularly throughout the year, and TEAC meetings are open to any interested party and have included representatives of the Connecticut Department of Public Utility Control, the OCC, the Institute for Sustainable Energy at Eastern Connecticut State University and the Connecticut Attorney General's Office.

Q. Can you briefly summarize the conclusions drawn by the RTEP process with respect to Southwest Connecticut?

A. Yes, the Regional Transmission Expansion Plan issued in October, 2001 ("RTEP01")[9] identified the system in Southwest Connecticut as having severe reliability problems whenever the largest single generation source in the SWCT sub-area is unavailable, and RTEP01 recommended feasibility studies to examine alternatives and cost estimates for major transmission upgrades to increase imports to the SWCT and NOR sub-areas. RTEP01 also noted the potential for significant congestion costs.

Q. Were the studies recommended by RTEP01 performed?

A. ISO, CL&P and UI personnel formed a working group (the "Working Group") to coordinate detailed thermal, voltage, short-circuit, transfer limit, and stability study analyses. A study scope was prepared and presented at a special TEAC meeting in August 2001, and the study was developed with public input as the first stage in an ongoing review of transmission system needs. The Working

9 ISO Admin. Notice No. 9; *See* http://www.iso-ne.com/smd/transmission_planning/Regional_Transmission_Expansion_Plan/RTEP_2001/

Group formulated ideas for the ultimate transmission plan for the southwestern region of Connecticut, and in January 2002 issued the Southwestern Connecticut Reliability Study – Interim Report ("Interim Report"), which covered the initial phase of the thermal, voltage and short-circuit analysis. Related studies were subsequently performed, including: (a) Southwestern Connecticut Reliability Study, Final Power-Flow, Voltage and Short Circuit Report, (issued in December, 2002) ("Final Report")[10]; (b) Comparative Analysis of a 345 kV Plumtree-Norwalk Overhead Line Versus 2 – 115 kV Cables from Plumtree-Norwalk (issued December, 2002, as part of the Southwestern Connecticut Reliability Study)("Comparison Study")[11]; (c) Southwest Connecticut Electric Reliability Study, 345-kV Plumtree – Norwalk Project Final Power-Flow, Voltage and Short-Circuit Report ("Phase I Report")[12]; and (d) Southwest Connecticut Reliability Study, Comparison of Middletown to Norwalk Project vs. East Shore Alternative (issued in February, 2004) ("East Shore Study")[13]. All of these reports form the Southwestern Connecticut Reliability Study.

Q. *Have subsequent RTEP reports further examined the system in SWCT and Nor-Stam sub-areas?*

A. Subsequent RTEP reports issued in November, 2002 and November, 2003 (respectively referred to as "RTEP02" and "RTEP03") reported extensively on

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[10] ISO Exhibit 4.
[11] ISO Exhibit 5.
[12] ISO Exhibit 6 (filed by CL&P in response to PSEG-01 and OCC-01 Interrogatories)
[13] See Addendum 3 to December 16, 2003 Supplemental Filing by Applicants.

problems in the SWCT and Nor-Stam sub-areas. RTEP02[14] contained the following finding:

> The most urgent system reliability need is in the SWCT and NOR Sub-Areas. The combined area lacks the required transmission infrastructure to provide adequate reliability to its electric customers. Without transmission infrastructure upgrades, studies demonstrate widespread violations of transmission planning criteria. As a result, without such upgrades, it is doubtful that the existing system could reliably support projected loads in the long term. In the short term, without significantly increased implementation of DSM and LRP it is doubtful that the existing system can reliably support the projected loads. ISO-NE has determined that the existing transmission system configuration cannot provide for significant generation expansion or even the simultaneous operation of the existing generation at full load. (See RTEP02, Section 1.2.1, p. 13)

RTEP02 recommended proceeding with 345 kV Phases I and II transmission upgrades to SWCT. (*Id.* at Section 1.3.1, p. 14)

The Executive Summary of RTEP03[15] repeated the foregoing admonition, indicating that in spite of recent local improvements, the most urgent system reliability need in New England continues to be in the SWCT and Nor-Stam sub-areas (RTEP03, Section 5.4.5, p.32), again warning that the existing transmission system in Southwest Connecticut can neither provide for significant generation expansion nor fully utilize the area's generating resources during times of need. RTEP03 expressed support for the approval of a 345 kV line from Middletown to Norwalk.

There have been no new developments that would significantly mitigate long term reliability concerns for this area since RTEP03 was issued.

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[14] ISO Admin. Notice No. 10; *see* http://www.iso-ne.com/smd/transmission_planning/Regional_Transmission_Expansion_Plan/RTEP_2002/

[15] ISO Admin. Notice No. 11; *see* http://www.iso-ne.com/smd/transmission_planning/Regional_Transmission_Expansion_Plan/RTEP_2003/

Accordingly, ISO recommends approval and completion of the 345kV full loop as soon as practicable.

Q. *Will ISO experience any pecuniary benefit if the Connecticut Siting Council approves the Applicants' request for a Certificate of Environmental Compatibility and Public Need for the electric transmission line at issue and the line is placed in service?*

A. No. Because ISO is an independent, not-for-profit entity, neither ISO as a corporate entity nor its directors, employees or consultants, may experience a pecuniary benefit from the Siting Council's approval of the application in this proceeding for a Certificate of Environmental Compatibility and Public Need.

IV. THE RELIABILITY OF THE TRANSMISSION SYSTEM IN SOUTHWEST CONNECTICUT

Q. *Does ISO consider electricity service in the southwestern region of Connecticut to be unreliable?*

A Yes.

Q. *Why does ISO consider electricity service in the southwestern region of Connecticut to be unreliable?*

A. ISO believes that electricity service in the southwestern region of Connecticut is unreliable because under current assumptions about electric demand growth and available generation in the area, the existing transmission system is incapable of importing sufficient amount of electricity into and moving it reliably within the region. As a result, there are an unacceptable number of violations of the

NEPOOL Reliability Standards when the system is tested and modeled in accordance with those Standards. Transmission system inadequacies could also hamper new generation from addressing growing load in the region.

Generally speaking, the electric demand in the southwestern region of Connecticut – *i.e.*, the number of consumers of electricity and the amount of electricity they consume – regularly increases, demanding new sources of electricity. Additionally, because there are inadequate transmission facilities, the local electricity supply plus the supply that must be imported from other areas of Connecticut and New England are unable to reach the demand areas in the southwestern region of Connecticut.

Because there is an insufficient local supply of electricity, users of electricity in the southwestern region of Connecticut must rely on transmission lines not only to transport electricity produced within the southwestern region of Connecticut, but also to import electricity from the rest of Connecticut and New England. For example, the peak demand in the Norwalk-Stamford area is approximately 2.5 times the total amount of local generation.

As a result, this region of Connecticut is highly dependent on power imports over the 115-kV transmission system in Connecticut and is critically dependent on a 138-kV transmission line from Long Island, New York in the event of severe demands for electricity. This 138-kV line has, however, been unavailable for prolonged periods of time and has an uncertain future.

The problems in providing electricity are exacerbated if local supplies of electricity are unavailable. Given the natural occurrences of unexpected outages, there is concern that local generating units, which may be in great demand, may not be available. In addition, given the age of the units and the environmental and political pressures, there is also concern that units in key locations could be shut down due to a catastrophic or other failure, either permanently or for an extended period for replacement. As a result, there must be a robust transmission system in place to import needed electricity into and around this region. However, the amount of electricity that the existing transmission system can import from other areas and transmit within the southwestern region of Connecticut is limited, creating an unacceptable risk of failure under NEPOOL Reliability Standards.

Q. *Have there been any actual experiences which have caused operational concern?*

As described in more detail below, residents and businesses in the SWCT sub-area experienced two close calls in losing electricity in August, 2001 due to circumstances arising within the SWCT sub-area. These events illustrate the potential of the system in the SWCT sub-area, without the full 345 kV loop, to trigger disturbances which could have widespread consequences. I was concerned when I testified during Docket No. 217 regarding the Bethel to Norwalk 345 kV line, that a situation in Southwestern Connecticut could give rise to a widespread outage affecting several states in a matter of seconds, and I remain concerned today that until the 345 kV full loop is installed, such an event in Southwestern Connecticut could still occur with massive consequences.

While ISO's operating experience is that the system in southwestern Connecticut has been unreasonably close to experiencing blackouts on other occasions without the influence of any events external to the system, my concerns about the speed and scope of an outage caused by Southwestern Connecticut's unreliable system were nevertheless illustrated by the Northeast power system disturbance on August 14, 2003. That event spread eastward from Ohio in a matter of seconds, affecting some 50 million people in the Northeastern United States and adjacent parts of Canada. While the August 14, 2003, disturbance did not originate in our system, and while electricity service was not disrupted in most of New England, it is worth noting that much of the SWCT sub-area, the weakest part of the New England grid, was blacked out for close to 12 hours. No other part of the New England system was affected as seriously or lost so much load.

Q. What criteria did ISO use to determine whether electricity service was unreliable in the southwestern region of Connecticut?

A. In accordance with the NEPOOL Reliability Standards applicable to ISO's transmission system planning process, ISO reviewed those generation and transmission facilities in the southwestern region of Connecticut on which faults or disturbances can have a significant effect in New England.

Since several years are required for permitting, financing, designing and constructing a major transmission system upgrade, as evidenced by the Applicants' proposed 2007 target for placing the M-N Line in service, ISO relied on reasonable load forecasts and assumptions about the future availability of generation units, applying that information in a computer modeling process designed to observe problems on the transmission system under a variety of scenarios.

Q. What do the NEPOOL Reliability Standards establish?

A. NEPOOL Reliability Standards define the criteria that are used to assure the reliability and performance of the interconnected electrical network in New England. Adherence to these standards assures that the New England transmission system shall be designed with sufficient transmission capacity to integrate all resources and serve area demands under certain specified conditions. Analyzing the system with due regard to these standards determines whether the transmission is capable of delivering generation to the load in any given region under both anticipated and unusual circumstances.

Q. What are the NEPOOL Reliability Standards based on?

A. NEPOOL Reliability Standards are based on standards developed by regional and independent bodies to avoid large-scale blackouts. Following blackouts in the northeastern United States in the 1960s and 1970s, what is now known as NERC was formed in an attempt to prevent future occurrences by establishing broad-based reliability standards. The NPCC, of which ISO is a member, was subsequently formed to develop regionally-specific criteria based on NERC standards. The NEPOOL reliability standards are consistent with NPCC reliability criteria.

These reliability standards have long provided the basis for the development of the New England transmission grid, and provide the basis for similar standards throughout the Nation, and portions of North America.

Q. How did ISO analyze whether the transmission system in the southwestern region of Connecticut violates NEPOOL Reliability Standards?

A. The Interim Report and the Final Report issued by the Working Group analyzed the operational capability of the transmission facilities in the southwestern region of Connecticut. These reports identify the transmission system inadequacies and reliability violations prior to installation of the 345 kV line from Bethel to Norwalk (Phase I) approved by the Connecticut Siting Council in Docket 217. The reliability violations ran into the hundreds, as listed in Appendix D to the Interim Report. The Final Report identified numerous thermal overload, voltage violation and voltage collapse scenarios which exist with today's transmission system, prior to installation of the Phase I line, and proposed that a 345 kV "loop" be constructed to fully integrate SWCT and the Norwalk–Stamford area into the New England 345-kV network and alleviate reliability problems. The Phase I Report indicates that while system performance improves at the design peak load level of 27,700 MW with the installation of the 345 kV line from Bethel to Norwalk, significant thermal overloads and voltage violations continue to exist following construction of this line. The Phase I Report therefore concludes that the SWCT electric power system does not meet regional reliability performance standards.

The Phase I Report is consistent with the Comparison Study, which examined Phase I both as a stand alone project and as part of a full 345 kV loop connecting Bethel to Middletown through Norwalk. Construction of the 345 kV line from Bethel to Norwalk would alleviate system performance, but modeling indicates that even after installation of this line, 276 contingency overloads would occur on 40 lines and there would be 17 non-convergent contingencies. A non-convergent contingency is one for which there is no mathematical solution, and it signals the potential for voltage collapse. The Comparison Study, which assumed an overhead project with no underground lines, showed no violations when the Phase I line was modeled as part of a full 345 kV loop which would continue from Norwalk to Middletown.

Q. Does ISO therefore believe that the proposed M-N Line will eliminate all SWCT reliability violations?

A. As noted, the Comparison Study was based on the assumption of an overhead line so its conclusions do not necessarily apply to the combination overhead/underground alternative approved for Phase I from Bethel to Norwalk, especially as the M-N Line also proposes an underground component. Because overhead lines and underground cables have different electrical characteristics and properties and behave differently, one is not necessarily a substitute for the other under all circumstances. Underground cables are inherently more capacitive, have lower impedance, and lower capacity than overhead lines. Heavy reliance on long underground cables in the SWCT area can result in increasing and excessive voltage on the bulk power system, thereby causing heretofore unforeseen threats to reliability associated with high voltage levels. Additionally, power will naturally flow on the lower impedance path introduced by the cables, resulting in a disproportionate loading of these lower capacity facilities. Therefore, modification of the full overhead loop to an overhead/underground combination requires supplemental studies to determine any additional system modifications required to develop a cost-effective design with acceptable transient and steady-state voltages and facility thermal loadings. Impacts on the entire loop will be considered. The length of underground cable, with its lower impedance, must not undermine short-circuit current mitigation efforts addressed by the project.

Q. Why was a 27,700 MW peak load used in these studies?

A. It is good utility practice to consider a range of forecasted peak demands in selecting a design basis load level. ISO issues a forecast which assumes average weather conditions and a peak load which has a 50% probability of being exceeded (the so-called "50/50" forecast), and ISO also issues a forecast which assumes extreme weather conditions and a peak load which has a 10% probability of being exceeded (the so-called "90/10" forecast). Designing a system on the peak load projected by the 50/50 forecast essentially means that the system would not meet peak loads reached 50% of the time. It is therefore prudent to plan for peak loads which may be reached in extreme weather conditions. The 27,700 MW design basis peak New England demand level used in this study is based on the NEPOOL 2003 Capacity, Energy, Load and Transmission ("CELT") Report, issued in April 2003, that predicts a 2010 peak demand of 27,820 MW with a 50% probability of being exceeded. However, considering a 10% probability of exceeding the forecasted peak demand, this load level would be reached as early as 2006. Bearing in mind the Applicants' proposed completion date of December, 2007, a 27,700 MW load level appeared to represent demanding, yet plausible, stresses on the transmission grid. Based on the peak load of 25,348 MW on August 14, 2002, which as of that time had not been projected to occur until

Summer 2005, and extreme weather conditions experienced on several occasions during the summer of 2002, the 27,700 MW load level is reasonable.

RTEP03 indicates that the summer peak has increased by 20 percent over the last ten years and is expected to continue to grow by 15 percent over the next ten years, a compound annual growth rate of 1.5 percent per year. The 2003 CELT Report predicts a peak New England summer load of 25,690 MW in 2004 based on normal weather and a 50% probability of being exceeded, and this would increase to 26,300 MW based on extreme weather and a 10% probability of being exceeded. Historical and anticipated load growth rates, applied to extreme weather conditions, indicate that the 27,700 MW design load level would be exceeded in the summer of 2008.

Q. What sorts of reliability problems was ISO concerned about in conducting the Southwestern Connecticut Reliability Study and why are they problematic?

A. The Southwestern Connecticut Reliability Study examined the thermal and voltage capability of the transmission facilities in the southwestern region of Connecticut. The Working Group had several concerns, each associated with the combination of demand in the southwestern region of Connecticut and available generation.

We share the Working Group's concerns with thermal overloading of transmission lines, poor voltage performance, potential voltage collapse, and high short circuit current levels. We are concerned that there not be any interruption of service in Southwest Connecticut, and as the operator of the regional bulk power grid for all of New England, we are further concerned that any outage in

Connecticut not cascade into neighboring states and neighboring systems in New York and Canada. The Northeast Blackout of August 14, 2003 is clear evidence that if voltage collapse occurs, it can spread in a matter of seconds over a large geographic area, creating massive blackouts and resulting damage and loss.

Q. How do thermal overloads occur?

A. Thermal overloads occur when transmission lines are forced, often as a result of a contingency event elsewhere on the system, to carry current in excess of their design capacity. Overloaded lines build up heat beyond their temperature limits and may fail, redirecting power to other lines, which in turn may become overloaded, a pattern which may result in loss of load, equipment damage and cascading outages which could affect areas inside of and well outside of Connecticut.

Transmission lines have normal and emergency current ratings. Normal ratings are the rating limits within which a line should generally operate at all times. Normal line loading ratings are violated when a transmission line is used to carry more current than it is capable of carrying under normal conditions. Transmission lines can be operated at current loads that exceed the normal rating, but only for a limited period of time, such as in an emergency. An emergency current rating is the upper operational limit of the line. A consequence of running lines between normal and emergency limits is reduced life expectancy of the transmission line. Exceeding emergency ratings of transmission lines could result in line mechanical failure or sagging into public areas, such as highways, thereby compromising public safety, and uncontrolled outages.

Q24. Why is low voltage a concern?

A24. Low voltage is also a concern because it could damage equipment and interfere with the proper operation of appliances and machinery. Insufficient voltage can also cause unanticipated and undesirable protective equipment operation, voltage collapse and loss of load.

Q. Are there concerns involving busses?

A. There is a concern that busses, which are substation terminals, would experience voltage outside of their design criteria. If a bus's voltage is below design criteria, then there is an increased and unacceptable likelihood that an area will lose supply of electricity. Left unchecked, low voltage can damage customer equipment.

There is also concern that voltage to busses could be so low that the System Operator would be unable to take action (such as controlled load shedding) to avoid widespread voltage collapse. Under this scenario, affected areas will likely lose supply of electricity in an uncontrolled manner.

Q. Why are high short circuit current levels a concern?

A. High short circuit currents are a concern because they could result in catastrophic equipment failure and present a danger to personnel. The equipment failure could lead to extended equipment and customer outages and diminish the ability to reliably operate the power system.

Q. *How many violations of NEPOOL Reliability Standards may occur before a system is considered to be out of compliance?*

A. None. A system that has one violation of the criteria outlined in the NEPOOL Reliability Standards is not in compliance.

Q. Are there other studies or analyses ISO has conducted to assess the reliability of the electric network in Connecticut?

A. ISO regularly performs "System Impact Studies." These are studies that ISO is contractually obligated to perform pursuant to the NEPOOL Open Access Transmission Tariff and Section 18 of the Restated NEPOOL Agreement. In these studies, ISO determines the transmission requirements necessary to interconnect generation units or transmission facilities in a manner that would not adversely affect the reliability of the transmission grid in New England. In conducting these studies, ISO found that the circuit breakers at both the Devon and Pequonnock substations have come close to exceeding their ratings for the amount of current they are capable of interrupting. If the rating is exceeded, a catastrophic equipment failure could result. For this reason alone, ISO believes that considerable system changes would be necessary to protect the integrity of the system if a party sought to add another generator.

Q. Are there other reasons why ISO believes electricity service in southwestern region of Connecticut to be unreliable?

A. Yes. ISO's experience in operating the New England transmission system makes it concerned that the southwestern region of Connecticut is unreasonably close to losing electrical supply. For example, on August 31, 2001, a day on which demand for electricity was relatively light in the region, Bridgeport Energy Station tripped off-line. The loss of this generation increased the flow on lines supplying the area, causing certain lines to fail. Due to the rapid loss of energy supply, ISO declared an emergency for the area, dispatched all area generation, and was required to purchase emergency energy from the Long Island system over the 138-kV transmission line that runs from Northport, New York, to Norwalk Harbor, an option which might well not be available in the near future. ISO also configured the system to enable discontinuance of electric service to several communities in the Danbury area to avoid large-scale blackouts in the event of a particularly severe contingency. The operators, during this non-peak condition, were able to manage the system without disconnecting the load.

On August 9, 2001, a heat wave resulted in unprecedented demand for electricity in the southwestern region of Connecticut. The high demand required ISO to dispatch nearly all generating units in New England. ISO was not required to discontinue electricity service to areas in the southwestern region of Connecticut because all generating units happened to be available and no contingencies occurred on the transmission system.

It was fortunate in these circumstances that every available generating unit was on-line, unlike January 22, 2003, when SWCT and Nor-Stam suffered outages of eight units representing 1,038 MW, close to 40% of the 2700 MW installed capacity of these sub-areas. The loss of any one generating unit on either August 9 or August 31, 2001, would have resulted in ISO discontinuing electricity service to some areas in an effort to prevent a cascading outage. Under certain load conditions, load-shedding schemes are automatically set following certain contingency events in order to ensure that electricity service will not be discontinued in an uncontrolled fashion.

Q. *What are the consequences of an uncontrolled blackout?*

A. There are two consequences to uncontrolled blackout. First, there is no way to predict how large an area will be affected by blackout, and as a result, it could encompass vast areas of the northeastern United States, as happened in August, 2003 and September, 1965. Second, it will likely result in equipment damage that will hamper restoration of service and make efforts to remedy the system more expensive.

Q. *Would the use of underground cable be a reliability concern?*

A. Yes. Underground cable is generally used in urban areas where it might be difficult to locate and maintain overhead lines, generally for relatively short distances and at lower transmission voltages. There are various underground cable technologies, and I am aware that each has its advantages and disadvantages. Excessive reliance on underground cable in the SWCT area would result in a more complex system, potentially exceeding the practical limits of operator interaction to prevent increasing and excessive voltage on the system due to the inherent capacitive nature of the cable and control loadings on the cables due to their lower impedance. In addition, ISO would point out that if an underground cable experiences a fault which takes it out of service, it would take considerably longer to restore an underground cable to service than would be the case for an overhead line. It is relatively easy to locate and repair the problem in an overhead line, all of which can generally be accomplished in a day or two. It may take many days to locate the break in an underground cable, since it is buried and inaccessible, and the repair itself, which may require splicing of cables, is also more complicated and time-consuming. If an underground cable fails, it may therefore stay out for up to weeks or months.

It should also be understood that an underground cable does not necessarily have the same properties and characteristics as an overhead line, and while the differences can be accommodated and planned for, the system will not necessarily behave the same way if one is viewed simply as a substitute for the other in all circumstances. Transmission solutions, often with several components, like the full 345 kV loop, are planned as an integrated and balanced "whole". Indiscriminately substituting an underground cable in one component can easily upset the balance and substantially undermine the solution.

V. CONGESTION IMPACTS

Q. Do transmission inadequacies create other disadvantages for Connecticut customers?

A. Transmission system inadequacies prevent access to more economical generation because the transmission facilities are unable to carry less expensive electricity into Southwest Connecticut from newer, lower cost facilities located outside of the area. Transmission also allows for access to additional generation capacity, thereby resulting in approved reliability.

Q. Will you comment on the impacts of "Standard Market Design" on costs in a transmission-constrained area, such as Southwest Connecticut?

A. Congestion costs incurred by all areas in New England used to be spread across customers in all states through the mechanism of a single region-wide clearing price. The management of congestion and congestion costs has changed under Standard Market Design ("SMD"), which became effective in New England in March, 2003. Under the new system, the costs of paying higher-cost generators to address the electricity needs of a transmission-constrained area are reflected in "locational marginal pricing" ("LMP"). Under this pricing mechanism, a different electric price is charged in each zone in New England, and Connecticut is one zone. The wholesale prices of electricity in zones where transmission constraints prevent access to the least-cost sources of generation located outside the zone will be higher in order to reflect the extra costs resulting from dispatch of more expensive sources of generation inside those zones. These higher costs to serve a zone are no longer "socialized" across New England, but are borne directly by wholesale purchasers supplying power to retail customers within the constrained zone. Due to current constraints, Connecticut residents will thus incur additional indirect financial burdens.

Q. Is your support for the 345 kV full loop based on an anticipated reduction in congestion costs?

A. ISO believes that a 345 kV full loop is necessitated by reliability alone, whether or not congestion costs are reduced, and reliability is the main reason ISO supports the M-N Line. Congestion costs ordinarily occur where there are transmission constraints, so the M-N Line, in relieving transmission constraints, should also have the collateral benefit of reducing congestion costs.

VI. NEW GENERATION

Q. Have any new generating facilities in the southwestern region of Connecticut been approved for interconnection, in addition to those assumed for the <u>*Southwestern Connecticut Reliability Study – Interim Report*</u>*, to alleviate the strain on transmission lines?*

A. No. In fact, there is the threat of existing generating facilities being retired in the next few years. The age and condition of generators in the area is a concern, and financial considerations may prevent units from remaining in operation.

The first generating unit in Milford has come on line, as had been anticipated, at a summer claimed capability of 234 MW. However, the addition of the new Milford unit does not necessarily represent an increase in generation above existing supply of the full 234MW. First, there had been a conditional dependency between Milford and Devon units which had prevented the simultaneous operation of both units, and that dependency can only be relieved by a transmission upgrade. Second, Devon Units 7 and 8, had been operating pursuant to a "Reliability Must Run" ("RMR") contract, under which ISO could terminate the contract with respect to one or both of the units. Because one Milford unit is in-service, the ISO has given notice of its termination of the RMR contract with one of the Devon Units. As a result, from the perspective of the overall capacity of the SWCT area, the Milford unit's contribution to area generation may be offset by the loss of approximately 107 MW at Devon.

Q. *Would the construction of new generating facilities in Southwest Connecticut resolve ISO's concerns about reliable electricity service?*

A. No. ISO has analyzed the existing transmission system to assess the range of local generator outputs and power transfers that can be accommodated without violating system reliability standards. These analyses show that as the load increases in the southwestern region of Connecticut, reliance on any particular local generator precludes reliance on other local generators due to constraints on the transmission facilities. As a result, the reliability of service for the region is unacceptable, because the transmission facilities are simply inadequate, especially with major generating units out of service.

ISO has found that this situation worsens with load growth to the point at which nearly any and every combination of local area generation outputs and power imports results in violations of NEPOOL Reliability Standards. This can result in an unacceptable likelihood of load being shed in order to avoid equipment damage or a possible cascading outage that results in a significant blackout. In considerable contrast, a "compliant" system would allow any amount of, or at least most, generation from area generators to be used under any load scenario without any violations of Reliability Standards.

Additionally, the high short circuit current levels present a very significant challenge to the interconnection of new generation in Southwest Connecticut.

VII. BENEFITS OF THE 345-kV TRANSMISSION LINE

Q. What reliability benefits will the project proposed by the Applicants provide to the transmission system?

A. Installation of this the M-N Line will reduce the number of line segments and busses that violate NEPOOL Reliability Standards. While further study must be done to determine whether the overhead/underground combination 345 kV loop will be as helpful as an overhead solution would have been, addition of the M-N Line will improve performance of the Phase I line, which does not achieve its full potential without the M-N Line. It will increase power flow into the region, increase the area's import capability and enable both the use of the full capacity of local generating units and the addition of local generation. The installation of the M-N Line should also result in less lost energy at a transmission level.

In the RTEP process, ISO set out to formulate a long-term transmission solution for the southwestern region of Connecticut that satisfies reliability criteria, eliminates operating difficulties, eliminates "first contingency" (including double circuit overloads) and eliminates the threat of voltage collapse. The 345kV transmission "full loop" would resolve these concerns.

Q. Has ISO examined the so-called "East Shore Alternative" to the M-N Line?

A. Yes, this alternative was examined in the East Shore Study. The East Shore Alternative as studied was found to be an unacceptable substitute to the M-N Line because it does not meet NERC, NPCC, or NEPOOL criteria. The East Shore Alternative does not strengthen the power supply into SWCT by introducing a new source; it simply connects the load in SWCT to an already heavily loaded

387 line. The most notable overload in this report is the one on the 387 line. Even with the assumed reconductoring of the limiting portion of the 387 line, the line continues to overload. In addition, an extended outage of this line yields substantial overloads on the remaining corridors serving SWCT and the 345-kV across the state.

Since the East Shore Alternative is not considered acceptable, continued comparative testing was not performed.

VIII. NON-TRANSMISSION ALTERNATIVES

Q. Has ISO advocated that other actions be taken to address reliability concerns in Southwest Connecticut?

A. ISO supports any action that can be taken that promotes reliable, efficient and competitive electricity service. ISO believes that the reliability problems in the southwestern region of Connecticut are critical. Because the proposed M-N Line is not scheduled for completion until December 2007, ISO has taken other actions to address its concerns about reliability in the southwestern region of Connecticut for the interim, including the issuance of a Gap RFP in December 2003. The RFP, whose results may not be finalized until early spring, 2004, sought 300 MW of generation resources, demand response resources or peak-load reducing Conservation and Load Management projects for up to four and possibly five years. These solutions are intended to provide temporary relief to "buy time" until the 345-kV project is complete.

The problems inherent in the Southwest Connecticut transmission system have even made it very difficult to temporarily address reliability concerns with the GAP RFP. Generation resources responding to the RFP may be restricted to operate in only significant emergency conditions.

ISO has also advocated weighting load response dollars toward greater participation in Southwest Connecticut, where the need for such action is greatest.

ISO believes, however, that the 345 kV full loop is the only proposal that promises to provide a long-term solution to concerns about reliability. Neither new generation nor load response programs can achieve the same long-term results as the 345-kV full loop.

Q. *Has ISO reflected the load reduction contributions of distributed resources, demand response and other conservation and load management efforts in its load forecasts?*

A. Yes. ISO the 27,700 MW load level reflects expected contributions from these programs.

Q. *Can distributed generation in the southwestern region of Connecticut resolve ISO's concerns about reliability?*

A. Distributed Generation, which generally means small generators of kW to multi-MW size installed at a customer's point of use, will not alone resolve ISO's concerns about reliability. Distributed Generation has a number of different uses, including emergency or backup power, peak shaving, premium power for critical loads, and combined heat and power. There are cost and performance issues with distributed generation, and it will take some time for these to be resolved. There may also be noise and emissions concerns. ISO does not foresee any rapid expansion of Distributed Generation over the next five years or so.

Even if sufficient distributed generation could be installed to offset annual growth in load, this course of action would do nothing to eliminate the severe operating constraints that exist in the southwestern region of Connecticut today. As a result, ISO's concerns about violation of NEPOOL Reliability Standards would remain unaddressed.

Q. *Can demand response programs resolve ISO's concerns about reliability?*

A. Demand response can help, but it will not eliminate the need for a 345-kV full loop. ISO has overseen a FERC-approved Load Response Program for New England. ISO New England's 2003 Demand Response Program signed up approximately 400 MW of relief for Summer, 2003, for New England. Of this, a Northeast Utilities sponsored program specifically for Southwest Connecticut provided 20 MW of load relief and over 60 MW of emergency generation for use during high load periods. Typically, only a portion of the load in a voluntary demand response program actually responds when called upon. As a result, ISO believes it unlikely that load response programs could be implemented in a manner that addresses its concerns about reliability. Those concerns will best be addressed by a 345 kV full loop connecting Southwestern Connecticut with the rest of New England's 345 kV bulk power grid.

Q *Does this conclude your testimony?*

A. Yes.