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
	JUNE 7, 2004

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

I. Introduction

Q. Please state your name and business affiliation.

A. My name is Stephen G. Whitley and I am Senior Vice President and Chief Operating Officer of ISO New England Inc. ("ISO" or "ISO-NE").

Q. Will ISO-NE experience any pecuniary benefit if the Connecticut Siting Council either approves or denies 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.

Q. Have you or any other representative of ISO New England Inc. ("ISO") previously testified in this proceeding?

A. Yes. I submitted pre-filed testimony on March 9, 2004, and Mr. Kowalski and I appeared before the Siting Council for cross-examination on March 23, 2004.

II. ISO's Responsibilities Regarding Applicant's Proposal

Q. Why are you submitting supplemental pre-filed testimony in this proceeding?

A. ISO has expressed in its previous testimony certain reservations regarding extensive use of underground 345kV cable, and we wanted to report on our continuing evaluation of the Applicants' proposed Middletown-Norwalk overhead/underground 345kV project (the "Project"). We also wanted to provide the Siting Council with a context which might enable better understanding of the ISO's responsibilities regarding ultimate evaluation of the Project.

Q. What are the ISO's responsibilities with respect to the Project?

A. ISO's responsibilities with respect to and authority over the Project arise within our broader mission of assuring the reliable day-to-day operation of New England's bulk power generation and transmission system ("bulk power system") and conducting the planning of the bulk power system in accordance with Good Utility Practice and national and regional reliability criteria. Pursuant to that mission, Section 18.4 of the Restated NEPOOL Agreement calls for a review of any proposed additions to the transmission system rated 69kV or above and a determination that no such addition proposed by any NEPOOL Participants (such as the Applicants in this Docket) shall have a significant adverse effect upon the reliability or operating characteristics of its system or of the systems of one or more other Participants in NEPOOL. If the Participant proposing the transmission system receives a notice from the ISO that the proposed addition will have a significant adverse effect upon the reliability or operating characteristics of its system or the systems of one or more other Participants, that Participant may

not proceed with the proposed addition (save for preliminary engineering work) unless it agrees to such mitigative measures as ISO may determine to be necessary to avoid significant adverse system impacts.

Q. What is Good Utility Practice?

A. "Good Utility Practice" is defined in the NEPOOL Open Access Transmission Tariff as follows:

> Any of the practices, methods and acts engaged in or approved by a significant portion of the electric utility industry during the relevant time period, or any of the practices, methods and acts which, in the exercise of reasonable judgment in light of the facts known at the time the decision was made, could have been expected to accomplish the desired result at a reasonable cost consistent with good business practices, reliability, safety and expedition. Good Utility Practice is not intended to be limited to the optimum practice, method, or act to the exclusion of all others, but rather includes all acceptable practices, methods, or acts generally accepted in the region.

Q. Is ISO obligated in any way to follow Good Utility Practice?

A. Yes. ISO's highest priority is designing and operating a safe and reliable bulk power system, and Good Utility Practice informs all of the ISO's system design and operating decisions. I should add that ISO's decisions with regard to designing and operating the bulk power system must comply with national and regional reliability criteria, and that obligation is memorialized in ISO's operating documents.

For example, in addition to the responsibilities I've already described, the NEPOOL Tariff also requires that in ISO's assessment of the New England bulk power system (the "Regional Transmission Expansion Plan" or "RTEP"), the ISO must publish the RTEP to conform to Good Utility Practice, as well as applicable

reliability principles. The Tariff requires that all proposed transmission upgrades must also meet the requirements of Good Utility Practice and applicable reliability principles. In short, ISO has an obligation to assure that any proposed major transmission upgrades, including the Project, conform to Good Utility Practice.

Q. Is Good Utility Practice related to reliability?

A. Yes, and this is quite clear not only from the definition of Good Utility Practice given above, but also from the definition of a Reliability Upgrade in the NEPOOL Tariff, which states that "Good Utility Practice, applicable reliability principles, guidelines, criteria, rules, procedures and standards of NERC and NPCC and any of their successors, applicable publicly available local reliability criteria, and the NEPOOL System Rules" will be used to define the system facilities required to maintain reliability in evaluating proposed Reliability Upgrades. This indicates that proposed Reliability Upgrades must conform to the requirements of Good Utility Practice in order to qualify as Reliability Upgrades.

Q. Didn't ISO include in prior RTEPs the full 345kV loop in Southwestern Connecticut, including both the Phase I line from Bethel to Norwalk and the Phase II line from Middletown to Norwalk, and if so, wouldn't this suggest that ISO views the full loop, including the Middletown-Norwalk segment, as conforming to Good Utility Practice?

A. In prior RTEPs, the ISO has included the so-called "full loop" transmission project, which would consist of a line from Bethel to Norwalk and a line from Middletown to Norwalk. However, the full loop configuration included as part of

RTEP's assessment of system needs was an overhead line configuration. The RTEPs did not contemplate the substantial amount of underground cable in the full loop that would result from the combination of underground cable required in Docket No. 217 and the amount of underground cable included in the Project, as proposed by the Applicants.

Q. Does the concept of Good Utility Practice apply to ISO in any other way?

A. Yes, it is one of the considerations we must apply, pursuant to Schedule 12C of the NEPOOL Tariff, in determining what costs are eligible for regional cost support and what costs must be localized. Schedule 12C requires ISO, in making its determination of whether Localized Costs exist, to consider the reasonableness of the proposed design and construction method with respect to (i) Good Utility Practice, (ii) the current engineering design and construction practices in the area in which the Transmission Upgrade is built, (iii) alternate feasible and practical Transmission Upgrades and (iv) the relative costs, operation, timing of implementation, efficiency and reliability of the proposed Transmission Upgrades.

In that regard, FERC has recently given the ISO additional guidance on how to implement Schedule 12C, directing the ISO that "[a]ny costs incurred above these basic costs (which include the costs necessary to maintain a safe, reliable and adequate transmission infrastructure) should be borne by the locality that will benefit from them."[1]

[1] *See Patrick C. Lynch, Attorney General of the State of Rhode Island v. ISO New England Inc.*, "Order Dismissing Petition for Declaratory Order," 107 FERC ¶ 61,272 at P.17 (Docket EL04-91) (2004).

III. Evaluation of Underground Cable Aspects of the Project

Q. Can you summarize the conclusions to date resulting from your evaluation of the underground aspects of the Project as presently designed?

A. It is ISO's belief, as explained more fully below, that the Project, as proposed and presently designed, will not operate reliably. The proposal would introduce too much capacitance to a relatively weak system, resulting in low order harmonic resonances. This phenomenon can cause system failures, including cascading outages, and damage to equipment, including transformers. The driving factors regarding capacitance are linked to the length and type of cable installed and the strength of the system to which it is connected. We have not seen a plan that would satisfactorily mitigate these problems.

Q. Where does ISO stand with respect to its evaluation of the Project, as proposed by the Applicants?

A. ISO has participated with the Applicants in the Southwest Connecticut Working Group and has reviewed various studies prepared for the Applicants by their consultants (the "GE Studies"). We have also devoted substantial efforts toward identifying and resolving problems associated with the extensive use of underground cable in the Project, as proposed by the Applicants. Lastly, because of concerns raised by the GE Studies, we asked our own consultant, PB Power of Boston, Massachusetts ("PB Power"), to review GE's analysis and conclusions.

Q. What concerns were raised by the GE Studies?

A. The concerns generally relate to the extensive amount of underground cable proposed for the Project, which creates too much capacitance. For example, in its

Connecticut Cable Transient and Harmonic Feasibility Study, Final Report, March 2003, GE observed, as we knew, that a long-distance Extra High Voltage AC transmission cable system is unprecedented, and that the large amount of cable charging capacitance associated with the transmission distances involved in the SWCT Full Loop, combined with moderate short-circuit strengths which occur under credible operating conditions, relative to the cable charging currents, created the possibility of system configurations which introduce the risk of transient and harmonic problems occurring. That Report noted the potential for low-order harmonic resonance issues which could result in amplification of harmonic voltage and current distortion and severe transient and temporary overvoltages. These phenomena could cause power quality problems and could damage customer and utility equipment, which in turn may cause cascading failures on the bulk power system, impacting the region as a whole.

Q. *In reviewing the GE Studies, did ISO draw any conclusions regarding a minimum acceptable resonant frequency?*

A. In Connecticut Cable Transient and Harmonic Study for Middletown to Norwalk Project, East Devon-Beseck 40-mile Cable Option (M/N-P1), Final Report, November 2003, GE stated that designing a system configuration which results in an impedance resonance at 2nd harmonic is potentially very risky, could result in severe power system disturbances and is not recommended. With respect to this proposal, GE also stated that attempts to avoid the 2nd harmonic resonance by adding 2nd harmonic filters would not be practical. Designing such a system of distributed filters would also be a significant challenge.

Q. Does ISO agree with GE's position regarding 2nd harmonic frequencies?

A. As noted, we consulted with PB Power regarding the GE Studies. PB Power reviewed the Project and GE's analysis, and they concurred that the Project, as proposed or including suggested alternatives involving *additional* lengths of underground cable, could result in resonant frequencies at or below the 3rd harmonic. PB Power also cautioned that such low order harmonics are difficult to mitigate as they result in complex, large and costly filter design. In order to limit the complexity of corrective measures it is desirable to shift the low harmonic order resonant frequencies (2^{nd} and 3^{rd}) to values above the 3^{rd}. PB Power recommended that consideration be given to reducing the additional connected capacitance by increasing the use of technologies such as overhead line, taking into account the number of proposed transmission interconnections necessary to satisfy the security criteria of the transmission network under all credible operating conditions. Alternative system configurations or equipment selection should be considered to reduce the capacitance on the system and therefore increase the frequency at which resonance is likely to occur to higher order harmonics at which, if necessary, more practical harmonic filters can be applied. If harmonics such as the 4^{th}, 5^{th}, 7^{th} and 11^{th} harmonic are still problematic, appropriate filters can be designed.

Q. What have you concluded from your consultation with PB Power with regard to acceptable levels of harmonics on the bulk power system?

A. The objective is to design a bulk power system, which when operating under all credible conditions, does not result unacceptable power quality at consumers'

substations or delivery points. Designing the bulk power system to require operation with resonant frequencies at or below the 3rd harmonic, unless practical control measures are available, is not in accordance with Good Utility Practice because common switching events, like the opening and closing of circuits that occur in the normal operation of the bulk power system, can cause amplification of harmonic voltage and current distortion that could lead to unacceptable power quality and failures on the bulk power system should essential components become damaged by the transient overvoltages imposed. Equally importantly, it does not appear that practical solutions (in the nature of further investment in transmission equipment) to mitigate against the excitation of a system which resonates at or below the 3rd harmonic would be completely effective under all foreseeable disturbances and would in any case be counter-productive due to the increase in complexity of the system from an operational standpoint.

Q. *Would the minimum resonance frequency in the Project, as proposed, always be above the 3rd harmonic?*

A. It is my understanding that the Project as proposed would result in operation below the 3rd harmonic being required for some credible system configurations and operating scenarios. Other higher resonant frequencies may also occur. The actual values at which resonance occurs are affected by the specific configuration of the system at the time of a particular disturbance.

Q. *Aside from Southwestern Connecticut, are you aware of any other area in the New England bulk power system where operations occur at or below the 3rd harmonic?*

A. No.

Q. Are you aware of any other Transmission Owner in New England proposing to construct transmission facilities resulting in harmonic levels at or below the 3rd harmonic?

A. No.

Q. You commented that PB Power suggested that other equipment selection could be considered to increase the level of harmonics. Did PB Power offer any comment on other cable technologies than HPFF?

A. PB Power suggested that XLPE cables offer the best ratings and the minimum capacitance, but noted that long length EHV XLPE cable circuits are still considered to be a developing technology. As the quantity of cable required for the Project, in the M/N-P1 or P2 forms, would make it the largest AC cable project ever undertaken anywhere in the world by a considerable margin, PB Power advised that it would therefore be difficult to present engineering justification for the implementation of all of the cable circuits using XLPE insulated cables, even if it reduced capacitance sufficiently to raise harmonics above the 3rd harmonic.

Q. So, if the Project were designed to achieve operations above the 3rd harmonic, would your concerns be resolved?

A. Not necessarily. At a minimum, what we understand from reviewing the Project as proposed, and consulting with PB Power, is that operation of the bulk power system at or below the 3rd harmonic, unless practical control measures are available, is not in accordance with Good Utility Practice. There are other design

or operating concerns, such as issues associated with scheme complexity, voltage control, stability, short circuit duty and thermal ratings, that may arise from some other configuration of overhead lines and underground cables, and that may further depend on the type of underground cable technology used. As we have previously testified, the complexity of the system design itself also introduces operating uncertainties and reliability risks. In order to receive approval for construction, we believe that it will be necessary to demonstrate that the underground sections used, whatever their length, will not cause the system to operate at or below the 3rd harmonic frequency level.

In short, the Project, or any modification of the Project which would result in additional underground cable or any different configuration, would need to conform with the requirements of Good Utility Practice and applicable reliability principles. The practices and methods to be used in the Project or any modification thereof must be engaged in or approved by a significant portion of the electric utility industry, or, in the exercise of reasonable judgment in light of the facts known at the time, could be expected to accomplish the desired result at a reasonable cost consistent with good business practices, reliability, safety and expedition.

Q. Has ISO reached a conclusion regarding the Project, as proposed?

A. At this time, based on information available to us and taking into consideration the full 345 kV loop, including both Phase I, as approved in Docket 217, and Phase II, as proposed in this proceeding, ISO has not seen a plan which results in an acceptable level of capacitance in the system. Because the proposed Project, in

conjunction with Phase I, would introduce too much capacitance into the system, which in turn would create harmonics and resonance conditions which cannot be satisfactorily mitigated and could damage customer and utility equipment and lead to outages, we would not find it acceptable. In light of PB Power's evaluation of the Project and our communications with PB Power, I am not comfortable that the Project, as proposed by the Applicants, offers the needed degree of reliability for the transmission system in Southwestern Connecticut, is designed in accordance with Good Utility Practice, or could otherwise be operated in an acceptable manner. PB Power has also suggested, however, the desirability of further study and evaluation to determine the extent additional overhead line, alternative cable technology, or some combination of the two could mitigate the adverse impacts to the bulk power system associated with the low harmonics caused by the Project as proposed.

Q. Would ISO support more underground cable than proposed by the Applicants?

A. No. For the reasons already indicated regarding the Project as proposed, ISO does not believe that it would be technically feasible to add more underground cable than proposed by the Applicants. It would have to be demonstrated, at a minimum, that any additional cable would not cause the system to operate at or below the 3rd harmonic frequency level or that simple, effective control measures are available to prevent power quality and overvoltage problems. Studies to date do not indicate that this standard can be reached if more cable is used than the Applicants have proposed.

Q. Does ISO continue to believe that the transmission system in Southwestern Connecticut needs reinforcement?

A. ISO certainly believes that a 345kV loop is needed to reinforce the transmission system in Southwestern Connecticut, and we believe that the Applicants have worked hard to propose an upgrade which would meet this need, but we have not yet seen a plan that will satisfactorily address the reliability concerns outlined above.

Q. Does this conclude your testimony?

A. Yes, thank you.