middletown | norwalk

December 16, 2003

VIA HAND DELIVERY

Mr. S. Derek Phelps
Executive Director
Connecticut Siting Council
10 Franklin Square
New Britain, CT 06051

Re: Docket No. 272: The Connecticut Light and Power Company and The United Illuminating Company Application for a Certificate of Environmental Compatibility and Public Need for the construction of a new 345-kV electric transmission line and associated facilities between the Scovill Rock Switching Station in Middletown and the Norwalk Substation in Norwalk, including the reconstruction of portions of existing 115-kV and 345-kV electric transmission lines, the construction of Beseck Switching Station in Wallingford, East Devon Substation in Milford, and Singer Substation in Bridgeport, modifications at Scovill Rock Switching Station and Norwalk Substation, and the reconfiguration of certain interconnections

Dear Mr. Phelps:

Enclosed are an original, 15 copies, and an electronic copy of a Supplemental Filing by The Connecticut Light and Power Company and The United Illuminating Company pursuant to Section VIII (Q) of the Council's Application Guides for Terrestrial Electric Transmission Line Facilities dated September 9, 2003. Section VIII (Q) provides in pertinent part that "the Applicant[s] shall provide supplemental information for the Council to make a reasonable comparison between the Applicant[s'] proposed route and any reasonable alternative route recommended by the site municipalities pursuant to C.G.S. section 16-501."

Very truly yours,

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Docket: 272

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STATE OF CONNECTICUT

SITING COUNCIL

Re:	The Connecticut Light and Power Company and The United Illuminating Company Application for a Certificate of Environmental Compatibility and Public Need for the Construction of a New 345-kV Electric Transmission Line and Associated Facilities Between Scovill Rock Switching Station in Middletown and Norwalk Substation in Norwalk, Connecticut Including the Reconstruction of Portions of Existing 115-kV and 345-kV Electric Transmission Lines, the Construction of the Beseck Switching Station in Wallingford, East Devon Substation in Milford, and Singer Substation in Bridgeport, Modifications at Scovill Rock Switching Station and Norwalk Substation and the Reconfiguration of Certain Interconnections	)	Docket 272 December 16, 2003

SUPPLEMENTAL FILING

The Connecticut Light and Power Company ("CL&P") and The United Illuminating Company ("UI") (together, the "Companies") submit this supplemental filing to the Connecticut Siting Council ("Council") pursuant to Section VIII (Q) of the Council's Application Guides for Terrestrial Electric Transmission Line Facilities, which provides that "the Applicant[s] shall provide supplemental information for the Council to make a reasonable comparison between the Applicant[s'] proposed route and any reasonable alternative route recommended by the site municipalities pursuant to C.G.S. section 16-50l."

The Companies have received numerous comments regarding routing from the municipalities traversed by the Companies' proposed or alternative routes for the Middletown to Norwalk Project ("Project"). These comments relate to five routing alternatives: (1) utilization

of existing highway corridors; (2) a change of the underground transmission line route location in Westport; (3) additional undergrounding of the transmission line; (4) connecting Oxbow Junction – Chestnut Junction – Black Pond Junction, rather than Oxbow Junction – Beseck Switching Station (see map identifying junction points in Executive Summary, Volume 1 of Application at p. ES-3); and (5) utilizing the existing East Shore Substation and 345-kilovolt ("kV") lines.

These alternatives were considered by the Companies before including in the Application to the Council the proposed route and Alternatives A and B. As discussed in the Application, the Companies' proposed route and Alternatives A and B were selected through a comprehensive siting selection process, including consideration of environmental, engineering, property impact and economic factors as required by the Public Utility Environmental Standards Act (Conn. Gen. Stat. §§16-50g et seq.). For this supplemental filing, the Companies have again reviewed the alternatives in light of the municipal comments. In this filing, the Companies are providing additional information, supplementing or summarizing the Application where appropriate, and also referring back to the Application (including its numerous volumes of technical data). Finally, this filing identifies further technical analysis that is being done with respect to one potential alternative.

1. Utilizing Existing Highway Corridors for the Route

The Town of Bethany Planning and Zoning Commission recommended that the Companies consider constructing the Project's new 345-kV transmission line along Interstate Highways 91 and 95, either overhead or underground. As stated in the Application, the Companies investigated the feasibility of routing the transmission line along Interstate Highways 91 and 95 and Route 15 (Merritt/Wilbur Cross Parkway). The *Middletown to Norwalk 345-kV*

Transmission Line Project Highway Corridor Study was included with the municipal consultation materials (filed with the Council as part of the municipal consultation package in accordance with Conn. Gen. Stat. § 16-50l(e)), and is attached to this Supplemental Filing as Attachment A. As discussed in the Application, only limited areas along the highways meet the requirements for either an underground or overhead transmission right of way. Because there are areas that do not have sufficient right of way potentially available, utilizing existing highway corridors was not a viable alternative. (See discussion in Volume 1 of the Application at pp. H-14 and H-15.)

2. A Change of the Route Location in Westport

Westport requested that the Companies not use the portion of Kings Highway located in the Westport historic district and downtown business district. A route change that avoids this portion of Kings Highway was suggested by a Westport resident. The Westport variation is identified as "Supported Change 3" in the Application and is discussed in detail on pages I-3 and I-4 of Volume 1 of the Application. The Companies support this route variation, which reduces impacts to communities.

3. Installation of Additional Underground Cable

The Companies have been aware for some time of the municipalities' general interest in having portions of the transmission line traversing their municipality installed underground rather than overhead. In early 2003, General Electric International, Inc.'s Power Systems Energy Consulting ("GE") undertook a transient and harmonic feasibility analysis of the Northeast Utilities ("NU") 345-kV system, assuming an all underground 345-kV transmission line from Bethel to Norwalk and a 345-kV underground transmission line from Beseck Switching Station (in the Town of Wallingford) to Norwalk Substation via the East Devon (Milford) and Singer

(Bridgeport) Substations. The distance from Beseck Switching Station to Norwalk is approximately 60 miles. The study investigated the impact of cable switching transients on the transmission system and the harmonic frequency response of the proposed cable system (comprised of two-5000 kcmil XLPE cables in parallel) on the transmission system.[1] This March 2003 GE study found:

> Underground AC cables have been exclusively applied for short distances in urban environments, which characteristically have high short-circuit levels. The large amount of cable charging capacitance associated with the transmission distances involved in this project, combined with moderate short-circuit strengths relative to the cable charging currents, could represent a significant risk for transient and harmonic problems. Such problems may be a challenge to mitigate with existing technology.

A copy of this study is attached to this Supplemental Filing as Attachment B.

In addition to the March 2003 GE study, the Companies considered the status of high voltage underground electric transmission line technology worldwide, and retained cable consulting experts to assess the viability of various undergrounding options for the 345-kV facilities. See Volume I of the Application, pp. H-17 – H-18. The Companies considered system reliability and the extent of successful cable operations elsewhere in the world. This analysis indicated that an all underground route would have significant technical and operational limitations, and therefore is not a feasible option for reliably serving the needs of southwestern Connecticut ("SWCT").

Prior to the commencement of the formal municipal consultation process in May 2003, representatives of the Companies met with officials from each of the municipalities

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[1] The March 2003 GE study assessed the use of solid dielectric cable technology because, at that time, CL&P's application in Docket 217 anticipated the use of that technology. CL&P altered its proposal in Docket 217 to specify the predominant use of more conventional high pressure fluid filled cable ("HPFF") because of its established history of reliability. In its Findings of Fact and Opinion in Docket 217, the Council recognized the reliability advantages of HPFF cable.

along or near the proposed Project route and alternative routes to discuss the Project. In response to numerous municipal requests for additional underground installation, the Companies stated their intent to study further the technical limitations of the use of additional underground installation, and to investigate the feasibility of installing more of the line underground.

In the summer of 2003, the Companies asked Burns & McDonnell to perform a switching transient study of the underground segments of the Project. Before this study was completed, the Companies determined that GE's greater expertise was required to undertake a more comprehensive analysis[2]. Therefore, the Companies again contracted with GE, which had performed the March 2003 cable transient and harmonic feasibility study. The Companies asked GE specifically to study the system effects of the overhead and underground configuration of the Bethel to Norwalk line approved by the Council in Docket 217 and the additional underground construction between East Devon Substation and Norwalk Substation for the proposed Middletown to Norwalk Project, together with: (i) an additional 40 miles of cable assumed to be installed underground for the entire length of line between Beseck Switching Station and East Devon Substation; and in the alternative, (ii) the addition of 20 miles of cable, installed underground in two 10-mile segments, one beginning at East Devon Substation proceeding north towards Beseck Switching Station and the second 10-mile segment beginning at Beseck and proceeding south towards East Devon Substation. The Companies specified the use of HPFF in light of the cable information developed in Docket 217 and the continued importance of this section of the line. The underground cable system segments north of the East Devon Substation

[2] This decision for a more comprehensive analysis was needed to include the planned Bethel to Norwalk configuration approved by the Council in Docket No. 217.

were assumed to consist of three 2500 kcmil HPFF cables in parallel, in order to achieve parity with the reliability of an overhead system.

The GE study dated November 2003 (attached to this Supplemental Filing as Attachment C) finds that an additional 40 miles of cable installed underground from Beseck Switching Station to East Devon Substation (referred to as the "M/N P-1 configuration") would result in the magnification of harmonic resonance and that:

> Designing a system configuration which results in an impedance resonance at 2nd harmonic is potentially very risky and is not recommended.

Attachment C, at p. E-1.

The magnification of harmonic resonance is of particular concern because the resonances would shift around with changing system strength and would greatly increase the likelihood that the system resonant frequencies would coincide with the system harmonic frequencies. This would result in greater amplification of harmonic voltage and current distortion, which may impact power quality and adversely affect both customer and utility power equipment. The November 2003 GE study concludes, "The resulting harmonic distortion can further interact with power electronic devices and loads to increase the severity of the distortion and possibly result in control or protection misoperation." Id. at pp. E-1 - E-2. As an illustration of the problems that harmonic distortion has caused, the report notes, "Second harmonic distortion, caused by a geomagnetic disturbance, interacted with the control and protection of a static var compensator during a geomagnetic disturbance in Quebec in 1989, ultimately resulting in a total blackout of that province." Id. footnote at p. E-2.

While it is not possible to quantify the impact of the harmonic amplification, intentionally or voluntarily designing a transmission system known to result in harmonic amplification is

routinely avoided because it is not good engineering practice and may jeopardize maintaining a highly reliable transmission system.

Similarly, the GE study dated December 2003 (attached to this Supplemental Filing as Attachment D) finds that a configuration between East Devon Substation and Beseck Switching Station with two 10-mile underground cable segments, with 14 miles of overhead line in the middle (referred to as the "M/N P-2 configuration") would "require considerable limitations and restrictions on operating practices and future modifications of the system." Attachment D, at p. E-1. The study "recommend[s] that the M/N P-2 configuration be avoided." Id. at p. E-1. The GE study concludes that if this configuration were utilized,

> it is expected that the system would be very sensitive to future upgrades and would require careful engineering to study changes in the transmission system, even at somewhat remote areas. With resonances near both 2nd and 3rd harmonics, power system events involving transformer exciting current could be more severe with system configuration changes.

Id. at p. E-3.

As the Companies noted in the Application (Volume 1 at p. H-51), it would be preferable from an operating standpoint to minimize the underground construction of 345-kV transmission lines. In cases such as the portion of the Companies' proposed route between East Devon and Norwalk, operational complexity was accepted in order to accommodate significant social and land use impacts that would have been associated with overhead construction. These impacts are avoided by underground construction between East Devon and Norwalk, at minimal additional cost compared to overhead construction.

As a result of municipal comments, the Companies have again looked at the technical and operational aspects of additional underground installation. The GE studies show the extreme operating risks associated with both an additional 40 miles of underground installation and an

additional two 10-mile underground portions, separated by an overhead portion of the line ("porpoising"). Extrapolating from the results of the GE studies, the Companies and GE have concluded that it may be technically possible to add in the range of 5 miles of underground cable construction to the Companies' proposed route, provided that the additional length is contiguous to or originating from a substation.[3] This technical feasibility, based on a review of transients and harmonics only, is risky from an operational, power distortion and future expansion standpoint[4]. In many areas where additional undergrounding has been suggested by the Municipalities, it would also be much more expensive than overhead construction, which would use existing rights of way. For these reasons, the Companies do not recommend taking any additional risks and associated power quality effects of additional underground construction.

4. <u>The Oxbow Junction - Chestnut Junction – Black Pond Junction Alternative</u>

The Town of Durham suggested that "a new 345kV line in the existing right of way from Oxbow Jct. to Chestnut Jct. and then from Chestnut Jct. to Black Pond" would be a "preferable alternative to building a new overhead 345 kV line through Durham from Oxbow Jct. to Beseck SS ." The Companies' proposed route already includes construction of two new 345-kV lines from Black Pond Junction (in Meriden) to Beseck Switching Station, which the Companies have identified as the "best strong source" for the termination of the loop. See Volume 1 of the Application at pp. G-11 – G-12.

The alternative suggested by Durham (the "Town of Durham Alternative") presumably assumes the construction of these two Black Pond to Beseck Switching Station lines, since it

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[3] Please note that this is an assessment of potential technical feasibility. Studies of transients, harmonics, stability and other technical elements of the ISO-required 18.4 application would need to be completed to determine whether the line would actually meet reliability standards.

[4] Additional underground construction here would limit the underground construction that is technically and operationally practical in the future. This may preclude underground construction in areas for which overhead construction is not desirable, such as highly urban areas.

identifies no other way for the suggested alternative line to connect with the loop. In fact, in order to provide service to Beseck Switching Station equivalent to that of the proposed configuration, the Town of Durham Alternative would require an additional 345-kV line between Black Pond Junction and Beseck Switching Station, in addition to the two proposed in the application. Thus, the Town of Durham Alternative proposes a route that would completely avoid the Town of Durham by proceeding north from Oxbow Junction (Haddam), northwest from there to Black Pond Junction (Meriden), and then south to Beseck Switching Station (Wallingford). In contrast, the route proposed by the Companies proceeds westerly from Oxbow Junction directly to Beseck Switching Station, through Haddam, Durham, Middlefield and Wallingford. (See map identifying junction points in Executive Summary of Volume 1 of the Application at p. ES-3.)

As discussed below, the Town of Durham Alternative would provide less reliability than the proposed route, with greater environmental, visual and social impacts than the proposed route, and at a greater cost than the proposed route.

Reliability

The Town of Durham Alternative would place the new 345-kV circuit on the same right of way from Chestnut Junction (in Meriden) to Black Pond Junction (in Meriden) and from Black Pond Junction to Beseck Switching Station (in Wallingford) where there are already three 345-kV circuits. In contrast, the Companies' proposed route will entail construction of a new 345-kV line (on a single composite structure) from Oxbow Junction to Beseck Switching Station, thus placing the new 345-kV line on right of way that is separated from the existing 345-kV lines in the area. Separating the locations mitigates the likelihood of a single event causing interruption of all the lines.

Environmental, Visual and Social Impacts and Cost

The Town of Durham Alternative is approximately three miles longer than the Companies' proposed route, an increase of about 40% for this portion of the route. As a result, the Town of Durham Alternative would have a larger number of structures, increasing the impact to the landscape and increasing the cost of construction compared to the proposed route. In addition, the Town of Durham Alternative would require additional widening of the right of way and may require the acquisition of existing houses, thereby further increasing the social impacts and costs of the Town of Durham Alternative, as compared to the Companies' proposed route. Specifically, the Town of Durham Alternative would require approximately 85 feet of additional right of way, or 70 acres, between Chestnut Junction and Black Pond Junction should an 80-foot H-frame structure similar to the existing structures be installed. In order not to expand the existing right of way, each of the three existing 345-kV lines, and the new 345-kV line, would have to be built on 130-foot steel monopole structures. The structure locations would have to be placed side by side. The northerly portion of the Black Pond to Beseck Switching Station right of way would need to be expanded a minimum of 45 feet to accommodate the required additional line, which would require construction in closer proximity to wetlands and may require the acquisition of several houses. In contrast, the Companies' proposed route from Oxbow to Beseck will not require additional widening of the right of way, nor will it require the acquisition of existing buildings or houses.

5. East Shore

The Mayor of Wallingford suggested that the Companies consider a route from East Wallingford Junction in Wallingford to UI's East Shore Substation in New Haven, and from there underwater in the Long Island Sound from New Haven to the proposed East Devon

Substation in Milford. This suggestion noted that this route (actually the portion of the route between East Wallingford and East Shore) "currently has a 345-kV line."

As the Application notes (see Volume 1 at pp. H-15 – H-17), construction of a 345-kV transmission line in Long Island Sound, when a land alternative is available, is not environmentally practical. The Companies reached this conclusion after examining a potential submarine segment between Bridgeport and Norwalk, and it is equally valid for a segment between New Haven and Milford.

Rather than dismissing the Wallingford suggestion because its marine segment was not practical, the Companies considered the feasibility of a connection to the East Shore Substation using a land route from the East Shore Substation to East Devon Substation. Such a land route would probably be initially under roadways, for a distance of approximately 7 miles, essentially along US Route 1 and CT Route 34, through New Haven and West Haven to the vicinity of the Maltby Lakes. At this point it would transition back to an overhead line somewhere around the West Haven/Orange town boundary and continue for approximately 10 miles on the same right of way as the Companies' proposed route to the proposed East Devon substation in Milford. The route would require two transition stations, each two to four acres in size, one adjacent to the East Shore Substation and the other near the West Haven/Orange town boundary and adjacent to the right of way. The underground portion of this mixed overhead and underground configuration could require, depending on the outcome of further evaluation, either two or three HPFF cables. Should an all underground configuration between the East Shore Substation and the East Devon Substation be technically practical, the most direct construction route would be essentially along US Route 1[5] for a distance of approximately 13 miles.

[5] West Haven municipal officials have informed the Companies that portions of US Route 1 in the West Haven/University of New Haven area contain substantial rock.

Before the municipal consultation package and the Application were filed, a 345-kV line between East Wallingford Junction and the East Shore Substation (the 387 line) was evaluated as part of the SWCT 345-kV loop. This analysis determined that the thermal capacity of the existing transmission path between the Middletown area and East Shore would be insufficient, by itself, to serve as a reliable segment of the loop. Accordingly, an East Shore alternative was modeled that included the construction of a second 345-kV line along this right of way. This alternative was determined to be not practical. See Application, Volume 1 at p. G-18.

In response to Wallingford's suggestion, the Companies undertook a new investigation of the potential of reducing new 345-kV construction by using the existing 387 line and starting new 345-kV construction at East Shore Substation. The Companies determined that the thermal rating of the East Shore to East Wallingford path could be uprated without additional line construction by significantly reconfiguring the East Shore Substation. Accordingly, the Companies have undertaken an intensive study to determine whether an East Shore route might be the basis of a practical alternative route. The first step in this process was to commission a new thermal analysis from PowerGEM, a consulting firm with expertise in electric system modeling, that assumed (a) the higher rating of the East Wallingford to East Shore path that would result from the substation reconfiguration described above; (b) the mixed overhead and underground configuration between East Shore and East Devon described above, assuming three circuits for the underground portion of the line; (c) 27,700 MW New England peak load, and (d) zero net transfers over the New York / New England interface. This analysis is nearly complete; preliminary results appear to show that, under these assumptions, the thermal performance of a loop incorporating the configuration studied is comparable to that of the Companies' proposed

construction. PowerGEM's final report of this analysis is expected by January 5, 2004. Upon receipt, the Companies will file it with the Council.

PowerGEM's preliminary thermal load flow results suggest that any East Shore solution may not be as long lasting as that of the Companies' proposed route, because it would cause relatively more power to flow on the 115-kV system, and relatively less to flow on the proposed 345-kV connection to Norwalk. These results suggest that as load in the area grows over time, the number of 115-kV overloads that must be corrected will increase over those which would be present with the Middletown to Norwalk Project.

The mixed overhead and underground East Shore configuration described above would add approximately 14 to 21 circuit miles (7 miles x 2 or 3 circuits) of 345-kV HPFF underground cable to the transmission system, adding approximately 300 - 460 MVARS to a part of the system that is considerably weaker than the much stronger source at Beseck. The wholly underground East Shore configuration would add approximately 26 to 39 circuit miles (13 miles x 2 or 3 circuits) of 345-kV HPFF underground cable to the system, adding approximately 560-840 MVARS to this weaker part of the system. Either configuration would make the transmission system more susceptible to voltage excursions and harmonic distortions during normal system operations such as switching and during abnormal system conditions such as equipment failures, lightning storms, and periods when generation patterns are appreciably different due to the unavailability of generation in SWCT. See the discussion and studies referenced in Section 3 of this filing. Transient and harmonic studies are required to determine if these effects could be sufficiently mitigated with specialized equipment or if the effects are sufficiently severe to disqualify an East Shore configuration from further consideration as an

alternative. Mitigation would itself add operational complexity and additional maintenance requirements.

The following additional work would be required to determine that an East Shore to East Devon alternative to the Middletown to East Devon portion of the Companies' proposal is technically practical:

- An analysis of the results of the PowerGEM thermal load flow study described above to compare the thermal and steady state voltage performance of the mixed overhead and underground East Shore configuration with that of the Companies' proposed route;
- A thermal load flow study of the transmission system including the all underground East Shore configuration assuming a 27,700 MW New England load;
- Thermal load flow analyses of both East Shore configurations assuming a 30,000 MW New England load. These analyses will enable a determination of whether two or three circuits are needed and will form the basis to compare long-term thermal performance with that of the Companies' proposed route;
- Thermal load flow analyses of both East Shore configurations at 27,700 MW assuming transfers between New York and New England, as required by ISO-NE criteria, and comparison of the results with those for the Companies' proposal;
- Transient and harmonic analyses of the transmission system for both East Shore configurations;
- Stability screening analyses of the transmission system with both East Shore configurations.

If any of the study results disqualify the East Shore alternative from further consideration, subsequent studies would not be required.

The thermal load flow analyses assuming transfers across the New York – New England interface will require work to be done by ISO-NE. The Companies are commissioning the remainder of the studies and expect to submit the first results by mid-January 2004.