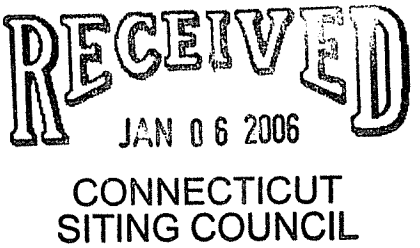
195 Church Street
Post Office Box 1950
New Haven, Connecticut
06509-1950

Telephone: 203 777-5501
Facsimile: 203 784-3199
afitzgerald@carmodylaw.com

CARMODY & TORRANCE LLP
Attorneys at Law

Anthony M. Fitzgerald

VIA HAND DELIVERY



January 6, 2006

S. Derek Phelps
Executive Director
Connecticut Siting Council
Ten Franklin Avenue
New Britain, CT 06051

Re: ***Docket Life-Cycle 2006*** – *Connecticut Siting Council Investigation into the Life-Cycle Costs of Electric Transmission Lines*

Dear Mr. Phelps,

Enclosed are an original and 20 copies of the pre-filed testimony of Robert E. Carberry, P.E., on behalf of The Connecticut Light and Power Company.

Very truly yours,

Anthony M. Fitzgerald

Enclosure
cc: Service List

{N0740959}

THE CONNECTICUT SITING COUNCIL :

January 6, 2006

DOCKET LIFE-CYCLE 2006 :

TESTIMONY OF ROBERT E. CARBERRY
on behalf of
THE CONNECTICUT LIGHT AND POWER COMPANY

Introduction

I am Robert E. Carberry, Manager of Transmission Siting and Permitting, Northeast Utilities Service Company. Assisting me today is Graham L. McTavish, Manager of Transmission Project Planning, Northeast Utilities Service Company Mr. McTavish is responsible for the cost estimating and scheduling of CL&P transmission projects. Thank you for your invitation to participate in this process for revising or rewriting the Council's report on "Life-Cycle Cost Studies for Overhead and Underground Transmission Lines," first prepared by ACRES International for the Council in March, 1996 (the "1996 Report") and updated by ACRES in 2001 (the "2001 Report"). We understand that the new or revised report will be prepared by the Council's current consultant, KEMA. KEMA's work for the Council with respect to the Council's recently completed Docket No. 272 has provided it with current knowledge of the Connecticut electric transmission system that should be very useful to it in completing this assignment.

Basis of This Proceeding

Public Act 94-176 (now codified as Conn. Gen. Stats. §§ 16-50r(b) and (c)) requires the Council to investigate the comparative life-cycle costs of overhead and underground transmission lines, as an aid to the Council in carrying out its responsibilities under the Public

Utility Environmental Standards Act ('PUESA"), Ch. 277a of the General Statutes. As PUESA itself states:

> The purposes of this chapter are: To provide for the balancing of the need for adequate and reliable public utility service *at the lowest reasonable cost to consumers* with the need to protect the environment and ecology of the state and to minimize damage to scenic, historic, and recreational values; to provide environmental quality standards and criteria for the location, design, construction and operation of facilities for the furnishing of public utility services at least as stringent as the federal environmental quality standards and criteria, and technically sufficient to assure the welfare and protection of the people of the state .... Conn. Gen. Stats. § 16-50g (emphasis added)

In estimating the comparative costs of alternate transmission line additions to a utility system, each of which could adequately address a reliability need, it makes eminent sense to consider not just the first cost of the competing alternatives, but all costs that each alternate may incur over its expected useful life.

Limitations of Life-Cycle Cost Studies

Because their scope is by design very broad and general, the usefulness of the 1996 and 2001 Reports for evaluating alternate proposals in specific Dockets is limited. It will be difficult to overcome such limitations in the new report.

The Significance of Land Costs

As the 1996 Report states (p. E-8), land costs are not acknowledged in the Report. At that time, the typical transmission line installation envisioned in the next 5 years was anticipated to require no right-of-way cost for a new line, whether it was built overhead (on existing right-of-way) or underground (in a public highway).

However, in the comparison of the life-cycle costs of overhead and underground 345-kV transmission line alternatives between the East Devon (Milford) and Norwalk Substation Sites in

the recently approved Middletown - Norwalk 345-kV transmission project, right-of-way costs were a critical driver of the Companies' initial preference for underground construction over approximately 24 miles of the project route. In this part of the project, there was no available and acceptable overhead right-of-way, so that overhead construction would have required the expansion of existing rights-of-way through densely settled suburban areas, at very significant cost, both for the acquisition price and for project delays. On the other hand, there were available highway rights-of-way that could accommodate underground construction, and the underground route was shorter than an overhead route would have been. These considerations greatly altered the comparison of overhead to underground line costs. Initially, the Companies estimated that the life-cycle cost of these approximately 24 miles of all-underground construction would be nearly equivalent to that of the almost all-overhead alternative that included only 4 miles of underground construction.[1] In the course of the Docket No. 272 hearings, the cost gap widened, because it was determined that the proposed 24 linear miles of undergrounding could only be accomplished by the replacement of the originally proposed high-pressure fluid-filled ("HPFF") underground cable technology with much more expensive solid-dielectric cross-linked polyethelyne ("XLPE") cable technology, and because other system improvements were found to be required in order to accommodate the addition of the underground cables. However, even then, the cost of the all-underground alternative did not rise to a multiple of that of the nearly all-overhead alternative.[2]

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[1] *See,* Docket No. 272, Ex. 54, "Direct Testimony of Roger Zaklukiewicz Regarding the Portion of the Middletown to Norwalk Project Between East Devon Substation in Milford and Norwalk Substation in Norwalk," d. April 8, 2004, at pp. 37, 38, which estimated a life-cycle cost for the proposed all-underground construction for Segments 3 and 4, using 345-kV high-pressure fluid-filled cable, at $539 million and a life-cycle cost for the nearly all-overhead alternative ("Alternative B") of $520.1 million".

[2] The Council's Finding of Fact ¶ 707 estimated a range of life-cycle costs for the proposed 24 miles of underground construction of $713 – 871 million; and a range of life-cycle costs for "Alternative B" of $549-631 million.

On the other hand, in a hypothetical project where there was an available overhead line right-of-way between two or more points that had to be electrically connected, if the right-of-way ran through rural areas with sparsely developed road networks, and over terrain not suitable for underground construction, the underground alternative would likely be much longer than the overhead alternative. That would be because the underground line would have to be installed within a winding route between the same points that were more directly connected by overhead right-of-way. In such a case, the 5 to 1 first cost differential in the 1996 report for a 115-kV line would not be pertinent, because the comparison made is of equal 5-mile lengths of conductors. 1996 Report, Part B. The disparity between overhead and underground line costs would be even greater.

Finally, on a life-cycle cost basis, the use of public highways for the installation of transmission lines may now entail the equivalent of right-of-way costs. While there is no "first cost" for use of the public right-of-way pursuant to CL&P's franchise rights, section 28 of Public Act 05-210 has amended section 13-126 of the General Statutes to impose on the utility the cost of relocating its facilities when required by the Connecticut Department of Transportation. In contrast, of course, once a transmission line is in place pursuant to a dedicated easement, the utility will not be required to move the line at its own expense to accommodate the landowner.

As the preceding examples suggest, land costs, while extremely important to a comparison of underground and overhead costs in a given application, are so variable and specific to a given set of conditions as to make it impractical to include them in a generic cost comparison. Nevertheless, their importance should be acknowledged and discussed in the Council's report.

The Significance of Fundamental Differences in Overhead and Underground Technology

The usefulness of the data in 1996 and 2001 studies as references for evaluating specific proposed transmission lines is further limited by fundamental differences that distinguish overhead and underground transmission technology. As the 1996 Report states:

> Overhead and underground systems are not electrically equivalent. Differences include – current carrying capabilities, load sharing, charging currents, fault currents, system restoration and losses. Overhead transmission lines cannot be replaced with underground transmission lines on a simple one for one basis. (p. E-8; *See also, §3*)

Similarly,

> Loading Equivalency. Overhead and underground transmission lines included in this study cannot always carry equal loads. While the overhead line can carry the loads specified, the underground lines cannot match the values under some emergency circumstances…Where underground ratings are inadequate it may be necessary either to install duplicate facilities or to make compensatory additions elsewhere in the transmission system. (p. E-8; *See also, §3*)

These essential limiting differences should also be acknowledged and discussed in the forthcoming report.

Developments Since the 1996 and 2001 Reports That Should Be Addressed in the New Report

Notwithstanding the limitations discussed in the preceding paragraphs, there is much in the 1996 and 2001 reports of continuing relevance. In addition, there have been more recent developments that should be considered in the new report. The most significant developments related to transmission facility costs that have occurred since the 2001 Report are as follows:

345-kV Overhead and Underground Costs

> The 1996 and 2001 Reports addressed only comparative costs of 115-kV line construction, because there was then very little 345-kV line construction in the CL&P and UI forecasts. However, since the 2001 report, the Council has certified 11.8 miles of 345-kV underground transmission line construction (double cables, XLPE and HPFF)

between Bethel and Norwalk (Docket No. 217) and approximately 24 miles of such construction (double cables, XLPE) between Middletown and Norwalk. The Council also certified approximately 45 miles of overhead 345-kV line construction in Docket No. 272. The first costs and likely life-cycle costs of these facilities will be pertinent to the new report. In addition to the preliminary cost estimates for these facilities submitted to the Council in the course of Docket No. 217 and No. 272, CL&P has, for the Docket No. 217 facilities, additional, more accurate cost data from the NEPOOL Schedule 12C Transmission Cost Allocation process and from detailed construction estimates In addition, CL&P has, for the Docket No. 272 facilities, developed more current and detailed cost estimates, which are partially reflected in CL&P's response to Data Request CSC-01, Q-CSC-004. CL&P would be pleased to make this information available to the Council and its consultant.

- Use of XLPE Cable Technology at 345 kV

In the 2001 Report, ACRES noted that solid dielectric (XLPE) insulated cable systems had been improving and were gaining acceptance "as proven technology for applications up to and including 230-kV." (p. 15) Since then, CL&P has become a world leader in the utilization of this technology by undertaking to construct 2.1 miles of double 345-kV XLPE cables in ducts, the first significant application of such cables in ducts and the first application in this country that requires splices. This installation is currently under construction as part of the Bethel - Norwalk (Docket No. 217) project. An additional 25 miles of double 345-kV XLPE cables (larger size) are planned for installation by CL&P and the United Illuminating Company between East Devon and Norwalk (Docket No. 272). The estimated costs of this installation are reflected in CL&P's response to Data Request CSC-01, Q-CSC-004.

- Increases in First Costs for Overhead and Underground Transmission Facilities

General:

  - General Escalation
    For both overhead and underground lines, there has been a significant labor and material cost escalation since the date of the 2001 report, and indeed since the estimates for the Bethel - Norwalk and Middletown - Norwalk projects were submitted to the Council. Factors driving these cost increases include high demands for raw materials, particularly steel; limitations on manufacturing capacity for large cables; labor and material shortages due to national disasters; and fuel costs.

  - Permitting
    The 1996 ACRES report (p. 6-14) contains a per-project estimate for permitting costs of new transmission lines (including preparation of the application and supporting reports, permit fees, hearings, and related legal fees) of $ 100,000 - $150,000. As was the case in 1996, utilities do not specifically track permitting

costs today. Nevertheless, it is undeniable that permitting costs are now a far more significant consideration than they were in 1996. The Glenbrook to Norwalk (Docket No. 292) project managers estimate that the permitting costs of this relatively uncontroversial, all-underground 115-kV transmission line project have exceeded $ 4 million. Much of this cost is due to the requirements of the Council's Application Guidelines for terrestrial electric transmission lines, effective September 9, 2003, which the Council adopted in response to the recommendation of the state Working Group established by Public Act 02-95. The permitting costs for the larger Bethel to Norwalk (Docket No. 217) line were double those of the Glenbrook project, even though the new Application Guidelines did not apply in Docket No. 217. The permitting costs of the Middletown to Norwalk project would be greater still. The increased length and contentiousness of siting proceedings and appeals and, in the case of 345-kV lines, the costs of demonstrating compliance with the "underground presumption" and "buffer zone" requirements of P.A. 04-246 will assure that permitting costs of future lines will remain very high; and that overhead lines will be relatively more costly to permit than underground lines. Moreover, we expect further significant increases in expense due to the additional permitting delay and effort that will accompany the implementation of the new role of the Connecticut Energy Advisory Board ("CEAB") in the siting process for new transmission line and substation facilities, pursuant to Public Act 03-140. Our initial experience with the RFP process related to our application for a new 115-kV substation in Wilton has been consistent with this expectation. Only for projects which the Council can permit by a declaratory ruling process, owing to no substantial adverse environmental effects, will permitting costs remain as low as those cited in the 1996 ACRES report.

- P.A. 04-286

  Public Act 04-286, as applied by the Council in Docket No. 272, resulted in a material increase in the project cost, by reason of requiring significant magnetic field management measures in the design of the overhead line segments of the project. CL&P's estimate of the incremental first cost of these measures was $68 to $80 million (Docket 272, Finding of Fact, ¶ 706); and its estimate of their incremental life-cycle cost was $105 to $121 million. (Id., FOF ¶ 707) These measures were incorporated into a total of 42.6 linear miles of overhead transmission line, for an average incremental cost per mile for low magnetic field designs of $1.6 to $1.9 million on a first cost basis and $2.5 to $3.3 million on a life-cycle cost basis.

  Because of its presumption that 345-kV lines will be constructed underground where adjacent to certain statutory facilities, including "residential areas," P.A. 04-286 is likely to cause more future underground 345-kV line construction than would otherwise be proposed. Indeed, as a practical matter, unless the project is in a rural or agricultural area, the effect of the statute is likely to be a requirement that a project be constructed underground to the maximum extent that is

technologically feasible. This was the case in Docket No. 272. As in Docket No. 272, compliance with such a "maximization" requirement will likely result in the, specification of costly XLPE underground cable technology, rather than less expensive HPFF cable technology, because of the lower capacitance requirements of the XLPE cables.

Even where P.A. 04-286 would require only undergrounding of a segment of a line in order to avoid overhead construction adjacent to a particular statutory facility, there would be a cost premium beyond that of the difference between overhead and underground lines of equal length. First, the cost of transition stations at each end of the underground segment must be included as part of its cost. Moreover, unless the right-of-way terrain is suitable for constructing an underground line segment and the required transition stations, the underground section will have to leave the overhead right-of-way at an access point, such as a public road, and come back to the right-of-way at another access point. Such a configuration increases the length, and thus the comparative cost, of the underground construction.

As the Council has learned in Docket No. 272, the presumption of P.A. 04-286 that 345-kV transmission lines will be constructed underground in many circumstances (including where adjacent to "residential areas") also is likely to impose costs above the cost of constructing the underground line and transition stations themselves. The VAR-management and system-resonance frequency issues caused by the insertion of long lengths of underground lines into a relatively weak and predominantly overhead transmission system require system modifications, such as the hundreds of uprated surge arresters specified in Docket 272; and could require more drastic and costly system modifications.

Overhead Transmission Lines:

The National Electrical Safety Code was revised in 2002. As revised, it requires structure strengths to withstand higher wind loadings, particularly for tangent structures. This increased performance specification, together with a current standard practice of using large diameter conductors, results in increases in line structure and foundation costs.

Underground Transmission Lines:

The underground construction costs that CL&P is encountering on the Bethel - Norwalk project, apart from general cost escalation, are substantially exceeding expectations. These increases are due to a number of factors, none of which would have been completely included in the ACRES estimates of 115-kV underground construction:

- <u>CDOT Requirements</u>
  While construction of an underground line in a public right-of-way avoids land acquisition costs, CL&P has encountered significant cost increases due to requirements of the Connecticut Department of Transportation ("CDOT"):

- CDOT is requiring most cable-splice vaults to be located out of the travel way, and in many cases, outside of the highway right-of-way on private property, thus necessitating land rights acquisition and significant additional construction costs.
- In contrast to the position it took during hearings on the Middletown - Norwalk, and Glenbrook to Norwalk projects, CDOT will not consent to attachment of the cables to any bridges or other state structures crossing water bodies, imposing extra water crossing costs.
- CDOT has imposed very strict work restrictions and other measures to minimize traffic disruption, thereby complicating scheduling activities and prolonging the construction period, thus increasing its cost.

o CTDEP Requirements

Connecticut's environmental regulatory requirements, as enforced by the Connecticut Department of Environmental Protection ("CTDEP"), have also caused a material increase in the estimated cost of the underground segments of the Bethel to Norwalk and Middletown to Norwalk projects. These requirements include the management of excavated soil that cannot be reused in the closure of underground cable trenches. These soils have been subject to special storage rules and increased disposal costs, including added transportation costs. The construction of overhead transmission line segments does not generate soils of this volume for off-site management and disposal.

o Other Considerations

The contractors have encountered very high rock content along the routes of the underground construction on the Bethel – Norwalk project. These conditions add substantial cost to the "typical" construction conditions assumed in the ACRES reports. High rock content has also added substantial costs for the construction of foundations for overhead line segments of the Bethel-Norwalk project, but the volume of excavation for foundations of an overhead line is considerably less than the volume of excavation for a continuous trench needed for an underground line.

o Cost Recovery

Since 1997, the recovery of costs of new transmission lines has been shared among all New England utilities, pursuant to the cost sharing provisions of a New England Power Pool (NEPOOL) agreement which has since become an ISO New England Transmission, Markets and Services Tariff. Under present procedures, these costs are allocated by the Independent System Operator – New England (after input by the NEPOOL Reliability Committee and others). Pursuant to the ISO-NE Tariff and Planning Procedure 4, certain costs deemed unnecessary to provide the required transmission solution (sometimes called "gold-plating" costs) will not be socialized across the region. CL&P's costs for the Bethel - Norwalk project are currently undergoing review pursuant to this procedure. Although there has been no ruling yet, preliminary indications are that a significant portion

of the project costs (perhaps the cost in excess of that of an all-overhead solution) will not be regionalized. Since the legislature presumably referred to Connecticut consumers when it ordered the Council, in Conn. Gen. Stats. § 16-50g, to take into account the "need for adequate and reliable public utility services at the lowest reasonable cost to consumers" it would be appropriate for the new report to consider the impact on costs to Connecticut consumers of the first and life-cycle costs required to comply with P.A. 04-286.

- New Technologies

Several new transmission line technologies have emerged, or have been put into practice in Connecticut, since the ACRES 2001 Report.

- **HVDC**. Connecticut now has an HVDC Lite facility in operation (the Cross-Sound Cable), and there was an extensive consideration of the viability of HVDC and HVDC Lite for various other applications in the context of Docket 272, with which the Council is quite familiar. It would thus be appropriate for the new report to comment on the cost implications (and applications) of these technologies.

- **High-temperature, low-sag (HTLS) conductors** (also called "composite" conductors) and accessories for overhead lines have reached a trial-use commercial stage. They are very costly, and it would be useful for the new report to identify at least their first costs. (Since their useful life is unproven, calculating a life-cycle cost would be speculative.) Notwithstanding their high first cost, these conductors hold promise for line-capacity upgrades where reconductoring can be effected with no or minimal structure replacements.

- **Superconducting cables** are still under development and are seeing some trial uses in short applications. But this technology is probably too far from commercial application to require extended discussion in the new report.

- **Gas Insulated Transmission Lines** ("GITL's") are a commercial line technology, but their high cost and other factors have limited their use to short applications, almost always within controlled utility property. *See,* Docket No. 272, FOF ¶¶ 313-333. However, since this technology has been claimed to be a practicable "underground" technology that could be incorporated into a new 345-kV transmission line, it would be appropriate for the new report to discuss it.

Conclusion

In conclusion, I would once again like to express my thanks for being invited to contribute CL&P's comments in this proceeding, and CL&P's willingness to provide the Council with any further cost information that we may have.

LIFE-CYCLE 2006
SERVICE LIST

Status	Status Holder (name, address, & phone number)	Representative (name, address, & phone number)
PARTY (approved on 12/21/05)	The Connecticut Light and Power Company (CL&P)	Robert E. Carberry Manager, Transmission Siting & Permitting Northeast Utilities Service Company P.O. Box 270 Hartford, CT 06141-0270 (860) 665-6774 carbere@nu.com Elizabeth A. Maldonado, Esq. Associate General Counsel Legal Department Northeast Utilities Service Company 107 Selden Street Berlin, CT 06037 (860) 665-5664 (860) 665-5504 fax maldoea@nu.com
PARTY (approved on 12/21/05)	United Illuminating Company (UI)	Michael A. Coretto Director-Regulatory Strategy & Retail Access United Illuminating Company 157 Church Street New Haven, CT 06506-0901 (203) 499-2969 (203) 499-3625 fax uiregulatory@uinet.com Linda L. Randell, Esq. Bruce L. McDermott Wiggin & Dana LLP One Century Tower P.O. Box 1832 New Haven, CT 06508-1832 (203) 498-4322 (203) 782-2889 - fax lrandell@wiggin.com bmcdermott@wiggin.com

LIFE-CYCLE 2006
SERVICE LIST

Status	Status Holder (name, address, & phone number)	Representative (name, address, & phone number)
	Connecticut Municipal Electric Energy Cooperative (CMEEC)	Maurice R. Scully, Executive Director Connecticut Municipal Electric Energy Cooperative 30 Stott Avenue Norwich, CT 06360-1526 (860) 889-4088 (860) 889-8158 – fax mscully@cmeec.org
	Department of Public Utility Control (DPUC)	~INTERDEPARTMENTAL~ Cindy Jacobs, Research Department of Public Utility Control Ten Franklin Square New Britain, CT 06051 Cindy.jacobs@po.state.ct.us
	Connecticut Center for Advanced Technology (CCAT)	Joel M. Rinebold Connecticut Center for Advanced Technology 111 Founders Plaza, Suite 1002 East Hartford, CT 06108 (860) 291-8832 (860) 291-8874 - fax jrinebold@ccat.us paresta@ccat.us
INTERVENOR (approved on 12/21/05)	Connecticut Energy Advisory Board c/o Gretchen Deans CERC 805 Brook Street, Bldg. 4 Rocky Hill, CT 06067 860-571-7147 860-571-7150 – fax gdeans@cerc.com	Mary J. Healey, Esq. Consumer Counsel Office of Consumer Counsel Ten Franklin Square New Britain, CT 06051 (860) 827-2900 (860) 827-2929 - fax occ.efile@po.state.ct.us Ms. Heather Hunt, Esq. Law Offices of Heather Hunt 242 Whipporwill Lane Stratford, CT 06614 (203) 380-1477 hfhunt@optonline.net

LIFE-CYCLE 2006
SERVICE LIST

Status	Status Holder (name, address, & phone number)	Representative (name, address, & phone number)
INTERVENOR	CEAB continued …	Mr. Brian Abbanat La Capra Associates 20 Winthrop Square Boston, MA 02110 (617) 367-6500 babbanat@lacapra.com
	ISO New England Inc. One Sullivan Road Holyoke, Massachusetts 01040	Anthony M. Macleod, Esq. Whitman Breed Abbott & Morgan LLC 100 Field Point Road Greenwich, CT 06830 (203) 869-3800 (203) 869-1951 - fax amacleod@wbamct.com Eric Johnson External Affairs ISO New England Inc. One Sullivan Road Holyoke, MA 01040 ejohnson@iso-ne.com Matthew Goldberg, Esq. Senior Regulatory Counsel ISO New England Inc. One Sullivan Road Holyoke, MA 01040 mgoldberg@iso-ne.com
	Environment Northeast (ENE)	Roger E. Koontz Environment Northeast 15 High Street Chester, CT 06412 (860) 526-4852 rkoontz@env-ne.org

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SERVICE LIST

Status	Status Holder (name, address, & phone number)	Representative (name, address, & phone number)
PARTY (approved on 12/14/05)	Richard Blumenthal Attorney General for the State of Connecticut	Michael C. Wertheimer Assistant Attorney General Ten Franklin Square New Britain, CT 06051 (860) 827-2620 (860) 827-2893 – fax Michael.wertheimer@po.state.ct.us