April 30, 2004

Ms. Pamela B. Katz
Chairman
Connecticut Siting Council
10 Franklin Square
New Britain, CT 06051

Re: Docket No. 272 - Middletown-Norwalk 345kV Transmission Line

Dear Ms. Katz:

This letter provides the response to requests for the information listed below.

This filing completes all the requested information for the TOWNS-06 set of interrogatories.

Response to TOWNS-06 Interrogatories dated 04/02/2004
TOWNS - 061 , 062 *, 063 , 064 , 065 , 066

Very truly yours,

Anne B. Bartosewicz
Project Director - Transmission Business

ABB/tms
cc: Service List

* Due to the bulk nature of this material, the Companies request bulk filing status.

Witness: **Roger C. Zaklukiewicz**
Request from: **TOWNS**

Question:
Reference the Applicants' response to CSC-28.

a. Please explain the bases for, and provide the analyses forming the basis for, the conclusion that while two circuits are specified for the underground segments of the proposed Project between East Devon and Singer Substations and Singer and Norwalk Substations, three circuits would be specified for any underground line between East Devon and Beseck Substations, and four circuits would be specified between the Beseck Substation and Oxbow Junction and Black Pond.

b. Please explain in detail, and provide any supporting documentation, the reasons why including two circuits (instead of three circuits) would not be adequate for an underground line between East Devon and Beseck.

c. Please explain in detail, and provide any supporting documentation, the reasons why including two circuits (instead of four circuits) would not be adequate for an underground line between Beseck and Oxbow or Beseck and Black Pond.

Response:
a through c) As part of designing any project on the transmission system, it is not permissible to reduce the transfer capability of the system. To that extent, any changes on a transmission line should not reduce the rating of that line. In addition, in order to account for the potential extended outage associated with 345-kV cable when compared to that of an overhead circuit, an additional cable must be added.

When evaluating the path from East Devon to Singer to Norwalk, the Companies have found that two cables can be used due to the fact that upon the outage of one cable, power can flow on the remaining parallel cable, the leg of the 345-kV loop from Plumtree to Norwalk and through the autotransformers at Singer and East Devon which provides acceptable system capability.

East Devon to Beseck provides the strongest support to the proposed 345-kV loop in SWCT. The proposed 2500 kcmil HPFF cables have a rating per cable of 632 MVA (normal) and 794 MVA (emergency). Peak flows on this will be around 900 MVA, depending upon system conditions. In the event that only two cables were installed, an extended outage of one of the cables would severely limit the ability of the proposed 345-kV loop to import power, requiring significant amounts of generation to be operated in SWCT, and possibly compromising system reliability. The addition of a third cable permits the outage of one cable without severely limiting the transfer capability into SWCT from this strong source.

The circuits from Beseck to Oxbow Junction and Black Pond have conductor ratings of 1488 MVA (normal) and 1912 MVA (emergency). To simply match the capability of the overhead circuit, three cables would be required. Due to the possible extended duration of an outage of one cable, an additional cable (for a total of 4) would be required.

Witness: **Roger C. Zaklukiewicz**
Request from: **TOWNS**

Question:
Reference the Applicants' response to CSC-28.

a. Quantify the levels of capacitance existing on Connecticut's transmission system and the amount by which this capacitance level is higher than it was in the past.

b. Provide the data which forms the basis for the statement that the level of capacitance on Connecticut's transmission system is "higher than that of other electric utilities in the region."

c. Quantify the amounts by which undergrounding of each of the following segments would increase the system capacitance: the line segment between Oxbow Junction and Beseck, the line segment between Black Pond and Beseck and the line segment between Beseck and East Devon.

Response:
a) Shunt transmission capacitors in Connecticut (all nameplate values stated in Mvar) in 2004 and 1994:

	2004	1994
Manchester	302.4	119.4
Southington	302.4 (151.2 Mvar of 302.4 to be installed in 2004)	
Frost Bridge	252 (100.8 Mvar of 252 to be installed in 2004)	80.0
Berlin	126	119.4
Plumtree	88.2	79.8
Glenbrook	333.0	151.2
Darien	37.8	
Waterside	37.8	
Montville	100.8	
Norwalk	75.6	79.4
East Shore	84.0	84.0
North Bloomfield	151.2	79.2
North Haven	42.0	42.0
Sacket	42.0	42.0
Rocky River	25.2	
Stony Hill	25.2	
Stony Hill under DVAR control	75.6	
Franklin Drive	37.8	
Canton	50.4	
Mystic	50.4	
Total	2239.8	876.4

The table illustrates that since 1994 the Companies have increased Connecticut's relative capacitance by 255%. The lack of voltage support, which is normally provided by generation within or in close proximity to load centers, was the primary reason for having to install the substation transmission capacitor banks. Voltage studies showed unacceptably low voltage conditions throughout the system, primarily in SWCT, following certain contingencies. In some cases voltage collapse was imminent and in other instances the computer program was unable to converge on a solution, which indicates that a voltage collapse has occurred. At the same time, the short circuit duty of the Connecticut transmission system did not increase proportionately. This system relationship, short circuit duty and installed capacitance is illustrated in the Companies' response to CSC-01, Q-CSC-028.

b) Appendix B of NEPOOL Operating Procedure No. 12, "Voltage and Reactive Control", which was approved by the NEPOOL Participants Committee on 10/23/2003, contains a listing of all shunt transmission capacitors which were in service in 2003. As an example, Appendix B-5 contains the transmission capacitors which are on the NSTAR (predominately Boston) system. Those capacitors are located at Hyannis, K Street, Mystic, Lexington, Baker Street, Needham, and Framingham for a total of 468.8 Mvar, compared to the 2,239.8 Mvar located in Connecticut in 2004.

c) Capacitance associated with 2500 kcmil HPFF 345-kV cable is 21.22 Mvar per mile of cable.

Line Section	Distance (miles)	Number of Cables	Circuit Miles (Distance x Number of Cables)	Charging in Mvar (Circuit Miles x 21.22)
Oxbow Junction to Beseck	9.1	4	36.4	772
Black Pond to Beseck	4.0	8	32.0	679
Beseck to East Devon	30.4	3	91.2	1935

If all proposed transmission was placed underground, Connecticut's transmission capacitance due to 345-kV cables would be 4846 Mvar. The capacitance associated with 345-kV cables on the Connecticut transmission system is approximately 5.8 times the capacitance on the NSTAR system due to 345-kV cables. Referencing the chart provided in CSC-01, Q-CSC-028, it would place Connecticut's transmission system off the top of the chart which is an indication that the system can not be operated reliably.

* Due to the bulk nature of this material, the Companies request bulk filing status.

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Witness: **Roger C. Zaklukiewicz**
Request from: **TOWNS**

Question:
Reference the December 31, 2003 PowerGEM "Southwest Connecticut Transmission, East Shore to Norwalk 345 KV OH/UG Alternative," included as an Attachment to the January 8, 2004 Appendum #1 to the Supplemental Filing. At page 5 of this report, PowerGEM listed six bulleted changes that were made to the Middletown to Norwalk base case "to reconfigure the system appropriately to simulate the "East Shore 27-OH/UG configuration."

a. Please describe in detail the basis for modeling each listed change from the base as part of the East Shore configuration and provide copies of any analyses or other documents that formed the basis for that change. Please also explain why each such change from the base case is necessary to appropriately model a potential East Shore route or configuration.

b. Provide the documentation in which the referenced "instructions from UI" or any other instructions from the Applicants were provided to PowerGEM.

c. Detail the reconfiguring of the East Shore substation that was done to increase the rating of the East Shore to Scovill Rock 345 kV line.

Response:
a) The "East Shore to Norwalk 345 KV OH/UG Alternative" study was intended to model the existing 345-kV transmission system with new 345-kV construction from East Shore Substation to Norwalk Substation, via East Devon and Singer Substations. The case that was provided to PowerGEM assumed that much of the proposed Middletown to Norwalk Project was in service.

The first four bullets of the listed changes in the report were performed to remove Beseck Substation from service and to return the 345-kV system to its existing configuration. These bullets were:
1. "Open the Southington to Scovill Rock 345 kV line (73106-73107)." There is no Southington to Scovill Rock 345-kV line in the existing system. It was added as part of the proposed Project.
2. "Close the Meriden to Haddam 345 kV line (73122-72113)". This item should read "Close the Meriden to Haddam Neck 345 kV line (73122 - 73113)". This returns the line between the proposed Meriden power plant and the Haddam Neck Switching Station to service (362 line). This would be removed from service when the Beseck Switching Station is placed in the model.
3. "Disconnect the Beseck bus (73295) and all of the connected branches." This removes the Beseck Switching Station which had been added to the model as part of the proposed Project.
4. "Model a 345 kV line from Southington (73106) to Millstone (73110) with a tap to a 345/115 kV autotransformer to the Haddam 115 kV bus (73230)". This returns the line from Millstone to Southington (348 line) to service and adds the NEPOOL approved Haddam autotransformer to the circuit. This line had been removed from service in the modeling due to the addition of Beseck Substation.

The fifth bullet reads "Open the Devon-Lucchini 115 kV line (73195-73193), the Middletown-Bokum 115-kV line (73241-73231), the Devon 115 kV bus tie (73195-73126), and Milford-Devon 115 kV line (73125-73126)". The Devon-Lucchini line is opened to remove a portion of the 1690 line in service to provide new room for the new 115-kV circuit between the proposed East Devon Substation and the existing Devon Substation. The Middletown-Bokum 115-kV line needs to be removed from service when the Haddam autotransformer is placed in service. The Devon 115-kV bus tie is opened as part of the changes at Devon Substation to help reduce fault current and control flows into and out of the substation. The Milford to Devon 115-kV line is removed from service since this was the generator lead from Milford Power to Devon Substation. With the proposed creation of the East Devon Substation, this generator lead is removed and Milford Power is connected to the East Devon Substation.

The last bullet reads "The rating of the East Shore to Scovill Rock 345 kV line was increased to reflect the line rating by reconfiguring the East Shore Substation and removing the 345/115 kV autotransformers from the 387 line path. The line ratings used were 1240 MVA normal and 1604 MVA long-term emergency, as provided by UI." By interconnecting the new circuit from East Shore to East Devon, adding a new 345-kV bus, and adding circuit breakers at East Shore, the 387 line between the Scovill Rock Switching Station and the East Shore Substation and the autotransformers at East Shore Substation are no longer in series with each other and the transformers will no longer limit the capability of the line. Therefore, this model was changed to model the 387 line and the autotransformers as individual elements, each with its own normal and emergency ratings.

b) This interrogatory is overly broad and goes beyond reasonable discovery and long-standing practice in Siting Council proceedings. Under the Uniform Administrative Procedure Act, a party has the opportunity to “inspect and copy relevant and material records, papers and documents not in the possession of the party or such agency, except as otherwise provided by federal law or any other provision of the general statutes...” Conn. Gen. Stat. § 4-177c(1) (emphasis added). CL&P and UI object to this interrogatory because it does not seek relevant and material information.

c) See the last paragraph in a) above. A new 345-kV substation was modelled at East Shore. In this configuration, the 387 line, the Cross Sound cable, the existing East Shore autotransformers and the cables to East Devon can be rated independently. Under the present configuration the rating of the 387 line is limited by the rating of the East Shore autotransformers and not the line itself.

Witness: **Roger C. Zaklukiewicz**
Request from: **TOWNS**

Question:
Please explain whether the Applicants' proposed East Shore route includes each of the following elements of the proposed Middletown to Norwalk Project. If the answer is no, please explain in detail why not:

a. The proposed 345-kV line from Scovill Rock Switching Station to Chestnut Junction.

b. The proposed 345-kV line from Oxbow Junction to the proposed Beseck Substation.

c. The proposed 345-kV line from Black Pond Junction to the proposed Beseck substation.

d. The proposed Beseck Substation. Please note that if a more limited substation is included for Beseck, please detail all of the differences between that more limited substation and the substation at Beseck that would be included as part of the proposed Middletown to Norwalk Project.

Response:
a through d) An East Shore route was evaluated in the study entitled "Comparison of the Middletown to Norwalk Project vs. East Shore Alternative" and PowerGEM reports (submitted in Addendum 2 and 3 to the Supplemental Filing). This evaluation relied upon the existing system configuration in the Middletown area. 345-kV transmission line additions were made from East Shore Substation to East Devon, Singer, and Norwalk Substations. There were no changes from Scovill Rock Switching Station to Chestnut Junction, from Oxbow Junction to the proposed Beseck Substation, and from Black Pond Junction to the proposed Beseck Substation. The proposed Beseck Switching Station was not represented in the East Shore route studies.

As described on page 12 of the Supplemental Filing, the Companies investigated the potential of reducing new 345-kV construction by using the existing 387 line and starting new construction at East Shore Substation. The studies indicate that the existing 387 line does not create a new electrical path into SWCT. Therefore, terminating the 387 line into a new substation at Beseck will not have a significant impact upon the results of these studies.

Witness: **Roger C. Zaklukiewicz**
Request from: **TOWNS**

Question:
Specify, and quantify where applicable, the criteria that GE uses when performing harmonic and switching transient analyses to determine whether a configuration being examined in adequate and should be recommended. Please also provide the GE documents which set out these criteria.

Response:

The Institute of Electronic and Electrical Engineers (IEEE), along with the American National Standards Institute (ANSI) have developed the standards and guidelines listed below as a means of assuring that the electrical power supply will be adequate for the effective and safe operation of both utility and customer equipment. Analysis of harmonic and switching transient performance includes consideration of both customer power quality and avoidance of damage to utility and customer equipment. The standards and guidelines listed below are applied universally throughout the United States. IEEE Std. 519-1992 provides recognized guidelines for the maximum individual harmonic and total harmonic distortion of voltage supplied to customers. Also, IEEE Std. 1100-1999 has a volt-time curve guideline for load voltages (known as the "ITIC" curve), which has been developed by the Information Technology Industry Council (ITIC), a trade group representing manufacturers of consumer and business equipment. This curve includes considerations of consumer device misoperation, a power quality issue, as well as device physical damage. The utility equipment types most vulnerable to overvoltages caused by switching are power transformers, circuit breakers, coupling capacitor voltage transformers, and surge arresters. Surge arrester performance and survivability are evaluated based on energy and current duties and magnitude and duration of temporary overvoltages. The withstand capabilities of typical station-class surge arresters are used as criteria for evaluating the duties observed, which are in accordance with the IEEE surge arrester application guide, Std. C62.22-1997. Circuit breaker recovery voltages and transient recovery voltages are evaluated based on ANSI C37.06-1997.

Based on the technical expertise and experience of the GE engineers who conducted and reviewed the transient and harmonic studies, the recommendations in the GE reports reflect their conclusions regarding the potential impact the proposed transmission system changes would have on the bulk power system studied.

Witness: **Roger C. Zaklukiewicz; James M. Hogan**
Request from: **TOWNS**

Question:
Reference Addendum #2 to the Supplemental Filing, at pages 2 and 3.

a. Explain the current status of the investigation of whether the 387 line transmission structures could support conductors with a capacity larger than 2-954 ACSR, and if so, how that would affect the thermal load flow results. Please also state when these analyses will be completed.

b. Please provide the analyses, reports, workpapers and source documents for the investigation of whether the 387 line transmission structures could support conductors with a capacity larger than 2-954 ACSR and if so, how that would affect the thermal load flow results.

c. Provide the documentation in which the ISO-NE SCWG informed the Companies that any thermal analysis of the East Shore Alternative must include generation dispatches that model the unavailability of the New Haven Harbor Generating Station and/or New York transfer analyses in accordance with NEPOOL standards and procedures.

d. Provide the NEPOOL standards and procedures which mandate that any thermal analysis of the East Shore Alternative must include generation dispatches that model the unavailability of the New Haven Harbor Generating Station and/or New York transfer analyses.

Response:
a) The existing 387 line has three different configurations of conductor and structure types. This analysis considered each type of construction:

Scovill Rock Switching Station to Black Pond Junction - Wood H-frames- 1-2156 kcmil Aluminum Conductor Steel Reinforced (ACSR) "Bluebird" conductor
Black Pond Junction to Beseck Junction - Steel Monopoles (Double circuit steel poles with a 345 kV and 115 kV circuit attached). The conductors on the 345-kV circuit are 2-954 kcmil ACSR "Rail" The conductor on the 115-kV line circuit is 1-1272 kcmil ACSR "Bittern"
Beseck Junction to Totoket Junction - Wood H-frames - 2-954 kcmil ACSR "Rail"
Totoket Junction to East Shore Substation - Double Circuit Steel Poles. The conductors on the 345-kV circuits are 2-954 kcmil ACSR "Rail". The conductors on the 115-kV circuit is 1-1272 kcmil ACSR "Bittern")

The first step of the analysis was to determine the feasibility of reconductoring the Bluebird section with 2-954 Rail conductor. The results of these analyses suggested that approximately 35% of the existing structures would have to be replaced between Scovill Rock Switching Station and Black Pond Junction.

The investigation was then extended to three larger conductor types and sizes. These conductors are listed below:

2-1158 kcmil ACSS/TW (Aluminum Conductor Steel Supported/Trapezoidal Wire) "Genesee"
2-1455.3 kcmil ACSS/TW "Mirimichi"

2-1272 kcmil ACSR "Bittern"

The largest conductor size judged to be potentially feasible to install on the 387 line is bundled Genesee/ACSS/TW conductor. This requires the replacement of approximately 39% of the structures on the section of line between Scovill Rock and Black Pond, approximately 5% of the structures between Beseck and Totoket Junction and approximately 13% of the steel structures between Black Pond Junction to Beseck and Totoket Junction to East Shore Substation.

A bundled pair of Genesee ACSS/TW conductor has a summer normal rating of 1655 MVA and an emergency rating of 2490 MVA at 180 degrees centigrade. While the use of such a conductor would eliminate the overload of the 387 line, overloads on other circuits would continue to persist. There are other 345-kV and 115-kV lines which would have to be upgraded, they are listed in Table 1 of PowerGEM Report 10021.001-6. It is important to note that the NY-NE transfers which were studied in the PowerGEM analysis of the East Shore configurations were at system transfers appreciably below the level required by NEPOOL Reliability Standards. Since there were an unacceptable number of line overloads observed at the lower transfer levels, a complete transfer analysis was not completed. This analysis would be required to determine the full scope of system upgrades which would be required for this configuration to meet reliability standards.

b) The structural analysis report is expected to be finalized and produced by May 4, 2004.

c) The ISO-NE SCWG verbally informed the Companies of the required generation dispatches.

d) Such a requirement is a compilation of various NEPOOL procedures and is also based on the combined experience of the members of the ISO-NE SCWG including experience on NEPOOL task forces such as the Transmission Task Force.

Specific language requiring testing to include stressed inter-Area transfers under a variety of system dispatches can be found in the following:

NEPOOL Planning Procedure No. 3, "Reliability Standards for the New England Power Pool"

> Section 3 - "With due allowance for generator maintenance and forced outages, design studies will assume power flow conditions with applicable transfers, load, and resource conditions that reasonably stress the system. Transfers of power to and from another Area, as well as within New England, shall be considered in the design of inter-Area and intra-Area transmission facilities."

Section 4 - "Therefore, design studies will assume applicable transfers and the most severe load and resource conditions that can reasonably be expected."

NEPOOL Planning Procedure 5-3, "Guidelines for Conducting and Evaluating 18.4 Application Analysis"

Section 3.1.1 - "Impact on area transmission requirements is investigated by showing that the resultant system (after the change/addition) has sufficient transmission capability to serve the area loads under the conditions noted below and in the NEPOOL Reliability Standards (Section 3). Impact on inter-Area and intra-Area transmission transfer capability should be demonstrated for the conditions noted below and in the NEPOOL Reliability Standards (Section 4)."

Section 3.3 - "It is the responsibility of the Participant submitting the 18.4 application to identify the most severe conditions that can be reasonably expected to exist. It must be demonstrated that under such conditions, the proposed additions or changes will not have any significant adverse impact upon the reliability or operating characteristics of the bulk power system; otherwise, the participant must propose system modifications, protection systems and /or operating restrictions on the proposed addition which will eliminate such an adverse impact. Studies demonstrating steady state performance must then simulate normal conditions as well as conditions that stress the system beyond "typical" combinations of load level, generation dispatch and power transfers."

Section 3.3.1.1.f - "Generation Dispatch - Testing should not be restricted to only typical dispatch; rather the dispatch(es) should be developed to reasonably test the proposed additions or changes." Section 3.3.1.1.g states "Modeling of Transfer Conditions - Generally, intrapool transfers will be simulated at or near their established limits (in the direction to produce "worst case" results) and sensitivities to interpool transfers will be determined as appropriate."

Although intended to set forth requirements for the study of a new resource (generator), NEPOOL Planning Procedure No. 5-6, "Scope of Study for System Impact Studies Under the Minimum Interconnection Standard" has also been applied by the NEPOOL Task Forces to determine if transmission projects have an adverse impact on the transmission system. This recognizes that new generators and transmission projects should be held to the same standards. If new generators or modifications to existing generators were held to a higher standard than transmission projects, this would be viewed as discriminatory against generation additions or modifications to existing generators. Section 1.(c) states "The proposed new Resource does not diminish the transfer capability across any transmission line or relevant interface below the level of achievable transfers during reasonably stressed conditions and does not diminish the reliability or operating characteristics of the New England bulk power system and its component systems." Section 3.4 states "No Resource(s) can be assumed as Must Run as a condition for acceptable operation of the new Resource."

When taken as a whole, the procedures and the interpretation of those procedures by the appropriate NEPOOL task forces require the ISO-NE SCWG to ensure that any SWCT solution is not solely dependent upon the operation of a single generator (New Haven Harbor) under a variety of system conditions, including stressed transfers between New York and New England.