547. Compliance with NESC provides protection of public health and safety. *Council's Administrative Notice Item 29* (The Connecticut Siting Council Electric and Magnetic Field Best Management Practices For the Construction of Electric Transmission Lines in Connecticut, dated December 21, 2004).

548. Magnetic fields at the edge of the ROW, whether low magnetic field designs are employed or not, do not pose an undue hazard to public health and safety or a risk to persons and property along the area traversed by the line (Cross reference to previous findings).

549. Buffer zones defined by magnetic field values or distance, based on scientific evidence or "prudent avoidance" have not been recommended by any international or national agency (IARC, NIEHS, NRPB, HCN). *Companies' Administrative Notice Item 18* (Health Council of the Netherlands (HCN): ELF Electromagnetic Fields Committee. 2001. Electromagnetic fields: Annual Update 2001. The Hague: Health Council of the Netherlands. Publication No. 2001/14); *Companies' Administrative Notice Item 19* (Health Council of the Netherlands (HCN): ELF Electromagnetic Fields Committee. 2004. Electromagnetic fields: Annual Update 2003. The Hague: Health Council of the Netherlands. Publication No. 2003/01); *Companies' Administrative Notice Item 20* (International Agency for Research on Cancer (IARC). 2002. IARC Monographs on the evaluation of carcinogenic risks to humans. Vol. 80: Static and extremely low-frequency (ELF) electric and magnetic fields. IARC Press, Lyon, France); *Companies' Administrative Notice Item 21* (National Institute of Environmental Health Sciences (NIEHS). 1998. Assessment of Health Effects from Exposure to Power-line Frequency Electric and Magnetic Fields: Working Group Report. NIH Publication No 98-3981. Research Triangle Park, NC: National Institute of Environmental Health Sciences of the U.S. National Institutes of Health); *Companies' Administrative Notice Item 22* (National Institute of Environmental Health Sciences (NIEHS). 2002. EMF Electric and Magnetic fields Associated with the use of Electric Power: Questions and Answers. Research Triangle Park, NC: National Institute of Environmental Health Sciences of the U.S. National Institutes of Health); *Council's Administrative Notice Item 2* (National Institute of Environmental Health Sciences and U.S. Department of Energy, Questions and Answers About EMF Electric and Magnetic Fields Associated with the Use of Electric Power, United States Government Printing Office, Washington D.C., June 2002); *Council's Administrative Notice Item 3* (National Institute of Environmental Health Sciences of the National Institutes of Health, NIEHS Working Group Report, Assessment of Health Effects from Exposure to Power-line Frequency Electric and Magnetic Fields, NIH Publication No. 98-3981, August 1998); *Council's Administrative Notice Item 4* (National Institute of Environmental Health Sciences of the National Institutes of Health, Health Effects from Exposure to Power-line Frequency Electric and Magnetic Fields, NIEHS Publication No. 99-4493, May 1999); *Companies' Administrative Notice Item 23* (National Research Council. 1997. Possible Health Effects of Exposure to Residential Electric and Magnetic Fields. Committee on the Possible Effects of Electromagnetic Fields on Biologic Systems, National Research Council, National

Academy Press, Washington, D.C); *Companies' Administrative Notice Item 24* (National Research Council. 1999. Research on Power-Frequency Fields, Completed Under Energy Policy Act of 1992, Committee to Review the Research Activities Completed Under the Energy Policy Act of 1002, Commission on Life Sciences, National Research Council, National Academy Press, Washington, D.C); *Companies' Administrative Notice Item 25* (National Radiological Protection Board (NRPB). 2004. Review of the Scientific Evidence for Limiting Exposure to Electromagnetic Fields (0-300 GHz). National Radiological Protection Board, Vol. 15, No. 3); *Companies' Ex. 1*, Vol. 6, "Electric and Magnetic Field Assessment: Middletown-Norwalk Transmission Reinforcement"); *Companies' Ex. 40* (Testimony of Cole et al., March 16, 2004, and additional information dated April 8, 2004); *Companies' Ex. 75* (Testimony of Bailey, May 3, 2004, p. 1-16); *Companies' Ex. 124a and 124b* (Testimony of Bailey, July 19, 2004, Exhibit 2 filed July 23, 2004 and Errata Pages read into record on July 27, 2004 hearing).

550. In the absence of any basis to conclude that transmission line magnetic fields cause adverse health effects, and any basis for belief as to what the exposure of interest would be if they did, the definition of a "buffer zone" according to distance, milligauss limits, or any other uniform characteristic can only be justified on a prudent avoidance basis. The World Health Organization explains that prudent avoidance "does not imply setting exposure limits at an arbitrarily low level, and requiring that they be achieved regardless of cost, but rather adopting measures to reduce public exposure to EMF at modest cost" *Woodbridge Organizations' Ex. 1* (Testimony of Bell et al., March 16, 2004, Appendix 2, Tab 32, p. 4). Moreover, the WHO cautions, "scientific assessments of risk and science-based exposure limits should not be undermined by the adoption of arbitrary cautionary approaches. That would occur, for example, if limit values were lowered to levels that bear no relationship to the established hazards or have inappropriate arbitrary adjustments to the limit values to account for the extent of scientific uncertainty." *Woodbridge Organizations' Ex. 1* (Testimony of Bell et al., March 16, 2004, Appendix 2, Tab 32, p. 5). The WHO recommends against adoption of an ALARA (as low as reasonably achievable) policy for power line magnetic fields as inappropriate "in the absence of any expectation of *risk at low exposure levels and given the ubiquity of exposure" Woodbridge Organizations' Ex. 1* (Testimony of Bell, March 16, 2004, Appendix 2, Tab 32, p. 5); *Woodbridge Organizations' Ex. 1* (Testimony of Bell et al., March 16, 2004, p. 4-10); *Companies' Ex. 183* (Testimony of Bailey et al., January 24, 2005, p. 47-49).

551. Based on its overall evaluation of the evidence concerning magnetic field levels that will be associated with the existing and new lines, the lack of scientific evidence establishing that transmission line magnetic fields are hazardous, and the levels of magnetic fields that will be associated with the lines, whether as proposed or as the Council may modify them by requiring the adoption of low magnetic field designs, the Council finds that the new lines will be contained within a buffer zone adequate to protect public health and safety, and will not

pose an undue hazard to persons and property along the location traversed by the line (See, preceding subordinate proposed findings).

15.0 Determining the Maximum Amount of Undergrounding That is Technologically Feasible

552. PA 04-246, which became effective June 3, 2004, sets forth a statutory presumption in favor of installing 345-kV electric transmission lines underground adjacent to certain types of facilities (listed in the Public Act) unless it is not technologically feasible to do so.

553. The technology and type of construction selected for the Project must enable the Project to be reliable and operable. If Connecticut builds a transmission loop with reliability problems, it could impact the regional system, as well as Connecticut and SWCT. 6/17/04 Tr. at 30 (Whitley).

554. The installation of 24 linear miles (48 circuit miles) of 345-kV underground cable from the East Devon Substation in Milford, to Singer Substation in Bridgeport, and then from Singer Substation to the Norwalk Substation in Norwalk is technologically feasible, provided that XLPE cable is used rather than HPFF cable, to reduce capacitance, and provided that substation equipment is upgraded to provide higher withstand capability for TOVs. The addition of any incremental length of underground cable would subject the electric system to unacceptable risk to system reliability. *Companies' Ex. 176* (Reliability and Operability Committee (ROC) Report dated December 20, 2004, pp. 1, 3, 5-6, 22-28); *Council's Ex. 25* (KEMA Inc. engineering summary of the February 14, 2005 technical meeting dated February 16, 2005); 1/11/05 Tr. at 32-33, 43-44 (Whitley); 1/13/05 Tr. at 80-81 (Whitley); 2/17/05 Tr. at 22-24, 37-38, 43-45, 95-96, 108-09 (Wakefield, Enslin and Prete).

555. The Companies' revised proposal to install 24 linear miles (48 circuit miles) of 345-kV underground cable is at the very limits of what can be reliably operated, and therefore is at the limits of what is technologically feasible. The reliability and operability risks associated with TOVs, which can result in equipment failures and cascading outages, render a system with additional underground cable technologically infeasible. *Companies' Ex. 176* (Reliability and Operability Committee (ROC) Report dated December 20, 2004, pp. 2-8, 14-28).

556. Each project that receives certification from a state siting agency must be submitted to ISO-NE by the companies proposing to build the project. ISO-NE, with input from the NEPOOL Reliability Committee pursuant to Section 18.4 of the Restated NEPOOL Agreement, will determine whether a project can be reliably connected to the bulk power system in New England, and whether the project can have an adverse effect on the regional electric system. A project cannot be connected to the bulk power system in New England without Section 18.4 approval. *Companies' Ex. 176* (Reliability and Operability Committee (ROC) Report dated December 20, 2004, p. 37); *ISO-NE's Ex. 8* (Testimony of

Whitley, June 7, 2004, pp. 2-3, 11); 3/23/04 Tr. at 134-35 (Kowalski); 1/13/05 Tr. at 79-80 (Whitley).

557. While the siting process generally addresses "linear miles" along a route, the technological feasibility of undergrounding relates to "circuit miles." Because the Project segments west of East Devon require only two circuits, while the Project segments east of East Devon require three circuits for reliability purposes, maximizing linear length of undergrounding logically starts with the portion of the Project between East Devon and Norwalk. A project with additional underground cable or cable segments beyond the 24 linear miles (48 circuit miles) between East Devon and Norwalk would result in unacceptable reliability and operability risks, including unpredictable system responses during contingencies, which increase the likelihood of exceeding the magnitude and duration of TOV limits of system equipment. *Companies' Ex. 176* (Reliability and Operability Committee (ROC) Report dated December 20, 2004, pp. 4, 8).

558. The SWCT electric system cannot be considered reliable if TOVs exceeding the equipment specifications (withstand capability) of any of the system elements can occur. *Companies' Ex. 176* (Reliability and Operability Committee (ROC) Report dated December 20, 2004, pp. 5, 19, 27-28).

559. Because of the already high capacitance in the relatively weak SWCT transmission system, the potential for TOVs is a particular problem in SWCT. *Companies' Ex. 147* (Reliability and Operability Committee Report, dated August 16, 2004, p. 9); *Companies' Ex. 44*, Response to CSC-01, Q-CSC-028; *Companies' Ex. 176* (Reliability and Operability Committee (ROC) Report dated December 20, 2004, p. 15); *ISO-NE's Ex. 8* (Testimony of Whitley, June 7, 2004, p. 6); 1/11/05 Tr. at 27 (Whitley).

560. The Council's independent consultant, KEMA, has concluded that the studies undertaken by the ROC Group and its consultants are an adequate basis upon which to judge whether or not a configuration is technologically feasible. Based upon all the studies and data, KEMA determined that sufficient data has been provided to support the engineering conclusion that it is not technologically feasible to install further undergrounding, beyond the 24 linear miles (48 circuit miles) proposed by the Companies for the Project. 2/17/05 Tr. at 22-24, 43-45, 67-68 (Wakefield).

561. The following specific findings set forth the development of the body of information supporting the determination that the Companies' modified proposal is the maximum amount of underground installation of 345-kV cable that is technologically feasible for the Project, and that additional underground cable would be technologically infeasible.

15.1 Issues Related to Use of 345-kV Underground Cable

562. There are several factors that constrain the connection of 345-kV underground cables to a predominantly overhead transmission system. *Companies' Ex. 1* (Application, Vol. 1, p. H-8).

- Underground electric transmission cable works best when the underground cable is connected to a strong source, which helps to control voltages and voltage differences. 4/21/04 Tr. at 156-162 (Zaklukiewicz).

- Cable reliability is a concern in any underground cable analysis. Faults on an underground system typically require weeks to locate and could require months to repair. During this period, the entire circuit on which the fault occurred would be unavailable, thereby increasing the transmission system's exposure to unacceptable levels of risk. As a result of this concern, a minimum of two circuits for each underground segment of the Project are required. *Companies' Ex. 44*, Response to CSC-01, Q-CSC-028).

- Possible installations of underground extra high voltage cable must be carefully analyzed by power system engineers, taking into account design limitations of the cable and substation equipment at the cable termination. *Companies' Ex. 1* (Application, Vol. 1, p. H-8); *Companies' Ex. 176* (Reliability and Operability Committee (ROC) Report dated December 20, 2004); *Companies' Ex. 147* (Reliability and Operability Committee Report, dated August 16, 2004).

- The SWCT electric system is "weak." The Companies proposed this Project in order to strengthen the system and create a strong source at Beseck, to which the SWCT system can connect. Because the system is presently weak, the Companies undertook harmonic frequency scans to assess the effect of capacitance from the proposed underground cables on system operation and reliability. *Companies' Ex. 176* (Reliability and Operability Committee (ROC) Report dated December 20, 2004, pp. 14-28); *Companies' Ex. 147* (Reliability and Operability Committee Report, dated August 16, 2004, pp. 9, 11-26); *Companies' Ex. 44,* Response to CSC-01, Q-CSC-028; *Companies' Ex. 1* (Application, Vol. 1, ES-4, F-1, F-24 to F-27); *ISO-NE's Ex. 8* (Testimony of Whitley, June 7, 2004, p. 6); 1/11/05 Tr. at 27 (Whitley).

- Capacitance is substantially higher for underground cable than for overhead lines. Each incremental amount of underground cable increases the amount of capacitance on the system. *Companies' Ex. 44,* Response to CSC01, Q-CSC-028; *Companies' Ex. 1* (Application, Vol. 1, H-49); *ISO-NE's Ex. 8* (Testimony of Whitley, June 7, 2004, pp. 6-7);

Cable Capacitance and Temporary Overvoltages

563. Increased capacitance results in an increased potential for electric system problems with respect to switching transients, voltage control and swings, transfer limit limitations, and stability. The increased capacitance associated with underground cables increases the potential for temporary overvoltages ("TOVs"). TOVs can lead to equipment failures resulting from voltages that exceed the equipment's specifications and limits, and reduced service life of equipment. *Companies' Ex. 176* (Reliability and Operability Committee (ROC) Report dated December 20, 2004, pp. 5, 19, 27-28); *Companies' Ex. 164* (Interim Report of the Reliability and Operability Committee, dated October 8, 2004, p. 3); *Companies' Ex. 147* (Reliability and Operability Committee Report, dated August 16, 2004, pp. 2, 9, 13); *Companies' Ex. 44*, Response to CSC-01, Q-CSC-028); 2/14/05 Tr. at 25, 27 (Whitley); *ISO-NE's Ex. 8* (Testimony of Whitley, June 7, 2004, pp. 6-11, 12).

564. Unacceptably high sustained and distorted overvoltages, or switching transients, can occur when switching an all underground transmission circuit or a circuit comprised of both underground and overhead sections. These conditions arise because a high voltage cable in a predominantly overhead and relatively weak transmission system has the electrical characteristics of a giant capacitor. *Companies' Ex. 1* (Application, Vol. 1, p. H-8).

565. Upon the loss of an adjacent transmission line or generating unit, power flows on an underground cable could change dramatically, increasing by a factor of 3 to 5 or greater, or decreasing to extremely low levels approaching zero. Because shunt reactors at the cable terminals cannot be connected or disconnected instantaneously to compensate for the change in power flow on the cable, system voltages in proximity to the cable could increase or decrease to unacceptable levels, when the fault is isolated from the electrical system. *Companies' Ex. 1* (Application, Vol. 1, p. H-9).

566. System electrical equipment, including the cable, must be able to withstand TOVs. Surge arrestors are typically installed in substations to protect equipment from transient overvoltages; however, studies must be conducted to ensure their energy ratings are not exceeded. *Companies' Ex. 1* (Application, Vol. 1, p. H-9).

567. If not successfully controlled, excessive high voltage swings will damage system electrical equipment (e.g., cables, reactors, and transformers) and may damage customer equipment. Conversely, abnormally low voltages could result in excessively low voltage at customer facilities, resulting in equipment damage and process disruptions and a potential voltage collapse of the transmission system. *Companies' Ex. 1* (Application, Vol. 1, p. H-9).

15.2 The Companies' Proposal in the Application to Install 24 Linear Miles of 345-kV Underground Cable and Modifications to Enable The Proposal to be Reliably Operated

568. The Companies undertook extensive evaluation of potential routing and technology options, even before the enactment of P.A. 04-246. During the initial development of the Project, the Companies considered the reliability and operability issues associated with underground cable, as well as other factors under PUESA affecting route and technology selection, including environmental impact, constructability, need to expand rights of way, need to acquire property and cost of potential underground and overhead configurations. *Companies' Ex. 1* (Application, Vol. 1, Section H).

569. Prior to submitting the Application, the Companies consulted with cable experts to evaluate the reliability, operability and constructability of various cable technologies and construction methods, maintenance requirements and repair considerations. These factors can significantly affect the reliability of a cable system. *Companies' Ex. 1* (Application, Vol. 1, pp. H-5 to H-9).

570. CCI, a consultant to the Companies, reviewed and compared underground cable configurations in general. PDC, another consultant to the Companies, evaluated cable types used at 345 kV, determined types that would be suitable for the Project, and performed a conceptual design of cable systems that would meet the Companies' requirements. *Companies' Ex. 1* (Application, Vol. 1, pp. H-6 to H-7; Vol. 6, "Tutorial – Underground Electric Power Transmission Cable Systems" (CCI); and Evaluation of Potential 345-kV and 115-kV Cable Systems as Part of the Middletown-Norwalk Project).

571. The Companies' Application to the Council for the Project proposed 24 linear miles (48 circuit miles) of 345-kV HPFF underground cable for the Project, to be installed from East Devon Substation to Singer Substation, and then from Singer Substation to Norwalk Substation. The Companies recognized the public preference to have electric transmission lines installed underground rather than overhead, and proposed an amount of 345-kV cable for this Project that was significantly greater than the underground cable previously used in any similar application. *Companies' Ex. 1* (Application, Vol. 1, Section H).

572. In their Application to the Council, the Companies proposed to use HPFF cable technology for the underground sections of the Project, because it is the most common underground technology in use at 345 kV in the United States, and has a history of proven reliability. *Companies' Ex. 54* (Testimony of Zaklukiewicz, et al. dated April 8, 2004, pp. 24-29).

573. In June 2004 ISO-NE reported to the Council that it had determined that the Project, as then designed to use HPFF cables, would not operate reliably because it would introduce too much capacitance into a weak system, and would pose the risk of system failures including cascading outage and dame to transmission system equipment. *ISO-NE's Ex 1* (Testimony of Whitley, March 9, 2004, p. 26); 3/23/04 Tr. at 49-51; 4/21/04 Tr. at 121-122; *ISO-NE's Ex. 8* (Testimony of

Whitley, June 7, 2004, p. 6). ISO-NE therefore indicated it cold not support the Project as proposed in the Application. 6/17/04 Tr. at 58, 91.

574. ISO-NE's determination was based on harmonic screening studies and a TNA. These studies are generally not done until detailed engineering designs are done which would follow the siting process. *ISO-NE's Ex. 8* (Testimony of Whitley, June 7, 2004, pp. 7-8); 6/17/04 Tr. at pp. 41-42 (Whitley).

575. At approximately the same time that ISO-NE determined the proposed 24 linear miles of undergrounding would not be reliable, the passage of P.A. 04-246 required the Companies to maximize underground. P.A. 04-246.

15.2 The ROC Group Studies and Conclusions

576. After the June 2004 hearings in this docket, CL&P, UI and ISO-NE formed a Reliability and Operability Committee ("ROC" or "ROC Group"). The ROC Group was formed after the enactment of PA 04-246, with the express purpose of considering potential Project modifications that would maximize the feasible use of underground 345-kV cable while still enabling the Project to meet operability and reliability requirements and electric system need. *Companies' Ex. 147* (Reliability and Operability Committee Report, dated August 16, 2004, p. 1).

577. In order to understand better the impact of additional capacitance on the electric system, the ROC Group undertook extensive analyses over a period of several months. The ROC Group relied on the engineering and operational experience of the ISO and of the Companies, as well as the study results of a large group of independent, expert consultants. The ROC Group directed its consultants to model potential Project configurations and perform sophisticated transient network analysis ("TNA") studies to predict TOV conditions if the underground cable configurations under consideration were constructed. The ROC Group considered the effects of the TOVs on electric system equipment, potential means of mitigation, and the need to retain the ability to make future system additions. *Companies' Ex. 118* ("Connecticut Cable Resonance Study for XLPE Alternative in Middletown to Norwalk Project" by General Electric, Summary Report (Case 5), July 12, 2004); *Companies' Ex. 119* ("Connecticut Cable Resonance Study for XLPE Alternative in Middletown to Norwalk Project" by General Electric, Summary Report (Case 6), July 19, 2004); *Companies' Ex. 125* (Thermal and Voltage Analysis (Case 6) filed July 19, 2004); *Companies' Ex. 146* (Connecticut Cable Resonance Study for Dual DC Option (Case 5b); Connecticut Cable Resonance Study for Synchronous Condenser Option 1 (Case 5c); and Connecticut Cable Resonance Study for Synchronous Condenser Option 2 (Case 5d) with the cover letter dated August 6, 2004); *Companies' Ex. 195* (Northeast Utilities' Connecticut Cable Resonance Study for XLPE Alternative in Middletown to Norwalk Project – Case 5 with Overhead Lines Between Plumtree and Norwalk, Summary Report, October 2004); *Companies' Ex. 176* (Reliability and Operability Committee (ROC) Report dated December 20, 2004, Appendices

A-E and PBPower SWCT M-N Project Transient Studies to Evaluate Temporary Overvoltage Levels dated January 2005).

578. The ROC Group's consultants undertook hundreds of TNAs, at a cost of over one million dollars. The linear length of underground cable in the TNA screening analyses ranged from 4 to 44 linear miles. These analyses have provided the ROC Group with a better understanding of the risks and operability of the SWCT electric system. *See Companies' Ex. 147* (Reliability and Operability Committee Report, dated August 16, 2004); *Companies' Ex. 164* (Interim Report of the Reliability and Operability Committee, dated October 8, 2004); *Companies' Ex. 176* (Reliability and Operability Committee (ROC) Report dated December 20, 2004); 1/13/05 Tr. at 89-91 (Zaklukiewicz).

579. The ROC Group issued a report on August 16, 2004; an interim report on October 8, 2004, and a final report on December 20, 2004. Each of these reports was reviewed by KEMA, the Council's independent consultant. *Companies' Ex. 147* (Reliability and Operability Committee Report, dated August 16, 2004); *Companies' Ex. 164* (Interim Report of the Reliability and Operability Committee, dated October 8, 2004); *Companies' Ex. 176* (Reliability and Operability Committee (ROC) Report dated December 20, 2004); *Council's Ex. 25* (KEMA Inc. engineering summary of the February 14, 2005 technical meeting dated February 16, 2005).

580. In order to maximize underground construction, the ROC Group studied the substitution of 345-kV XLPE underground cable for the originally proposed HPFF cable. A 345-kV HPFF cable has a charging current of approximately 21 MVARS per circuit mile, while the charging current of a 345-kV XLPE cable is approximately 12 MVARS per circuit mile. Because the capacitance of 345-kV XLPE cable is approximately 60% of the capacitance of 345-kV HPFF cable, more can be used before the additional capacitance associated with the cable creates unacceptable operability and reliability problems. *Companies' Ex. 175* (Reliability and Operability Committee (ROC) Report dated December 20, 2004, pp. 18-19).

581. In its December 20, 2004 Final Report, the ROC Group identified three "cases" as technologically feasible: Alternative B, including four linear miles of 345-kV underground cable, between Singer Substation and Seaview Transition Station; Case 2, including 13 linear miles of 345-kV underground cable, between East Devon Substation and Singer Substation and Hawthorne transition station; and Case 5, including 24 linear miles of 345-kV underground cable from East Devon Substation to Singer Substation, and then from Singer Substation to Norwalk Substation. Case 2 was the same route as Alternative A in the Application, with a change of cable type from HPFF to cross-linked polyethylene cable ("XLPE"), while Case 5 was the proposed route in the Application, with a change from HPFF to XLPE. In addition, the ROC Group noted that existing equipment would need to be upgraded and other specific required mitigation actions would be required in order to make the 24 linear miles of 345-kV underground cable

technologically feasible. The Final Report also states that the ROC Group's studies do not support any incremental length of 345-kV underground cable, beyond the 24 linear miles proposed by the Companies, as technologically feasible. *Companies' Ex. 176* (Reliability and Operability Committee (ROC) Report dated December 20, 2004).

582. Each piece of electric transmission and distribution equipment has a capability to withstand a rated range of overvoltages for a short period of time. In order to determine if the system could withstand – or could be made to withstand – the overvoltage conditions of the kind the TNA studies show could occur, the Companies determined the withstand capabilities of the equipment that is currently installed on the system and the withstand capabilities of the equipment that is contemplated for the proposed project. The Companies identified the equipment that had insufficient capability to withstand the overvoltage conditions and considered whether that equipment could be replaced with equipment that had a higher withstand capability without compromising other equipment on the system. *Companies' Ex. 176* (Reliability and Operability Committee (ROC) Report dated December 20, 2004, p. 20 and Appendix B).

583. In order to render the 24 linear miles (48 circuit miles) originally proposed by the Companies in the Application technologically feasible in light of the problems associated with TOVs, many mitigative actions must be taken. Without these actions, it would not be technologically feasible to install 24 linear miles of 345-kV underground cable in the Project. The actions required to render the 24 linear miles technologically feasible are:

- XLPE cable must be used rather than HPFF cable as had originally been proposed;
- Up to 1,200 surge arrestors and upgrades of other equipment will be required, at about half of CL&P's transmission substations and UI's transmission substations, to improve the capability of the arrestors to survive TOVs with an inherent compromise of the current protection margins that exist with other substation equipment; and
- 500-kV equipment will have to be installed in the new 345-kV substations.
- More extensive changes must be made to remedy local areas problems, such as those that exist at Rocky River Substation.

Companies' Ex. 176 (Reliability and Operability Committee (ROC) Report dated December 20, 2004, pp. 1, 3, 5-6, 23-24); 1/11/05 Tr. at 32, 139 (Whitley and Zaklukiewicz); 1/13/05 Tr. at 128, 132, 183-85 (Whitley and Zaklukiewicz).

584. The Chief Operating Officer of ISO-NE, which is obligated to operate New England's electric transmission system reliably and in accordance with Good

Utility practice, believes that there are no insurmountable barriers to operating the electric system including the Project, with the modifications identified in the Final ROC Report, in accordance with Good Utility Practice. 1/11/05 Tr. at 32-33, 43-44 (Whitley); 1/13/05 Tr. at 79-82, 192-93 (Whitley).

15.4 KEMA's Analysis of the Maximum Amount of Underground Cable that is Technologically Feasible

585. The Council retained KEMA, Inc. ("KEMA") to perform an independent technical review of the technological feasibility of installing underground cable in the Project. *See Council's Ex. 24* (KEMA Inc. white paper entitled "Observations on the Reliability and Operability Committee's Final Report," dated January 18, 2005, p. 1 (the "January White Paper").

586. KEMA reviewed the August 2004 ROC Report. The KEMA work was based strictly on technical issues with no consideration of the cost of maximizing underground cable rather than installing portions of the Project overhead. The KEMA investigation included not only an evaluation of the Companies' proposal, but also consideration of potential mitigation efforts to see if such mitigation could extend the portion of the Project that could feasibly be installed underground. *Council's Ex. 9* ("Harmonic Impedance Study for Southwest Connecticut Phase II Alternatives," by KEMA, Inc., dated October 18, 2004, p. 6).

587. KEMA developed its own system model in order to evaluate different system alternatives from a harmonic resonance point of view. *Council's Ex. 9* ("Harmonic Impedance Study for Southwest Connecticut Phase II Alternatives," by KEMA, Inc., dated October 18, 2004, p. 6).

588. On October 18, 2004, KEMA issued a report evaluating the October 8, 2004 interim ROC report's conclusions with respect to the installation of underground cable. The KEMA report confirmed that harmonic resonance peaks move lower as the amount of additional undergrounding increases. KEMA stated that based upon harmonics studies alone, if effective mitigation were employed, such as passive filtering, alone or in combination other FACTS devices additional undergrounding of up to 20 miles would be technologically feasible. These statements were preliminary, and based solely upon harmonic studies, which did not take into account line outages or system contingencies. KEMA recommended that C-Type filters be studied, and that TNAs should be conducted. *Council's Ex. 9* ("Harmonic Impedance Study for Southwest Connecticut Phase II Alternatives," by KEMA, Inc., dated October 18, 2004).

589. The ROC Group thereafter undertook an evaluation of C-Type filters, as well as retaining independent consultants to perform hundreds of TNA screening analyses on many potential system configurations. The ROC Group's December 20, 2004 Final Report concluded that C-Type filters would not reliably increase the amount of 345-kV underground cable that is technologically feasible, and that while

proposed Project configurations with 4, 13 or 24 linear miles of 345-kV underground cable would (with certain modifications) be technologically feasible, additional underground cable would not be technologically feasible. *Companies' Ex. 176* (Reliability and Operability Committee (ROC) Report dated December 20, 2004, pp. 33-34).

590. Based upon its initial review of the December 20, 2004 Final ROC Report, KEMA issued the January White Paper on January 18, 2005, which set forth KEMA's observations on the conclusions in the ROC Report. The January White Paper noted that there were four key findings of the December 20, 2004 Final Report of the Reliability and Operability Committee ("ROC Group"):

> 1. Options including either 13 miles or 24 miles of underground cable between Norwalk and Devon are acceptable
>
> 2. Additional undergrounding beyond 24 miles is not feasible
>
> 3. Neither C-Type filters or other types of mitigation will help
>
> 4. VSC HVDC solutions are not feasible for the SWCT system.

Council's Ex. 24 (KEMA Inc. white paper entitled "Observations on the Reliability and Operability Committee's Final Report, dated January 18, 2005, p. 1).

591. The January White Paper agreed with findings 1 and 4 and stated that findings 2 and 3 were not directly supported in the Final Report. *Council's Ex. 24* (KEMA Inc. white paper entitled Observations on the Reliability and Operability Committee's Final Report, dated January 18, 2005).

592. The issues identified in the January White Paper formed the basis for further analysis and explanation by the Companies and ISO-NE, as well as the basis for the technical meeting discussion on February 14, 2005. *See Council's Ex. 25* (KEMA Inc. engineering summary of the February 14, 2005 technical meeting dated February 16, 2005).

593. Appendix E to the December 20, 2004 Final ROC Report included many large spreadsheets of data. Analysis of the data required significant time. After filing the January White Paper, KEMA had *additional* time to extract the data, tabulate and review the data further. That tabulation was filed by KEMA in February 2005, prior to the Council's February 14, 2005 technical meeting. *Council's Ex. 26* (Comparison of TOVs after 2 cycles and 6 cycles for Selected EnerNex Transient Switching Study Cases distributed in a Council memo dated February 11, 2005); 2/17/05 Tr. at 13-14 (Wakefield).

594. On February 14, 2005, the Council held a technical meeting to allow for discussion among KEMA and the ROC Group's experts, and other experts

desiring to attend, of three fundamental issues: whether additional undergrounding beyond 24 linear miles (48 circuit miles) is technologically feasible; the potential use of C-Type filters and other types of mitigation, and the feasibility of alternative underground transmission technologies. This meeting had been publicly noticed and was open the public to listen to the experts' discussion. *Council's Ex. 25* (KEMA Inc. engineering summary of the February 14, 2005 technical meeting dated February 16, 2005).

595. At the February 14, 2005 technical meeting, EnerNex presented and discussed additional investigations undertaken in response to KEMA's white paper and discussed further the data included in Appendix E to the December 20, 2004 Final ROC Report. The EnerNex studies demonstrated that there are changes in the resonance characteristics of the system if underground cable is extended beyond the 24 linear miles proposed for the Project. 2/17/05 Tr. at 22-23, 51 (Enslin and Wakefield).

596. After the technical meeting, KEMA analyzed the additional study results presented at the meeting, considered the discussion at the meeting, and analyzed in more detail the data included in Appendix E to the December 20, 2004 Final ROC Report. KEMA concluded that a more thorough analysis had been conducted by the ROC Group than had been apparent from the discussion in the body of the ROC Report. The data indicated a greater number of high TOVs, and a higher severity of the TOVs that are possible, than had been evident in the text of the December 2004 ROC Report. 2/17/05 Tr. at 26, 46-47, 50 (Enslin and Wakefield).

597. On February 16, 2005, KEMA issued its findings on the results presented at the technical meeting. KEMA's findings state that after reviewing the results of additional investigations by the Companies and their consultants, KEMA had revised its conclusions previously set forth in its January White Paper. After reviewing the EnerNex results presented at the technical meeting and filed with the Council, KEMA concluded that an additional 10 to 20 miles of undergrounding would not be technologically feasible. With respect to C-Type filters, the KEMA findings discuss the additional work of GE Energy regarding the location and design of the filters and note that the feasibility of mitigating TOVs with passive filtering has not been established in actual industry practice. Therefore, KEMA states that "the technical and operational feasibility of additional undergrounding cannot be confirmed at this time." *Council's Ex. 25* (KEMA Inc. engineering summary of the February 14, 2005 technical meeting dated February 16, 2005, p. 2-3). KEMA had previously concluded, in its January White Paper, that high voltage direct current technology is not feasible for the Project. *Council's Ex. 25* (KEMA Inc. engineering summary of the February 14, 2005 technical meeting dated February 16, 2005).

598. At the opening of the hearings on February 17, 2005, KEMA elaborated on the conclusions it had reached after its review of the data in the ROC Report and the additional data presented in the technical session. KEMA's initial suggestion that

additional undergrounding beyond 24 linear miles could be technologically feasible was based on the concept that "C-Type Filters" could be used to mitigate temporary overvoltages. C-Type filters have never been used for the purpose of mitigating TOVs. Upon analyzing the scope of the TOV problems associated with the underground cable, as demonstrated by the transient network analyses and related harmonic studies performed by the ROC Group's consultants, KEMA concluded that it would not be prudent or feasible to attempt to mitigate the TOVs with C-filters. The scale of the Project and the demands that would be made upon the C-filters, coupled with the critical consequences of a failure of mitigation, caused KEMA to recommend against trying this risky mitigation technique. Accordingly, KEMA concurred with the ROC Group that the installation of underground 345-kV cable beyond the 24 miles (48 circuit miles) in the Companies' revised proposal was not technologically feasible. 2/17/05 Tr. at 16-17, 23-27 (Wakefield and Enslin and *passim.*)

15.5 Safety Margin for Equipment Ratings

599. An electricity transmission system should not be designed with the expectation that it will be operated for an indefinite time at or near the limit of tolerance of new system equipment. *Companies' Ex. 176* (Reliability and Operability Committee (ROC) Report dated December 20, 2004, p. 20).

600. Because of the difficulty of modeling load, the type of load and generation, the fact that equipment degrades over time, and because of the impossibility of modeling every system component and every potential contingency that can occur over the expected life of a transmission line and other electric system components, a margin to account for uncertainties (safety margin) is required to assure reliability of the system in actual operation. *Companies' Ex. 176* (Reliability and Operability (ROC) Report dated December 20, 2004, pp. 6-7, 16, 20-21); 1/13/05 Tr. at 48-50 (Gunther); 2/17/05 Tr. at 79-80, 94-96, 108-09, 119-120 (Prete and Gunther).

601. KEMA, the Council's independent consultant, agrees with the ROC Group that a safety margin of 0.25 per unit voltage when evaluating TOVs is appropriate. 2/17/05 Tr. at 56-57 (Wakefield).

602. The studies and data evaluated by the ROC Group's consultants and by KEMA in February 2005 demonstrate that the number of TOVs and the severity of TOVs within the 0.25 per unit safety zone is greater than had originally been expected when the 24 miles of underground cable had been reviewed by the ROC Group in the fall of 2004. *See Companies' Ex. 176* (Reliability and Operability (ROC) Report dated December 20, 2004, Appendix C, p. 12). The following table summarizes the TOVs modeled:

Bin	Case 5	Case 5+5	Case 5+10	Case 5+20
1	16	40	33	5
1.05	2033	2006	2023	1337
1.1	3987	3602	3605	3026
1.15	2960	3525	3611	2774
1.2	2780	3146	3097	2969
1.25	2229	2233	2145	2411
1.3	1414	1246	1217	1711
1.35	880	763	783	1172
1.4	634	446	462	852
1.45	329	268	273	596
1.5	237	186	156	386
1.55	127	104	104	232
1.6	93	79	90	127
1.65	35	45	47	65
1.7	6	34	41	39
1.75	0	14	10	21
1.8	0	8	9	14
1.85	0	5	8	10
1.9	0	1	14	12
1.95	0	4	10	1
2	0	1	6	0
More	0	4	16	0
Into Safty Margin	134	195	251	289
Above Equip Capability	0	15	54	23

603. Because of voltage variations, there is a "safety zone" where, even if the system can be operated reliably under certain conditions, the risk of overvoltages exceeding equipment capability is too great, posing unacceptable reliability risks. *Companies' Ex. 199* (Applicant and ISO-NE summary report of the February 14, 2005 meeting dated February 15, 2005 including data sheets distributed at the February 14, 2005 technical meeting); 2/17/05 Tr. at 107-12 (Zaklukiewicz and Prete).

604. The goal is not to be in the safety zone at all. This would likely be achieved with about 18 linear miles of underground cable, rather than the 24 linear miles (48 circuit miles) proposed by the Companies. However, from a geographic viewpoint, there is no feasible location for a substation in Bridgeport and/or Stratford that would be needed to install 18 linear miles of underground. 2/17/05 Tr. at 107-10 (Prete).

15.6 Reliability of XLPE 345-kV Underground Cable

605. XLPE technology is the standard for 115-kV installations in the United States and worldwide. EHV XLPE cable has been installed in varying lengths in Europe, the Middle East, and the Far East, but the operating experience of EHV XLPE cable is not as extensive as that of 115-kV XLPE cable or 345-kV HPFF technology. *Companies' Ex. 1* (Application, Vol. 6, Evaluation of Potential 345-kV and 115-kV Cable Systems as part of the Middletown-Norwalk Project, pp. 4, 10-11, 26); *Companies' Ex. 176* (Reliability and Operability Committee Report, dated December 20, 2004, Appendix A, p. 6).

606. If 345-kV XLPE cables are used in the Project and one of them failed, it would take approximately 3-5 weeks to locate, repair, and put the cable back into service. 1/19/05 Tr. at 129 (Zaklukiewicz).

607. XLPE cable technology is newer and still maturing but has certain advantages over 345-kV HPFF cables despite the longer repair time, including: (1) the lower capacitance reduces the risk of TOVs; (2) XLPE cables have higher load carrying capability; (3) unlike HPFF cables which require continuous splicing, XLPE cables can be spliced in discontinuous shifts which allows the scheduling of splicing during periods of lower traffic; (4) XLPE cables do not utilize an insulating fluid, thereby eliminating the risk of accidental releases of insulating fluid posed by HPFF cables; (5) XLPE cables have lower losses and lower maintenance costs. *Companies' Ex. 176* (Reliability and Operability Committee Report, dated December 20, 2004, Appendix A, p. 2).

608. Disadvantages of XLPE cable systems as compared to HPFF cable systems at 345-kV include: (1) XLPE cables cost more ; (2) XLPE cables produce higher levels of magnetic fields; and (3) there are fewer years of operating experience for XLPE cables at 300 kV and above. *Companies Ex. 176* (Reliability and Operability Committee Report, dated December 20, 2004, p. 5, 18-19, Appendix A, p. 2).

609. CL&P created an extensive database regarding 345-kV XLPE cable through an intensive data gathering effort and meetings with 11 of the world's leading suppliers of EHV XLPE cable. This database includes the operating experience for 403 km (250 miles) of XLPE cable operating above 300 kV. This is significantly larger than the database in Docket 217, and reflects additional years of operating experience and additional cable installations. Using this expanded database, the Companies, with the assistance of their cable consultant, Brian Gregory of CCI, prepared projections of failure rates of 345-kV XLPE cable:

- Optimistic Case – 0.64 failures/100 miles/year;
- Realistic Case – 2.02 failures/100 miles/year;
- Pessimistic Case – 9.93 failures/100 miles/year.

610. The Optimistic Case is based only on CL&P's database for cables operating over 300 kV; the Realistic Case is based on CL&P's data for cables operating over 300 kV as well as data obtained from its consultant regarding cables between 230 kV and 275 kV; and the Pessimistic Case is based only on a Singapore installation that has had several failures.

611. Applying these failure rate projections to the 48 circuit miles (24 route miles) of 345-kV XLPE cable proposed in the Final ROC Report produces the following annual projections:

- Optimistic Case – one failure every 39 months;
- Realistic Case - one failure every 12 months;
- Pessimistic Case – one failure every 2.5 months.

Council's Administrative Notice Item 15, Docket No. 217, Findings of Fact, Opinion, and Decision and Order; *Companies' Ex. 179* (Statistic and Projected Failure Rate for 345-kV Cable, dated January 14, 2005); *Companies' Ex. 176* (Reliability and Operability Committee Report, dated December 20, 2004, Appendix A); 1/18/05 Tr. at 197-201 (Zaklukiewicz).

612. There have been significant improvements made in both the manufacturing and installation of EHV XLPE cable systems. As a result of these improvements, manufacturers have the capability to produce and install 345-kV XLPE cable that is nearly as reliable as 345-kV HPFF cable. *Companies Ex. 176* (Reliability and Operability Committee Report, dated December 20, 2004, Appendix A, p. 6); 2/1/05 Tr. at 95 (Zaklukiewicz); Council's Administrative Notice Item 16 (Update of ACRES International Life-Cycle Cost Studies for Overhead and Underground Transmission Lines, May 2001) 6/15/04 at 180 (Gregory); 1/13/05 Tr. at 61-62, 74 (Whitley).

613. As a result of improvements in manufacturing and installation procedures for EHV XLPE cables, the rate of failures attributable to splice failures has decreased significantly in the past few years. Splice failures were the cause of 64% of the failures for the Pessimistic Case (which was based on the single Singapore installation), while splice failures represent only 14% of the failures for the Optimistic Case. 1/19/05 Tr. at 136 (Zaklukiewicz).

614. Any elevated risk of cable failures associated with the use of 345-kV XLPE cables (as opposed to HPFF cable) can be reduced with the employment of rigorous cable specifications, close monitoring of the origin, shipping, and handling of raw materials used in the manufacturing process, monitoring of the cable manufacturing process, factory testing of the cable, requiring rigorous cable installation procedures and commissioning tests, and, where appropriate, selecting multiple cable manufacturers. *Companies' Ex. 176* (Reliability and Operability Committee Report, dated December 20, 2004, Appendix A, p. 6); 1/13/05 Tr. at 61-62, 74 (Whitley).

615. The Companies do not intend to use any of the vendors associated with the Singapore 345-kV XLPE installation that was the sole source for the "Pessimistic Case" data. The Companies expect that the anticipated failure rate of the 345-kV cables proposed for the Project would be within the "Optimistic" or "Realistic" ranges. 1/19/05 Tr. at 127-129 (Zaklukiewicz).

616. The December 20, 2004 ROC Report includes a study of the reliability of XLPE cable. *Companies' Ex. 176* (Reliability and Operability Committee (ROC) Report dated December 20, 2004, Appendix A).

617. ISO-NE performed its own separate evaluation of the reliability of EHV XLPE cable. ISO-NE concluded that EHV XLPE cable technology has improved and matured significantly in the last four years, and that the industry is moving toward increased use of EHV XLPE cable technology. ISO-NE concluded that the risk of failures of 345-kV XLPE cables is mitigated because ISO will require the Companies to employ best practices in the design, manufacture, and installation of XLPE cables and the required splices, and because the underground portion of the Project between East Devon, Singer, and Norwalk substations will include two circuits between each of the substations, so that if one of the circuits fails the other circuit can remain in service during the period required to repair the other circuit. 1/13/05 Tr. at 61-62, 74 (Whitley); 2/17/05 Tr. at 81-83 (Whitley).

618. The Council's independent consultant, KEMA, prepared a literature review regarding the reliability of EHV XLPE cables. KEMA concluded that utilities and manufacturers are satisfied with the reliability of EHV XLPE cables to date, but noted that data for a long period of application is not available because most EHV XLPE cable installations have been made in the last 10 years. *Council's Ex. 27* (Short Literature Survey on the Reliability of EHV XLPE Cables prepared by KEMA, Inc., dated January 15, 2005).

619. The ROC Group concluded that the greater risk of employing 345-kV XLPE cable can be accepted in order to comply with the mandate of P.A. 04-246 to maximize 345-kV underground construction. *Companies' Ex. 176* (Reliability and Operability Committee (ROC) Report dated December 20, 2004, p. 19).

620. Even though having 48 circuit miles of 345-kV XLPE underground cable renders the Project less reliable than a Project with substantially less underground cable would be, this configuration is nevertheless technologically feasible and can be supported by the Companies and ISO-NE. 1/11/05 Tr. at 45-48 (Zaklukiewicz); 1/13/05 Tr. at 141-143 (Zaklukiewicz); 2/1/05 Tr. at 85-92 (Zaklukiewicz); *Companies' Ex. 181*, Response to Q-OCC-017-RV01; *Companies' Ex. 176* (Reliability and Operability Committee (ROC) Report dated December 20, 2004, pp. 1-8).

15.7 C-Type Filters

621. C-Type filters are not technologically feasible as mitigation for TOVs. Given the size and scope of the Project, the severity and number of the TOVs that potentially could occur, and the fact that C-Type filters have never been used for the purpose of mitigating TOVs, KEMA does not recommend that C-Type filters be utilized to attempt to extend undergrounding beyond the 24 miles proposed by the Companies. *Companies' Ex. 199* (Applicant and ISO-NE summary report of the February 14, 2005 meeting dated February 15, 2005 including data sheets distributed at the February 14, 2005 technical meeting, p 2-4); 2/17/05 Tr. at 16, 44-45 (Wakefield and Enslin).

622. Because there is no industry experience in utilizing C-Type filers for mitigating TOVs, there is significant risk in employing C-Type filters in the Project because this application could affect customer loads and power supply equipment. If something went wrong, there may be reliability risks, given that the preferred locations of the C-Type filters would be on or near the 345-kV substations where the cables terminate. Due to the low impedance of the 345-kV system, all of the filters would be exposed to virtually identical conditions. For example, if a component of the C-Type filter were not properly rated for the TOV mitigation application, this could cause operational problems that had not been anticipated, such as filter failure leading to subsequent TOVs and further failures. 2/17/05 Tr. at 17, 33-34, 63, 90-92, 120-22 (Wakefield, Enslin, Pratico and Zaklukiewicz).

623. C-Type filters and other types of mitigation such as adding STATCOMs or synchronous condensers, do not increase the amount of underground cable that can be utilized. STATCOMs and synchronous condensers have not been proven to alleviate TOVs. Although computer modeling showed that C-Type filters could be effective in mitigating TOVs, there is no industry experience in this type of application. Prior successful application is necessary before utilizing C-Type filters or other mitigation in a critical situation such as SWCT. *Companies' Ex. 176* (Reliability and Operability Committee (ROC) Report dated December 20, 2004, pp. 5, 8-9, 13-14, 33-37); *Companies' Ex. 164* (Interim Report of the

Reliability and Operability Committee, dated October 8, 2004, pp. 2, 5-6); *Companies' Ex. 147* (Reliability and Operability Committee Report, dated August 16, 2004, pp. 20-22, 26); 2/17/05 Tr. at 16-34, 103-04, 117-22 (Wakefield, Enslin, Whitley, Gunther and Zaklukiewicz); 12/14/05 Tr. at 83, 91 (Enslin).

15.8 Location of the Underground Cable

624. Changing the location of the underground cable, to another portion of the Project route from the East Devon to Singer to Norwalk location proposed by the Companies, will not increase or decrease the number of circuit miles of underground cable that is technologically feasible. 2/17/05 Tr. at 33 (Enslin). Because three circuits would be required north of East Devon, whereas two circuits are required from East Devon to Norwalk, moving the location of the underground cable to north of East Devon will result in reduced linear length of underground cable that is technologically feasible for the Project. *Companies' Ex. 176* (Reliability and Operability Committee (ROC) Report dated December 20, 2004, pp. 4, 8).

625. Combining overhead and underground sections in the same circuit (sometimes referred to as "porpoising") exposes the transmission line to an increased risk of damage due to overvoltages caused by lightning strikes and switching events on the network. *Companies' Ex. 1* (Application, Vol. 1, p. H-49); 6/1/04 Tr. at 238 (Zaklukiewicz).

626. Porpoising is a particularly critical concern when using XLPE cable. *See* 6/15/04 Tr. at 73-74 (Zaklukiewicz). At least one of the termination points of the underground section must be extremely well grounded, such as would be the case at a substation, such as Norwalk or East Devon. *See* 2/17/05 Tr. at 29-30, 96-98 (Enslin, Wakefield and Zaklukiewicz).

627. From an operational standpoint, a utility should ideally have a well-grounded system. But when a cable comes from underground to an overhead line, it is not as well-grounded as if it were connected to a substation. Under some circumstances, having two different grounds can cause problems on a power system. 2/17/05 Tr. at 30, 41, 96-97 (Enslin and Zaklukiewicz).

15.9 Direct Current Technology

628. HVDC, including voltage source converter high voltage direct current ("VSC HVDC"), is not technologically feasible for this Project, and does not meet the electric system criteria established for the Project. The use of HVDC to accomplish the objectives of the Project would require control technologies that are unproven and have never been employed to mimic the robust near instantaneous, self-equalizing nature of AC systems. There is no previous experience with the technology in a product of this type, where HVDC is a principal transmission backbone within a tightly interconnected with AC networks. It would be unprecedented to embed an HVDC line into the alternating

current ("AC") system in SWCT. *Companies' Ex. 176* (Reliability and Operability Committee (ROC) Report dated December 20, 2004, pp. 9, 29-32).

629. Either conventional HVDC or VSC HVDC would present unacceptable operating complexities, fail to improve the strength of the AC system, be more expensive, require more land, result in greater energy loss (i.e., greater total transmission losses due to the losses in conversion from AC to DC to AC) and would hinder the development of a competitive generation market. Expanding and modifying the electric system, including the addition of substations and the interconnection of new generation, would be more complicated and more expensive if HVDC were utilized in this Project. The complex operating procedures that would be required for a VSC HVDC system are not practical. The unavailability rates for HVDC systems are higher. There is only one commercial supplier of VSC HVDC technology, which raises commercial issues when considering the installation of a system with a 30 or more year life. *Companies' Ex. 176* (Reliability and Operability Committee (ROC) Report dated December 20, 2004, pp. 9, 13, 29-33); *Companies' Ex. 164* (Interim Report of the Reliability and Operability Committee, dated October 8, 2004, pp. 7-14); *Companies' Ex. 147* (Reliability and Operability Committee Report, dated August 16, 2004, pp. 4-5, 10); *Companies' Ex. 54* (Testimony of Zaklukiewicz, July 19, 2004, p. 2); *Companies' Ex. 1* (Application, Vol. 1, pp. G-13-14); *Council's Ex. 24* (KEMA Inc. white paper, entitled "Observations on the Reliability and Operability Committee's Final Report," dated January 18, 2005, pp. 6-7); 7/29/04 Tr. at 31-32 (Kowalski).

15.10 Gas Insulated Line Technology

630. KEMA found that gas insulated transmission line technology, which had been discussed at the technical meeting, has not been adopted for common use in long distance transmission lines. *Council's Ex. 25* (KEMA Inc. engineering summary of the February 14, 2005 technical meeting dated February 16, 2005, p. 2-3).

631. Although Gas Insulated (Transmission) Line (GIL) technology has existed for 30 years or more, utilities have not adopted this technology for common use in long distance transmission lines, and the technology is not well-suited for use in rights-of-way as opposed to on utility company property because of safety concerns. It is therefore not technologically feasible to increase the length of undergrounding using GIL technology. *Council's Ex. 25* (KEMA Inc. engineering summary of the February 14, 2005 technical meeting dated February 16, 2005, p. 3); 2/17/05 Tr. at 131-40, 152-54 (Boggs).

15.11 Summary of Findings

632. The Companies' proposed route, including 24 linear miles (48 circuit miles) of 345-kV underground cable between Norwalk and East Devon, and Alternative A, including 13 linear miles (26 circuit miles) of underground cable, are technologically feasible.

633. The potential for high TOVs increases with the amount of cable (capacitance) as the linear miles of underground cable increases from 24 linear miles (48 circuit miles).

634. Adding any incremental underground cable to the 24 miles proposed by the Company is not technologically feasible.

635. In order to maximize the amount of underground cable, the Companies have revised their original proposal to include:

- The use of XLPE cable.
- Replacement of surge arrestors.
- Use of 500kV equipment at substations.
- Procedures to operate only one HPFF cable in the Bethel to Norwalk line under most conditions.

636. Although computer modeling suggests that C-Type filters could be effective in mitigating TOVs and therefore could conceptually enable some additional undergrounding beyond the Companies' proposed 24 miles, C-Type filters have never been used to mitigate TOVs. The risk of using them in this application is not acceptable.

637. HVDC and GIL are not feasible for the SWCT system.

16.0 Environmental Effects

16.1 Introduction and Summary

638. To identify environmental, land use, and cultural resources in the Project area, the Companies researched published data; reviewed maps and aerial photography; conducted field surveys; and consulted with the public and with government resource agencies, including the DEP, the U.S. Fish and Wildlife Service ("USFWS"), the National Marine Fisheries Service ("NMFS"), and the DOA, Bureau of Aquaculture. Data were mapped and described in conformance with the Council's Application Guides for Terrestrial Electric Transmission Line Facilities ("Application Guides") dated September 9, 2003. *Companies' Ex. 1* (Application, Vol. 1, pp. L-1 to L-2); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, pp. 2-4; *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, pp. 20-22).

639. The features characterized and evaluated were geology, topography and soils; water resources (wetlands, watercourses, groundwater resources, public water supplies, and flood zones); biological resources (vegetative communities, wildlife,

fisheries, amphibians, birds, marine resources, threatened and endangered species, and species of special concern); coastal area resources; existing land uses (including residential areas, parks, open space, recreation, and public trust lands); future land use plans; visual resources; transportation and utility crossings; cultural resources (archaeological and historic); air quality; and noise. *Companies' Ex. 1* (Application, Vol. 1; Vol. 9, 11, and 12; *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, pp. 2-10); *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, pp. 20-23).

640. The Companies retained specialized consultants to perform baseline noise surveys for areas near substation and switching station sites, and to examine inland and tidal wetlands and watercourses; potential amphibian breeding habitats; breeding birds and their habitats; and cultural resources. *Companies' Ex. 1* (Application, Vol. 1, p. L-2); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, pp. 3-10); *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, pp. 20-26).

641. The results of these environmental evaluations demonstrate that the construction and operation of the Project will have no substantial adverse effects on environmental, cultural, or aesthetic resources. *Companies' Ex. 1* (Application, Vol. 1, p. M-1); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, pp. 10-17); *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, pp. 27-37); 6/1/04 Tr. at 60 (Mango).

642. Avoidance or minimization of environmental effects will continue to be important during final Project design, the preparation of the D & M Plan, and Project construction and operation. *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 23-24); *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, p. 3); 6/1/04 Tr. at 61-63 (Mango).

16.2 Consistency with Existing Land Uses and Future Development

16.2.1 General Land Use

643. The transmission route will be aligned primarily within existing ROWs (either roadways or the Companies' transmission line corridors) that traverse or border various land uses. Generally, the eastern portion of the Project area is characterized primarily by open space, forest land, agricultural land, and suburban residential development, whereas the western portion of the route traverses densely developed suburban and urban areas. *Companies' Ex. 1* (Application, Vol. 1, p. L-51; Vol. 9, 11 and 12).

644. Only about 9.5 acres of new easement (located along the 2.5-mile segment between Scovill Rock Switching Station and Chestnut Junction) will have to be acquired from private landowners for the overhead transmission portion of the Project. Apart from property that will be acquired for the new East Devon Substation, along the rest of the overhead portion of the route originally proposed by the Companies, the ROW will be on lands either owned by or already within

Companies' utility easements. *Companies' Ex. 1* (Application, Vol. 1, pp. I-2, I-21, I-24; *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, p. 8).

645. Along the overhead portion of the Project, minor deviations (or "bypasses") were considered to portions of the existing ROW in three specific areas: the Royal Oak Bypass, the JCC Bypass, and the Ezra Academy Bypass. Should the Council direct the Companies to install the transmission line along these routes, additional ROW will have to be acquired. *Companies' Ex. 175*, Response to CSC-03, Q-CSC-070; 2/1/05 Tr. at 154-155 (Bartosewicz).

646. Should the Council direct the Companies to adopt the 1.1-mile Royal Oak Bypass (affecting Middletown and Middlefield), the Companies would have to acquire approximately 17 acres of new 125-foot easement from six property owners. The Royal Oak Bypass would potentially impact wetlands, undiscovered cultural resources, and the land use plans for the development of a new 25-lot subdivision. *Companies' Ex. 175*, Response to CSC-03, Q-CSC-070; 6/2/04 Tr. at 225-230 (Bartosewicz); 7/27/04 Tr. at 58-59 (Bartosewicz); 2/1/05 Tr. at 155 (Bartosewicz); 1/19/05 Tr. at 68-75 (Wilson and Bartosewicz); *Wilson's Ex. 1; Wilson's Ex. 4.*

647. The underground portion of the route will be located primarily within existing public road ROWs. At the limited locations where the route must diverge from road ROWs (e.g., at river crossings), easements will be required from private landowners. *Companies' Ex. 1* (Application, Vol. 1, pp. I-21 to I-22).

648. Based on the results of consultations with representatives of affected municipalities and reviews of land use documents, the Project will not conflict with local land use plans because the transmission facilities will be located primarily within long-established ROWs. *Companies' Ex. 1* (Application, Vol. 1, p. M-29); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, pp. 15-16); *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, p. 33).

649. Along the overhead portion of the Project, the transmission facilities will be located principally within Companies' ROWs that have been dedicated to utility purposes for 40 to 80 years. Within these existing ROWs, the development of non-utility permanent structures is already prohibited. *Companies' Ex. 1* (Application, Vol. 1, p. M-29); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, pp. 15-16); *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, p. 4).

650. Within the limited additional ROW that will be required for the new overhead transmission facilities, permanent non-utility uses will be precluded within the easement and the existing forest land will be converted to utility ROW (characterized by lower growing vegetation) for the life of the Project. *Companies' Ex. 1* (Application, Vol. 1, pp. M-29 to M-30).

651. For the overhead portion of the Project, the Companies will apply established easement policies, which restrict the types of activities that can be conducted on the ROW and address requests from property owners and parties external to the Companies for the use of ROWs. *Companies' Ex. 1* (Application, Vol. 1, p. M-39).

652. To minimize unauthorized use of the ROWs (e.g., by all-terrain vehicles), on fee-owned ROWs, the Companies will install gates or barricades (commonly wood poles, concrete blocks, and fences), coupled with vegetation screening or natural barriers, to restrict access. On non-fee-owned portions of the ROW, the Companies will coordinate with property owners regarding access restriction measures. *Companies' Ex. 71,* Response to CSC-02, Q-CSC-040.

653. During installation of the underground cable system, the Companies will coordinate with the affected municipalities and will take measures to maintain access to nearby land uses, including businesses. *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, pp. 16-17).

16.2.2 Recreational / Open Space Uses

654. Various recreational and open space uses are located near or traversed by the proposed route. *Companies' Ex. 1* (Application, Vol. 1, Table L-11, pp. L-52 to L-53); *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, p. 26); *Companies' Ex. 185*, Response to TOWNS-07, Q-TOWNS-086.

655. The Companies will design and schedule the Project to avoid or limit the potential for interference with recreational uses, and will consult with representatives of the recreational areas to identify site-specific mitigation measures. *Companies' Ex. 1* (Application, Vol. 1, p. M-30).

16.2.3 Visual Resources

656. In the initial design of the Project, the Companies considered public perceptions regarding the potential visibility of the transmission facilities. Further, as part of the technology station at the "Open Houses" conducted as part of the Municipal Consultation Process, the Companies prepared visual simulations of potential views of the overhead and underground portions of the Project. *Companies' Ex. 1* (Application, Vol. 1, p. M-30); *Companies' Ex. 4* (Municipal Consultation Filing, Open House "Technology" Station Illustrations, Simulated Illustrations of the ROW, and Handouts).

657. The Companies reviewed the potential sightlines of the existing and proposed structures from trails on ridgelines. *Companies' Ex. 58*, Response to CSC-01, Q-CSC-022.

658. After construction, the underground portion of the Project will have no effect on visual resources. The cable system will not be visible, except where manholes to access the underground splice vaults are embedded in streets and where

aboveground facilities are required at the East Devon, Singer, and Norwalk stations. *Companies' Ex. 1* (Application, Vol. 1, p. M-30); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 16).

659. As proposed by the Companies, the overhead portion of the Project would typically result in marginal effects on visual resources because the new transmission facilities would be aligned along existing transmission line ROWs, where views of transmission lines are already present. Further, the Companies propose to limit the height of the new transmission structures; to remove / consolidate certain existing structures; and to place the new structures in the same general locations as existing structures. In some locations, the planned consolidation of existing, older 115-kV structures with the new 345-kV facilities would reduce the number of structures from what presently exists along sections of the ROW and may improve the appearance of the ROW. *Companies' Ex. 1* (Application Vol. 1, pp. M-31 to M-38, Table M-5, pp. M-34 to M-38; Vol. 8, "Photographs along Proposed Route," Vol. 10 Plan and Profile Drawings); *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, pp. 33-34); *Companies' Ex. 4* (Bulk Filing, Open House "Technology" Station Illustrations, Simulated Illustrations of the ROW, and Handouts).

16.2.4 Incremental Environmental Impact of Low EMF Overhead Line Designs

660. If the Council certifies an overhead structure design other than that originally proposed by the Companies or routes not along existing ROWs (e.g., the Royal Oak Bypass on virgin ROW), then the potential effects on aesthetic resources, and in fact other environmental resources, would be more significant, particularly if the Council requires the Companies to implement low magnetic field designs involving substantially taller structures. *Companies' Ex. 191* (Aerial Mapping, Segment 1 and 2, dated January 28, 2005).

661. As illustrated by the cross section drawings, the low magnetic field structures would vary in typical height from about 85 feet (for a 345-kV Delta monopole with optimized height and phasing along Cross Section 1 – Scovill Rock to Chestnut Junction) to 150 feet (345-kV split phase along Cross Section 2 – Oxbow Junction to Beseck at the Royal Oak Bypass). In comparison, the typical heights of the structures proposed by the Companies range from 80 feet to 130 feet. "Typical height" refers to the height of the structures under certain prescribed conditions in topography and the line layout. *Companies' Ex. 1* (Application, Vol. 1, p. I-8, n.4); Appendix to Companies' Proposed Findings of Fact; *Companies' Ex. 191* (Aerial Mapping, Segments 1 and 2, dated January 28, 2005). *See also*, Appendix to Companies' Proposed Findings of Fact.

662. In the Valley View Drive area of Wallingford (Oxbow Junction to Beseck segment), low magnetic field structure designs with heights varying from 117 feet to 182 feet in height were identified as options to achieve different mG levels at homes within the subdivision. Visual simulations were provided to illustrate the

potential views of the different structure configurations. In this area, the existing 115-kV structures consist of double H-frames with a typical height of 57 feet. In the Application, the Companies proposed a monopole design (with the 345-kV and 115-kV on a single pole), with a typical height of 105 feet. *Companies' Ex. 1* (Application, Vol. 10, "Typical Cross Sections," Figure 2); *Companies' Ex. 202* (Structure heights and magnetic field calculations for Valley View Drive in Wallingford, dated February 16, 2005); 2/1/05 Tr. at 190-191 (Bartosewicz).

663. In general, low magnetic field design structures would be taller than the structures proposed by the Companies. As a result, the size (diameter) of the low magnetic field structure foundations would be comparatively larger. For example, the foundation diameter of a 105-foot-tall structure would be approximately 4 – 6 feet, whereas the foundation diameter of a 150-foot-tall structure would be between 6 and 8 feet. A 182 - 190-foot-tall structure would have a wider foundation (probably 10-12 feet in diameter). Angle structures also would require larger diameter foundations. Taller structures also would have to be more deeply embedded in the ground. 10/14/04 Tr. at 228, 236 -237 (Prete); 10/14/04 Tr. at 237 (Zaklukiewicz); 2/1/05 Tr. at 163 -164, 191 (Prete).

664. In response to the direction of the Council, the Companies developed and presented alternative transmission line designs that would lower magnetic fields at the edge of the ROW, directly beneath the lines, and at adjacent statutory facilities. These strategies included generic strategies that would apply to all structures within an identified section of the ROW ("cross sections"), and site-specific strategies that could provide additional reductions at identified locations. The generic strategies included raising the height of the towers and conductors (thereby increasing the distance between the source of the magnetic fields and receptors on the ground) and "split-phasing" lines. The site-specific strategies included adding structures in order to reduce line "sag" and therefore maintain distance from the receptor; further increases in structure height; and relocating structures in the ROW, both laterally and longitudinally. *Companies' Ex. 73* (Testimony of Bailey, April 30, 2004, errata replacement p. 15); *Companies' Ex. 82a and 82b* (B'nai Jacob- North ROW: 15 GW Case (with relocated ROW); JCC: 15 GW Case); *Companies' Ex. 96* (EMF Mitigation for all Cross Sections of Overhead Route with a Basis of Comparison, dated May 28, 2004); *Companies' Ex. 135* (Dr. Bailey's presentation of split-phasing bulk file of CD submitted at July 27, 2004 hearing); *Companies' Ex. 137* (Photographs of Eisenhower Park, Milford, CT submitted July 28, 2004); *Companies' Ex. 138* (Buffer zone statutory facilities adjacent to the proposed route submitted at July 28, 2004 hearing); *Companies' Ex. 139* (Measured and calculated magnetic fields of an existing split-phase transmission line submitted at July 28, 2004 hearing); *Companies' Ex. 140* (Optimized EMF reductions by cross section summary submitted at July 29 2004 hearing); *Companies' Ex. 142a,* Response to AG-03, Q-AG-16, Measured and Calculated Electric and Magnetic Fields at Boundaries of Facility Locations Categorized by the CSC for the Proposed Route); *Companies' Ex. 143*, Responses to AG-03, Q-015 and 017 through 034; *Companies' Ex. 158* (Mapping homework assignment presented September 28, 2004. Number of structures within the 300-

foot buffer, 6 mG and 3 mG boundaries of mapping provided in Exhibit 154); *Companies' Ex. 159* (Magnetic field calculations for Figure 46, in Application Vol. 6); *Companies' Ex. 160* (Magnetic field calculations for Figure 47, in Application Vol. 6); *Companies' Ex. 161* (Magnetic field calculations for Figure 48, in Application Vol. 6); *Companies' Ex. 162* (PDC document titled Magnetic field calculations for Middletown-Norwalk 345-kV XLPE transmission cables, dated September 27, 2004); *Companies' Ex. 163* (Revised "Buffer Zone" maps (Exhibit 154) with circles around structure locations, dated October 5, 2004); *Companies' Ex. 166* ("Homework Assignment" Reductions in Magnetic Fields from Increasing Transmission Structure Heights Cross Section 8 and Cross Section 5 with cover letter dated October 12, 2004 (Revised- October 16, 2004, cover letter dated October 18, 2004)); *Companies' Ex. 174* (AC Magnetic Field from XLPE Cable at 1 Meter Above Ground for 15 GW Case); *Companies' Ex. 187a,* Response to W-M-O-01, Q-W-M-O-09, Applicant Exhibit 96- table of cross sections with EMF Mitigation; *Companies Ex. 189* (Route variations, EMF calculations and cross section drawings for structures on property of the Jewish Community Center dated January 27, 2005); *Companies' Ex. 191* (Aerial Mapping, Segment 1 and 2, dated January 28, 2005); 5/13/04 Tr. at 111-113 (Prete); *Companies' Ex. 202* (Structure heights and magnetic field calculations for Valley View Drive in Wallingford dated February 16, 2005).

665. The requirement of six, rather than three conductors for "split-phased" lines requires larger structures with more davit arms and more conductors. In addition, where a 345-kV line and a 115-kV line are to share a right-of-way, split-phasing the 345-kV line will preclude putting both lines on one 345-kV/115-kV structure. The 115-kV line must be constructed on its own set of structures, or moved off of the ROW. *Companies' Ex. 135* (Dr. Bailey's presentation of split-phasing bulk file of CD submitted at July 27, 2004 hearing); *Companies' Ex. 139* (Measured and calculated magnetic fields of an existing split-phase transmission line submitted at July 28, 2004 hearing).

666. In order to reduce expected average magnetic fields at certain structures of interest adjacent to the ROW to 6mG with site specific strategies, structures as high as 199 ft would be required in some areas. *Companies' Ex. 166* ("Homework Assignment" Reductions in Magnetic Fields from Increasing Transmission Structure Heights Cross Section 8 and Cross Section 5 with cover letter dated October 12, 2004 (Revised- October 16, 2004)).

667. During the Municipal Consultation process, the Companies provided comparative analyses and photographic simulations of potential views of different 345-kV structure types (standard design and modified design) along each of the different route segments. The different options were evaluated based on potential effects on homes, property, visual resources, environmental resources; system benefit; technical feasibility; and cost. These analyses and photographic simulations, which were presented at the Open Houses and provided to the municipalities for review, included different structure configurations and typical heights, ranging from approximately 85 feet to 130 feet. *Companies' Ex. 4* (Open House

"Technology" Station Illustrations, Simulated Illustrations of the Rights of Way, and Handouts); 2/17/05 Tr. at 280 (Bartosewicz).

668. The extensive environmental information contained in the Companies' Application and supporting materials allows a full assessment of the potential environmental effects of low magnetic field designs, compared to the Companies' proposal. The cross section drawings for both the low magnetic field designs and the proposed structures identify the juxtaposition of the structures within the ROW along each overhead segment, indicating generally where vegetation clearing may be required. *Companies' Ex. 191* (Aerial Mapping, Segments 1 and 2, dated January 28, 2005); *Companies' Ex. 1* (Application, Vol. 10, "Typical Cross Sections," XS-001, Figure Nos. 1 through 8).

669. The vegetative communities along the ROW, as well as other key environmental and land use features (including watercourses, wetlands, access roads, wildlife management areas, parks, forests, recreational and scenic areas, watershed protection districts, historic areas, trails, residential areas, commercial areas, industrial uses, utility ROWs and roads, coastal management zone boundaries, floodplain boundaries, and topographic contours) are illustrated on the aerial maps included as part of the Application. These features are described in detail in the environmental sections of the Application. The Plan and Profile maps, also included as part of the Application, provide further data concerning the vegetation and topographic conditions along the ROW, particularly in relation to the existing structure locations and the Companies' original plans for 345-kV structure installation and existing structure removals. *Companies' Ex. 1* (Application, Vol. 1, "Description of Existing Environment Along Proposed Route," pp. L-1 to L-67; Vol. 2, "Wetland and Waterways Description Report" and "Supplemental Wetland and Waterways Description Report"; Vol. 3, "Cultural Resources Assessment"; Vol. 4, "Amphibian Breeding Survey," "Analysis of Bird Species Along the Proposed Middletown to Norwalk 345-kV Transmission Line," "Geologic Map of Connecticut – Surficial Materials (USGS) with Overlay of Route"; Vol. 8, "Photographs Along Proposed Route"; Vol. 9, *Aerial Photographs – 400 Scale;* Vol. 10, *Plan and Profile Drawings*; Vol. 11, *Aerial Photographs – 100 Scale*); *Companies' Ex. 4* (Open House "Technology" Station Illustrations, Simulated Illustrations of the Rights of Way, and Handouts).

670. To the extent that the Council instructs the Companies to use low magnetic field designs for overhead structures, the environmental effects would relate principally to increased potential structure visibility (due to the comparatively greater height of the structures or to modifications in the planned reconstruction of existing transmission lines), additional land disturbance at the new structure sites (to install the larger diameter foundations that are associated with the taller structures) or for access roads to reach new structure sites, and possibly additional vegetation clearing (in some areas), either to maintain clearances from the conductors to along access roads. *Companies' Ex. 4* (Open House "Technology" Station Illustrations, Simulated Illustrations of the Rights of Way, and Handouts); *Companies' Ex. 191* (Aerial Mapping, Segments 1 and 2, dated January 28,

2005); *Companies' Ex. 193* (Letter Describing Temporary Work Areas in Wetlands dated February 1 2005); *Companies' Ex. 202* (Structure heights and magnetic field calculations for Valley View Drive in Wallingford, dated February 16, 2005); 10/14/04 Tr. at 228, 236-237 (Prete); 10/14/04 Tr. at 237 (Zaklukiewicz); 2/1/05 Tr. at 163 -164, 191 (Prete).

671. However, in some areas, more extensive construction, and associated land disturbance, would be required to implement the low magnetic field design. For example, south of Beseck, in order to use a low magnetic field design, the existing 90-foot (typ.) 387 Line H-frame would have to be removed and replaced with a 130-foot-tall monopole and then the new 345-kV line would have to be constructed adjacent to the 387 Line on a second, similar monopole. Compared to the Companies proposed design, which will involve only the addition of a second 345-kV H-frame, the use of the low magnetic field design will double the amount of construction work required on this portion of the ROW. *Companies' Ex. 191* (Aerial Mapping, Segments 1 and 2, dated January 28, 2005, Figure 5 LEMF); *Companies' Ex. 1* (Application, Vol. 10, "Typical Cross Sections," XS-001, Figure No. 5); 2/1/05 Tr. at 183 (Bartosewicz).

672. Even where low EMF structures are mandated, the Companies expect to be able to limit the temporary construction work area at most structure sites in wetlands (where wetlands cannot otherwise be avoided) to significantly less than the typically 10,000 square feet anticipated for construction areas at upland structure sites. The Companies remain committed to minimizing or avoiding wetland impacts and propose to include in the D & M Plan(s) site-specific data about wetland construction and mitigation procedures, based on the structure designs approved by the Council. *Companies' Ex. 193* (Letter Describing Temporary Work Areas in Wetlands dated February 1 2005).

673. Of the potential environmental effects associated with the low magnetic field designs, possibly the most significant in some areas will be the increased visibility of the taller structures or the visual effect of the change in structure design (compared to that which exists on the ROW at present). However, the long-term effect of such structures on visual resources will be a function of the same factors as described for the Companies' proposed structure configurations. *Companies' Ex. 1* (Application, Vol. 1, pp. M-30 to M-38, including Table M-5, "Summary of ROW and Structure Visual Changes: Overhead Portion of Proposed Route"; Vol. 8 – "Photographs"); *Companies' Ex. 4* (Open House "Technology" Station Illustrations, Simulated Illustrations of the Rights of Way, and Handouts); *Companies' Ex. 191* (Aerial Mapping, Segments 1 and 2, dated January 28, 2005); *Companies' Ex. 202* (Structure heights and magnetic field calculations for Valley View Drive in Wallingford, dated February 16, 2005).

674. The Companies have committed to various measures, including the use of existing ROWs, which are designed to avoid or minimize adverse effects on environmental, social, and cultural resources. Such measures will apply to the final design, construction, and operation / maintenance of the Project, regardless

of the type of overhead structures selected. *Companies' Ex. 1* (Application, Vol. 1, Section M, "Environmental Effects and Mitigation Measures" see in particular pp. M-1 to M-2); *Companies' Ex. 193* (Letter Describing Temporary Work Areas in Wetlands dated February 1 2005).

675. Applicable environmental mitigation measures would include, among others, the Companies' commitments to adhere to erosion and sediment control procedures; avoid the installation of structures in wetlands (where possible); avoid or minimize vegetation clearing in buffer zones around watercourse crossings and wetlands (including vernal pools); avoid vegetation clearing during the bird breeding and nesting season; and continue to consult with the State Historic Preservation Office regarding cultural resources. *Companies' Ex. 1* (Application, Vol. 1, Section M, "Environmental Effects and Mitigation Measures" see in particular pp. M-2 to M-3, M-5 to M-6, M-14 to M-16, M-18, M-22, M-24 to M-27, M-42); *Companies' Ex. 193* (Letter Describing Temporary Work Areas in Wetlands dated February 1 2005).

676. The Companies' D & M Plan(s) will reflect detailed engineering design and will incorporate both the environmental mitigation commitments made by the Companies in the Application, as well as the conditions of the Council's certificate and other permits obtained for the Project. *Companies' Ex. 193* (Letter Describing Temporary Work Areas in Wetlands dated February 1 2005); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 23).

16.2.5 Coastal Resources

677. The underground portion of the project will traverse the coastal boundary, as designated by the Connecticut Coastal Management Act, in six municipalities: Milford, Stratford, Bridgeport, Fairfield, Westport, and Norwalk. *Companies' Ex. 1* (Application, Vol. 1, pp. L-48 to L-50; Vol. 9, *Aerial Photographs – 400 Scale*); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, pp. 8-9).

678. The overhead portion of the Project will not cross the designated coastal boundary. *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, p. 25).

679. The East Devon and Singer substations will be located on the upland edges of the coastal boundary in industrially-zoned portions of Milford and Bridgeport, respectively. *Companies' Ex. 1* (Application, Vol. 1, p. M-28; Vol. 9, *Aerial Photographs – 400 Scale*); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, pp. 8, 15).

680. The Project will not adversely affect coastal resources. The East Devon and Singer substations are both planned for industrially-zoned sites, that are set back at least 1,000 feet from the coast line. The underground cable system crossings of coastal waters have been sited and will be constructed to avoid adverse effects on aquatic resources, tidal wetlands, intertidal flats, deepwater habitats, submerged

aquatic vegetation, shellfish concentration areas, benthic habitats, fish and wildlife habitat and water quality. Any potential effects will be short-term, limited to the construction phase, and highly localized. *Companies' Ex. 1* (Application, Vol. 1, pp. M-28 to M-29); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 15).

681. The Companies have consulted with the DEP, Office of Long Island Sound Programs (OLISP) regarding coastal resources in the project area and in July 2004 submitted an application to DEP OLISP for coastal permits relevant to the project. *Companies' Ex. 1* (Application, Vol. 1, p. M-29); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 12).

16.3 Topography, Geology, and Soils

682. Topographic, soils, and geologic conditions vary in the Project area, with elevations generally higher and topography more varied along the eastern portion of the Project in Middlesex and New Haven counties. Depth to bedrock, based on a review of published soils and geology maps, is estimated to range from outcrops to greater than 60 inches. *Companies' Ex. 1* (Application, Vol. 1, pp. L-2 to L-5; Vol. 4, Geologic Map of Connecticut – Surficial Materials).

683. The Project will have negligible, if any, adverse effects on topography and geology. Grading will only be performed along the overhead ROW, as required to create a level workspace in the immediate area around structure footings or to level access roads to provide safe passage for construction vehicles/equipment. No grading will be required where the terrain is flat and open (e.g., in agricultural areas) or along the underground portion of the Project, which will be located primarily within road ROWs. *Companies' Ex. 1* (Application, Vol. 1, p. M-2); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 11); *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, p. 27).

684. To minimize the potential for soil erosion and sedimentation, activities involving soil disturbance and soil movement will be performed, and suitable erosion and sedimentation control measures will be implemented, in accordance with the Companies' best management practices, consistent with the *2002 Connecticut Guidelines for Soil Erosion and Sediment Control. Companies' Ex. 1* (Application, Vol. 1, p. M-2); *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, p. 27).

685. Along the overhead portion of the Project, temporary erosion controls (e.g., silt fence, hay/straw bales, mulching, temporary reseeding) typically will be installed after clearing in areas of disturbance based on the field judgment of the Companies' personnel. The need for and extent of temporary erosion controls will depend on site-specific factors (e.g., slope, extent of vegetative cover remaining after clearing, soil type, proximity to water resources). *Companies' Ex. 1* (Application, Vol. 1, pp. M-2 to M-3).

686. The temporary erosion controls will be maintained, as necessary, throughout the period of active construction until restoration has been deemed successful, as determined by standard criteria for storm water pollution prevention and erosion control. During the course of periodic post construction inspections, the Council will determine when it is appropriate to remove these temporary erosion controls. The Companies will remove erosion and sediment controls from construction sites within 30 days of final site stabilization, in accordance with the recommendations of the "Best Development Practices: Conserving Pool-Breeding Amphibians in Residential and Commercial Developments in the Northeastern United States." *Council's Administrative Notice, Item 21* Best Development Practices: Conserving Pool-Breeding Amphibians in Residential and Commercial Developments in the Northeastern United States. MCA Technical Paper No. 5, Metropolitan Conservation Alliance, Wildlife Conservation Society, Bronx, New York, 2002; *Companies' Ex. 1* (Application, Vol. 1, p. M-3); *Companies' Ex. 55*, Response to CSC-02, Q-CSC-036.

687. During installation of the underground cable portion of the project, measures will be implemented to contain temporary spoil storage piles and to avoid sedimentation into watercourses. Soils not used for backfilling trenches will be trucked off-site and disposed of in accordance with regulatory requirements. *Companies' Ex. 1* (Application, Vol. 1, p. M-3); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 11).

16.3.1 Blasting – Rock Removal

688. Blasting is rarely expected to be necessary to install overhead transmission structures because of the small footprint of the structures, the flexibility in siting them, and the availability of alternative rock removal methods, such as drilling or mechanical excavation. *Companies' Ex. 1* (Application, Vol. 1, p. M-4).

689. Nonetheless, in certain areas of bedrock outcrops or shallow depth to bedrock, controlled drilling and blasting may be required to install foundations for overhead structures or to excavate the trench and splice vaults for the underground cable. *Companies' Ex. 1* (Application, Vol. 1, p. M-4).

690. If rock is encountered during construction, the preferred removal techniques will be either mechanical methods (e.g., mechanical excavators and pneumatic hammers) or mechanical methods supplemented by blasting. Potential effects from these activities may include localized dust and vibration/noise from rock drilling, blasting, and removal. *Companies' Ex. 1* (Application, Vol. 1, p. M-4).

691. If blasting is necessary, the Companies will implement measures to minimize potential effects, including the development of blasting plans that will be provided to the local Fire Marshals for approval and the coordination with property owners in proximity to the blasting. In areas where blasting is determined to be necessary, pre-blast surveys will be performed of all foundations within 250 feet

and all existing potable water wells within 150 feet of the blasting site. Blasting charges, if required, will be designed to loosen only the material that must be removed to provide a stable foundation for an overhead structure or to create an excavation of suitable depth for the cable system facilities. *Companies' Ex. 1* (Application, Vol. 1, pp. J-8 to J-9, M-4); *Companies' Ex. 71*, Response to CSC-02, Q-CSC-050.

16.3.2 Methods for Identifying and Handling Potential Contaminated Soils

692. The Companies recognize that the eastern side of the proposed crossing of the Saugatuck River (Westport) is in the vicinity of a former landfill. Prior to excavation or HDD work in this area, tests will be performed to determine whether contamination is present. As needed, soils will be tested during drilling. If contaminants are present, the Companies will properly dispose of contaminated materials removed from the excavation or boring and will provide suitable replacement fill. *Companies' Ex. 76,* Response to CSC-02, Q-CSC-054; 4/20/04 Tr. at 216–219 (Mango).

16.4 Water Resources (including Water Crossings and Wetlands)

16.4.1 Introduction

693. The Companies retained SSES to conduct field surveys to identify the type, extent, and functional quality of wetlands and watercourses along the ROW. The field studies, which were performed in 2002, 2003, and 2004 by a Registered Professional Soil Scientist and a biologist, were conducted in accordance with Connecticut and federal delineation methods. Both freshwater and tidal wetlands were delineated; the Companies subsequently surveyed the wetland boundaries. *Companies' Ex. 1* (Application, Vol. 1, pp. L-7, L-16; Vol. 2, Wetland and Waterways Description Report and Supplemental Wetland and Waterways Description Report); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 9); *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, pp. 20-21).

694. The Project has been sited and will be designed and constructed / operated to avoid or minimize effects to water resources and water quality. Any potential water resource/water quality effects associated with the construction of the Project will be minor, short-term, and highly localized. The operation of the Project will not cause any long-term effects on water resources. *Companies' Ex. 1* (Application, Vol. 1, pp. M-5, M-7 to M-8); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, pp. 12 -13).

695. The Companies have consulted with the U.S. Army Corps of Engineers, New England District (the "Corps" or the "ACOE"), to determine the federal permit requirements for work in wetlands and for crossings of rivers and streams, pursuant to the Clean Water Act and the Rivers and Harbors Act, and with the DEP (Office of Long Island Sound Programs and Inland Water Resources

Division) regarding the requirements for a Section 401 water quality certificate, a coastal zone consistency certificate, and other state environmental permits. The Companies have submitted or will file appropriate applications with these agencies. Project activities will conform to conditions included in the Corps permit; DEP permits / certificates; and the Council certificate. *Companies' Ex. 1* (Application, Vol. 1, p. M-5).

16.4.2 Watercourse Crossings

Overhead Portion

696. The overhead portion of the route, which follows existing Companies' ROWs, spans 94 perennial and intermittent streams. SSES's field observations indicate that the streams along the overhead portion of the route are characterized by stable banks and clear water. *Companies' Ex. 1* (Application, Vol. 1, Section L.2.1, p. L-7; Table L-3, pp. L-9 to L-13; Vol. 2, Wetland and Waterways Description Report, p. 4); *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, pp. 23-24).

697. The state has designated Stream Channel Encroachment Lines ("SCELs") along the Quinnipiac River, which the overhead portion of the Project will traverse. No new transmission structures will be located within the SCEL along the Quinnipiac River. *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, p. 24).

698. To minimize potential impacts to water resources during construction, the Companies will adhere to permit and certificate conditions and will implement specific procedures for work in or near watercourses (e.g., conformance to DEP timing requirements for in-stream work to prevent effects to important fisheries, no refueling of equipment within 100 feet of any watercourse). Structures will be located away from waterbodies wherever possible and wires will span watercourses. *Companies' Ex. 1* (Application, Vol. 1, pp. M-5 to M-6; *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, pp. 27-28).

699. Along the ROW (except along access roads), the Companies proposed to limit vegetation removal within a 50-foot wide buffer around streams to the minimum necessary for the safe construction and operation of the transmission facilities. To the extent practical, desirable streamside vegetation will be preserved for habitat enhancement, shading, bank stabilization, and erosion/sedimentation control. *Companies' Ex. 1* (Application, Vol. 1, pp. M-5 to M-6; *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, pp. 27-28).

700. In correspondence to the Council dated May 4, 2004, the DEP recommended that 100-foot-wide naturally vegetated buffers be maintained along perennial watercourses and 50-foot-wide buffers be maintained along intermittent watercourses. In making this recommendation, the DEP recognized that trees that

pose a safety concern would have to be removed from the ROW. Correspondence to the Council from the DEP dated May 4, 2004, p. 5.

701. The Companies will attempt to conform to the DEP recommendations regarding vegetative buffers along watercourses, taking into consideration safety requirements such as clearances from conductors and wires. Tr. 6/1/04 at 132 – 133 (Mango).

Underground Portion

702. The underground cable system will cross 17 watercourses, the majority of which are small and channelized. *Companies' Ex. 171* (Revised Table J-2, correspondence dated December 22, 2004).

703. Several larger tidally-influenced waterbodies also will be traversed, including the Housatonic River, Pequonnock River, Ash Creek, Mill River/Southport Harbor, Sasco Creek, and the Saugatuck River. In addition, the underground route will involve two crossings of freshwater portions of the Norwalk River, along which the state has designated SCELs. Companies' *Ex. 1* (Application, Vol. 1, Section L.2.1, p. L-7; Table L-4, pp. L-14 to L-15, as updated by *Companies' Ex. 171* (Revised Table J-2); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 7).

704. The cable system will be installed across watercourses using techniques appropriate to the width, depth, and location of the watercourse. The larger crossings (i.e., the Housatonic, Pequonnock, Saugatuck rivers) will be installed using HDD. The Yellow Mill Channel and one of the Norwalk River crossings will be installed using open cut techniques. Smaller streams will be crossed by installing the cable system either within the road ROW (above or below a culverted stream) or on existing bridges. *Companies' Ex. 1* (Application, Vol. 1, pp. M-7 to M-8); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, pp. 11-13); *Companies' Ex. 171* (Revised Table J-2); *Companies' Ex. 54* (Testimony of Zaklukiewicz, April 19, 2004).

705. The methods proposed for each water crossing along the underground portion of the Project were selected to avoid direct disturbance to sediments and impacts to water quality and aquatic organisms. The staging areas associated with each crossing will be located in upland areas, set back from the waterbody, and will be protected with erosion/sedimentation controls to prevent sedimentation into water resources. *Companies' Ex. 1* (Application, Vol. 1, p. M-7); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 12); *Companies' Ex. 171* (Revised Table J-2, correspondence dated December 22, 2004).

706. The Companies propose to install the cable across the Mill River (Southport Harbor) in Fairfield by attachment to the existing road bridge. The use of this method will avoid potential impacts to water quality and eliminate concerns regarding the resuspension of contaminated sediments in the riverbed.

Companies' Ex. 171 (Revised Table J-2, correspondence dated December 22, 2004); *Companies' Ex. 81,* Response to CSC-02, Q-CSC-048.

707. Design details concerning the methods for installing the cable across watercourses (e.g., the HDD paths and locations of staging areas) and the plans specific to each crossing (e.g., Operations and Monitoring Plan for use during HDDs) will be included in the D&M Plans and in the Companies' permit applications to the Corps and DEP. *Companies' Ex. 1* (Application, Vol. 1, p. M-7); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 12).

16.4.2 Wetland Crossings

708. There will be no significant loss of or disturbance to existing wetlands or ponds along the ROW resulting from Project construction or operation. Similarly, no new wetlands or ponds will be created during the construction of the Project. *Companies' Ex. 58,* Response to CSC-02, Q-CSC-038.

Overhead Portion

709. SSES delineated 168 state jurisdictional wetlands along the overhead portion of the Project. SSES determined that most of these wetlands are well-vegetated and are dominated by shrub swamp and shallow marsh communities. In many locations, the wetlands extend off the maintained portions of the existing ROWs. *Companies' Ex. 1* (Application, Vol. 1, Section L.2.2, pp. L-16 to L-17; Table L-5, pp. L-18 to L-24; Section M.2.2, p. M-14; Vol. 2, Wetland and Waterways Description Report); Vol. 9 and 11); *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, p. 24).

710. Only two wetlands (designated as wetland Nos. 26 and 66 in the SSES field surveys) were identified as vernal pools. *Companies' Ex. 1* (Application, Vol. 1, Section L.2.2, p. L-17; Section M.2.2, p. M-15).

711. Measures, such as the proper placement of temporary erosion and sedimentation controls, will be taken to protect these vernal pools during construction if ROW is to be performed in the vicinity. Any special mitigation measures will be included in the D&M Plan. *Companies' Ex. 55,* Response to CSC-02, Q-CCSC-037.

712. Along the existing ROWs that the overhead route will follow, approximately 116 transmission structures are currently located in or immediately adjacent to wetlands. In conjunction with the reconstruction of circuits for the Project, the Companies anticipate that some of these structures will be removed and that, overall, fewer new structures will be placed in wetlands. *Companies' Ex. 1* (Application, Vol. 1, Section L.2, Table L-5; Section M.2.2, p. M-14; Vol. 9); *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, pp. 28-29).

713. The Companies will attempt to locate new transmission structures in upland areas. Where installation of structures in wetlands cannot be avoided, the Companies will implement best management practices (e.g., temporary erosion controls, surface roughening, temporary seeding, and mulching) to limit potential wetland effects. *Companies' Ex. 1* (Application, Vol. 1, Section M.2.2, p. M-14); *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, p. 28).

714. After the submission of the Application to the Council, the Companies' conducted additional field and engineering studies and made preliminary design adjustments that would result in the resiting of 28 new structures, originally identified as within wetlands, to nearby upland areas. Further studies to locate new structures outside of wetlands will continue during the D&M Plan preparation phase of the Project. *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, p. 29); 6/1/04 Tr. at 61-63 (Mango); 6/1/04 at 93-94 (Zaklukiewicz).

715. Construction work in wetlands that cannot otherwise be avoided may be required for access roads (e.g., modifications to existing roads or establishment of new access roads to reach structure sites); installation of new 345-kV/115-kV structures; and/or activities associated with the removal and reconstruction of certain existing transmission structures that are presently located in wetlands. Minor but long-term effects on wetlands would occur from the installation / expansion of permanent access roads and the placement of structures in wetlands that cannot otherwise be avoided. However, most effects will involve the temporary use of work pads or accessways during construction; after construction, these temporary work areas would be removed and wetland functions restored. *Companies' Ex. 1* (Application, Vol. 1, Section M.2.2, pp. M-14 – M-15); *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, p. 29); 6/1/04 Tr. at 73-75, 89 (Mango); 6/1/04 Tr. at 90-91 (Zaklukiewicz); *Companies' Ex. 83,* Response to W-M-01, Q-W-M-016.

716. Where construction activities in wetlands are required for structure installation or removal, the Companies will limit temporary work sites to significantly less than the typical 10,000 square feet required for upland structure sites. *Companies' Ex. 193* (Correspondence regarding temporary work areas in wetlands, dated February 1, 2005).

717. Wetlands that could potentially be affected by construction will be reflagged by a registered soil scientist prior to the commencement of work on the affected portion of the ROW. *Companies' Ex. 1* (Application, Vol. 1, Section M.2.2, pp. M-15); 6/1/04 Tr. at 93-94 (Zaklukiewicz).

718. To minimize potential effects on wetlands during construction and operation of the Project, the Companies will adhere to best management practices and to the conditions of permits and certificates. These procedures will be incorporated into the D&M Plans for the Project and will specify measures for vegetation removal; maintenance of surface water flows and wetland functions; placement of

temporary erosion controls; accessways across wetlands; and restoration. *Companies' Ex. 1* (Application, Vol. 1, pp. M-15 to M-16); *Companies' Ex. 193* (Correspondence regarding temporary work areas in wetlands, dated February 1, 2005).

719. The use of herbicides for vegetation maintenance near wetlands will be in accordance with current federal regulations and State of Connecticut pesticide statutes. *Companies' Ex. 58,* Response to CSC-02, Q-CSC-041.

720. Specific data about wetland construction and mitigation procedures, based on the structure designs approved by the Council, will be provided in the D & M Plans for the Project. *Companies' Ex. 193* (Correspondence regarding temporary work areas in wetlands, dated February 1, 2005).

Underground Portion

721. SSES characterized both tidal and freshwater wetlands along the underground portion of the route. 6/1/04 Tr. at 105 (Mango); *Companies' Ex. 1* (Application, Vol. 2, Wetland and Waterways Description Report and Supplement; Vol. 9, *Aerial Photographs – 400 Scale*; Vol. 11, *Aerial Photographs – 100 Scale*).

722. No tidal wetlands are expected to be affected by the project, since the cable system will be installed within road ROWs or below or above most tidal waters and associated tidal wetland areas. Due to engineering or geotechnical constraints that preclude the use of trenchless technology, an open cut method is proposed to install the cable across Yellow Mill Creek, which although within the coastal boundary, is located in an industrial area north of a culvert that connects the creek to the tidal channel. More details about this and other proposed crossings will be provided in the Companies' permit applications to the Corps and the DEP, as well as in the D & M Plan. *Companies' Ex. 1* (Application, Vol. 1, pp. M-5, M-16; Vol. 9, *Aerial Photographs – 400 Scale*, Segment 52); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, pp. 12, 14, 23-24); *Companies' Ex. 171* (Revised Table J-2, correspondence dated December 22, 2004).

723. Also due to geotechnical or engineering constraints, the Companies propose to install the cable beneath the second Norwalk River crossing using an open cut method. Details about this proposed method will be provided in the applications to the Corps and the DEP, as well as in the D & M Plan. As presently proposed, the use of an open cut method to install the cable beneath the second Norwalk River crossing will affect forested floodplain vegetation and regulated wetlands. *Companies' Ex. 1* (Application, Vol. 9, *Aerial Photographs – 400 Scale*, Segment 66; Vol. 12, *Aerial Photographs – 100 Scale*, Segment 242); *Companies' Ex. 54* (Supplemental Testimony of Zaklukiewicz, April 19, 2004, Norwalk River Crossing); *Companies' Ex. 171* (Revised Table J-2, correspondence dated December 22, 2004).

16.5 Water Supply Areas

724. The Project is in the vicinity of potable water supply areas in the vicinity of the municipalities of Durham, Wallingford, Hamden, Bethany, Woodbridge, Orange, West Haven, Westport, and Norwalk. *Companies' Ex. 1* (Application, Vol. 1, Section L.2.3, pp. L-25 to L-26).

725. However, neither the construction nor the operation of the Project will affect groundwater resources, private groundwater wells, or public water supplies. *Companies' Ex. 1* (Application, Vol. 1, p. M-16).

726. If groundwater is encountered during excavations for overhead structure foundations, the water will be pumped into temporary settling basins and allowed to infiltrate back into the ground; into catch basins (if permitted by the municipality and the Council); or into a tank truck and then transported off site to a suitable disposal location. Similarly, if groundwater is encountered during the installation of the cable system, the water will be pumped into municipal catch basins or into a tank truck for disposal outside of the project area, in accordance with applicable regulations. *Companies' Ex. 1* (Application, Vol. 1, pp. M-16 to M-17).

727. During construction, care will be taken to avoid impacts to municipal water lines that may be located within the road ROWs near the proposed underground cable route. *Companies' Ex. 1* (Application, Vol. 1, p. M-17).

16.6 Biological Resources

16.6.1 Vegetation

728. The overhead portion of the Project will be located primarily within existing transmission line ROWs, where the vegetative communities reflect varying degrees of management. The maintained portions of the ROWs are characterized primarily by dense shrub and herbaceous growth, whereas the principal vegetation types in the vicinity are deciduous hardwood and mixed hardwood forest, intermixed with areas of agricultural use, maintained lawn, and wetlands. *Companies' Ex. 1* (Application, Vol. 1, Section L.3.1, pp. L-27 to L-29; Vol. 9, *Aerial Photographs – 400 Scale*; Vol. 11, *Aerial Photographs – 100 Scale*).

729. The underground portion of the Project will be located within or adjacent to road ROWs in urban areas, where limited, if any, vegetation would be affected. Where the underground route must be installed beneath or above watercourses, the proposed construction methods have been selected to avoid affects on riparian corridors. Similarly, the staging areas required for these crossings will typically be located in developed areas, where vegetation removal will not be necessary. *Companies' Ex. 1* (Application, Vol. 1, Section L.3.1, pp. L-28 to L-29; p. M-18;

Vol. 9, *Aerial Photographs – 400 Scale*; Vol. 12, *Aerial Photographs – 100 Scale*).

730. To accommodate the overhead portion of the Project, as proposed by the Companies, approximately 98 acres of forested vegetation will be removed and, in these areas, the ROW will subsequently be maintained as shrubland or old field habitat. *Companies' Ex. 1* (Application, pp. M-18 to M-19; *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, p. 31); 6/1/04 Tr. at 102 (Mango).

731. Additional forested vegetation clearing within the ROWs may be required if mandated by the Federal Energy Regulatory Commission's standards, which are being Reevaluated subsequent to the August 14, 2003 blackout, to assure the safe and reliable operation of bulk supply transmission lines. 6/1/04 Tr. at 101-102 (Zaklukiewicz).

732. The conversion from forest to shrubland vegetation along the ROW will represent a long-term, but not an adverse, effect because the vegetation clearing will modify, but will not eliminate, habitat. Further, the creation of additional shrubland habitat (and the preservation of such existing habitat) along the maintained ROWs would represent a long-term positive effect because shrubland habitat is otherwise declining in New England. In Connecticut, transmission line ROWs are considered a major source of shrubland habitat. *Companies' Ex. 1* (Application, pp. M-18, M-20; *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, p. 31); 6/1/04 Tr. at 223-224 (Mango).

733. In wooded wetlands that contain trees that will interfere with the construction or operation of the transmission line, selective removal of woody vegetation will create shrub swamp wetlands, such as are present along the existing maintained ROWs. *Companies' Ex. 1* (Application, p. M-20).

734. Along the overhead portion of the Project, the amount of vegetation removal required will depend on factors such as the width of the existing maintained ROW, the types of structures to be installed, the need for access roads, the terrain, and the types of existing vegetative communities along the ROW. In areas where the existing vegetation can be safely spanned by the transmission line conductors, no clearing may be necessary. However, clearing would be required at structure sites, along access roads, and at other locations as needed to maintain safe distances between the conductors and vegetation. *Companies' Ex. 1* (Application, pp. M-18 to M-19).

735. Most of the vegetation clearing required for construction of the Project will be along the existing ROWs north of the State Route 15 (Wilbur Cross Parkway) crossing in Wallingford. South of this crossing, the overhead portion of the Project will generally be within ROWs along which the vegetation is already cleared and managed to virtually the full width of the easement *Companies' Ex. 1* (Application, Vol. 1, p. M-20, Section J, Table J-1).

736. Vegetation on the existing CL&P ROWs is managed in accordance with CL&P's vegetation management program, i.e., trees that could interfere with the operation of the existing lines are periodically trimmed or removed. *Companies' Ex. 1* (Application, Vol. 1, p. M-19*)*.

737. After construction, desirable vegetative species are expected to regenerate naturally on the ROW. Through long-term ROW maintenance procedures such as integrated vegetation management, the Companies will promote the regrowth of desirable native vegetative species within the ROW. *Companies' Ex. 1* (Application, Vol. 1, pp. M-20 to M-21; 6/1/04 Tr. at 225 (Zaklukiewicz); *Companies' Ex.* 39, Response to CSC-01, Q-CSC-032 and Q-CSC-01-033.

738. Use of herbicides for ROW vegetation maintenance will be in accordance with current federal regulations and state statutes. Undesirable invasive plant species will be controlled during ongoing and scheduled ROW maintenance programs. *Companies' Ex. 58,* Response to CSC-02, Q-CSC-041 and Q-CSC-043.

16.6.2 Wildlife Resources

739. Wildlife in the Project vicinity can be expected to be adapted to the different habitats available, including mature mixed forest, old field/shrub land, wetlands/open water, agricultural lands, and urban areas. Various wildlife management areas, forests, parks, or other special wildlife use areas are located in the vicinity of the proposed route; these include Durham Meadows Wildlife Management Area, Cockaponset State Forest, Black Pond Wildlife Area, Sleeping Giant State Park, Naugatuck State Forest, Quinnipiac River State Park, Charles E. Wheeler Wildlife Management Area, and Sasco Creek Marsh. *Companies' Ex. 1* (Application, Vol. 1, Section L.3.2, pp. L-29 to L-31; Vol. 9).

740. The Project will have minor, short-term effects on wildlife resources as a result of habitat modifications (vegetation clearing) and potential disturbance during construction activities. The wildlife species that presently use the existing ROWs and the additional areas that would be required for the Project would be temporarily displaced or disturbed during construction. Mobile wildlife species can be expected to leave the Project area during construction. *Companies' Ex. 1* (Application, Vol. 1, p. M-21).

741. In the long-term, the Project will increase shrubland and old field habitats (both of which are declining in Connecticut), and will have localized, positive effects on wildlife species that use such habitats. *Companies' Ex. 1* (Application, Vol. 1, p. M-21); *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, p. 31).

742. The underground portion of the Project will not affect wildlife resources. 4/20/04 Tr. at 205 (Mango).

16.6.3 Inland (Freshwater) Fisheries

743. All of the watercourses along the overhead portion of the Project are freshwater and many support cold-water or warm-water fish species. The underground portion of the Project crosses freshwater portions of the Norwalk River and several smaller streams. *Companies' Ex. 1* (Application, Vol. 1, Section L.3.3 and Table L-8, pp. L-32 to L-38).

744. Cold-water fisheries are considered more sensitive than warm-water fisheries because the fish species that comprise the cold-water fisheries (e.g., trout) are less tolerant of habitat disturbance and poor water quality. *Companies' Ex. 1* (Application, Vol. 1, Section L.3.3, p. L-32).

745. The Companies have designed the Project to avoid direct effects on watercourses and, thereby, effects on fishery resources. *Companies' Ex. 1* (Application, *Vol. 1,* p. M-22).

746. Along the overhead portion of the Project, all watercourses will be spanned and no new structures will be located in or immediately adjacent to streams. Riparian vegetation along the ROW would be maintained to provide shade, and would be selectively cut only if required to maintain safe clearances from the transmission facilities. *Companies' Ex. 1* (Application, Vol. 1, p. M-22).

747. Along the underground portion of the Project, the cable system will be installed across watercourses to avoid or minimize disturbance to stream channels, banks, and riparian vegetation, thereby limiting the potential for effects on fishery resources. *Companies' Ex. 1* (Application, Vol. 1, p. M-22).

748. The Companies will continue to consult with the DEP, as appropriate, to identify methods for avoiding or minimizing adverse effects to fisheries resources during construction. *Companies' Ex. 1* (Application, Vol. 1, p. M-22).

16.6.4 Marine Fisheries and Shellfish Resources

749. The underground portion of the Project crosses seven tidally-influenced watercourses that provide potential habitat for marine fisheries and shellfish resources that are commercially, ecologically, and recreationally important. These watercourses are: Housatonic River, Yellow Mill Creek, Pequonnock River, Ash Creek, Mill River, Sasco Creek, and Saugatuck River. *Companies' Ex. 1* (Application, Vol. 1, Section L.3.3, p. L-32, Table L-8, pp. L-37 to L-38; Section L.3.6, pp. L-43 to L-45).

750. By installing the cable system above or beneath six of the tidal water crossings using trenchless construction methods (e.g., HDD, alignment within roadways, or on bridges), no adverse effects to marine fisheries or shellfish resources will occur. The Companies will submit permit applications to both the Corps and DEP

that will address the crossing methods for all regulated watercourses. These applications will include plans of the proposed crossing method for each waterbody, including details regarding staging areas, use of erosion and sediment controls, contingency procedures, and other techniques designed to protect water quality and marine resources. The Companies anticipate that the permits from the Corps and the DEP will also include conditions designed to protect water quality and marine resources, including shellfish. These plans and permit conditions will be incorporated into the D & M Plan(s) for the Project. *Companies' Ex. 1* (Application, p. M-25); *Companies' Ex. 171* (Revised Table J-2 of Application, Vol. 1); *Companies' Ex. 65,* Response to CSC-02, Q-CSC-044; *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, pp. 12-13, 23-24).

751. Although cable construction activities are not expected to affect marine resources, the Companies will adhere to construction timing restrictions for the installation of the marine waterbody crossings, if required by the Council or other involved resource agencies (e.g., NMFS, Corps, DEP, Connecticut Department of Agriculture-Bureau of Aquaculture). Initial consultations with DEP indicate that the most often used seasonal restrictions to protect marine fisheries are:

- Prohibit unconfined in-water work from April 1 to June 30 (to protect spawning migrations of anadromous fish).

- Prohibit unconfined in-water work from February 1 to May 15 (to protect winter flounder spawning and early-life stage development). *Companies' Ex. 1* (Application, pp. M-25 to M-26).

752. The Companies will submit applications for the tidal water crossings to the Corps and DEP, and will continue to consult with the DOA, Bureau of Aquaculture regarding shellfish resources, as appropriate. *Companies' Ex. 65*, Response to CSC-02, Q-CSC-044.

16.6.5 Amphibians

753. In 2002, SSES conducted a preliminary analysis to identify wetlands along the overhead portion of the route that might provide amphibian breeding habitat. Between mid-April and mid-May 2003, during the amphibian breeding season, SSES conducted additional field investigations of these wetlands to verify the presence or absence of amphibian use. *Companies' Ex. 1* (Application, Vol. 1, Section L.3.4, pp. L-38 to L-39; Vol. 2 and 4).

754. Based on the SSES field studies in 2002 and 2003, 10 wetlands on the existing ROWs were found to have high amphibian breeding potential; of these, two appear to be vernal pools. Twenty-four wetlands were identified as having moderate potential for amphibian breeding, while 35 wetlands were characterized as having low potential for productive amphibian breeding habitat. *Companies' Ex. 1* (Application, Vol. 1, Section L.3.4, pp. L-38 to L-39; Vol. 2 and 4)

755. Existing transmission structures are presently located within or adjacent to 14 of the wetlands with high or moderate amphibian breeding habitat. *Companies' Ex. 1* (Application. Vol. 1, p. M-23, Table M-3).

756. Where possible, new structures will not be located in wetlands that provide high or moderate potential for productive amphibian breeding. However, because several of the potential breeding habitats are large wetlands that presently contain a number of structures, it might not be possible to avoid such areas entirely. *Companies' Ex. 1* (Application, Vol. 1, p. M-24).

757. To further minimize potential effects on amphibians, the Companies will consult with the DEP to identify appropriate time periods during which construction should be performed, as well as to define mitigation measures. Construction activities in and near amphibian breeding areas may be scheduled to avoid critical periods in the species' life cycles. Mitigation procedures such as those identified in the document "*Best Development Practices: Conserving Pool-Breeding Amphibians in Residential and Commercial Developments in the Northeastern United States*" also may be appropriate. Such measures, which include the removal of temporary erosion and sediment controls from construction areas within 30 days of final site stabilization, will be included in the D&M Plan. *Companies' Ex. 1* (Application, Vol. 1, p. M-24); 6/1/04 Tr. at 63-64 (Mango); *Council's Administrative Notice, Item 21* (Best Development Practices: Conserving Pool-Breeding Amphibians in Residential and Commercial Developments in the Northeastern United States).

758. In developing appropriate mitigation measures for incorporation into the D&M Plan, the Companies have committed to consider not only the SSES amphibian breeding data, but also information developed by Land-Tech for the portion of the existing ROW in Woodbridge and Milford. 6/1/04 Tr. at 85-87 (Mango and Zaklukiewicz); *Woodbridge's Ex. 6* (Testimony of Land-Tech, May 24, 2004, at 6-7); *Milford's Ex. 11* (Testimony of Land-Tech, May 24, 2004, at 4-5).

16.6.6 Breeding Birds

759. Research was conducted to identify the bird species that are known or could be expected to breed in the Project vicinity, and then to evaluate the potential effects of the construction and operation of the Project on such species. *Companies' Ex. 1* (Application, Vol. 1, Section L.3.5, p. L-40; Vol. 4, *Analysis of Bird Species Along the Proposed Middletown to Norwalk 345-kV Transmission Line*; *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, p. 22).

760. Of the 173 bird species reported to breed within Connecticut, 152 species could potentially occur in the Project vicinity (including 45 species having a low potential for occurrence, 50 species with moderate potential, and 57 species with a high potential). *Companies' Ex. 1* (Application, Vol. 1, Section L.3.5, pp. L-40 to

L-41; Vol. 4, "*Analysis of Bird Species along the Proposed Middletown to Norwalk 345-kV Transmission Line*").

761. The old field/shrubland habitat typically maintained on utility ROWs is becoming scarce in Connecticut and in the Northeast generally, as abandoned farmlands revert to forest and as existing woodlands mature. ROWs represent an important component of regional habitat diversity, providing a stable, long-term source of shrubland habitat in a region where it is becoming scarce. *Companies' Ex. 1* (Application, Vol. 1, Section L.3.5, p. L-42; Vol. 4, *Analysis of Bird Species Along the Proposed Middletown to Norwalk 345-kV Transmission Line*, pp. 4-5).

762. Long-term studies confirm that utility ROWs typically support a greater number and diversity of birds than adjacent forested habitats, because they not only provide food and nesting opportunities for early successional species, but also are important sources of food and cover for family groups of woodland species with their fledglings. *Companies' Ex. 1* (Application, Vol. 1, Section L.3.5, p. L-42; Vol. 4, *Analysis of Bird Species along the Proposed Middletown to Norwalk 345-kV Transmission Line*, p. 4).

763. The construction of the underground portion of the Project would have no effect on birds. *Companies' Ex. 1* (Application, Vol. 1, p. M-24; Vol. 4, *Analysis of Bird Species along the Proposed Middletown to Norwalk 345-kV Transmission Line,* p. 7).

764. The overhead portion of the Project will benefit shrubland bird species by permanently increasing the amount of maintained ROW, which provides suitable habitat for such species. The limited removal forested vegetation required along the Project ROW will have highly localized, minor effects on bird species that utilize such existing habitats (mature mixed forest, wooded wetland). However, the amount of woodland habitat removed for the construction of the Project will be negligible compared to the amount of similar habitat that will remain available in the surrounding region. *Companies' Ex. 1* (Application, Vol. 1, p. M-24; Vol. 4, *Analysis of Bird Species Along the Proposed Middletown to Norwalk 345-kV Transmission Line*, pp. 10-12,).

765. To minimize potential effects on birds inhabiting the ROW, ROW vegetation removal and management will not be performed during the breeding and nesting season (April 1 – August 15), to the extent practical. If field observations indicate that red-shouldered hawks are nesting in the vicinity of Glen Lake in Woodbridge (where DEP has indicated there has been hawk activity in the past), vegetation removal in this areas would not be permitted between February 1 and August 15. *Companies' Ex. 1* (Application, Vol. 1, p. M-25; Vol. 4, *Analysis of Bird Species Along the Proposed Middletown to Norwalk 345-kV Transmission Line*, pp. 17-18); *Companies' Ex. 71*, Response to CSC-02, Q-CSC-039.

16.6.7 Rare, Threatened and Endangered Species

766. Consultations with the USFWS indicate that there are no federally listed, proposed threatened or endangered species, or critical habitats in the Project area. *Companies' Ex. 1* (Application, Vol. 1, p. M-26; Vol. 4, *Federal, State and Municipal Agencies Correspondence*, USFWS letter dated August 22, 2003).

767. The DEP Natural Diversity Data Base (NDDB) has indicated that there are several threatened, endangered, or species of special concern reported to occur in the Project vicinity, including two species of turtles, two species of plants, one fish species, and four species of birds. *Companies' Ex. 1* (Application, Vol. 1, pp. M-26 to M-28; Vol. 4, *Federal, State and Municipal Agencies Correspondence,* DEP NDDB correspondence dated March 17, 2003, March 24, 2003, May 7, 2003, May 14, 2003); 4/20/04 Tr. at 268-269 (Mango).

768. The Companies will continue to consult with DEP as project planning progresses, to assure that the final project design will avoid adverse effects on these species, and to assess the need, if any, for special field studies to determine whether critical habitats for these species actually exist in the areas where construction would occur. Mitigation measures, as appropriate, will be incorporated into the D&M Plan. *Companies' Ex. 1* (Application, Vol. 1, p. M-27; Vol. 4, "*Federal, State and Municipal Agencies Correspondence*" DEP NDDB correspondence dated March 17, 2003, March 24, 2003, May 7, 2003, May 14, 2003; 4/20/04 Tr. at 268-270 (Mango); *Companies' Ex.,* 65, Response to CSC-02, Q-CSC-042.

769. The two State Special Concern plant species (mudwort (*Limosella subulata*) and bayonet grass (*Scirpus paludosus* var *atlanticus*) were reported in the vicinity of the Saugatuck River. No effects on these plants are anticipated because the proposed crossing of the Saugatuck River will be performed using HDD and the staging areas for the crossing would be located in upland areas, back from the riverbanks, and would be protected with appropriate erosion and sediment controls. *Companies' Ex. 1* (Application, Vol. 1, p. M-26).

770. Potential effects on other listed species will be avoided by restricting construction activities in the vicinity of the species' known habitats or by using special construction techniques (e.g., HDD). To avoid critical periods in these species' lifecycles, the DEP has recommended that construction in the vicinity of the species' reported habitats be conducted in accordance with specified "construction windows." *Companies' Ex. 1* (Application, Vol. 1, Table M-4, pp. M-27 to M-28; Vol. 4, *Federal, State and Municipal Agencies Correspondence* DEP NDDB correspondence dated March 17, 2003, March 24, 2003, May 7, 2003, May 14, 2003); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 14); *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, pp. 32 -33); 4/20/04 Tr. at 268-270 (Mango).

16.7 Transportation

771. The transportation network in the Project region is well-developed and consists of a variety of Federal, State, and local highways, as well as various railroad and utility ROWs. *Companies' Ex. 1* (Application, Vol. 1, Section L.7 and Table L-13, pp. L-54 to L-57); *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, p. 34).

772. The well-established public road network will afford ready access to most work sites for construction vehicles and equipment. Along the overhead portion of the route, access roads are present along the established transmission ROWs and existing local, town and city streets provide further access to points on the ROWs. These access roads and access points are expected to be used during construction activities. *Companies' Ex. 1* (Application, Vol. 1, Section K.1, Table K-1, pp. K-2 to K-3; p. M-39; Vol. 9); *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, pp. 34-35).

773. The Companies will employ police personnel to direct traffic at construction work sites along roads, as needed, and will erect appropriate traffic signs to indicate the presence of construction work zones. *Companies' Ex. 1* (Application, Vol. 1, p. M-39).

774. The overhead portion of the Project will require crossings of various roads, railroads, other utilities, and pipelines. All such crossings will be overhead and will result in no adverse effects. *Companies' Ex. 1* (Application, Vol. 1, p. M-39; Vol. 9); *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, p. 35).

775. For the installation of the underground portion of the Project within road ROWs, the Companies will work with the involved highway and municipal authorities to minimize effects associated with the construction process. Measures will be taken to maintain access to nearby land uses during construction and to avoid effects on buried infrastructure facilities. *Companies' Ex. 1* (Application, Vol. 1, pp. M-39 to M-40); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 16).

776. To mitigate potential interference with traffic, underground cable construction may be performed during non-peak travel times or at night. Specific construction management measures will be planned with representatives of each affected municipality and, as appropriate, with CDOT. Traffic control measures will be specified in the D & M Plan(s) for the Project. *Companies' Ex. 1* (Application, Vol. 1, pp. M-39 to M-40); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, pp. 16-17, 24-25); 4/20/04 Tr. at 271 (Zaklukiewicz; Prete).

777. Further, in repairing roads affected by underground cable installation, the Companies will work with the highway authorities to determine the extent of road

resurfacing on a case-by-case basis. *Companies' Ex. 71.* Response to CSC-02, Q-CSC-052.

16.8 Archaeological and Historic Resources

778. Raber Associates performed cultural resource studies of the Project area, using a study scope endorsed by the Connecticut Historical Commission (CHC), State Historic Preservation Office (SHPO)[3]. The study objectives were to compile information about the history and prehistory of the Project area; identify known cultural resources and areas of archaeological sensitivity in the Project vicinity; identify historic architectural or engineering resources that could be visually affected by the overhead facilities; and make recommendations concerning the potential for locating as yet undiscovered cultural resources during the Project development. *Companies' Ex. 1* (Application, Vol. 1, Section L.8, pp. L-59 to L-60; Vol. 3, *Cultural Resources Assessment*); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 9); *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, pp. 25-26).

779. The archaeological portion of the assessment was conducted in accordance with the standards of the CHC's *Environmental Primer for Connecticut's Archaeological Resources.* The assessment also included visual inspection of the existing transmission line structure locations and examination of the entire ROW with respect to characteristics that affect the potential for archaeological site location (i.e., slope, drainage, ledge, ground disturbance, land fill). *Companies' Ex. 1* (Application, Vol. 1, p. M-40; Vol. 3, *Cultural Resources Assessment, September, 2003*).

780. The Raber studies determined that there are no documented archaeological sites within the proposed ROW. However, discontinuous areas, totaling approximately 27 miles of the overhead route, are sensitive for potential (as yet undocumented) Native American sites. *Companies' Ex. 1* (Application, Vol. 1, p. M-41; Vol. 3, *Cultural Assessment, September 2003*; *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 9).

781. At the sites for proposed transmission structures, additional assessment (field studies) of Native American archaeological sensitivity may be required to make a final determination of locations where reconnaissance testing will be necessary to locate sites. *Companies' Ex. 1* (Application, Vol. 1, p. M-41).

782. For 14 significant above ground historic resources identified within 0.25 mile of the overhead portion of the Project, digital profiles were prepared to simulate views of the new transmission structures. At 10 of the historic properties, existing

[3] Subsequent to the submission of the Application, as a result of a state reorganization, the CHC became the Commission on Arts, Tourism, Culture, History and Film. The SHPO is now part of this new Commission.

terrain and forest cover will preclude any visibility of new transmission structures at proposed pole heights. Of the remaining four properties, only one may be subject to visual effects. Adverse visual effects on the remaining three historic structures are unlikely because they are either located at distances over 800 feet from the proposed transmission line or because structure heights will not change significantly. In most cases, adverse visual effects on historic resources are unlikely at distances over 500 feet. *Companies' Ex. 1* (Application, Vol. 1, p. M-41; Vol. 3, *Cultural Resources Assessment, September 2003*).

783. Due to urbanization and road development, the road ROWs along which the underground portion of the Project will be located are not likely locations for archaeological sites. *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 9).

784. Along the underground portion of the Project, 33 significant above-ground historic resources (including four cemeteries that are at least 100 years old and are subject to statutory protection) were identified within 500 feet of the route. *Companies' Ex. 1* (Application, Vol. 1, p. M-41); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 9).

785. If cable construction is performed within public road ROWs and similar previously disturbed areas, the potential for adverse effects to cultural resources is limited. *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 17).

786. The SHPO has indicated that the cultural investigations undertaken by the Companies to date are consistent with state review standards and with the National Historic Preservation Act. The Companies will continue to coordinate with the SHPO regarding cultural resources and will commission further studies, if necessary, in accordance with study designs approved by the CHC. *Companies' Ex. 1* (Application, Vol. 1, p. M-42); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 17); *Companies' Ex. 83,* Response to W-M-01, Q-W-M-009, correspondence from SHPO dated April 13, 2003 and April 20, 2004.

16.9 Air Quality and Noise

787. The Project will result in short-term, highly localized effects on air quality during construction, primarily from fugitive dust and vehicular emissions; such effects may be minimized by techniques such as limiting the extent of exposed/disturbed areas, using stone to access roads to control dust, or wetting disturbed soils to minimize dust. The operation of the project will have no adverse effect on air quality. *Companies' Ex. 1* (Application, Vol. 1, p. M-42).

788. Construction-related noise will be generally short-term and localized, and will emanate from the operation of construction equipment and truck traffic. If practical, mitigation measures will be applied to minimize construction-related

sound levels at noise-sensitive receptors. *Companies' Ex. 1* (Application, Vol. 1, pp. M-42 to M-43).

789. The operation of the overhead 345-kV line could result in audible noise at the edge of the ROW. To mitigate audible noise, 1590 ACSR conductors will be used. Noise emanating from the 345-kV line will attenuate at a rate of about 3 decibels per doubling of distance from the conductors. The noise from the line will be further attenuated by buildings and vegetation. *Companies' Ex. 1* (Application, Vol. 1, p. M-43).

16.10 Substations and Switching Stations

16.10.1 Scovill Rock Switching Station

790. The Scovill Rock Switching Station, located in southeastern Middletown, has been in existence for 39 years and occupies a 5-acre fenced site within a 50-acre, largely undeveloped parcel owned by CL&P. CL&P also owns properties to the north and east of the site. *Companies' Ex. 1* (Application, Vol. 1, Section L.11.1, p. L-67; Vol. 9, *Aerial Photographs – 400 Scale,* Segment 1,).

791. The modifications to the existing Scovill Rock Switching Station will be minor and will be located within the existing station fence line. No vegetation or wildlife resources, threatened or endangered species or species of special concern, wetlands, watercourses, or cultural resources will be affected. The switching station is not within a designated floodplain or SCELs. *Companies' Ex. 1* (Application, Vol. 1, pp. M-44 to M-45).

792. Site preparation work for the new 345-kV facilities may involve grading and soil disturbance. Temporary sedimentation and erosion controls will be installed, as appropriate, around disturbed areas. *Companies' Ex. 1* (Application, Vol. 1, p. M-44).

793. The modifications to the switching station will have an incremental effect on visual resources because the 345-kV line structure would be approximately 90 feet in height, which is similar to the existing structures at the station. Further, the station is in a remote, wooded area, where it is not visible form private residences or public areas. *Companies' Ex. 1* (Application, Vol. 1, p. M-45).

794. Noise analyses determined that sound levels from the existing operation of the switching station, measured at the fence line, are very low, and that the planned modifications to the station will have no effect on the surrounding community and will be in full compliance with the most restrictive conditions of applicable state noise regulations. *Companies' Ex. 1* (Application, Vol. 1, Section L.11.1, p. L-69; p. M-46; Vol. 4, *Audible Noise Studies, July 30, 2003*).

16.10.2 Beseck Switching Station

795. The Beseck Switching Station will be located in northeastern Wallingford, on a 5.4-acre site within a 52-acre undeveloped, forested property owned by CL&P. The property is at the junction of CL&P's existing 387 Line 345-kV and two 115-kV transmission lines. CL&P purchased the property 40 years ago, along with other nearby parcels, for use as buffers for the transmission lines and as a location for a future substation site. *Companies' Ex. 1* (Application, Vol. 1, Section L.11.2, p. L-69); Vol. 9, *Aerial Photographs – 400 Scale,* Segment 14).

796. The Beseck site is zoned for industrial use; a large industrial district is located to the west of the CL&P property. Other land uses in the vicinity of the site include a mix of single-family residences and undeveloped forested areas. The station would be consistent with the existing industrial use designation and would be compatible with the other industrial uses located to the west and south. *Companies' Ex. 1* (Application, Vol. 1, Section L.11.2, p. L-70; p. M-48); *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, p. 35).

797. The construction of the Beseck Switching Station will require vegetation clearing, grading, and filling on the 5.4-acre site. These modifications will cause minor and localized, but long-term, effects to topography, soils, vegetation, wildlife, and visual resources. The mixed hardwood vegetative community that presently characterizes the site would be replaced by the fenced substation yard, and the wildlife species that use this habitat would be displaced from the site. However, other large mixed hardwood communities are located on properties owned by CL&P in the vicinity and these or similar areas can be expected to provide substitute habitat. *Companies' Ex. 1* (Application, Vol. 1, pp. M-46 to M-48).

798. The Beseck site is not located within a 100-year floodplain boundary or SCELs, and will not directly affect any wetlands, watercourses, or the habitat of any threatened or endangered species or species of special concern. *Companies' Ex. 1* (Application, Vol. 1, Section L.11.2, p. L-70; pp. M-46 to M-47; *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, p. 36).

799. Although the site is within a large area designated by Wallingford for watershed protection, neither the construction nor the operation of the switching station is expected to affect this watershed protection area. Appropriate spill prevention, control and countermeasure procedures will be implemented during construction (to minimize the potential for inadvertent spills or leaks from construction equipment) and during operation of the facility (e.g., to avoid or minimize the potential for spills or leaks from fuel stored on site to power an emergency generator). *Companies' Ex. 1* (Application, Vol. 1, p. M-47); *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, p. 36).

800. Wetland No. 45, which is located east of and downslope from the site, was identified by SSES as having moderate potential for amphibian breeding. The construction and operation of the Beseck Switching Station would not affect this habitat. *Companies' Ex. 1* (Application, Vol. 1, Section L.11.2, p. L-70; p. M-48; Vol. 4, *Amphibian Breeding Survey, August 15, 2003 pp. 2 and 4"*).

801. Single-family residential areas are located east of the Beseck site, on the eastern side of CL&P's existing 387 Line ROW. The residence nearest to the Beseck site is on High Hill Road, approximately 400 feet east of the boundary of the site. Dense woody vegetation 50-80 feet in height presently provides a buffer between the transmission line ROW and these residential areas, and would serve as a buffer for the switching station. *Companies' Ex. 1* (Application, Vol. 1, pp. M-48).

802. A single residence is located 600 feet northwest of the site, abutting CL&P's property and the industrial district. A portion of the existing driveway for this house would be relocated to accommodate grading for the switching station. Existing forested areas would be retained to provide screening between this house and the Beseck station to the extent possible. *Companies' Ex. 1* (Application, Vol. 1, p. M-49).

803. The development of the Beseck Switching Station would cause a long-term change to the visual characteristics of the site, but will be consistent with the property's industrial zoning and with the character of the facilities in the industrial park along Carpenter Road and Technology Drive. Potential views of the switching station from residential areas will be limited, due to the location of the site to the west of CL&P's existing transmission ROW; overall, the site is separated from the residential areas by approximately 600-1,000 feet. The property between the existing transmission ROW and High Hill Road is owned by CL&P and consists of undeveloped mature forestland, which serves as an effective visual screen. Additional vegetative screening will be planted around the switching station. *Companies' Ex. 1* (Application, Vol. 1, p. M-49; Vol. 7, *Proposed Substation and Switching Station Drawings – Beseck Station*; *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, pp. 36-37).

804. No known historic or archaeological resources are located on the station site or in the immediate vicinity. However, the site could be potentially archaeologically sensitive. Further consultations will be conducted with the CHC and cultural resource field investigations will be performed, if necessary. *Companies' Ex. 1* (Application, Vol. 1, p. M-50; Vol. 3).

805. In July 2003, the Companies commissioned an audible sound survey to quantify and characterize the acoustic environment in the vicinity of the Beseck Switching Station. *Companies' Ex. 1* (Application, Vol. 1, Section L.11.2, pp. L-71 to L-72, Table L-21; p. M-50; Vol. 4, *Audible Noise Studies,* July 30, 2003).

806. The noise survey determined that existing background sound in the vicinity of the proposed switching station is dominated by traffic noise from I-91 (located approximately 0.25 mile west of the site) and that the only source of steady state audible sound produced by equipment at the proposed switching station would be from a small ventilation fan in the control room building. The noise produced by this fan (which would only operate periodically) is not expected to be discernible at the nearest residences, all of which are more than 400 feet from the switching station. This negligible equipment noise would be in full compliance with both Wallingford's Noise Ordinance and with the DEP Noise Regulations. *Companies' Ex. 1* (Application, Vol. 1, Section L.11.1 p. L-71; p. M-50; Vol. 4, *Audible Noise Studies*, July 30, 2003).

807. An emergency generator is proposed for location at Beseck; this generator would only operate during area-wide power outages and for maintenance (estimated at approximately 30 minutes per month, during daytime hours). The noise study determined that sound from this emergency generator would be less than 50 dBA at the nearest residence. The generator would be placed in a weatherproof, acoustic enclosure and would be equipped with an exhaust silencer, which would reduce full load sound levels to less than 75 dBA at a distance of 50 feet from any position surrounding the generator. *Companies' Ex. 1* (Application, Vol. 1, Singer Substation Site Selection Study, p. M-50).

16.10.3 East Devon Substation

808. The East Devon Substation will be located on a 15-acre privately-owned, undeveloped industrial property in Milford. The proposed site is bordered to the west by the railroad, Oronoque Road, and the Iroquois Gas Transmission System natural gas pipeline; to the east by CL&P's existing 115-kV ROW; to the south by the Milford Power Plant; and to the north by Plains Road. The Companies would have to acquire the site, which is zoned for "LI-30" industrial use, from the private owner. *Companies' Ex. 1* (Application, Vol. 1, Section L.11.3, pp. L-72 to L-73; Vol. 9, *Aerial Photographs – 400 Scale*, Segment 45).

809. The site is relatively flat and is characterized by second growth mixed hardwood species. It is not located within a 100-year flood zone or SCELs; the Housatonic River is located about 0.5 mile to the west. According to the DEP NDDB, no threatened or endangered species or species of special concern have been reported on or in the vicinity of the site. Nearby land uses include industrial and utility developments (CL&P's 115-kV ROW, the Milford Power Plant, BIC Pen, O & G asphalt plant, Beard Sand & Gravel, Iroquois Gas Transmission System pipeline), with some single-family residential uses to the east and south. *Companies' Ex. 1* (Application, Vol. 1, Section L.11.3, pp. L-72 to L-73; Section M.10.3, pp. M-51 to M-52).

810. The development of the East Devon Substation will be consistent with the existing industrial use zoning and compatible with the other industrial uses in the

vicinity. However, the construction and operation of the substation would modify the existing on-site land use, creating long-term but minor changes in topography, soils, wetlands, vegetation and wildlife, visual resources, and noise. *Companies' Ex. 1* (Application, Vol. 1, Section M.10.3, pp. M-51 to M-52); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 27).

811. Two state inland wetland areas, consisting of 0.02 acre and 0.8 acre, would be filled as a result of the development of the substation. *Companies' Ex. 1* (Application, Vol. 1, Section M.10.3, p. M-51).

812. Although the East Devon Substation is within the designated coastal boundary along the Housatonic River, it is located on an industrially zoned, previously disturbed upland site. The construction and operation of the substation will not adversely affect any coastal resources. *Companies' Ex. 1* (Application, Vol. 1, Section M.10.3, p. M-52); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 27).

813. Because of its location near the Housatonic River, the East Devon Substation site is considered potentially sensitive for the location of Native American archaeological resources. Cultural resource field investigations, which would be performed in accordance with procedures approved by the CHC, would be conducted to determine whether archaeological sites are present, if sites are found, to assess their potential significance and to define appropriate mitigation measures. *Companies' Ex. 1* (Vol. 1, Application, p. L-73; Section M.10.3, p. M-53; Vol. 3, *Cultural Resources Assessment, September 2003*).

814. In July 2003, Cavanaugh Tocci Associates, Inc. conducted baseline noise surveys to determine sound levels in the vicinity of the proposed East Devon Substation and then used an acoustic model to estimate the sound levels from the full load operation of the substation. The baseline studies determined that background sound in the residential areas east of the proposed substation is dominated by traffic on I-95 (located approximately 1 mile to the south), with contributions of transient sound produced by motorcycles at the Milford Riders Motorcycle Club. *Companies' Ex. 1* (Application, Vol. 1, Section L.11.3, p. L-73 to L-74; Section M.10.3, pp. M-53 to M-54, Table M-6; Vol. 4,*"Audible Noise Studies, July 30, 2003, Table L-22*).

815. To minimize the effects of substation-generated sound on the residential areas located to the east, three barrier walls, each approximately 20 feet tall and 30 feet long, would be installed east of the transformer pad and the shunt reactors. *Companies' Ex. 1* (Application, Vol. 1, Section M.10.3, p. M-54; Vol. 4, *Audible Noise Studies*, p. 4); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, pp. 27-28).

816. The noise modeling, which assumed the presence of the barrier walls and acoustic shielding produced by buildings, earth berms, and firewalls, etc., determined that

sound levels from the substation would be in full compliance with the most restrictive aspects of State noise regulations, and would result in a negligible change in background sound levels at the nearest residences. *Companies' Ex. 1* (Application, Vol. 1, Section M.10.3, pp. M-54 to M-55, Table M-6; Vol. 4), *Audible Noise Studies,* p. 5).

16.10.4 Singer Substation

817. The Singer Substation is planned for location on a 1.5-acre site in an urban, "multi-use" zone of Bridgeport. 4/20/04 Tr. at 39 (Parnell; Prete); 4/20/04 Tr. at 40, 265 (Prete) *Companies' Ex. 1* (Application, Vol. 6, "Singer Substation Site Selection Study," pp. 14-15); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 26).

818. UI has reached an agreement with PSEG, the current property owner, with respect to the development of the substation on this site. The City of Bridgeport also does not object to the proposed site development. 4/20/04 Tr. at 39-40 (Parnell); 4/20/04 Tr. at 40, 265 (Prete); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 26); *Companies' Ex. 71*, Response to CSC-02, Q-CSC-055.

819. The principal potential changes associated with the development of the substation would be to visual resources and noise. To minimize the potential effects on visual resources, a 35 to 40-foot-high architectural wall, visually consistent with architectural treatments in the vicinity, will be constructed around three sides of the substation. This wall will provide visual screening, site security, and noise buffering. Companies' *Ex. 53* (Testimony of Mango, April 8, 2004, pp. 26-27); 4/20/04 Tr. at 263-264 (Prete).

820. The results of baseline noise studies and noise modeling, assuming the installation of the architectural wall, determined that the sound levels resulting from the operation of the Singer Substation will conform to noise regulations. *Companies; Ex. 64* (Singer Substation – Bridgeport, Connecticut, Environmental Sound Evaluation for Revised Site 8 Location" April 10, 2004).

16.10.5 Norwalk Substation

821. CL&P's existing Norwalk Substation is located in Norwalk at the northwest corner of the intersection of U.S. Route 7 and New Canaan Avenue (State Route 123). *Companies' Ex. 1* (Application, Vol. 1, Section L.11.5, p. L-76; Vol. 9, *Aerial Photographs – 400 Scale*, Segment 66).

822. Extensive modifications to the Norwalk Substation were approved by the Council as part of CL&P's Bethel to Norwalk 345-kV project (Docket 217). The additional modifications to the Norwalk Substation to accommodate the Project facilities will be accomplished within the station fence line and will result in only minor effects. The modifications will not affect water resources; floodplains;

vegetation and wildlife; threatened or endangered species or species of special concern; land use plans; coastal resources, or cultural resources. The proposed modifications will represent only an incremental and minor change to visual resources on the site, which has long been devoted to utility purposes. *Companies' Ex. 1* (Application, Vol. 1, Section M.10.5, pp. M-58 to M-60; Vol. 7, *Norwalk Substation Drawings*; Vol. 9, *Aerial Photographs – 400 Scale*, Segment No. 66); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 28).

823. The Norwalk Substation modifications will require limited grading and soil disturbance within the station fence line. Because of the location of the substation adjacent to the Norwalk River, particular care will be taken to install appropriate temporary erosion controls around work areas to prevent off-site erosion or sedimentation. *Companies' Ex. 1* (Application, Vol. 1, Section M.10.5, p. M-58, M-59).

824. The results of baseline noise studies and noise modeling determined that the sound levels resulting from the operation of the Project modifications at the Norwalk Substation will be significantly less than the lowest existing measured background sound levels at the residential receptors. Based on this modeling, the sound levels associated with the modifications will be in full compliance with the most restrictive aspects of Norwalk and State noise regulations. *Companies' Ex. 1* (Application, Section M.10.5, pp. M-60 to M-61; Vol. 4, *Audible Noise Studies*, July 30, 2003).

16.11 D&M Plan Environmental Issues

825. Prior to the submission of the D&M Plans, the Companies will conduct studies to assess the properties along the route that might be subject to DEP environmental clean up orders. If necessary, the Companies will apply their previous experience in successfully addressing soil contamination within state roadways to the Project. 4/20/04 Tr. at 154 (Mango); 4/21/04 Tr. at 81-82 (Shanley); 4/21/04 Tr. at 82-86 and 88-91 (Zaklukiewicz).

826. At the Saugatuck River HDD crossing in Westport, the Companies recognize that a former landfill is located in the vicinity and, prior to the commencement of construction, will test the work area for potential contamination. Depending on the results of the test, appropriate measures will be taken during the HDD; such measures will be detailed in the D&M Plan. *Companies' Ex. 76,* Response to CSC-02, Q-CSC-054.

827. Independent environmental inspectors assigned by the Council to the Project during construction may be involved in handling issues related to the discovery of contaminated soils within the ROW. 4/21/04 Tr. at 90 to 91 (Zaklukiewicz).

828. The Council will monitor compliance with D&M Plans. 4/20/04 Tr. at 272 (Mango).

17.0 Safety of Persons and Property Along the Area Traversed by the Line (Conn. Gen. Stat. 16-50p(a)5)

829. The proposed line will be constructed in full compliance with the National Electrical Safety Code (NESC), including but not limited to all NESC requirements regarding clearances from humans and structures, as well as the standards of the Association of Edison Illuminating Companies, good utility practice, and DPUC regulations covering the method and manner of high voltage line construction. Should the line experience a failure due to a short circuit, voltage, or thermal overloads, high speed protective relaying equipment would immediately remove the line from service, thereby protecting the public and the line. *Companies' Ex. 1* (Application, Vol. 1, p. N-1).

830. The location of the project will not pose an undue hazard to persons or property traversed by the line. (Conn. Gen. Stat. § 16-50p(c)(2)(E)).

18.0 Other Statutory Findings Under Conn. Gen. Stat. § 16-50p(c)

831. The nature of the probable environmental impacts of this project are not excessive and do not conflict with the policies of the State concerning the natural environment; ecological integrity and balance; public health and safety; scenic, historic, and recreational values; forests and parks; air and water purity; and fish and wildlife, either alone or cumulatively with other effects. (Conn. Gen. Stat. § 16-50p(c)(2)(B)).

832. The adverse effects of this project are not sufficient reason to deny the application. (Conn. Gen. Stat. § 16-50p(c)(2)(C)).

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