357. The existing ROW in this area is occupied by two sets of wooden H-frame structures that support the 1975 Line. Installation of the 345-kV line along the proposed route would involve the removal of both H-frame structures and the reconstruction of the existing 115-kV lines on a single monopole structure with the 345-kV line. No additional ROW would be needed to accommodate the 345-kV line and the rebuilt 115-kV facilities if they are constructed in the existing ROW. Alternatively, the existing 115-kV lines could be removed from the ROW and reconstructed underground, within local streets, and the 345-kV could be centered on the existing ROW in a split phase configuration. *Companies' Ex. 1* (Application, Vol. 9, Segment Maps 6 and 7, Aerial Photographs – 400 Scale; Vol. 10, Typical Cross Sections); *Companies' Ex. 96* (EMF Mitigation for all Cross Sections of Overhead Route with a Basis of Comparison, dated May 28, 2004); *Companies' Ex. 175*, Response to CSC-03, Q-CSC-070; 1/19/05 Tr. at 79, 99-100 (Wilson); *Wilson's Ex. 1* (Testimony of Boggs, January 14, 2005); *Companies' Ex. 121* (Correspondence dated September 7, 2004 to Maryann P. Boord (First Selectwoman, Durham) Regarding Structure Configurations and Magnetic Field Level Information).

358. If the Council should order the use of the bypass, it would be located in Middletown and Middlefield and would require acquisition of about 17 acres of new easements from the Middletown Water Company and four private landowners. Land along the bypass route is presently undeveloped, but an application for a 25-lot residential subdivision has been filed in connection with property owned by the Wilson family located to the east of State Route 17, directly north of the present Royal Oak Subdivision. *Companies' Ex.* 175, Response to CSC-03, Q-CSC-070; *Wilson's Ex. 1, 4* (Topographic, Subdivision, and Aerial Mapping).

359. The Wilson family, the owners of the parcel over which a substantial portion of the Royal Oak Bypass traverses, oppose the use of their property for the bypass, primarily due to their concern about the effects of the bypass route on their plans for a residential subdivision, in which they plan to live as well. CL&P would have to acquire rights for this bypass from the Wilsons by eminent domain. 1/19/05 Tr. at 79, 99-100 (Wilson).

360. In November 2004, SSES conducted wetlands analyses of the bypass route. SSES's studies determined that wetlands are present along the bypass route, including a very large high-quality wooded swamp, within which about 10 acres would have to be cleared for the new ROW. *Companies' Ex. 175*, Response to CSC-03, Q-CSC-070.

361. In comparison, no large wetlands are located along the portion of the proposed route that the bypass would replace and those that are present are small. *Companies' Ex. 1* (Application, Vol. 1, p. L-18; Vol. 9, *Aerial Photographs – 400*

Scale, Segment Maps 6 and 7; Vol. 11, *Aerial Photographs – 100 Scale*, Segment Maps 18-21).

362. Raber Associates conducted a cultural resource assessment of the bypass route in December 2004. This assessment concluded that about 52% of the bypass appears sensitive for possible Native American resources. If the bypass were certified by the Council, archaeological testing would be required (prior to construction) to confirm the presence or absence of Native American sites. *Companies' Ex. 175*, Response to CSC-03, Q-CSC-070.

363. Audible noise levels along the bypass would be comparable to those along the proposed route. *Companies' Ex. 175*, Response to CSC-03, Q-CSC-070.

364. To the best of the Companies' knowledge, no statutory facilities for buffer zone determination are adjacent to the Royal Oak Bypass ROW. 7/27/04 Tr. at 76 (Cretella).

365. However, the owners of the Wilson property have proposed a 25 lot subdivision, an application for which is pending. *Wilson's Ex. 2* (Topographic and Subdivision Maps of Wilson et al property); *Wilson's Ex. 5* (Map of Proposed Wilson Subdivision with Overlay of Royal Oak Bypass); 1/19/05 Tr. at 39-41 (Wilson). The Royal Oak Bypass, as presently configured, would pass through several of these lots. *Wilson's Ex. 5* (Map of Proposed Wilson Subdivision with Overlay of Royal Oak Bypass); 1/19/05 Tr. at 105 (Wilson). The number of lots crossed by the bypass may be able to be reduced by reconfiguring the bypass during design investigations conducted during the preparation of the D&M Plan(s), should the Council order the bypass. The owners of the Wilson property vigorously oppose the relocation of the ROW to their property. 1/19/06 Tr. at 116, 117 (Bartosewicz); 1/19/05 Tr. at 39-41 (Wilson).

366. The owners of the Wilson property suggested that the new 345-kV line could be constructed on the existing ROW, using a Gas Insulated Transmission Line ("GITL") installed above the existing ROW, or in a covered trench. However, GITL is not technologically and environmentally feasible for the suggested application and GITL has not been used in long distance transmission lines. *Wilson's Ex. 1* (Testimony of Boggs, January 14, 2005, pp. 1-2); *Council's Ex. 25* (KEMA Inc. engineering summary of the February 14, 2005 technical meeting dated February 16, 2005).

367. GITL lines have a very good history of reliability,. However, they are typically used only on utility owned property, where the utility controls access to them. 2/17/05 Tr. at 132 (Boggs). Most installations are in short lengths, but there are some in the range of 1,000 feet. 2/17/05 Tr. at 152 (Boggs). If installed in a covered trench below grade, the cover would be an open grate, so that air could circulate. 1/17/05 Tr. at 50 (Boggs). The surface of the outer aluminum tube, which would be current carrying, would be close to the cover. Determined and

curious people, such as children, could touch or penetrate the aluminum tube with metallic objects and be killed. 2/17/05 Tr. at 140 (Boggs). In addition, a continuous concrete lined trench, approximately 10-15 feet wide through wetlands on the ROW would be required in order install the recommended two GITL circuits. 1/17/05 Tr. at 93 (Boggs). Based upon a number of serious safety and technical issues, ISO-NE would not approve the use of GITL for this application, even for a one-mile distance on a ROW. 2/17/05 Tr. at 259-260 (Whitley)

368. The Companies agreed to support a Royal Oak Bypass by which the new 345-kV line would be constructed on the bypass and the existing 115-kV line would be left in place, provided that this solution was acceptable to the affected Towns. 7/27/04 Tr. at 59 (Bartosewicz). The Companies did not agree to support reconstruction of the 115-kV line on the new row together with the new 345-kV line. See 6/2/04 Tr. at 231 (Bartosewicz); 7/28/04 Tr. at 49-50 (Bartosewicz); 9/28/04 Tr. at 168-172 (Bartosewicz); 1/18/05 Tr. at 176 (Bartosewicz); 2/1/05 Tr. at 151 (Bartosewicz); *Companies' Ex. 172* (Testimony of Bartosewicz et al., December 28, 2004, Appendix B); *Companies' Ex. 191* (Cover Letter to Aerial Mapping filing, dated January 28, 2005, p. 2). The towns of Middletown, Durham and Middlefield indicated that they want *both* the new 345-kV line and the existing 115-kV line relocated to the bypass. *See* Letter dated 12/30/04 to Chairman Katz from Mayor Thornton of Middletown; Letter dated December 30, 2004 to Chairman Katz from Maryann Boord.

11.4.2 Jewish Community Center ("JCC")

369. In the Application, the Companies' proposal for the configuration of the overhead 345-kV line along the existing easement across the JCC parcel in Woodbridge was delta monopole construction with a typical height of 85 feet on the existing ROW. There are currently three rows of structures in the ROW. These structures would be removed and a double circuit monopole with a typical height of 80 feet would be constructed to accommodate two existing 115-kV circuits. *Companies' Ex. 1* (Application, Vol. 1, p. I-16; Vol. 10 (Drawing No. XS-001, Figure 8).

370. At the request of the Council and the JCC, the Companies provided information regarding options for reducing magnetic fields at this site, including three different route realignment options. Under each of these realignment options, the proposed 345-kV and the existing 115-kV transmission facilities would be moved to a relocated ROW that would also be located on the JCC property. The three different route realignments were: (1) shifting the ROW to the west over the pool; (2) shifting the ROW to the west over the infield of the ball field; and (3) shifting the ROW west over the outfield of the ballfield. Information regarding calculated magnetic field levels at the JCC can found in the Appendix to the Findings of Fact. *Companies' Ex. 73* (Testimony of Bailey, April 30, 2004); *Companies' Ex. 82* (Magnetic Field Calculations for B'nai Jacob – North ROW: 15GW Case (with relocated ROW) and Jewish Community Center (15GW Case)); *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. 163* (Revised Buffer Zone Maps, October 5, 2004, Map 10A); 2/17/05 Tr. at 160-168 (Cohen).

371. The JCC's routing preferences are: (1) underground lines; (2) if the line must be overhead, relocate the ROW over the JCC youth camp and move the camp to CL&P land to the south, but only if the Companies are ordered to pay for the cost of relocation and provide the land at no cost; (3) if the line must be overhead and the Companies will not be ordered to pay for the cost of relocating the camp, install the lines in the existing ROW and employ low field designs to reduce magnetic fields. *Woodbridge Organizations' Ex. 14*, Responses to Council Interrogatories dated February 10, 2005; 2/17/05 Tr. at 160-168 (Cohen).

11.4.3 Congregation B'nai Jacob/Ezra Academy

372. In the Application, the Companies' proposal for construction of the new 345-kV line over the B'nai/Ezra Academy parcel in Woodbridge was delta monopole construction with a typical height of 85 feet on the existing ROW. In addition, the three existing structures on the ROW would be removed, and a double circuit monopole with a typical height of 80 feet would be constructed to accommodate two existing 115-kV circuits. *Companies' Ex. 1* (Application, Vol. 1, p. I-16; Vol. 10 (Drawing No. XS-001, Figure 8).

373. At the request of the Council and B'nai Jacob/Ezra Academy, the Companies provided information regarding options for reducing magnetic fields at this property, including the relocation of the ROW on the parcel. This option would shift the proposed line to the north further from the existing building. B'nai Jacob/Ezra Academy favored relocating a portion of the ROW to a parcel located to the north of the B'nai Jacob/Ezra Academy parcel (the Reis parcel). The owner of the Reis parcel opposes this relocation so this parcel would likely have to be acquired by condemnation. Information regarding calculated magnetic fields at the B'nai Jacob/Ezra Academy parcel can be found in the Appendix to the Findings of Fact. *Companies' Ex. 73* (Testimony of Bailey, April 30, 2004, Exhibits 3, 4, 6); *Companies' Ex. 82* (Magnetic Field Calculations for B'nai Jacob – North ROW: 15GW Case (with relocated ROW) and Jewish Community Center (15GW Case); *Companies' Ex. 163* (Revised Buffer Zone Maps, October 5, 2004, Map 10A); 2/17/05 Tr. at 168-174 (Birke Fiedler); 2/17/05 Tr. at 208-210 (Prete).

374. Ezra Academy's preferences regarding the routing of the line are as follows: (1) underground lines; (2) if the line must be overhead, relocate the ROW over the Reis parcel to the north; (3) relocate the ROW to the north on the B'nai/Ezra Academy parcel so that the line is as far as possible from the buildings on the campus. Ezra also favors the use of low magnetic field designs if overhead lines must be installed. *Woodbridge Organizations' Ex. 14,* Responses to Council Interrogatories dated February 10, 2005; 2/17/05 Tr. at 168-174 (Birke Fiedler).

11.4.4 CDOT Routing Alternatives

375. The CDOT presented testimony regarding alternative routes that would primarily use local roads rather than state roads. These routes would increase the total amount of undergrounding beyond the 24 linear miles proposed by the Companies. At the request of the Council, the Companies, the towns through which the underground portion of the route passes, and the CDOT met to attempt to determine whether any agreement could be reached on the CDOT's suggestions for route variations for the underground portions of the route. The parties discussed these route variations during this meeting, but no agreements were reached. *See CDOT's Ex. 9* (ConnDOT's Comments on the Preferred Overhead/Underground Routing for the New 345-kV Electric Transmission Line and Associated Facilities, dated July 19, 2004); *DOT's Ex. 13* (Testimony of Gruhn, September 24, 2004, pp. 1-3); 9/29/04 Tr. at 8-13 (Bartosewicz); *Norwalk's Ex. 1* (Testimony of Knopp et al., September 28, 2004, pp. 1-6).

376. The CDOT also suggested a route variation in Norwalk that would eliminate the need for the two crossings of the Norwalk River that are a component of the Proposed Route. The Companies have proposed using a HDD for the southern crossing of the Norwalk River and an open cut method for the northerly crossing. (The Companies' subsurface testing has revealed that use of a HDD is not feasible for this northerly crossing.) These proposed watercourse crossing methods will be reflected in the Companies' permit applications to the ACOE and DEP and will be subject to their review and approval. If these planned crossing techniques are not approved by the environmental regulators, then the Companies may have to revisit the possibility of the CDOT route variation in this segment of Norwalk in order to avoid the crossings. The Town of Norwalk supports the proposed route in Norwalk and does not support the CDOT route variation in Norwalk that would avoid the Norwalk River crossings. *Companies' Ex. 171* (Update to Waterbody Crossings in Segments 3 and 4, Revised Table J-2); 9/29/04 Tr. at 8-13 (Bartosewicz); *Norwalk's Ex. 1* (Testimony of Knopp et al., September 28, 2004, pp. 1-6); 8/19/04 Tr. at 29-30 (Knopp).

11.5 Substation and Switching Station Alternatives

377. After system planning studies determined that two new substations and a new switching station would be needed to complete the 345-kV loop to SWCT, the Companies identified and evaluated potential alternative sites for these facilities. Factors considered in these evaluations were: proximity of developable sites to required interconnection points; existing utility land ownership; compatibility with existing land uses; environmental resources; and technical and cost considerations. *Companies' Ex. 1* (Application, pp. H-43 to H-44).

378. For the proposed Singer Substation in Bridgeport, UI commissioned a Site Selection Study. *Companies' Ex. 1* (Application, Vol. 1, pp. H-47 to H-48; Vol. 6, Singer Substation Site Selection Study)

379. Alternatives also were reviewed for the new facilities proposed at Beseck (Wallingford) and at East Devon (Milford). *Companies' Ex. 1* (Application, Vol. 1, pp. H-44 to H-46).

380. No off-site alternatives were considered to the proposed Project modifications at the existing Scovill Rock and Norwalk facilities because these modifications will be performed within the existing station boundaries, on property owned by CL&P and already devoted to utility use. As a result, there are no alternative sites that could be developed more cost effectively, or with fewer environmental impacts. *Companies' Ex. 1* (Application, pp. H-43 to H-44, H-48 to H-49); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 28).

11.5.1 Scovill Rock Switching Station

381. For the consolidation of electric supplies from the Middletown area, the Companies determined that the existing Scovill Rock Switching Station must interconnect to the proposed Project. Currently, 345-kV lines from the east and north interconnect at Scovill Rock and extend west to Chestnut Junction. A 115-kV line also interconnects to the switching station from the east and north. *Companies' Ex. 1* (Application, Vol. 1, pp.G-12, L-67).

382. Scovill Rock Switching Station is developed on a 5-acre portion of a 50-acre existing CL&P property. The property, which was acquired by CL&P about 40 years ago, is located in a wooded section of southeastern Middletown. CL&P also owns undeveloped properties located to the north and west of the site. *Companies' Ex. 1* (Application, Vol. 1, pp. H-44, L-67; Vol. 9, *Aerial Photographs – 400 Scale*, Segment 1).

383. All of the proposed modifications for the 345-kV Project can be accommodated within the existing Scovill Rock Switching Station fenced area, on CL&P property. Further, the proposed modifications will not affect any environmental resources and will be compatible with the existing use of the property for utility purposes. There are no off-site alternatives for the location of these new 345-kV facilities that would similarly meet the Companies' siting criteria. *Companies' Ex. 1* (Application, pp. H-43 to H-44, H-48 to H-49); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 28).

11.5.2 Beseck Switching Station

384. The Beseck Switching Station site, is to be located within a 52-acre Parcel of property owned by CL&P. The property is north of the intersection of Carpenter Lane and High Hill Road in Wallingford. The junction currently consists of bundled 115-kV lines from Oxbow Junction that continue to North Wallingford Substation; two 115-kV lines that extend to East Meriden Substation; and the 345-kV 387 Line that runs from Black Pond Junction to Totoket Junction. The

Project's 345-kV line will traverse the site. *Companies' Ex. 1* (Application, Vol. 1, pp. H-44 to H-45).

385. Because the site is already devoted to an electrical junction use, is located at the junction point of the lines at issue, has some screening, and is already owned by CL&P (thereby eliminating the need for acquisition of additional land), it offers the best possible site for the proposed switching station from both an environmental and economic perspective. Because of the inherently superior nature of this site, no other alternative sites were considered. *Companies' Ex. 1* (Application, Vol. 1, p. H-45).

11.5.3 East Devon Substation

386. Multiple transmission lines are tied to the Companies' substations and to generating facilities (e.g., the Devon Generating Station and the Milford Power Plant) in Milford. The Companies determined that a substation should be built in the vicinity of the Milford Power Plant and Devon Generating Station, near the existing transmission lines in order to minimize the length and space requirements of the interconnections to the new substation. *Companies' Ex. 1* (Application, Vol. 1, p. H-45).

387. The site selection process for the East Devon Substation was constrained by both the location of the Milford Power Plant (to which the substation would interconnect) and the location of developable property. For example, south of Caswell Street, there is no undeveloped land of sufficient size for a new substation. In comparison, the area north of Caswell Street is characterized by more vacant, unutilized, or industrial/commercial properties. *Companies' Ex. 1* (Application, Vol. 1, pp. H-45 to H-46).

388. CL&P proposes to locate the substation on an undeveloped 15-acre site situated adjacent to Plains Road and Shelland Street, between the railroad and CL&P's existing 115-kV transmission ROW that extends north to Cook Hill Junction. The site is northwest of the Milford Power Plant. The surrounding land use is commercial or industrial, except for residential development located to the east of the proposed site and the existing transmission line ROW. Development of a substation at this site would enable the Companies to link transmission lines to the north, south and west. *Companies' Ex. 1* (Application, Vol. 1, p. H-46).

389. The Companies initially considered a site located along Oronoque Road for the East Devon Substation. This site, which is owned by the Blacktite Corporation, is currently used by several businesses: a golf driving range, an asphalt sand and gravel operation, and a composting operation. This site was originally rejected because it would likely have to be acquired by condemnation, resulting in the forced relocation of the businesses currently operating on the site. At the request of the City of Milford to reconsider the use of this parcel, CL&P indicated it would reevaluate this parcel on the condition that the owner granted CL&P the

right to perform Phase I and Phase II environmental testing and other testing at the property in order to evaluate its suitability as a substation site. CL&P forwarded forms ("the Access Documents") to the parcel's owner seeking authorization to conduct such testing. The owner of the parcel would not agree to execute the Access Documents without a commitment by CL&P (prior to conducting any testing on the parcel) to purchase the parcel. Based on this response, CL&P did not pursue the parcel further. *Companies' Ex. 1* (Application, Vol. 1, p. H-46); 4/22/04 Tr. at 43 (Prete); 4/22/04 Tr. at 43 (Bartosewicz); *Companies' Ex. 93* (Response to the City of Milford and Blacktite Parcel, dated May 26, 2004); 6/1/04 Tr. at 237 (Bartosewicz).

390. In addition, the Companies eliminated from consideration the location of the proposed East Devon Substation on the property encompassed by either CL&P's existing Devon Substation (Milford) or the adjacent Devon Generating Station, which is owned by NRG. The existing substation and power plant abut the Housatonic River, directly north of the I-95 and Amtrak / Metro-North Railroad river crossing bridges and the railroad's substation. The Companies eliminated this location as a viable site for the new substation because, there is no available land for development to accommodate an overhead-to-underground transition for the 345-kV facilities, and environmental features (rock location adjacent to the river) would pose constraints to development. *Companies' Ex. 1* (Application, Vol. 9, *Aerial Photographs – 400 Scale*, Segment 47); 4/21/04 Tr. at 131 to 136 (Zaklukiewicz); 4/21/04 Tr. at 136 to 137 (Mango); 4/22/04 Tr. at 39 (Prete).

11.5.4 Singer Substation

391. The target location for the Singer Substation was identified as in southwestern Bridgeport, in the vicinity of the Bridgeport Harbor Generating Station, Bridgeport Energy, and the existing Pequonnock Substation. Because the Companies do not own property in this area, land will have to be acquired for the Singer Substation. *Companies' Ex. 1* (Application, Vol. 1, p. H-47).

392. Because the Singer Substation will be located in densely developed urban area where land availability is limited, the Companies propose to use a Gas Insulated Substation ("GIS") design that will limit the land requirements for the facility. Thus, a site of approximately 2.5 acres rather than approximately 6 acres, is required. *Companies' Ex. 1* (Application, Vol. 1, p. H-47); *Companies' Ex. 188* (Singer Substation Relocation from Site 1 as Proposed to Site 8 to Accommodate PSEG Power, dated January 27, 2005).

393. To identify, evaluate, and recommend a proposed site for the Singer Substation, UI conducted a site selection study, which resulted in the review and evaluation of 11 sites in the Bridgeport Harbor area. *Companies' Ex. 1* (Application, Vol. 1, pp. H-47; Vol. 6, Singer Substation Site Selection Study); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 26).

394. From among these 11 sites, the Companies identified three viable sites, two of which are owned by PSEG. The Companies initially selected the PSEG site at 280 Main Street (referred to as Site 1) for the proposed substation site. This site, which is adjacent to the Bridgeport Energy Power Plant, is presently occupied by a brick warehouse, which would have to be demolished to accommodate the substation. *Companies' Ex. 1* (Application, Vol. 1, pp. H-47 to H-48; Vol. 6, Singer Substation Site Selection Study).

395. UI subsequently reached an agreement with PSEG to use Site 8, which was also identified in the *Site Selection Study* as a viable location for the development of the substation. UI and PSEG have discussed this substation site location change with the City of Bridgeport, which does not object to Site 8. *Companies' Ex. 1* (Application, Vol. 6, Singer Substation Site Selection Study); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 26); 4/22/04 Tr. at 44 (Prete).

396. The Companies propose to purchase the 1.5-acre Site 8 from PSEG in order to develop the Singer Substation. (4/20/04 Tr. at 39 (Parnell); *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); *Companies' Ex. 64* (Singer Substation – Bridgeport, Connecticut, Environmental Sound Evaluation for Revised Site 8 Location, dated April 10, 2004); *Companies' Ex. 188* (Singer Substation Relocation from Site 1 as Proposed to Site 8 to Accommodate PSEG Power, dated January 27, 2005); 4/20/04 Tr. at 12 (Zaklukiewicz).

11.5.5 Norwalk Substation

397. CL&P's existing Norwalk Substation, which is located in the heart of the Norwalk-Stamford and SWCT areas, will soon be supplied from the north by the 345-kV Bethel to Norwalk line. The Norwalk Substation was determined to be the obvious destination point for the new 345-kV line to provide additional electric supplies (from the east) to SWCT. *Companies' Ex. 1* (Application, Vol. 1, pp.G-12 – G-13, H-48).

398. CL&P owns the 14.2-acre Norwalk Substation property, which has adequate room to accommodate the Project facilities. The substation is located in an urbanized area of Norwalk, where there are limited available sites for new utility development. *Companies' Ex. 1* (Application, Vol. 1, pp. H-48 to H-49).

399. The installation of the Project modifications on the existing Norwalk Substation site conforms to the Companies' siting criteria, including utility ownership of the site and avoidance of conflicts with land uses and environmental resources. As a result, there are no alternative sites that could be developed for the Project facilities more cost-effectively or with fewer environmental impacts. *Companies' Ex. 1* (Application, pp. H-43 to H-44, H-48 to H-49); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, at 28).

12.0 Construction and Maintenance Procedures

400. The Project will be constructed in accordance with established industry practices, the Companies' specifications, and the conditions identified in the Council's certificate and other permits. *Companies' Ex. 1* (Application, Vol. 1, p. J-1).

401. After Council certification of the Project, the Companies will prepare D & M Plans that will conform to the Council's requirements. Separate D&M Plans are likely to be prepared for the underground and overhead portions of the Project, reflecting the different issues unique to each type of construction and the results of additional field studies and detailed engineering design. Further, separate D & M Plans may be prepared for the substations. *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, pp. 23-24).

402. The D & M Plans will be submitted to the Council for review and approval, prior to the commencement of construction. *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, p. 23).

12.1 Overhead Transmission Line Construction Procedures

403. Overhead transmission line construction will involve both the installation of new structures, wires, and conductors and the removal and reconstruction, where specified, of existing 115-kV structures, wires and conductors. *Companies' Ex. 1* (Application, Vol. 1, Table I-1, pp. I-8 to I-10; Table I-3, p. I-12).

404. The overhead transmission line will be constructed in several stages, some of which will occur concurrently. The construction process typically will include: (1) pre-construction activities (e.g., take soil borings at structure locations, reflag wetland boundaries, survey to stake the centerline of the ROW and planned structure locations, establish staging areas); (2) ROW preparation (e.g., remove vegetation where necessary, improve or install access roads, deploy temporary erosion and sediment controls); (3) prepare work areas at new structure sites, excavate and construct foundations (where necessary), and install new structures; (4) install conductors and shield wires; (5) remove existing 115-kV structures and associated conductors and wires; and (6) clean-up and restoration. *Companies' Ex. 1* (Application, Vol. 1, pp. J-1 to J-2).

405. The types of construction equipment required for the Project will range from pickup and other small trucks to flatbed trucks, bulldozers, brush hogs, wood chippers, dump trucks, bucket trucks, conductor pulling rigs, and cranes sized to handle the steel poles. In addition to the electric facility components, predominant materials used in the construction of the Project will include erosion and sediment controls (e.g., silt fence, straw/hay bales, seed, mulch); crushed stone or gravel; wood wetland mats; culverts; and concrete. *Companies' Ex. 1* (Application, Vol. 1, pp. J-2 to J-3).

12.1.1 Staging Areas, Storage Areas, and Field Offices

406. Temporary storage areas and staging areas, which will be used to store or stage construction materials, equipment, and supplies, will be required to support construction. Where possible, these areas will be established on properties owned by the Companies or otherwise not in active use (e.g., parking lots). Storage and staging areas may range from 2 to 5 acres, and will be located close to construction work areas in the vicinity of the ROW. After use during construction, the sites will be restored. *Companies' Ex. 1* (Application, Vol. 1, pp. K-3, K-4).

407. The Companies conducted a preliminary review and inventory of potential sites along the proposed route that could accommodate such support areas. However, actual sites will depend on final engineering design and will be selected by the construction contractor, who also will make arrangements with property owners for their use. *Companies' Ex. 1* (Application, Vol. 1, pp. K-5 to K-6, Table K-2).

408. Construction field offices (for Project engineering and supervisory personnel) will be located in the areas where work is being performed, and will typically be located on property owned by the Companies or on the existing transmission line ROW. *Companies' Ex. 1* (Application, Vol. 1, p. K-8).

12.1.2 Soil Erosion and Sediment Control

409. To limit the potential for erosion or sedimentation into streams, wetlands or adjoining properties, temporary erosion and sedimentation controls (e.g., silt fence, straw/hay bales, mulching) will be installed after ROW clearing or grading, as necessary, in areas of land disturbance. *Companies' Ex. 1* (Application, Vol. 1, p. J-3).

410. Erosion and sedimentation controls will be installed before commencement of work on access roads. *Companies' Ex. 1* (Application, Vol. 1, p. K-1).

411. The need for and extent of temporary erosion and sedimentation controls along the ROW will depend on site-specific considerations, such as slope, soil type, vegetation characteristics (e.g., amount of vegetative cover remaining after clearing), proximity of work areas to sensitive environmental resources, weather conditions, soil moisture, time of year, and the anticipated time frame between vegetation or soil disturbance and other construction activities. *Companies' Ex. 1* (Application, Vol. 1, pp. J-3 to J-4).

412. In addition, the type of erosion and sedimentation control methods used will take into consideration the time of year in which construction and restoration occur. For example, ROW reseeding will not generally be effective under winter conditions (e.g., after mid-October or before March 1) and other temporary soil

stabilization measures will be deployed until seeding can be performed. *Companies' Ex. 1* (Application, Vol. 1, p. J-4).

413. The Companies' will adhere to the *2002 Connecticut Guidelines for Soil Erosion and Sediment Control* and will prepare a Project-specific *Erosion and Sedimentation Control Plan,* which will be part of the D&M Plan. *Companies' Ex. 1* (Application, Vol. 1, p. J-3).

414. Temporary erosion and sediment controls will be removed from construction areas within 30 days of final site stabilization. *Companies' Ex. 55*, Response to CSC-02, Q-CSC-036.

12.1.3 Vegetation Management During Construction

415. The overhead 345-kV line will be located along CL&P ROWs, where vegetation is already managed to assure the safe operation of the existing transmission facilities. Because CL&P's existing vegetation management program focuses primarily on preventing the growth of trees that could interfere with conductors or wires, the managed portions of the existing ROWs typically are characterized by shrubs and herbaceous species. *Companies' Ex. 1* (Application, Vol. 1, pp. J-4, M-19; Vol. 9, *Aerial Photographs – 400 Scale*; Vol. 11, *Aerial Photographs – 100 Scale*).

416. CL&P presently manages vegetation on less than the full width of some ROWs. On non-managed portions of the existing ROWs, the vegetative communities vary, ranging from forestland to orchards. *Companies' Ex. 1* (Application, Vol. 1, p. J-4, Table J-1, Summary of Existing and Proposed ROW Widths and Vegetation Clearing, pp. J-6 to J-7; Vol. 9, *Aerial Photographs – 400 Scale*; Vol. 11, *Aerial Photographs – 100 Scale*).

417. To accommodate the construction and safe operation of the new 345-kV facilities, additional vegetation removal will be required. The amount of vegetation removed will depend on factors such as the existing width of ROW clearing, the types and heights of structures proposed, the terrain, and existing land uses. In general, vegetation along the existing ROWs will be removed only where necessary to allow construction of the new line and reconstruction of the 115-kV facilities, maintain access, and/or provide safe distances between 345-kV and 115-kV conductors/wires and woody vegetation. *Companies' Ex. 1* (Application, Vol. 1, p. J-4; Vol. 9, *Aerial Photographs – 400 Scale*; Vol. 11, *Aerial Photographs – 100 Scale*); *Companies' Ex. 184*, Response to CSC-05, Q-CSC-095.

418. Undesirable tall-growing woody species will be removed from the 345-kV ROW and, if necessary, to allow reconstruction of the existing 115-kV lines. Low-growing desirable species (e.g., shrubs and herbaceous vegetation) will be preserved to the extent practical. In selected cases, certain desirable trees may be

kept on the ROW and only trimmed to assure adequate clearance from wires and structures. Generally, woody vegetation must be managed to provide:

- A vertical clearance of 12 feet from 115-kV lines and 16 feet from 345-kV lines at the maximum operating temperature of the conductor.

- A horizontal clearance spacing of 20 feet from 115-kV lines and 30 feet from 345-kV lines. *Companies' Ex. 1* (Application, Vol. 1, p. J-5); *Companies' Ex. 184,* Response to CSC-05, Q-CSC-095; Companies' Ex. 198, Response to CSC-05, Q-CSC-094-R01.

419. During construction, vegetation will be removed using mechanical methods. To the extent practical, trees will be cut flush with the ground surface and felled parallel to the ROW to minimize the potential for off ROW vegetation damage. Off ROW "danger" trees, which could pose hazards to the integrity of the transmission line, also will be identified and removed. *Companies' Ex. 1* (Application, Vol. 1, p. J-5).

420. Unless otherwise prevented by site-specific conditions, the Companies propose to minimize vegetation removal within a 50-foot-wide buffer around streams. Within this area, except for existing access roads, woody vegetation will be selectively cut only if required to maintain safe distances from wires and conductors. *Companies' Ex. 1* (Application, Vol. 1, pp. J-7, M-5 to M-6).

421. All watercourses along the overhead portion of the Project will be spanned by transmission facilities. Crossings of streams by construction equipment will be minimized or avoided. In addition, all crossings will be located within existing ROWs. *Companies' Ex. 1* (Application, Vol. 1, pp. J-17, M-5 to M-6).

422. When removing vegetation within 50 feet of wetlands, the Companies will selectively remove trees and will maintain a brush understory. Further, if required, vegetation in wetlands will be selectively cut only as necessary to maintain safe clearances from conductors. Woody vegetation that is cut will not be piled so as to block surface water flows or adversely affect the integrity of the wetland. *Companies' Ex. 1* (Application Vol. 1, pp. J-7, M-15); *Companies' Ex. 90* (Testimony of Zaklukiewicz, May 25, 2004, p. 29).

423. Specific procedures for vegetation clearing and removal will be developed as part of the D&M Plan. *Companies' Ex. 1* (Application, Vol. 1, p. J-7).

12.1.4 Access Roads

424. Temporary or permanent access along the ROW will be established by improving existing access roads or building new access roads to approximately 12 to 15 feet in width. Roads may be graveled, and where streams or wetlands must be crossed, wetland mats (or equivalent) and/or culverts may be used or, if already

present, improved. The roads must be able to accommodate heavy construction equipment and over-the-road and off-the-road vehicles. As a result, grades must typically be 10% or less. *Companies' Ex. 1* (Application, Vol. 1, pp. J-2, K-1).

425. To reach the ROW, various existing accessways (including local streets) will be used. Field reconnaissance will be conducted during the preparation of the D&M Plan to verify access road locations. *Companies' Ex. 1* (Application, Vol. 1, pp. J-2, K-1 to K-2; Table K-1, Review of Existing Access Roads for Overhead Portion, pp. K-2 to K-3.

12.1.5 Structure Installation

426. Clearing and grading will be performed in the vicinity of existing and new structure sites and guy wire locations, as necessary, to create a level site for construction work. The size of the work area at a structure site will be limited to the size of the ROW width or an area approximately 100 by 100 feet unless wetlands or other sensitive areas restrict the site. Erosion and sediment controls will be installed around areas of disturbed soils, as appropriate. *Companies' Ex. 1* (Application, Vol. 1, pp. J-2, J-8); *Companies' Ex. 193* (Letter describing temporary work areas in wetlands dated February 1, 2005).

427. Construction of the reinforced concrete foundations for the new 345-kV structures and the relocated 115-kV structures will involve mechanical excavation, controlled rock drilling and blasting, if necessary. Installation of form work, anchor bolt steel, supporting/reinforcing and the placement of concrete will also be performed. Structures will be delivered in sections and assembled and installed using a crane. *Companies' Ex. 1* (Application, Vol. 1, pp. J-8, J-9).

428. Pre-construction soil borings at proposed structure locations will be conducted. Most excavations for overhead structure foundations are expected to be accomplished using mechanical excavators and pneumatic hammers. Fencing or other barricades will be placed around excavations for structures during non-working hours. *Companies' Ex. 1* (Application, Vol. 1, pp. J-1, J-8, M-4).

429. If blasting is required, a controlled drilling and blasting plan will be developed, in compliance with state and local regulations, by a certified blasting contractor and approved by the Companies. The plan will be provided to the local Fire Marshal for approval. Residents will be consulted in advance of the blasting and pre-blast surveys will be performed as appropriate. In areas where blasting is determined to be necessary, pre-blasting surveys will be conducted of all foundations with 250 feet and all existing potable water wells within 150 feet. In the unlikely event that there is damage to a property as a result of the blasting, the Companies will compensate the property owner for the actual damage or appropriate repairs will be made. *Companies' Ex. 1* (Application, Vol. 1, pp. J-8, J-9, M-4); *Companies' Ex. 71*, Response to CSC-02, Q-CSC-050).

12.1.6 Structure Removal

430. Existing ROW access roads will be used to reach existing wood and steel structures. In locations where existing structures are located in wetlands, wood mats will be temporarily placed at work sites to accommodate the equipment required to remove the structure. The line will be de-energized and the conductors will be connected to an earth ground for safety. Then, conductors and shield wires will be removed from support attachments and the tension will be slowly released, using winches. *Companies' Ex. 39,* Response to CSC-01, Q-CSC-031; *Companies' Ex. 71,* Response to CSC-02, Q-CSC-046; 6/1/04 Tr. at 123 to 125 (Zaklukiewicz); 6/1/04 Tr. at 128-129 (Mango).

431. For wood poles, overhead cranes will be used to secure the structure and the pole will typically be cut off at the ground surface. If required, the portion of the pole below the ground line can be removed by excavating around the pole and then making the cut below grade. Alternatively, the entire pole can be removed by pulling them out of the ground. *Companies' Ex. 39,* Response to CSC-01, Q-CSC-031; 6/1/04 Tr. at 123-125 (Zaklukiewicz).

432. For steel poles and steel lattice towers, overhead cranes will be used to secure the structure before it is disconnected and removed from the foundation. Larger structures may be dismantled into smaller, manageable pieces, starting from the top. Foundations are typically left in place or can be removed to a depth of 1 – 3 feet below grade. Although shallow foundations (e.g., spread footings) can be completely removed, they are typically left in place. Drilled shafts (piers or caissons) are rarely removed in their entirety because of the large sized equipment required, the size of the excavation required, and the degree of difficulty. *Companies' Ex. 39,* Response to CSC-01, Q-CSC-031.

433. The removed wood poles and steel structures will be hauled away for reuse, or cut up for either salvage or proper disposal. *Companies' Ex. 39,* Response to CSC-01, Q-CSC-031.

434. Existing telecommunications facilities (antennas) that are located on transmission structures to be replaced as part of the Project will be relocated to a new structure. During construction, if antennas do not provide overlapping coverage, telecommunications providers could experience a short outage during the transfer of equipment between structures. Any new telecommunications facility will be accommodated on the new transmission structures, consistent with each telecommunication provider's contract. *Companies' Ex. 33,* Responses to CSC-01, Q-CSC-017 to 019.

12.1.7 Conductor Work

435. Conductors and shield wires will be installed in 1-to-3-mile long sections. The wires will be pulled under tension to prevent contact with the ground and other objects. The insulators and hardware will be installed and the wires will be sagged and connected to the structures in accordance with industry standards and design specifications. *Companies' Ex. 1* (Application, Vol. 1, p. J-9).

436. Approximately 20 conductor pulling sites, each typically about 1/3 acre, will be required for setting up material and equipment associated with pulling and tensioning the overhead conductor from structure to structure. Conductor pulling sites will be selected based on accessibility, terrain, angles within the sections where the conductor will be pulled, location of dead end structures, length of conductor to be pulled, puller capacity, snub structure loads (including placement of pullers), tensioners, and conductor anchor locations. Other considerations include the placement of reel stands, pilot line winders, reel winders, and the ability to provide an adequate grounding system. Most of the equipment will be set up within the transmission line ROW. Steps will be taken to minimize temporary disturbance to adjacent landowners from noise and activity associated with the pulling operation, which typically takes about a day-and-a-half (during daylight hours) for all three phases, per average pole. *Companies' Ex. 1* (Application, Vol. 1, p. K-7); *Companies' Ex. 83,* Response to W-M-01, Q-W-M-015; 6/1/04 Tr. at 134 (Hogan), 135 (Zaklukiewicz).

437. Potential conductor pulling sites are identified in the Application, Volume 11 – Aerial Photographs – 100 Scale. Final conductor pulling sites will be provided in the D & M Plan. Efforts will be made to avoid locating pulling sites in wetlands. *Companies' Ex. 1* (Application, Vol. 1, p. J-9); 6/1/04 Tr. at 134 (Prete).

12.1.8 ROW Clean-up and Restoration

438. Disturbed ground will be back-bladed to approximate preconstruction contours unless the Companies are directed otherwise. For work sites in actively used agricultural fields, the soil may be decompacted by disking or equivalent methods. *Companies' Ex. 1* (Application, Vol. 1, p. J-10).

439. Areas disturbed during construction will be revegetated. The Companies may seed disturbed areas with appropriate grass-type mixes. Vegetative species compatible with the use of the ROW for transmission line purposes are expected to regenerate naturally, over time. The Companies will promote the regrowth of desirable species by implementing vegetative maintenance practices, including spot application of herbicides, to control undesirable invasive species, thereby enabling native plants to dominate. *Companies' Ex. 1* (Application, Vol. 1, pp. J-2, J-7, J-10, M-20 to M-21).

440. Steep areas will be stabilized with jute netting (pre-made erosion control fabric containing seed, mulch, and fertilizer) or the equivalent. Erosion controls will be left in place until removal is approved by the Council. *Companies' Ex. 1* (Application, Vol. 1, p. J-10).

441. Construction debris will be removed from the ROW for disposal. Brush and other vegetative materials may remain on the ROW and may be piled, scattered, chipped or a combination thereof, depending on the property owner's preference and/or the conditions of the Council's certificate and other permits. Access roads where culverts or crushed stone fords were installed will be left in place or removed as directed by the Council and in accordance with other permit conditions. *Companies' Ex. 1* (Application, Vol. 1, p. J-10).

442. Periodic monitoring and reporting (with on-site inspection by the Council) will be performed until it is determined that restoration has been achieved. *Companies' Ex. 1* (Application, Vol. 1, p. J-10).

12.2 Underground Cable Construction Procedures

443. The underground cable system will be installed principally within or adjacent to public roadways. Within such roadways a trench averaging about 4 feet wide and 5 feet deep will be excavated using mechanical methods, supplemented by blasting where necessary. *Companies' Ex. 1* (Application, Vol. 1, p. J-11).

444. The underground cable system will consist of two sets of three 3000 kcmil XLPE cables, which will be installed within ducts, as well as splice vaults for each XLPE circuit. XLPE cables are extruded (or solid insulation) and do not contain any insulating fluid. The procedures for installing XLPE cable systems are substantially similar to the construction methods for HPFF cable systems. *Companies' Ex. 1* (Application, Vol. 1, p. J-13; Vol. 6, "Tutorial - Underground Electric Power Transmission Cable Systems," p. 17-19 and "Evaluation of Potential 345-kV and 115-kV Cable Systems as part of the Middletown-Norwalk Project," p. 16); *Companies' Ex. 43,* Response to CSC-01, Q-CSC-034; 1/13/05 Tr. at 77-78 (Zaklukiewicz).

445. Like the overhead portion of the Project, the underground cable system will be constructed in phases, which typically will include (1) pre-construction planning (including coordination with municipal officials, preparation of a traffic control plan, and identification of existing infrastructure); (2) site preparation (including establishment of construction field offices and staging areas); (3) excavation for and installation of splice vaults; (4) trenching; (5) duct installation and trench backfill; (6) permanent restoration (e.g., repaving); (7) cable reel delivery and cable pulling; and (8) cable splicing within the splice vaults. *Companies' Ex. 1* (Application, Vol. 1, p. J-14).

446. Prior to construction, the Companies will prepare D & M Plan(s). The D&M Plan for the underground portion of the Project can be expected to include information concerning facilities and land requirements; construction procedures; construction scheduling; work site and public safety during construction; traffic control and access to adjacent land uses; water crossings; procedures for construction near noise sensitive receptors; soil erosion and sediment control; and excess spoil disposal, among other topics. The Companies will work with state and local officials to devise a Traffic Control Plan appropriate for the work in each of the affected municipalities along the underground portion of the Project, as well as to discuss the time frames for construction. Further, the Companies will notify businesses, landowners, and residents along the route of the Traffic Control Plan and the construction schedule. *Companies' Ex. 1* (Application, Vol. 1, pp. J-14 to J-15); *Companies' Ex. 53* (Testimony of Mango, April 8, 2004, pp. 24 – 25); 4/22/04 Tr. at 9 (Zaklukiewicz).

447. The detailed engineering design of the underground portion of the Project, including the location of splice vaults, will take into consideration a number of key factors, including the results of subsurface investigations, the configuration of the roads in which the cable will be located (e.g., curves, location of intersections), the depth of cable burial, and cable pulling strength. Although the amount of cable that can be accommodated on a reel is a factor, it is not the only consideration in cable system design. 4/22/04 Tr. at 8 - 11 (Zaklukiewicz).

448. To minimize conflicts with traffic and business operations, it is anticipated that some underground construction may occur at night or on weekends. Night construction will require lighting and will result in localized noise impacts. *Companies' Ex. 1* (Application, Vol. 1, pp. J-14 to J-15).

449. During trenching for cable installation, the Companies propose to use steel plates to temporarily cover open trenches at the end of the work day. 4/20/04 Tr. at 73, 80-81 (Prete).

450. Various types of construction equipment will be required to install the underground cable. Such equipment will include, but not be limited to side booms, pavement breakers, earth hauling trucks, portable air compressors, cranes, ready mix trucks, dump trucks, splicing trailer, temporary shoring, water pumps, pickup trucks, cranes, and paving equipment. *Companies' Ex. 1* (Application, Vol. 1, pp. J-15 to J-16).

451. A bed of thermal sand or fluidized thermal backfill™ would be placed in the bottom of the trench for protection. Short segments of ducts will be laid and then joined in the trench. Additionally, up to three PVC conduits for the installation of fiber optic cable and ground continuity conductors will be installed. *Companies' Ex. 1* (Application, Vol. 1, p. J-12); *Companies' Ex. 162* (PDC document titled Magnetic field calculations for Middletown-Norwalk 345-kV XLPE transmission cables, dated September 27, 2004).

452. After the ducts are installed, the trench will be backfilled. The trench typically would be backfilled with special compacted sand or low-strength concrete with good heat transfer characteristics. Overall, the trenching, duct installation, and backfilling work will proceed sequentially along the route, with only short sections under construction in an area at one time. In urban or densely developed areas, 100 to 200 feet of trenching and shoring is generally achievable in a day, provided that the cables are installed with 3 feet of cover, and the contractor is able to leave portions of the trench open at the conclusion of the work day, covered by steel plating, as proposed by the Companies. *Companies' Ex. 1* (Application, Vol. 1, pp. J-12, J-14).

453. A temporary cover will be placed over disturbed areas within paved roads. *Companies' Ex. 1* (Application, Vol. 1, p. J-12).

454. Splice vaults will be required for each XLPE circuit. Each concrete splice vault will have inside dimensions of approximately 8 feet high x 8 feet wide x up to 28 feet long. The splice vaults will be installed approximately every 1,800 to 2,000 feet along the route. The length of a section of underground cable between splice vaults is limited both by cable reel size (length of cable on the reel) and by pulling considerations. Compared to HPFF cable, XLPE cable is larger in diameter and heavier; therefore, cable pulling lengths between splice vaults are shorter. *Companies' Ex. 1* (Application, Vol. 1, p. J-12; Vol. 6, Evaluation of Potential 345-kV and 115-kV Cable Systems as part of the Middletown-Norwalk Project, p. 16); 1/13/05 Tr. at 78 (Zaklukiewicz); 1/18/05 Tr. at 143-144 (Prete).

455. Each splicing vault will have two entry manholes to the surface. Several feet of road base fill would be placed on top of each vault. After these vaults and ducts are in place, the cable will be installed and spliced. Individual phases will be pulled into individual ducts. The three splices will be mounted on rack arms along one wall of the splice vault. *Companies' Ex. 1* (Application, Vol. 1, p. J-12; Vol. 6, Evaluation of Potential 345-kV and 115-kV Cable Systems as part of the Middletown-Norwalk Project, p. 16); 3/10/04 Tr. at 81-82 (Reed).

456. Splicing XLPE cables within splice vaults involves a complex technical procedure, performed in a controlled atmosphere, which will be provided by an enclosure or vehicle located over the splice vault access manhole during the period of splicing. The splicing operation is expected to take approximately 10-14 days (working 24 hours per day) to complete the splices in each vault. *Companies' Ex. 1* (Application, Vol. 1, p. J-13; Vol. 6, Evaluation of Potential 345-kV and 115-kV Cable Systems as part of the Middletown-Norwalk Project, p. 16).

457. At the end of the underground portion of the route, terminations would be connected to the ends of the cables. These terminations, also known as potheads, would link the cables to switches, transformers, or overhead transmission lines

located in substations or in transition stations. *Companies' Ex. 1* (Application, Vol. 1, pp. J-12 to J-13).

Water Crossings

458. The cable system will be installed across watercourses using various types of construction techniques that have been selected, on a site-specific basis, taking into consideration engineering design, construction, and environmental factors, as well as the results of environmental and engineering field studies that were performed as part of the Council's hearing process and the Companies' preparation of applications to the U.S. Army Corps of Engineers ("ACOE") and the Connecticut Department of Environmental Protection ("DEP"). *Companies' Ex. 1* (Application, Vol. 1, pp. J-17 to J-18); *Companies' Ex. 171* (Update to Waterbody Crossings in Segments 3 and 4, Revised Table J-2).

459. Across most of the smaller watercourses, the Companies propose to install the cable system either within roadbeds or on bridges. Horizontal directional drilling ("HDD") is proposed for the installation of the cable system beneath the Housatonic, Pequonnock, and Saugatuck rivers. Two watercourses (Yellow Mill Creek and the northern Norwalk River crossing) will be crossed using an open cut method. The proposed watercourse crossing methods will be reflected in the Companies' permit applications to the ACOE and DEP. *Companies' Ex. 171* (Update to Waterbody Crossings in Segments 3 and 4, Revised Table J-2).

Cable Pulling Sites

460. The selection of pulling sites for the underground cable will be governed by the location of splice vaults, which will be sited based on reel lengths and cable pulling tensions. Cable pulling equipment and cable reels will be located in public roads and may cause some traffic disruptions. During construction, the Companies will work with the municipalities to minimize these disruptions. *Companies' Ex. 1* (Application, Vol. 1, p. K-7).

12.3 Substation and Switching Station Construction Procedures

461. The modifications to the existing Scovill Rock Switching Station and the Norwalk Substation, and the development of the new East Devon and Singer substations and the new Beseck Switching Station will involve several construction phases. These phases include site preparation; foundation construction; component installation; testing and interconnections; and final clean-up, site security, and landscaping. The actual sequence of construction activities and methods of construction will depend on the characteristics of and final engineering designs for each site. *Companies' Ex. 1* (Application, Vol. 1, pp. J-21 to J-25; Vol. 7, "Proposed Substation and Switching Station Drawings"); *Companies' Ex. 64* ("Singer Substation, Revised Location"); *Companies' Ex. 188* (Singer Substation Relocation from Site 1 as proposed to Site 8 to Accommodate PSEG Power).

462. The construction equipment typically required for station construction includes bulldozers, backhoes, man-lift vehicles, compressors, trucks (various sizes), large capacity crane (e.g., 100-ton), and flat-bed trailers. *Companies' Ex. 1* (Application, Vol. 1, p. J-23).

463. Site preparation work may include: installation of temporary soil erosion and sedimentation controls; demolition of existing buildings or structures; vegetation clearing; access road installation; grading; and installation of temporary fencing around construction site (if appropriate). *Companies' Ex. 1* (Application, Vol. 1, pp. J-23 to J-24).

464. Foundation construction, which typically will commence after rough grading, involves excavation, form work, use of steel reinforcement, construction of the transformer and shunt reactor sumps, and concrete placement. Excavated material will either be reused on-site or disposed of off-site in accordance with applicable requirements. Pile driving may be required for construction of the Singer Substation in Bridgeport. *Companies' Ex. 1* (Application, Vol. 1, p. J-23).

465. After the foundations are installed, the ground grid is laid down and the site is brought up to grade, then construction activities will shift to the erection of structures and equipment, including insulators, buses, disconnect switches, etc. In addition, control and power conduits, and splice vaults. *Companies' Ex. 1* (Application, Vol. 1, p. J-23).

466. At the East Devon Substation and Beseck Switching Station, a control house enclosure will be installed. At Singer Substation, the control room will be constructed integral to the GIS facility. Such facilities will enclose the relay and control switchboards, substation batteries and chargers, SCADA system, and heating, ventilation, and air conditioning equipment. Companies' Ex. 1 (Application, Vol. 1, p. J-23); *Companies' Exhibit 188* (Singer substation relocation from site 1 as proposed to site 8 to accommodate PSEG Power dated January 27, 2005).

467. At the East Devon, Singer and Norwalk substations, transformer equipment will be installed on concrete foundations and connected to the rest of the substation. During installation, the transformers will be filled with insulating fluid. Special fluid-handling equipment will be used to vacuum-fill the transformers; this process typically requires 24-72 hours to complete. Each unit will include a fluid containment system to minimize the potential for the uncontrolled release of spills. *Companies' Ex. 1* (Application, Vol. 1, p. J-24).

468. The Companies will purchase transformers that are designed to achieve the ambient noise levels specified by local regulations. At the East Devon and Singer substations, transformers will be specified to no greater than 65 dBA and shunt reactors will be specified to 70 dBA at Singer Substation (A-weighted sound

levels, measured in dB at a distance of 1 foot from the surface). The emergency generator at East Devon Substation will be specified to no greater than 75 dBA (measured at 50 feet from the generator in any direction). *Companies' Ex. 1* (Application, Vol. 1, p. J-24); *Companies' Ex. 44,* Response to CSC-01, Q-CSC-01; *Council's Administrative Notice Item 15* (Connecticut Siting Council Docket No. 217, Finding of Fact 243).

469. At the Singer and Norwalk substations, GIS will be installed within a GIS enclosure expected to be about 40-50 feet in height. At the Norwalk Substation, the enclosure and foundations will be completed as part of Docket 217. GIS equipment requires less space and will be used in place of open-air circuit breakers, disconnect switches, and bus work that is typically found in substations. The GIS facility will be installed after the enclosure foundation and concrete slabs are complete. In addition to the GIS equipment, the enclosure may also house relay and control switchboards, substation batteries and chargers, the SCADA system, and heating, ventilation, and air conditioning equipment. *Companies' Ex. 1* (Application, Vol. 1, p. J-24).

470. The 345-kV circuit breakers at each of the station sites will not produce noise during normal system operation, but will produce an impulse noise when tripped. Breakers will be located in the GIS buildings at the Singer and Norwalk substations, but in the station yards at Scovill Rock, Beseck, and East Devon. The Companies will specify that circuit breakers do not produce noise greater than 100 dB while opening or closing. *Companies' Ex. 44,* Response to CSC-01, Q-CSC-013.

471. After all electrical equipment, components, and power / control cables are installed, the substation equipment will be commission-tested prior to final connection to the transmission grid. *Companies' Ex. 1* (Application, Vol. 1, p. J-25).

472. Terminal structures will be constructed at each facility. At Scovill Rock, Beseck, and East Devon, terminations for the overhead line will consist of approximately 90-foot-tall steel A-frame structures. At East Devon and Norwalk, the terminal structure will be a pothead approximately 25 feet high. At Singer, the termination will be within the GIS building. *Companies' Ex. 1* (Application, Vol. 1, p. I-20).

473. The Beseck, East Devon, and Singer station sites will be fenced or otherwise enclosed to prevent unauthorized access. At East Devon, three barrier walls for sound attenuation will be installed. At Singer, the GIS building will be installed along the west boundary of the site (along Main Street), a 35 foot-high architectural wall will be installed on the north and south sides of the substation; this wall will serve as a sound barrier and a visual screen, and will provide security for the site. The exact type of enclosure will be specified in the final engineering designs for each site and will be reflected in the D&M Plan. *Companies' Ex. 1* (Application, Vol. 1, pp. J-25, M-54; Vol. 7, "Proposed

Substation and Switching Station Drawings"); *Companies' Ex. 64* (Singer Substation – Bridgeport, Connecticut, Environmental Sound Evaluation for Revised Site 8 Location, dated April 10, 2004); *Companies' Ex. 188* (Singer Substation Relocation from Site 1 as Proposed to Site 8 to Accommodate PSEG Power, dated January 27, 2005).

474. After construction work is complete, any remaining construction debris will be collected and removed from the site. Temporary erosion controls will be maintained until the disturbed areas are satisfactorily stabilized. Landscape plans and specifications, if appropriate, will be identified as part of the final engineering designs of the station facilities and will be presented in the D & M Plan. *Companies' Ex. 1* (Application, Vol. 1, p. J-25).

12.4 Operations and Maintenance Procedures

Overhead Transmission Line Right-of-Way Maintenance

475. The proposed 345-kV overhead transmission line will be aligned along ROWs that are already covered by CL&P vegetation management programs. There are two scheduled vegetation maintenance programs: (1) the brush control program, which includes the floor area of the maintained ROW width and is performed on a 4-year cycle; and (2) the side trimming program, which is based on a 10-year cycle. *Companies' Ex. 33,* Response to CSC-01, Q-CSC-033.

476. CL&P presently uses integrated vegetation management on its ROWs. Integrated vegetation management is the practice of using multiple methods of vegetation control in combinations to achieve the optimal control of undesirable vegetation. CL&P's primary approach involves the cutting of brush and woody vegetation, with a follow-up herbicide application. Where herbicides cannot be used, cutting or mowing is the preferred method. *Companies' Ex. 39*, Response to CSC-01, Q-CSC-032.

477. For the proposed Project, the Companies will adhere to standard specifications for ROW management, including NEPOOL Operating Procedure No. 3, Transmission Maintenance Scheduling for Facilities Operating at 115-kV and Above (Appendix 3-C1, NEPOOL Standard 115-kV and Above Transmission Line Patrol & Inspection Program and Appendix 3-D1, NEPOOL Right-of-Way Vegetation Management Standard). *Companies' Ex. 33,* Response to CSC-01, Q-CSC-033.

Underground Cable System

478. Routine maintenance on the underground cable system can generally be expected to include periodic inspection of splicing vaults, cable joints, and link box connections, regular patrols along the cable route to look for evidence indicating that the system has been or is likely to be damaged; and regular testing of ground

bonding connections, alarm connections, corrosion protection systems and surge limitors that protect the cable system from lightning strikes and other abnormal electric events. *Companies' Ex. 1* (Application, Vol. 6, "Tutorial - Underground Electric Power Transmission Cable Systems," p 24).

13.0 Project Schedule

479. The projected in-service date for the Project is 2009. *Companies' Ex. 172* (Testimony of Bartosewicz et al., December 28, 2004, p. 3); 1/11/05 Tr. at 123 (Zaklukiewicz).

14.0 Electric and Magnetic Fields

14.1 Introduction

480. Electricity is transmitted as alternating current (AC) to all homes and to the electric lines that deliver power to neighborhoods and commercial establishments. The power provided by electric utilities in North America oscillates 60 times per second, i.e., at a frequency of 60 hertz (Hz). These extremely low frequency (ELF) fields differ significantly from fields at the higher frequencies characteristic of radio and television signals, microwaves from ovens, cellular phones, and radar (which can have frequencies up to billions of Hz). *Companies' Ex. 1* (Application, Vol. 6, "Electric and Magnetic Field Assessment: Middletown-Norwalk Transmission Reinforcement," p. 2); *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. (1988); *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. (1998); *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 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 (1999); *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 (1998).

481. Electric fields are the result of voltages applied to electrical conductors and equipment. The electric field is expressed in measurement units of volts per meter (V/m) or kilovolts per meter (kV/m; 1 kV = 1000 V). Most objects

including fences, shrubbery, and buildings easily block electric fields. Therefore, certain appliances within homes and the workplace are the major sources of electric fields indoors, while power lines are the major sources of electric fields outdoors. *Companies'* Ex. 1 (Application, Vol. 6, "Electric and Magnetic Field Assessment: Middletown-Norwalk Transmission Reinforcement," p. 3); *Companies' Administrative Notice Item 21* (National Institute of Environmental Health Sciences (NIEHS), Assessment of Health Effects from Exposure to Power-line Frequency Electric and Magnetic Fields: Working Group Report. NIH Publication No 98-3981. (1998); *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. (2002); *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, (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 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, p. 58).

482. Magnetic fields are produced by the flow of electric currents; however, unlike electric fields, most materials do not readily block magnetic fields. The strength of magnetic fields is commonly expressed as magnetic flux density in units called gauss (G), or in milligauss (mG; 1000 mG = 1G). The strength of the magnetic field at any point depends on characteristics of the source, including the arrangement of conductors, the amount of current flow through the source, and its distance from the point of measurement. *Companies' Ex. 1* (Application, Vol. 6, "Electric and Magnetic Field Assessment: Middletown-Norwalk Transmission Reinforcement," p. 2); *Companies' Administrative Notice Item 21* (National Institute of Environmental Health Sciences (NIEHS), Assessment of Health Effects from Exposure to Power-line Frequency Electric and Magnetic Fields: Working Group Report. NIH Publication No 98-3981 (1998); *Companies' Administrative Notice Item 22* (National Institute of Environmental Health Sciences (NIEHS), EMF Electric and Magnetic Fields Associated with the use of Electric Power: Questions and Answers (2002); *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, (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, (1999).

483. The intensity of both electric and magnetic fields diminishes with increasing distance from the source. Over the last 30 years, research has been conducted in the US and around the world to examine whether exposures to AC ELF (60 Hz) EMF have health or environmental effects. The scientific research has focused on magnetic fields since objects such as trees, walls, etc. easily shield electric fields. *Companies' Ex. 1* (Application, Vol. 6, "Electric and Magnetic Field Assessment: Middletown-Norwalk Transmission Reinforcement," pp. 2; 81-105); *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).

14.2 Transmission Line EMF and Health Effects

484. The Council has taken administrative notice and otherwise considered completed and ongoing EMF research per Best Management Practices. *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 (2001); *Companies' Administrative Notice Item 19* (Health Council of the

Netherlands (HCN): ELF Electromagnetic Fields Committee. 2004. Electromagnetic fields: Annual Update 2003. Publication No. 2003/01); *Companies' Administrative Notice Item 20* (International Agency for Research on Cancer (IARC). IARC Monographs on the evaluation of carcinogenic risks to humans, Volume 80: Static and extremely low-frequency (ELF) electric and magnetic fields. (2002); *Companies' Administrative Notice Item 21* (National Institute of Environmental Health Sciences (NIEHS). Assessment of Health Effects from Exposure to Power-line Frequency Electric and Magnetic Fields: Working Group Report. NIH Publication No 98-3981 (1998); *Companies' Administrative Notice Item 22* (National Institute of Environmental Health Sciences (NIEHS). 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); *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* (Application, Vol. 6, "Electric and Magnetic Field Assessment: Middletown-Norwalk Transmission Reinforcement"); *Companies' Ex. 40* (Testimony of Cole et al. Concerning Power-Frequency Electric and Magnetic Fields, March 16, 2004, and additional information dated April 8, 2004); *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).

14.2.1 There is No Scientific Basis for Claims that Transmission Line Magnetic Fields Cause Adverse Health Effects

485. Over the last 30 years, massive research efforts to investigate suggestions that magnetic fields may cause adverse health effects, particularly leukemia in children, has not produced scientific or medical evidence to support such a conclusion. The weight-of-the-evidence reviews by multidisciplinary national and international scientific panels of scientists that have reviewed the totality of the EMF research, including the National Institute of Environmental Health Sciences (NIEHS); the National Academy of Sciences (NAS); (United Kingdom) National Radiological Protection Board (NRPB); the Health Council of the Netherlands (HCN); and the International Agency for Research on Cancer (IARC); do not support the assumption that EMF is harmful. NIEHS: *Companies' Administrative Notice Item 21* (National Institute of Environmental Health Sciences. 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); *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); NAS: *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); *Woodbridge Panel Ex. 1* (Testimony of Bell et al., March 16, 2004, at Appendices 1 and 2); NRPB: *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); HCN: *Companies' Administrative Notice Item 18* (Health Council of the Netherlands; 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); IARC: *Companies' Administrative Notice Item 20* (International Agency for Research on Cancer (IARC). 2002. IARC Monographs on the evaluation of carcinogenic risks to humans. Volume 80: Static and extremely low-frequency (ELF) electric and magnetic fields. IARC Press, Lyon, France); Generally: 3/25/04 Tr. at 19-20 (Cole); 3/25/04 Tr. at 96 (Cole); 3/25/04 Tr. at 39-40 (Aaronson); 5/12/04 Tr. at 203-211 (Aaronson); 5/12/04 Tr. at 132 (Ginsberg); *Companies' Ex. 1* (Application, Vol. 6, "Electric and Magnetic Field Assessment: Middletown-Norwalk Transmission Reinforcement" pp 81-105); *Companies' Ex. 40* (Testimony of Cole et al., March 16, 2004, and additional information dated April 8, 2004); *Companies' Ex. 169* (Testimony of Bailey, October 12, 2004, pp. 3-10); *Companies' Ex. 183* (Testimony of Bailey et al., January 24, 2005, p. 4-13); *Council's Ex. 5* (Testimony of Ginsberg, May 6, 2004, pp. 4-13); *Council's Ex. 6* (Supplemental Testimony Regarding Potential Health Effects of EMF Submitted to the Connecticut Siting Council, June 17, 2004, submitted by Gary Ginsberg, Ph.D. Toxicologist).

486. Epidemiology is the science that studies the patterns of health and disease in human populations. The two largest epidemiology studies ever conducted of childhood leukemia and exposure to EMF – conducted by the US National Cancer Institute and the United Kingdom Childhood Cancer Study (UKCCS) group – concluded that they found no significant excess risk of childhood leukemia associated with residential magnetic field levels nor did they observe a significant dose-response trend. *Companies' Ex. 1* (Application, Vol. 6, "Electric and Magnetic Field Assessment: Middletown-Norwalk Transmission Reinforcement," pp 81-105); 5/12/04 Tr. at 146-147 (Ginsberg).

487. Greenland et al. (2000) and Ahlbom et al. (2000) reanalyzed the data from some previous epidemiology studies of magnetic fields and childhood leukemia. The researchers found no evidence of an increased risk of childhood leukemia at residential magnetic field exposure below 3 mG or 4 mG, respectively. Neither study found evidence of a dose response relationship. In their own words, the authors of the Greenland et al. (2000) meta-analysis state, "We believe that the dose-response modeling is important in the present context because, even upon pooling, there are still too few data to reject any plausible dose-response shape, especially above 0.2 μT (2mG). In particular, the data appear to be statistically consistent with anything from curves that are nearly flat to curves that rise and then fall at high exposures to curves that rise faster than exponentially." *Companies' Ex. 1*, (Application, Vol. 6, "Electric and Magnetic Field Assessment: Middletown-Norwalk Transmission Reinforcement," pp. 84-85); *Companies' Administrative Notice Item 18* (Health Council of the Netherlands; ELF Electromagnetic Fields Committee. 2001. Electromagnetic fields: Annual Update 2001. The Hague: Health Council of the Netherlands. Publication No. 2001/14, pp 38-41); *Companies' Ex. 40* (Testimony of Cole et al., March 16, 2004, pp. 2-3, and additional information dated April 8, 2004, p 9; Exhibit B); *Companies' Ex. 183* (Testimony of Bailey et al., January 24, 2005, pp. 2-4);

3/25/04 Tr. at 29 (Cole)(citing Greenland et al., 2000 p. 631-632); *Companies' Ex. 169* (Testimony of Bailey, October 12, 2004, pp. 7-10).

488. In studies of leukemia and other cancers, epidemiologists evaluate an association between magnetic fields and disease by comparing the proportion of exposures of individuals with the disease (cases) to other individuals without the disease (controls). While the presence of a positive statistical association (exposure more often for cases or higher exposure among cases) does not mean that the exposure caused the disease (i.e., a cause and effect relationship), it is part of the total database to be evaluated. To evaluate the validity of an association reported in an epidemiologic study, it is first necessary to evaluate whether the observed association is likely to be "real" or whether it is possible that a spurious association was produced due to chance, bias, or confounding. Conclusions about cause and effect cannot be reached until the totality of the evidence is taken into account. *Companies' Ex. 1* (Application, Vol. 6, "Electric and Magnetic Field Assessment: Middletown-Norwalk Transmission Reinforcement," pp. 81-105); Companies' Ex. 40 (Testimony of Cole et al., March 16, 2004, and additional information dated April 8, 2004, pp. 4-8); Companies' Ex. 169 (Testimony of Bailey, October 12, 2004, pp. 1-10); 3/25/04 Tr. at 19-20, 95-96 (Cole).

489. Animal data are important in assessing causation. Experimental, or laboratory, studies of humans, in animals (*in vivo* studies), and in cells and tissues (*in vitro* studies) complement epidemiology studies of people because while people are the species of interest, there are large variations in heredity, diet, and other health-related exposures. Variables (e.g., the intensity and duration of exposure) can be controlled to provide precise information regarding biological effects on cells or animals under these defined conditions. These variables can be better controlled or eliminated in studies of experimental animals than in humans. Studies in isolated cells or tissues can be designed to observe changes that may be related to the development of disease but may not be visible in living organisms. *Companies' Ex. 1* (Application, Vol. 6, "Electric and Magnetic Field Assessment: Middletown-Norwalk Transmission Reinforcement," pp. 81-105); *Companies' Ex.* 40 (Testimony of Cole et al., March 16, 2004, and additional information dated April 8, 2004, pp. 14-17); 3/25/04 Tr. at 42-44 (Aaronson).

490. *In* vivo (studies of whole animals) and *in vitro* (studies of cells and tissues) experimental studies supported by the NIEHS at exposures up to thousands of times higher than exposures associated with the proposed transmission line outside the ROW provide a lack of evidence to support the hypothesis that magnetic fields promote or cause any type of cancer, including leukemia. The assessments by the International Association for Research on Cancer, the National Institute of Environmental Health Sciences, the National Academy of Sciences, the National Radiological Protection Board (of the United Kingdom), and the Health Council of the Netherlands agree that the experimental laboratory data do not support a causal link between EMF and any adverse health affect, including leukemia, and have not concluded that EMF is, in fact, the cause of any disease.

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 Institute 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 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); *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* (Application, Vol. 6, "Electric and Magnetic Field Assessment: Middletown-Norwalk Transmission Reinforcement," pp. 81-105); *Companies' Ex. 40* (Testimony of Cole et al., March 16, 2004, and additional information dated April

8, 2004, pp. 6-8); 3/25/04 Tr. at 39-40 (Aaronson); 5/12/04 Tr. at 203-211 (Aaronson); 3/25/04 Tr. at 315 (Ginsberg); 5/12/04 Tr. at 129-132 (Ginsberg).

491. Dr. Martha Linet, a physician and senior epidemiologist at the U.S. National Cancer Institute, who was a principal author of original studies investigating EMF and childhood cancer, and who has special expertise with respect to the causes of childhood leukemia, together with co-authors, has advised pediatricians that the relationship between exposure to power frequency and childhood leukemia "does not meet the criteria for causality." *Companies' Ex. 169* (Testimony of Bailey, October 12, 2004, p. 3-10, Ex. 1 (Linet et al: "Interpreting Epidemiological Research: Lessons from Studies of Childhood Cancer, Pediatrics," Vol. 112, No. 1, July 2003)).

492. The available evidence does not support the view that magnetic fields from power lines cause cancer, including childhood leukemia. *Companies' Ex. 40* (Testimony of Cole et al., March 16, 2004, p. 2).

493. There is no convincing or consistent evidence that power lines pose a cancer risk. *Companies' Ex. 40* (Testimony of Cole et al., March 16, 2004, pp. 8, 15); *Companies' Ex. 169* (Testimony of Bailey, October 12, 2004, p. 3); Tr. 3/25/04 at 19, 26, 48 (Cole); Tr. 3/25/04 at 39, 41 (Aaronson); Tr. 5/12/04 at 203 (Aaronson).

14.2.2 Testimony of the Woodbridge Organizations' Panel

494. A panel of witnesses testifying for the Woodbridge Organizations expressed disagreements with the experts presented by the Applicants with respect to many aspects of the literature relating to the potential health effects of magnetic fields *Woodbridge Organizations' Ex. 1* (Testimony of Bell et al., March 16, 2004, Appendices 1 and 2); *Woodbridge Organizations' Ex. 4* (Testimony of Bell et al., June 7, 2004); *Woodbridge Organizations' Ex. 8* (Testimony of Bell et al., May 11, 2004); *Woodbridge Organizations' Ex. 9* (Testimony of Bell et al., July 19, 2004, pp. 1-5); *Woodbridge Organizations' Ex. 11* (Testimony of Bell, January 12, 2005). The Woodbridge witnesses agreed, however, "nobody claims that EMF has been established as a cause of childhood leukemia. The concern is that there are suggestions in the literature that that might be a possibility." 5/13/04 Tr. at 244 (Bell).

495. By "cherry picking" studies, one can point to studies that appear to support any position. This is why the International EMF Program of the World Health Organization stresses the importance of relying on the weight-of-the-evidence reviews—where the totality of the voluminous scientific literature evaluating EMF and potential health effects has been reviewed—to reach conclusions of EMF and potential health effects. 2/1/05 Tr. at 131-33 (Cole); 5/12/04 Tr. at 203-11 (Aaronson).

14.3 Magnetic Fields Associated with the Proposed Line

496. The magnetic fields expected to be associated with the proposed overhead and underground transmission lines are similar to those present along transmission lines today in Connecticut and throughout the nation, and similar to those produced by other sources of exposure. *Companies' Ex. 1* (Application, Vol. 6, "Electric and Magnetic Field Assessment: Middletown-Norwalk Transmission Reinforcement," p. 4); *Companies' Ex. 1*90 (EMF Measurements taken by Dr. Gary Johnson in New Britain, CT on October 13, 2004, submitted January 28, 2005); *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); *Companies' Administrative Notice Item 15* ("Position Paper on Electric and Magnetic Power Frequency Fields and The Velco Northwest Vermont Reliability Project," prepared by the Vermont Department of Health, Division of Health Protection, December 15, 2003); *Companies' Administrative Notice Item 29* (Final Decision of the Vermont Public Service Company ("VPSC") in its Docket No. 6860, *Petitions of Vermont Electric Power Company, Inc.,* concerning the Northwest Vermont Reliability Project).

497. Considering EMF from a perspective of specific sources or environments does not fully reflect the variations in a person's personal exposure as encountered in everyday life. Sources of magnetic fields include transmission lines, distribution lines, home appliances, wiring in the home, exposure at grocery stores, visits around town, etc. *Companies' Ex. 1* (Application Vol. 6, "Electric and Magnetic Field Assessment: Middletown-Norwalk Transmission Reinforcement," pp. 1-5); 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); *Companies' Ex. 1*90 (EMF Measurements taken by Dr. Gary Johnson in New Britain, CT on October 13, 2004, submitted January 28, 2005).

498. Measurements were taken around the boundaries of the Scovill Rock Switching Station in January 2003 and Norwalk substation in June 2001 to characterize existing levels of EMF at these sites. Measurements were also taken at selected locations along and adjacent to the Middletown-Norwalk right-of-way. Measurements were taken at a height of one meter (3.28 feet) above ground in

accordance with the industry standard protocol for taking measurements near power lines. *Companies' Ex. 1* (Application, Vol. 6, "Electric and Magnetic Field Assessment: Middletown-Norwalk Transmission Reinforcement," pp. 7-8, 13-14, 22-23); *Companies' Administrative Notice Item 28* (IEEE Standard 644-1994, Standard Procedures for Measurement of Power Frequency of Electric and Magnetic Fields from AC Power Lines, dated March 7, 1995)). Both electric and magnetic fields were expressed as the total field computed as the resultant of field vectors measured in the x, y, and z-axes (rms). The electric field was measured in units of kV/m with a single-axis field sensor and meter (Electric Field Measurements, Inc.) at five- or ten-foot intervals. The magnetic field was measured in units of milligauss (mG) in x, y and z-axes by orthogonally mounted sensing coils whose output was logged by a digital recording meter (Dexil Corp) at one-foot intervals. Measurements were taken along a transect perpendicular to transmission lines and around the perimeter of substation sites. Personal exposure measurements were taken at 10-second intervals. These instruments meet the IEEE instrumentation standard for obtaining valid and accurate field measurements at power line frequencies. The meters were calibrated by the manufacturers by methods described by IEEE Std. 644-1994. *Companies' Ex. 1* (Application, Vol. 6, "Electric and Magnetic Field Assessment: Middletown-Norwalk Transmission Reinforcement," p. 8).

499. Pre- and post-construction EMF levels were calculated using a computer program developed by the Bonneville Power Administration, an agency of the US Department of Energy. The program has been shown to accurately predict electric and magnetic fields measured near power lines. The inputs to the program are data regarding voltage, current flow, phasing, and conductor configurations. The fields associated with power lines were estimated along profiles perpendicular to lines at the point of lowest conductor sag, i.e., closest to the ground or opposite points of interest. All calculations were referenced to a height of 1 m (3.28 ft) above ground according to standard. *Companies' Ex. 1* (Application, Vol. 6, "Electric and Magnetic Field Assessment: Middletown-Norwalk Transmission Reinforcement," pp. 8-9).

500. Transmission line magnetic fields are a product of currents flowing on the lines. Such currents will be determined by, among other things, the load (customer demand) that is being served at a given time, and the location of the sources of the generation that is being dispatched to serve that load. *Companies' Ex. 156* (Testimony of Prete, September 24, 2004, p.2)

501. In order to model magnetic fields that are likely to be associated both with the proposed lines, and with existing lines, the Companies constructed two "Cases" for modeling purposes. The "15 GW Case" represents typical conditions when the line is put into service, and for years thereafter. This "Case" assumes an average New England wide load, together with a "light" generation dispatch from the local generators in SWCT, which is an economic dispatch consistent with that

average load. *Companies' Ex. 156* (Testimony of Prete, September 24, 2004, p.2,3); 10/14/04 Tr. at 241 (Prete); 10/14/04 Tr. at 242-243 (Scarfone).

502. The 15 GW New England load used for modeling the "15 GW Case" is not just an average number, but represents a load within a relatively narrow range in which the system operates most of the time. Minimum load and peak load conditions occur in only a small number of hours in the year. For most of the year (83% of the year in 2003) the load is below or, if above, fairly close to, the average load of 15 GW. *Companies' Ex. 156* (Testimony of Prete, September 24, 2004, p.2)

503. The growth in average load is gradual, and less than the growth of peak load. Thus, even as load grows in future years, for most hours of the year, it will remain in a relatively narrow range that includes the 15 GW value. *Companies' Ex. 156* (Testimony of Prete, September 24, 2004, p.3,4). For instance, when the average New England wide load reaches 30 GW (about twice today's average load) under average weather conditions (a time that is beyond the 10 year planning horizon of the 2004 CELT Report), the average load is estimated to be only approximately 18 GW. ((Testimony of Prete, September 24, 2004, p.7) Moreover, by the time such a load is achieved, additional transmission lines and/or generation will be required and the load pattern in SWCT will change. (Testimony of Prete, September 24, 2004, p.2)

504. A comparison with historic current loading data on the transmission lines in the proposed overhead section of the Project, made after the 15 GW Case was modeled, showed that the actual average current loads for 2003 were very close to those assumed in the 15 GW model. *Companies' Ex. 165* (Testimony of Scarfone et al., September 28, 2004, p. 3).

505. In order to model the highest magnetic fields that might be associated with the proposed lines, the Companies constructed the "27.7 GW Case" model. This "Case" does not represent typical or normal conditions, or even normal conditions that might exist in the distant future when the New England average load may have grown to 27.7 GW, nearly twice what it is today. *Companies' Ex. 156* (Testimony of Prete, September 24, 2004, p.3)

506. The 27.7 GW Case assumes both an anticipated peak hour dispatch and that generation resources in SWCT that would normally be dispatched to serve this load are unavailable, so that the transmission lines importing power into SWCT are stressed near the limits of their transfer capacity. *Companies' Ex. 156* (Testimony of Prete, September 24, 2004, p. 4).

507. The 27.7 GW case was developed in system planning to stress the system under an assumed peak load condition. While the transmission system must be planned to perform reliably even if stressed by generation being unavailable at a time of peak load (in accordance with national and regional reliability standards), these are not conditions that could be expected to occur for a significant amount of time

in a given year, if they occur at all. *Companies' Ex. 156* (Testimony of Prete, September 24, 2004, p.3, 4).

508. In addition to modeling the magnetic fields based on the 15 GW and 27.7 GW cases, the Companies, in response to interrogatories, calculated the magnetic fields that would be produced if the proposed lines could be loaded to 80% and 100% of their continuous normal line rating. However, these levels are unrealistic, because system limitations and operating requirements will not allow the lines to be used to carry such high currents. *Companies' Ex.* 45, Responses to D-W-2, Q-D-W-037 and 038.

509. The magnetic fields associated with the transmission lines that will be present along the ROW after construction of new lines, under typical conditions, are fairly represented by calculations based on the 15 GW Case. *Companies' Ex. 156* (Testimony of Prete, September 24, 2004, p.1-10); *Companies Ex. 165* (Testimony of Scarfone et al., p. 3); 5/12/04 Tr. at 34-41 (Bailey and Zaklukiewicz); 10/14/04 Tr. at 241 (Prete); 10/14/04 Tr. at 242-243 (Scarfone).

14.3.1 Magnetic Fields Associated With Line Designs Proposed in Application

510. In designing the proposed overhead route, the Companies sought to minimize visual impacts by using the lowest structure height possible without having to widen the ROW significantly through developed areas, and to use the existing structure locations for the new structures. So that these designs would comply with the Council's Best Management Practices, the Companies consolidated circuits on towers where appropriate and optimally phased the lines for magnetic field cancellation wherever possible. *Companies' Ex. 1* (Application, Vol. 6, "Electric and Magnetic Field Assessment: Middletown-Norwalk Transmission Reinforcement", pp. 9, 24, 97).

511. In their proposed designs, the Companies did not propose to increase the height and number of the new structures, or to use spilt-phasing of lines as magnetic field reduction strategies, because their primary design goal was to minimize the visual impact of the new lines and structures. *Companies' Ex. 1* (Application, Vol. 1, pp. H-4, I-57-58, M-30-31; Vol. 6, "Electric and Magnetic Field Assessment: Middletown-Norwalk Transmission Reinforcement", p. 97); 5/13/04 Tr. at 111-113 (Prete).

512. The ranges of magnetic fields along the edges of the proposed overhead ROW, calculated for both the existing lines and for the new lines built as proposed in the Application, under both the 15 GW and 27.7 GW Cases, are as follows:

	15 GW ("Average") Case	27.7 GW ("Extreme") Case
Existing Lines	0.2 mG – 33.8 mG	0.9 mG – 80.6 mG
Lines As Proposed in Application	5.4 mG – 30.4 mG	3.0 mG – 61.3 mG

Companies' Ex. 35 (Letter Updating Magnetic Field Calculations, dated March 15, 2004).

14.3.2 Reducing Magnetic Fields from Overhead Transmission Lines

513. Magnetic fields at edge of rights of way and in specific areas of interest can almost always be reduced below those that would be associated with the existing transmission line on the proposed route by the use of low magnetic field designs. CL&P has submitted project-specific assessments of EMF including pre-construction measurements of EMF, projected EMF levels of existing transmission lines and from existing and proposed transmission lines after construction of the project, and, with respect to statutory facilities along the overhead portion of the route, low field construction options by cross section. *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, revised July 20, 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-166, 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 15, 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); *Companies' Ex. 202* (Structure heights and magnetic field calculations for Valley View Drive in Wallingford dated February 16, 2005).

514. The Companies developed a number of low magnetic field designs during the course of the proceeding:

a. The Companies initially developed and presented numerous (up to 6 in some cases) low magnetic field alternative structure designs for each Cross Section, and calculated the edge of ROW fields that would be associated with each. *Companies' Ex. 96* (EMF Mitigation for all Cross Sections of Overhead Route with a Basis of Comparison, dated May 28, 2004); *Companies' Ex. 124* Testimony of Bailey, July 19, 2004, Exhibit 2; errata pages read into record on July 27, 2004, p. 30); 7/27/04 Tr. at 186 (Bartosewicz) .

b. At the request of the Council, the Companies then narrowed that list of potential designs, first by asking the participating Towns to designate two of the options for each cross section in that Town. The Towns of Woodbridge, Orange, and Milford responded to that request. The Companies then prepared a more detailed set of magnetic field calculations for each Cross Section, using either the two options chosen by the Towns or, in the absence of such a choice, the options that the Companies' concluded struck the best balance between maximum field reduction and structure height. *Companies' Ex. 124* (Testimony of Bailey, July 19, 2004, at 3; Exhibit 1); *Companies' Ex 136* (Middletown-Norwalk Project low magnetic field transmission design options submitted at the July 27, 2004 hearing).

c. Thereafter, the two options for each cross section were reduced to one for the purpose of further presentations. The Chairman instructed the Companies to develop information using the options that produced the lowest magnetic fields for each Cross section, with the proviso that if there was no one option that was lowest on both sides of the ROW, the

Companies would choose the option that was lower on the side of the ROW where there were the most residences. 7/28/04 Tr. at 14, 15 (Katz).

d. The Companies then presented magnetic field calculations relating to such "optimized" low magnetic field designs; if a Town had designated two cross sections, the lower of the two was used. Otherwise, the Companies used the configuration that they considered produced the overall lowest fields at adjacent houses, except that they developed a new, lower field design for Cross Section 6 East (East Wallingford Jct. to North Haven Jct.). *Companies' Ex. 140* (Optimized EMF reductions by cross section summary submitted at July 29, 2004 hearing); *Companies' Ex. 145* (Updated Homework-Optimized Magnetic Field Reductions Summary, dated July 30, 2004); *Companies' Ex. 148* (Supplemental to Exhibit 79 and 92 – Summaries of the Number of Structures, dated August 18, 2004, p.2).

e. A single set of "generic" low magnetic field designs were described in *Companies Ex. 158* (Mapping homework assignment presented September 28, 2004. Number of structures within the 300-foot buffer, 6 milliguass and 3 mG boundaries of mapping provided in Exhibit 154). This set was further refined, at the request Council's by increasing the height and location of some transmission structures, so as to produce lower fields at adjacent homes. *Companies' Ex. 170*, Responses to CSC-05, Q-CSC-05-091-094.

f. A final set of low magnetic field designs and illustrated cross sectional drawings were presented in *Companies' Ex. 191* (Aerial Mapping, Segment 1 and 2, dated January 28, 2005). These "optimized" low magnetic field designs were developed after the Council's *Interrogatory 091 and 092* and subsequent request of "no more than 6mg at the house under the 15GW loading." *Companies' Ex. 170*, Responses to CSC-05, Q-CSC-05-091-094.

515. One of the principle strategies that the Companies employed for low EMF designs was "split-phaseing." "Split-phasing" is a configuration in which a line is constructed using six, rather than the conventional three, phase conductor positions. The conductors are positioned on opposite sides of a transmission structure, phased for optimal field cancellation, and the current flow is split among the six conductors. The resulting cancellation effect reduces the magnetic fields associated with the lines. *Companies' Ex. 73* (Testimony of Bailey, April 30, 2004, p. 3).

516. In addition to support from the laws of physics, split phasing has been demonstrated to lower magnetic fields under experimental and real world conditions. *Companies' Ex. 134* (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).

517. Split phasing and the other strategies employed by Exponent and the Companies to reduce EMF are well known. *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, p. 57-60); Council's Administrative Notice Item 16 (Connecticut Siting Council Life Cycle Cost Studies for Overhead and Underground Transmission Lines, March 1996 and the Update of Life-Cycle Cost Studies of Overhead and Underground Transmission Lines – 1996, May 2001, ACRES International); *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); *Companies' Administrative Notice Item 9* (Interagency Task Force Studying Electric and Magnetic Fields, Connecticut 1998 Report on Task Force Activities to Evaluate Health Effects from Electric and Magnetic Fields, 1998)

518. As shown on the following table, by adopting low magnetic field designs, the magnetic fields along the edge of the proposed overhead ROW could be limited to at or below those *associated* with the existing lines for most of the length of the ROW. *Companies' Ex. 145* (Updated Homework – Optimized Magnetic Field Reductions Summary, dated July 30, 2004). The aggregate length of the "cross sections" shown in the following table where magnetic fields would be at or below existing levels is approximately 40 of the 45 miles of the overhead route. Moreover, where the magnetic fields at the edge of the ROW would not be lower than for the existing lines, they would be for the most part at or below 6 mG, with the highest fields calculated under the "15 GW Case" that reflects average conditions, at 12. 4 mG. (The 40 miles just comes from adding up the lengths of each cross section in the previous table).

Optimized Magnetic Field Reductions by Cross Section – Proposed Overhead Route @ Edge of ROW									
		S/E Edge of ROW				N/W Edge of ROW			
Cross Section	Application Volume 9 Segment	mG Increase	Calculated mG[4] Edge of ROW "Low Field Option" (Generic Cross Section)	Statutory Facilties[1] (Specific) Facility ID	Statutory Facilties[1] (Specific) Calculated mG "Low Field Option"	mG Increase	Calculated mG Edge of ROW "Low Field Option" (Generic Cross Section)	Statutory Facilties (Specific) Facility ID	Statutory Facilties (Specific) Calculated mG "Low Field Option"
1	1-3	-	At or Below	-	-	-	At or Below	-	-
2	4-10	-	At or Below	-	-	-	At or Below	-	-
3	11-12	-	At or Below	-	-	6.7 mG	11.4 mG	N/A[2]	N/A[2]
4	12-13	-	At or Below	-	-	-	At or Below	-	-
5	14-19	-	At or Below	-	-	-	At or Below	-	-
6E	19-20	3.9 mG	4.1 mG	R-14	3.7 mG	-	At or Below	-	-
6W	20-21	4.8 mG	5.1 mG	N/A[2]	N/A[2]	10 mG	12.4 mG	N/A[2]	N/A[2]
7	21-23	3.2 mG	3.6 mG	N/A[2]	N/A[2]	-	At or Below	-	-
7B	23-24	0.7 mG	1.1 mG	R-08	1.1 mG	1.4 mG	5.8 mG	N/A[2]	N/A[2]
8A	24	-	At or Below	-	-	0.8 mG	3.0 mG	R-09[3]	0.8 mG
8N	24-31	-	At or Below	-	-	0.3 mG	2.9 mG	R-10	1.7 mG
8M	31-33	-	At or Below	-	-	0.1 mG	2.9 mG	P-19	0.6 mG
8S	33-45	-	At or Below	-	-	1.3 mG	2.9 mG	S-11 DC-81 DC-81 R-32 R-34 R-35 R-36 R-37 R-47	0.0 mG 2.9 mG 0.4 mG 2.9 mG 2.9 mG 2.9 mG 2.9 mG 2.9 mG 2.3 mG

Companies' Ex. 145 (Updated Homework – Optimized Magnetic Field Reductions Summary, dated July 30, 2004)

[1] Buffer zone statutory facilities "residential areas, private or public schools, licensed child daycare facilities, licensed youth camps or public playgrounds" adjacent to the overhead portion of the Proposed Route.
[2] No statutory facilities adjacent to this side of the ROW in this cross section.
[3] Option 5 provides lower magnetic field levels at the statutory facility while option 4 provides lower magnetic field levels at the edges of the right-of-way.
[4] Based on 15GW new average New England load

519. With additional site specific mitigation strategies such as further increases in structure heights, adding and relocating structures, magnetic fields associated with the proposed overhead lines could be reduced so that, calculated according to the "15 GW Case," they would not exceed 6 mG at the nearest portion of any house or statutory facility along the ROW. *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. 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. 191* (Aerial maps of segment 1 and 2 with 6 mG boundary at 15 GW load dated January 28, 2005); *Companies' Ex. 202* (Structure heights and magnetic field calculations for Valley View Drive in Wallingford dated 2/16/05).

520. In addition, site-specific low field options have been evaluated at numerous locations along the route including the Congregation B'nai Jacob, the Jewish Community Center, Ezra Academy, the Orange High Plains Community Center, Racebrook Elementary School and several day care centers and neighborhoods along the route. *Companies' Ex. 73* (Testimony of Bailey, April 30, 2004, errata replacement p. 15); *Companies' Ex. 82a and 82b* (B'nai Jacob – North ROW: 15GW Case (with relocated ROW) and Jewish Community Center: 15GW Case); *Companies' Ex. 124a and 124b* (Testimony of Bailey, dated July 19, 2004, Exhibit 2; Errata Pages read into record on July 27, 2004 hearing); *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. 202* (Structure heights and magnetic field calculations for Valley View Drive in Wallingford dated February 16, 2005).

521. The Companies have filed, together with this Proposed Finding of Facts, a separate Appendix, entitled "Appendix to Companies' Proposed Findings of Fact," which summarizes the results with respect to the proposed structure designs and the magnetic fields that would be associated with them. The Appendix, which is comprised of excerpts of exhibits in the record, shows each existing "Cross Section" of structures for the proposed overhead sections of the lines; how the cross section would change with the proposed construction; and how it would change with the construction of the optimal low magnetic field structure design.

522. The Appendix to Companies' Proposed Findings of Fact also provides calculations of magnetic fields at the edge of the ROW, calculated according to the 15 GW Case, which would be associated with both the proposed and low magnetic field structures.

523. The Appendix to Companies' Proposed Findings of Fact, together with the visual impact analyses in this Docket, enables the Council to estimate the incremental visual impact of ordering a low EMF overhead line design for any given section of the proposed overhead ROW. Appendix to Companies' Proposed Findings of Fact; *Companies' Ex. 1* (Application, Vol. 1, 8, 10).

524. The Appendix to Companies' Proposed Findings of Fact also summarizes the evidence with respect to the configuration, location, and magnetic fields of the proposed underground lines.

525. Finally, the Appendix to Companies' Proposed Findings of Fact summarizes the information provided with respect to "Areas of Interest," including the facilities and land uses for which a "buffer zone" finding is required by P.A. 04-246 along the overhead sections of the proposed route, Alternative A, and Alternative B, and provides the above information by Town, as well as by Cross Section.

526. The Council may order low EMF designs to be implemented of some, but not all, Cross Sections, or for part of a Cross Section. However, an immediate transition from one cross section design to another can not be achieved. Typically, 3 spans, or approximately 2500 linear feet, will be required to transition from one structure design to another. 2/17/05 Tr. at 199 (Bartosewicz and Prete).

14.3.4 Lack of Underground Rights on Existing Overhead ROWs

527. The existing overhead ROW easements do not include rights for installing underground facilities. As a result, installing the cable underground within existing transmission line ROWs would require the acquisition of additional easement rights from private landowners, at additional cost. 10/14/04 Tr. at 229–230, 232–233 (Bartosewicz).

14.3.5 Magnetic Fields Associated With Underground Cable

528. Power Delivery Consultants used the computer program, CableZ, to model the magnetic field produced by the underground XPLE transmission cables. This program is based on the Biot-Savart law of fundamental magnetic field theory implemented and described by Electric Power Research Institute (EPRI). The accuracy of magnetic field calculations made by CableZ has been verified by field measurements performed in the vicinity of 138-kV XLPE cable systems in Hawaii and Maryland. *Companies' Ex. 162* (PDC document titled Magnetic field calculations for Middletown-Norwalk 345-kV XLPE transmission cables, dated September 27, 2004).

529. The underground portion of the 345-kV route would be constructed principally in public streets, under 3 feet of cover. The magnetic fields associated with the underground XLPE lines are reduced by optimal phasing of the conductors.

9/29/04 Tr. at 86 - 87, 106, 107 (Johnson); 1/05/05 Tr. at 50 (Johnson); 1/05/05 Tr. at 46-48 (Prete).

530. Magnetic fields directly above the cable trench, under the average conditions represented by the 15 GW Case, measured at one meter above ground, would be approximately 10 mG for East Devon-Singer and 25 mg for the Singer-Norwalk cables. *Companies' Ex. 162* (PDC document titled Magnetic field calculations for Middletown-Norwalk 345-kV XLPE transmission cables, dated September 27, 2004).

531. Magnetic fields from XLPE cables decrease rapidly with distance from the line. The 10 mG field measured over the top of the East Devon-Singer cable trench in the 15 GW Case declines to 1.51 mG within 50 feet. *Companies' Ex 162* (PDC document titled Magnetic field calculations for Middletown-Norwalk 345-kV XLPE transmission cables, dated September 27, 2004).

532. In areas of special interest, magnetic fields over the cable trench can be reduced by factor of 2 installing steel plates over the top of the cable trench. However at distances beyond the width of the place (approximately 4 feet) the fields would be slightly elevated ("wing effect"). *Companies' Ex. 162* (PDC Document titled Magnetic field calculations for Middletown-Norwalk 345-kV XLPE transmission cable, dated September 27, 2004); *Companies' Ex. 174* (AC Magnetic Field from XLPE Cable at 1 Meter Above Ground for 15 GW Case); *Companies' Administrative Notice Item 27* (IEEE Technical Paper "Five Years of Magnetic Field Measurement"); 1/05/05 Tr. at 46-61, 154 (Johnson and Prete); 2/1/05 Tr. at 266-272 (Zaklukiewicz); 09/29/04 Tr. at 87-96; 102-106 (Johnson); 7/27/04 Tr. at 116-17 (Johnson).

14.4 Standards

533. Exposure limits have been recommended by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and the International Commission on Electromagnetic Safety (ICES) based on a review of current EMF research. They concluded that the only data reliable enough to base standards were short-term effects of electric and magnetic fields. The ICNIRP guidelines recommend limiting the magnetic field exposure of the general public to 100μT (1,000 mG at 50 Hz; 833 mG at 60 Hz); the ICES recommend limiting magnetic field exposure of the general public to 9,040 mG. *Companies' Ex. 40* (Testimony of Cole et al., March 16, 2004, and additional information dated April 8, 2004, pp. 3-7); *Companies' Ex. 75* (Testimony of Bailey, May 3, 2004, at Attachment 5); 2/1/05 Tr. at 80 (Bailey).

534. Great Britain and approximately 30 other countries have adopted or are in the process of adopting the ICNIRP guidelines. Several countries have set additional exposure limits where children spend significant amounts of time. For example, Italy has set a precautionary measure exposure limit of "10μT in children's playgrounds, residential dwellings, and school premises and in areas where people

are staying for 4 hours or more per day. Th(is) attention value is the median of values recorded over 24 hours, under normal operating conditions" Other countries have set similar exposure limits (e.g., Poland has set a magnetic field exposure limit of 251 mG for exposures longer than 8 hours). *Companies' Ex. 183* (Testimony of Bailey et al., January 24, 2005, pp. 9-11 and Attachment 1); *Council's Administrative Notice Item 27* (Union of the Electricity Industry, Environment & Society Working Group EMF Exposure Standards Applicable in Europe and Elsewhere, dated May 2003); 2/1/05 Tr. at 79-80 (Bailey).

535. No federal or state standards exist, nor does the scientific evidence support a need to limit exposure to electric or magnetic fields by creating a buffer zones around transmission lines that are defined by distance or by electric and magnetic field values lower than those permitted by the National Electric Safety Code. *Companies' Ex. 124 a and b* (Testimony of Bailey, July 19, 2004, at Exhibit 2 and Errata Pages read into record on July 27, 2004 hearing); *Companies' Ex. 183* (Testimony of Bailey et al., January 24, 2005, pp. 11).

536. Some states (New York and Florida) have recommended that the magnetic field at the edge of the right-of-way not exceed 150 – 250 mG. The basis of this recommendation is an objective of maintaining the status quo – assuring that magnetic fields for new lines will be within the range of those that could be associated with existing lines. The magnetic fields that would be associated with both the overhead and underground sections of the new and reconstructed lines, as proposed, are well within all standards and guidelines adopted or recommended by siting agencies. *Companies' Ex. 74* (Testimony of Carberry et al., May 3, 2004, pp. 5); *Companies' Ex. 75* (Testimony of Bailey, May 3, 2004, at Attachments 2, 4 and 5); *Companies' Ex. 183* (Testimony of Bailey et al., January 24, 2005, p. 11); *Companies' Administrative Notice Item 15* (Position Paper on Electric and Magnetic Power Frequency Fields and The Velco Northwest Vermont Reliability Project, prepared by the Vermont Department of Health, Division of Health Protection, December 15, 2003); *Companies' Administrative Notice Item 29* (Final Decision of the Vermont Public Service Company ("VPSC") in its Docket No. 6860, *Petitions of Vermont Electric Power Company, Inc.,* concerning the Northwest Vermont Reliability Project); *Companies' Administrative Notice Item 16* (State Policies with Respect to 60 Hz Electric and Magnetic Fields); 3/25/04 Tr. at 284 (Cole).

537. Some states have adopted non-binding "goals" for edge of ROW magnetic fields for new transmission projects, which are lower than the 150-250 mG levels *recommended* by New York and Florida. Massachusetts observes a "threshold" of 85 mG, and considers edge of ROW fields below that threshold to be acceptable. *Woodbridge Organizations' Ex. 8* (Testimony of Bell et al., May 11, 2004, at Appendix, Item 5).

538. Recently, the Vermont Public Service Commission approved new 115-kV and 345-kV transmission lines after considering a comprehensive assessment of the evidence of EMF and health effects prepared by the Vermont Department of

Health. *Companies' Administrative Notice Item 15* (Position Paper on Electric and Magnetic Power Frequency Fields and the Velco Northwest Vermont Reliability Project, prepared by the Vermont Department of Health, Division of Health Protection, Dec. 15, 2003); *Companies' Administrative Notice Item 29* (Final Decision of the Vermont Public Service Company ("VPSC") in its Docket No. 6860, *Petitions of Vermont Electric Power Company, Inc.,* concerning the Northwest Vermont Reliability Project).

539. In this evaluation, the Vermont Department of Health "applied the ICNIRP [833 mG] and IEEE [9,040 mG] guidelines for electric and magnetic power frequency fields." *Companies' Administrative Notice Item 15* ("Position Paper on Electric and Magnetic Power Frequency Fields and The Velco Northwest Vermont Reliability Project," prepared by the Vermont Department of Health, Division of Health Protection, December 15, 2003, pp. 44, 45).

540. In its Final Decision on the Velco Northwest Reliability Project, on January 28, 2005, the Vermont Public Service Commission announced that it would continue to follow a policy of "prudent avoidance" in the siting of transmission lines, and approved a line expected to produce edge of ROW magnetic fields of 14mG to 42 mG at average loads, and 183 mG to 286 mG at maximum continuous loads. *Companies' Administrative Notice Item 29* (Final Decision of the Vermont Public Service Company ("VPSC") in its Docket No. 6860, *Petitions of Vermont Electric Power Company, Inc.,* concerning the Northwest Vermont Reliability Project, pp. 6, 64).

541. In 1999, the Public Service Commission of Wisconsin announced that, in light of the growing scientific consensus that despite many years of focused research, exposure to power frequency EMF has not been shown to adversely affect human health, it would no longer require low-EMF design structures where practicable. *Companies' Ex. 75* (Testimony of Bailey, May 3, 2004, at Attachment 3 (Wisconsin Public Service Commission, Dkt. 05-EP-8, Advance Plans for Construction of Facilities, Findings of Fact, Conclusions of Law, and Phase II Order)).

542. No evidence was presented of any state standard, recommendation, or goal for projected edge of ROW magnetic field values under average loading of less than Massachusetts' non-binding goal of 85 mG. *Record of Docket 272.*

14.5 Best Management Practices

543. The project as proposed, and as the Council may modify it by the adoption of low magnetic field structure designs for overhead sections, will be consistent with the Council's Electric and Magnetic Field Best Management Practices. *Companies' Ex. 1* (Application, Vol. 6, "Electric and Magnetic Field Assessment: Middletown-Norwalk Transmission Reinforcement").

544. The Council's Electric and Magnetic Field Best Management Practices in effect at the time this Application was filed were those initially adopted on February 11, 1993 ("Original BMP's"). *Companies' Ex. 1* (Application, Vol. 6, "Electric and Magnetic Field Assessment: Middletown-Norwalk Transmission Reinforcement"). The Council adopted revised Electric and Magnetic Field Best Management Practices for the Construction of Electric Transmission Lines in Connecticut, effective December 21, 2004 ("Revised BMP's"). *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). (While the Revised BMP's were listed on the Hearing Program as *Council's Administrative Notice Item No. 29*, the Council did not take administrative notice of the Revised BMP's during the proceeding. 1/5/05 Tr. at 13-15, 131; 1/5/05 Tr. (Special Meeting) p. 3. *See also*, Council's Hearing Program on which this item remains highlighted). This may have been inadvertent, in which case the Council can still take notice of the Revised BMP's after the record closes. On the other hand, the Council may have deliberately not taken notice of the Revised BMP's, contemplating an amendment or recession, or recognizing that the Revised BMP's, adopted more than fourteen months after the Application was filed, and two months before the close of hearings, should not apply to this Application. Accordingly, these draft Findings of Fact have been drafted to satisfy both the Original and Revised BMP's)

In accordance with the Original and Revised BMP's:

a. The Council has taken administrative notice of and otherwise considered completed and ongoing EMF research. (*See preceding citations)*

b. The Companies have provided project-specific assessments of EMF, including:

   Measurements and calculations of electric and magnetic fields from existing and proposed transmission lines for proposed overhead rights of way and at the sites of existing and proposed substations have been prepared. *Companies' Ex. 1* (Application, Vol. 6, "Electric and Magnetic Field Assessment: Middletown-Norwalk Transmission Reinforcement," p. 12-23); *Companies' Ex.* 35 (Letter to Pamela B. Katz, Chairman, regarding updates to EMF Modeling, dated March 15, 2004)

   Information concerning the location of "statutory facilities" (P.A. 04-246) and other BMP "areas of interest," collectively, residential areas, public and private schools, licensed youth camps, public playgrounds, licensed day care facilities, hospitals, and licensed nursing homes within 300 feet of the proposed lines; measurements of existing electric and magnetic fields at such areas of interest; and calculations of expected EMF levels at the above listed locations under normal and peak normal operating conditions. *Companies' Ex. 1* (Application, Vol. 9, 400' Scale Aerial Photographs of Proposed Route); *Companies' Ex. 132* (Map satisfying requirement C.G.S. 16-50l(a)(1), as amended – Segments 1 and 2); *Companies' Ex. 173* (Maps, with cover letter dated December 28, 2004, showing facilities and areas along segments 3 and 4, the underground portions of Alternative A within segments 3 and 4, and the underground portion of Alternative B within segment 3); *Companies' Ex. 138* (Buffer zone statutory facilities adjacent to the proposed route submitted at July 28, 2004 hearing); *Companies' Ex. 124* (Testimony of Bailey, July 19, 2004, at Ex. 2) (measured and calculated fields from existing lines, originally proposed lie designs, and low magnetic field line designs)); *Companies' Ex. 150*, Responses to D-W-04, Q D-W-064, 065, 066, 067, 068; *Companies' Ex. 121* (Ex. 2, Table of "Buffer Zone" Facilities, with measured and calculated fields); *Companies' Ex. 142*, Response to AG-03, Q-AG-03-016; *Companies' Ex. 143,* Responses to AG-03, A-AG-03-015, 017-034 (providing measured and calculated fields from existing lines to broader list of facilities); *Companies' Ex. 79* (Structures within 3mG & 6 mG fields, dated May 7, 2004); *Companies' Ex. 92* (Summaries of the Number of Structures, dated May 27, 2004); *Companies' Ex. 148* (Supplemental to Exhibit 79 and 92 – Summaries of the Number of Structures, dated August 18, 2004); *Companies' Ex. 154* (Buffer Zone Maps showing the ROW, dated September 24, 2004);

Calculations of transmission line magnetic fields at right-of-way edge, at one foot intervals (profiles) and at 15 foot intervals from lines, and at areas of interest under expected normal (average) loads and under peak loads that stress the transmission system, assuming the construction of the overhead lines as proposed, and alternatively the construction of various "low magnetic field" line designs. *Id.; see also Companies' Ex. 96* (EMF Mitigation for all Cross Sections of Overhead Route with a Basis of Comparison, dated May 28, 2004); *Companies' Ex. 124* (Testimony of Bailey, July 19, 2004, at Exhibit 2); *Companies' Ex. 73* (Testimony of Bailey, April 30, 2004, Errata Replacement Page 15); *Companies' Ex. 136* (Middletown-Norwalk Project low magnetic field transmission design options submitted at the July 27, 2004 hearing); Companies' *Ex. 140* (Optimized EMF reductions by cross section summary submitted at July 29, 2004 hearing); *Companies' Ex. 145* (Updated Homework - Optimized Magnetic Fields Reduction Summary); *Companies' Ex. 148* (Supplemental to Exhibit 79 and 92 – Summaries of the Number of Structures, dated August 18, 2004); *Companies' Ex. 135* (Dr. Bailey's presentation of split-phasing bulk file of CD submitted at July 27, 2004 hearing); *Companies' Ex. 158* (Mapping homework assignment presented September 28, 2004. Number of structures within the 300-foot buffer, 6 millgauss boundaries of mapping provided in Exhibit 154); *Companies' Ex. 159-161* (Magnetic Field Calculations for Figures 46, 47, and 48 in Application Vol. 6); *Companies' Ex. 170,* Responses to CSC-05, Q-CSC-05-091-094 (identifying statutory facilities in calculated fields of 6 mG or more and additional mitigation to get below 6 mG in 15 GW Case); *Companies' Ex. 163* (Revised "Buffer Zone" maps [Exhibit 154] with circles around structure locations, dated October 5, 2004); *Companies' Ex. 82A and 82b* (B'nai Jacob – North ROW: 15GW Case (with relocated ROW) and Jewish Community Center: 15GW Case); *Companies' Ex. 189* (Route variations, EMF calculations and cross section drawings for structures on property of the Jewish Community Center dated January 27, 2005).

Calculations of magnetic field levels at the edge of the overhead ROW assuming the loading of the lines to 80% and 100% of their rated current carrying capacity, for both the existing and proposed lines. *Companies' Ex. 45,* Response to Towns-02, Q-Towns-037, 38.

Calculations of EMF from the proposed underground XLPE cables. *Companies' Ex. 162* (PDC Document titled <u>Magnetic field calculations for Middletown-Norwalk 345-kV XLPE transmission cables</u>, dated September 27, 2004).

Calculations of magnetic fields under expected normal and peak conditions from the proposed underground lines; *Companies' Ex. 174* (AC Magnetic Field from XLPE Cable at 1 Meter Above Ground for 15 GW Case).

c. Magnetic field measurements were taken in accordance with a uniform measurement protocol - the IEEE Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields From AC Power Lines. *Companies' Ex. 1* (Application, Vol. 6, "Electric and Magnetic Field Assessment: Middletown-Norwalk Transmission Reinforcement," p 8); *Companies' Administrative Notice Item 28* (IEEE Standard 644-1994, Standard Procedures for Measurement of Power Frequency of Electric and Magnetic Fields from AC Power Lines, dated March 7, 19951/05/05 Tr. at 141, 142 (Johnson); 2/1/05 Tr. at 59-64 (Johnson, Bailey and Zaklukiewicz).

d. The Council requested comments from the Department of Environmental Protection, the DPUC, and the Department of Public Health. Only the DPH provided comments concerning EMF. The DPH provided extensive comments and testimony. *Council's Ex. 5* (Testimony of Ginsberg, May

6, 2004); *Council's Ex. 6* Testimony of Ginsberg, June 17, 2004) 3/25/04 Tr. at 306-316 (Ginsberg); 5/12/04 Tr. at 98; 170-72 (Ginsberg); 5/13/04 Tr. at 68-189 (Ginsberg); 6/16/04 Tr. at 7-8; 311 (Ginsberg); 6/17/04 Tr. at 8-20 (Ginsberg); 7/29/04 Tr. at 20 (Ginsberg); 10/14/04 Tr. at 84-85; 177-89 (Ginsberg).

e. The Companies presented extensive evidence concerning further potential reduction of magnetic fields by the use of low-EMF designs, including split-phasing of the 345-kV line to achieve optimal magnetic field cancellation; increasing structure height; optimizing the location of structures on the ROW; and adding structures ("compact spacing" of structures).

f. The Companies presented evidence as to the incremental cost and practicality of the low magnetic field designs. *Companies' Ex. 172* (Testimony of Bartosewicz et al., December 28, 2004, pp. 1-8); *Companies' Ex. 156,* (Testimony of Prete, September 24, 2004, pp. 4-9); 1/20/05 Tr. at 208-213 (Bartosewicz and Prete); 2/1/05 Tr. at 140-285 (Bartosewicz and Prete); *Companies' Ex. 194* (Response to Restated Question, dated February 3, 2005); *Companies' Ex. 191* (Aerial Mapping, Segments 1 and 2, dated January 28, 2005).

g. The lines will be constructed in accordance with the National Electric Safety Code. *Companies' Administrative Notice Item 7* (Connecticut General Statutes Section 16-243 and Sections 16-11-137 and 139 of the Regulations of Connecticut State Agencies (and reference, the National Electrical Safety Code ANSI C2, 2002 Edition); *Companies' Ex. 1* (Application, Vol. 1, Technical Description, p. I-21, 57, 58); 1/5/05 Tr. at 135-140 (Zaklukiewicz); 2/1/05 Tr. at 51-55 (Zaklukiewicz).

h. The Council may require, as part of its D&M Plan that post-construction measurements of EMF be obtained and reported to the Council.

14.6 Buffer Zones

545. The Council is not required to establish a "buffer zone" defined by a particular distance from the transmission lines, a specific milligauss limit, or any other characteristic. Rather, it is required only to make a factual finding that the overhead sections of the line will be contained within a buffer zone that will be adequate to protect the public health and safety. (Conn. Gen. Stats. § 16-50p(a)(4)(C)). The "buffer zone" must be at least equal to the existing ROW.

546. Similarly, the Council must find that the location of the line will not pose an undue risk to persons or property along the area traversed by the line (Conn. Gen. Stat. § 16-50p(a)(5)).