Pre-filed Testimony

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CONNECTICUT SITING COUNCIL

Eversource Energy Application For A Certificate Of Environmental Compatibility And Public Need For The Construction, Maintenance, And Operation Of A 115-Kilovolt (kV) Bulk Substation Located At 290 Railroad Avenue, Greenwich, Connecticut, And Two 115-kV Transmission Circuits Extending Between The Proposed Substation and The Existing Cos Cob Substation, Greenwich, Connecticut, and Related Substation Improvements	DOCKET NO. 461A May 5, 2017

DIRECT TESTIMONY OF KENNETH B. BOWES IN SUPPORT OF PROPOSED MODIFIED PROJECT

Introduction

Q. Mr. Bowes, what is your current position with the Connecticut Light and Power Company doing business as Eversource Energy?

A. My current position is Vice President, Transmission Performance.

Q. Please introduce the other panel members who may assist you in responding to questions posed by the Council and any parties or intervenors.

A. At the table here with me are Jason Cabral of Burns & McDonnell, who is now Project Manager of the Greenwich Substation and Line Project, and who took the lead, under my supervision, in the design of the "Proposed Modified Project" presented in our Petition for Reconsideration, and Michael Libertine of All-Points Technology Corporation, who has done the supplemental environmental analyses for the Proposed Modified Project. Others on the project team who might be called upon to answer specific questions are Farah Omokaro, Eversource Manager, Project Solutions, who supervised the revised need analysis; John Case, Eversource Manager, Transmission Line Engineering, who assisted with the cost estimation; Christopher Soderman, Eversource Lead Engineer, who prepared the supplemental electric and magnetic field analyses provided with our Petition for Reconsideration, and Ronald Araujo, the leader of a team working with the Town of Greenwich on energy conservation. Statements of our qualifications are provided in *Attachment B* to this testimony.

Q. What is the subject matter of your testimony?

A. This testimony concerns the following subjects:

- The continuing public need for reliability improvements to the electric distribution system of the Town of Greenwich, which was initially identified by the Council in its decision denying "without prejudice" the original Greenwich Line and Substation Project (GLSP) in Docket 461.

- The "Proposed Modified Project" presented by our petition, which is described in detail in *Exhibit A* to the Petition, as well as two potential variations of that project, and an Alternate Modified Project specified by the Town of Greenwich, which is described in detail in *Exhibit B* to the Petition.

- The environmental effects of each project.

- EMF that would be associated with each project.

- Eversource's efforts to work with the Town of Greenwich to identify a mutually acceptable solution, which did not result in an agreement, but which did result in the identification, design, and evaluation of the Alternate Modified Project.

- Eversource's efforts to work with the Town of Greenwich to reduce future load growth.

- A comparison of the Proposed Modified Project, the Alternate Modified Project, and the GSLP as originally proposed in Docket 461.

- An explanation of how the Proposed Modified Project and the Alternate Modified Project address the deficiencies of the GSLP that the Council identified as its reasons for denying approval of the GSLP.

- Eversource's notification to abutters of the overhead segment of the transmission line of the Proposed Modified Project of our plans to present the Proposed Modified Project and the Alternate Modified Project to the Council.

Continuing Public Need for Greenwich Reliability Improvements

Q. Please explain the public need for the Proposed Modified Project.

A. The need for the Proposed Modified Project is the same system need that the Council identified in its Findings of Fact and Opinion of May 12, 2016, in Docket 461, when it declined to approve the GSLP as originally proposed. At that time, the Council concluded that "the current electric system serving Greenwich is antiquated and was designed to serve much lower load demands than exist today" (Opinion, p. 4) and that "the proposed GSLP, or some variation thereof, is necessary for the reliability of the electric power supply of the Town of Greenwich. (Opinion, p. 6). The detailed support for this conclusion is provided by Findings of Fact Nos. 33 – 108. I will not reproduce all of these detailed findings here, but provide only the highlights:

49. The electric distribution system in Greenwich was designed over 50 years ago to serve much lower load levels than those that exist today…

50. Greenwich is at the farthest extent of Eversource's electric network in southwest Connecticut. Greenwich is electrically isolated and relies heavily on one bulk substation, the Cos Cob Substation, to provide power to three distribution substations in Greenwich; the Prospect, Byram and North Greenwich Substations…

56. The Cos Cob Substation is one of two bulk substations in Eversource's service area that has three transformers serving 27.6-kV load. No bulk substation in Eversource's service area has four or more transformers serving 27.6-kV load…

57. Approximately 76 percent of the Western Greenwich area is served by the 27.6-kV system. There are no other nearby substations that can serve load at 27.6-kV…

62. A contingency event, an event causing the loss of one or more system components, would require the remaining system components to carry higher loads, leading to potential system damage due to component overloads. The Greenwich electric system needs additional capacity to avoid overloads during contingency events…

68. Although [interim] measures have delayed the need for a new substation, first identified in 1989, none of these measures would be a suitable long-term solution for the need of a new substation west of Indian Harbor, closer to the load center of Greenwich…

73. The 2011 [storm] event demonstrated inadequate supply of power during contingency events, an unacceptable interruption of service (over 5,000 customers lost power) and cascading effects from the interruption in service, and the inability to recover from the interruption in a timely manner (75 minutes to 18 hours).

79. Four 27.6-kV distribution circuits from Cos Cob Substation provide power to the Prospect Substation. If one or more of these circuits is out, the remaining circuits must carry the load. If two of the circuits are out during summer peak conditions, load would have to be shed to protect system components…

80. The Prospect Substation is a non-bulk substation with a 55 MVA capacity. It is only served by Cos Cob Substation and only has about a one percent backup from other sources in the event of an outage of the entire substation.

89. Electric power at 27.6-kV cannot be transferred [from Cos Cob] to another substation to reduce power demand on the transformers, thus causing electrical components to go into emergency ratings. Although Eversource is willing to operate equipment above nameplate ratings for short intervals, it cannot operate its equipment in their emergency ratings for extended periods of time without permanent damage to equipment. As the age of the equipment increases, the more likely permanent damage would occur if operated above its nameplate rating…

90. Eversource does set a transformer emergency rating, but operating in this rating has the potential to create a one percent loss of service life for each emergency occurrence. The maximum short-term emergency loading during contingency events is 135 MVA on two transformers for a maximum of two hours…

92. Overloads on the current electric system could lead to loss of service to Greenwich customers through equipment failures or through targeted electric curtailments to protect system components…

93. Under existing circumstances, with no increase in capacity, there is a possibility that there would be an overload at the Cos Cob Substation…

Q. In the course of developing the Proposed Modified Project, did Eversource confirm the reliability need the Council found to exist in its Opinion and Findings of Fact?

A. Yes, we did.

Q. What did you do to confirm that need?

A. First, in light of the Council's conclusion that the scope of the GSLP, which would have provided reliability for a 30- to 40-year planning horizon, was unnecessarily large and therefore unnecessarily costly, we determined to assess the needed scope of system improvements based upon the historical 2013 peak load on the Greenwich 27.6-kV system served by the Cos Cob Substation, which was 130.5 MVA. We felt that this peak load, which had occurred within the last three years, could be deemed representative of current conditions. We then ran a set of contingency simulations assuming that peak load. The results of those simulations confirmed the same reliability deficiencies in the existing system identified by the Council in its May 2016 decision: potential overloads of the distribution feeders supplying power to Prospect Substation from Cos Cob Substation; and potential transformer overloads at Cos Cob Substation and at Prospect Substation.

Q. Please explain the contingencies that were simulated to test the reliability of the Greenwich distribution system using the 2013 peak load, and the results of those tests.

A. In order to understand the contingencies that were simulated and their results, it is useful to refer to the simplified schematic one-line diagram of the Greenwich 27.6-kV system in *Figure 1* below. This illustration is consistent with, but less detailed than, the diagram in Finding of Fact 143.

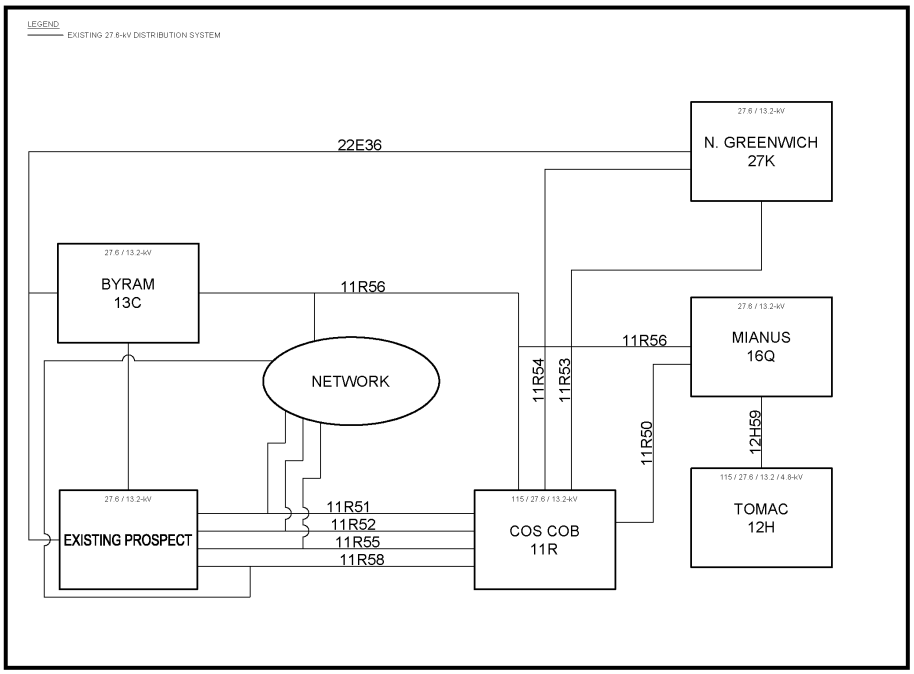

Figure 1, Greenwich Distribution System

To test system reliability, we simulated the performance of the system under the 2013 peak load first with all elements in service (the "N-0" condition) and then with each of the system elements of concern out of service ("N-1" conditions). These simulations confirmed the existence of the following system deficiencies:

Inadequate Distribution Feeders

As *Figure 1* shows, there are four 27.6-kV feeders from Cos Cob to the Prospect Substation. These cables operate in parallel, so that if one is lost from service (out of service or O.O.S) its load is automatically redistributed to the remaining three cables. When the loss of each of the cables was modeled with the 2013 peak load at the Cos Cob Substation of 130.5 MVA, remaining cables were overloaded. The results of this analysis are displayed in *Figure 2*:

Feeders	Load relative to Normal cable ratings			
11R51	O.O.S.	151%	140%	122%
11R52	117%	O.O.S.	109%	95%
11R55	114%	117%	O.O.S.	97%
11R58	73%	73%	69%	O.O.S.

Figure 2, Single Contingency Scenarios (N-1)

In fact, contingency simulations showed overloads on these feeders at loads much lower than the 2013 peak. Overloads on one or more of the feeders were seen at loads as low as approximately [82 MVA] or approximately 63% of the 130.5 MVA peak in 2013. Because the feeders are not all of the same length, and therefore have different impedances, in many conditions, the capability of the feeders left in service was insufficient to accept flow from one or more feeders lost from service, without overloading.

Insufficient Transformation Capacity

Both the Prospect and Cos Cob Substations were overloaded in the simulation using 2013 load levels.

A.) The Prospect Substation

The Prospect Substation has four transformers. One of them, the 4X transformer, is overloaded under N-0 peak load conditions. That is, even without the loss of any system element, the transformer will be required to operate in its emergency range. If the high load continues for more than 24 hours, the load on the transformer should be reduced to normal by shedding load, according to planning criteria. Of

greater concern, the loss of any of three substation transformers at peak load will overload others, as shown in *Figure 3*. In addition, since the 22E-3X transformer is not connected to any of the other transformers at Prospect Substation, its loss results in temporary load interruption without regard to the available capacity of the other transformers.

Transformers	Nameplate MVA	2013 Loading MVA	% Nameplate	N-1 % of Nameplate (N/O = <100%)				N-1 % of Emergency Rating (N/O = <100%)			
22E-1X	15	13.3	89%	O.O.S	168%	N/O	N/O	O.O.S	133%	NO	N/O
22E-2X	12.5	11.9	95%	202%	O.O.S	N/O	225%	158%	O.O.S	N/O	176%
22E-3X	12.5	9.8	78%	N/O	N/O	O.O.S	N/O	N/O	N/O	O.O.S	N/O
22E-4X	15	16.2	108%	108%	108%	108%	O.O.S	N/O	N/O	N/O	O.O.S
Total	55	51.2									

Figure 3, Prospect Substation Transformer Overloads

B.) The Cos Cob Substation

The Cos Cob Substation has three 115-kV to 27.6-kV transformers with nameplate ratings of 50.4 MVA, 46.7 MVA and 46.7 MVA, respectively. In the 2013 peak load condition, the loss of any one of these transformers placed the remaining transformers into their emergency ratings, *Figure 4* below shows the worst-case scenario, loss of the 11R-1X transformer.

Transformers	MVA		% Nameplate Rating	N-1	2-hr Rating	% of 2-hr rating	22- hr rating	% of 22-hr rating
	Nameplate Rating	2013 Load						
11R-1X	50.4	26.8	53%	O.O.S		O.O.S		O.O.S
11R-2X	46.7	52.1	112%	66.4	67.5	98%	62.00	107%
11R-3X	46.7	51.6	110%	64.1	67.5	95%	62.00	103%
Total Load MVA		130.5		130.5				

Figure 4, Loss of 11R-1X Transformer at Cos Cob Bulk 27.6 kV Substation

Q. In addition to the results of computer modeling, is there other evidence that the Greenwich distribution system fails to meet reliability criteria under current peak loads?

A. Yes, feeder overloads and loss of service to customers have actually occurred in contingent conditions at loads lower than the 2013 peak. The Council recognized a series of such overloads in its Finding of Fact No. 76:

> 76. In July 2015, three different underground 27.6-kV cable failures on three different days occurred on the 27.6-kV system from Cos Cob Substation to Prospect

Substation. These failures were not related to peak loading. The outages caused the remaining distribution cables to enter into their emergency ratings...

Q. Have there been additional instances of cable failures and overloads in actual operating experience since the Council's decision of May 2016 in this Docket?

A. Yes. On July 10, 23, and 25, 2016, there were a series of cable faults and overloads on the Greenwich 27.6-kV and 13.2-kV systems, which showed feeder deficiencies in addition to those of the Cos Cob – Prospect feeders, including 27.6-kV feeders from Cos Cob to the North Greenwich (11R53), Byram (11R56), and Mianus (11R50) Substations. The July 25 events resulted in the loss of 388 customers for 142 minutes.

Q. Has the Council recognized that overloads of equipment such as you have just described demonstrate reliability deficiencies that must be corrected?

A. Yes, the Council has routinely recognized this fundamental fact of reliability planning. In this Docket alone, see Findings of Fact Nos. 41, 62, 71, 76, 77, 89, 90, 91, 92, 93, and 167; and the Reliability section of the Opinion, pp. 4 and 5.

Q. Are there aspects of the design of the existing Prospect Substation and the condition of the equipment in it that exacerbate the modeled reliability deficiencies?

A. Yes. Overloading of the two 12.5 MVA transformers at Prospect is of particular concern because Eversource's operating experience with this type of transformer indicates that it is prone to failure when loaded above its nameplate (normal) capacity. Moreover, the substation switchgear is degraded and at the end of its useful life. The 13.2-kV switchgear in the Prospect Substation was installed in 1954, and so is over 60 years old. Eversource has deferred the expense of replacing it in the expectation that a solution to the Greenwich distribution deficiencies will be implemented that will allow the Prospect transformers and switchgear to be retired. Improving the Prospect Substation to add additional transformation capacity is not practical. There is no room to add additional 27.6 feeders. Finally, the Prospect Substation is located in a 500-year flood plain. Requirements of PURA and the Siting Council adopted in response to the storm events of 2012 are such that if the substation were rebuilt, all of its critical elements would have to be located at least one foot above the 500-year flood level. The cost of such construction makes rebuilding of the substation in place impractical. As the Council recognized in its May 2016 Opinion, the Prospect Substation is "obsolete." (*Id*., at 5).

Q. Are there aspects of the design of the Cos Cob Substation that contribute to reliability deficiencies?

A. Yes. Unlike other bulk substations in the Eversource System, excess load caused by the loss of a transformer cannot be transferred from Cos Cob to another substation. However, 6 MVA of load can be transferred to the Cos Cob 13.2 KV system. Under the 2013 system peak condition assumed in the

current planning analysis, the ability to off-load that relatively small amount of power is sufficient to relieve the overloads on the transformers that remain in service after the failure of a single transformer. This is a key factor in maintaining continuity of customer service, since it is likely that a faulted transformer would require more than 24 hours to repair. Without the ability to transfer the 6 MVA to the 13.2-kV system, there would be no way to bring the remaining transformers down into their normal operating range after 24 hours except for a natural decline in load or shedding of customer load. In addition, the largest emergency mobile transformer that could be temporarily installed in the Cos Cob Substation has a capacity of only 30 MVA, which is insufficient to support the 2013 peak loading on either the 2X or 3X transformers. Accordingly, should one of these transformers be lost from service, the substation has to be manually reconfigured so that the mobile unit takes over the duty of the 1X transformer (which feeds North Greenwich) and the 1X transformer is configured to assume the duty of the transformer that is out of service. Any plan for resolving the deficiencies of the Greenwich distribution system should take into account the relatively small reliability margin at the Cos Cob Substation, which would likely disappear with 6 MVA of load growth, and the operability restrictions presented by the unequal loading of the transformers when a mobile unit must be substituted for one of the permanent transformers. In its Docket 461 Opinion, the Council recognized the small reliability margin at Cos Cob under current loads, and that the redistribution of bulk power between Cos Cob and a new Greenwich Substation would enhance the reliability of the system by allowing load transfers during contingency events. (*Id.,* at 5).

Finally, two of the three transformers at Cos Cob (the 11R-2X and the 11R-3X) are connected by a common bus served by a single circuit breaker. A fault on the bus or on the breaker would cause the loss of the entire load served by those transformers.

Q. By using a current (2013) peak load level for testing the need for system improvements, rather than a peak load that assumes peak load growth for many years into the future, are you creating a significant risk that the Proposed Modified Project will be itself obsolete as soon as it is built?

A. No. The regional bulk power system planning criteria, which must use a 20-year planning horizon and assume load growth consistent with the ISO-NE forecast, do not apply to the planning of local distribution systems, so we are free to proceed by smaller steps than required for the bulk power system. A reliability solution based on current loads will usually include some margin for growth. System elements such as lines, transformers, and breakers are manufactured in standard sizes, such that a system improvement that provides a minimum of required additional transformation or transmission capacity will typically provide somewhat more than required. This effect is particularly likely to occur when the study area is small, as is the case here. In this case, although the Proposed Modified Project was

designed to address only the modeled overloads associated with the 2013 peak load, the solution testing showed that it would function reliably with peak loads of up to 190 MVA because of the ability of the improved system to automatically transfer load between substations. This margin of 60 MVA above the current load represented by the 2013 peak provides a durable reliability solution. In addition, Eversource and the Town of Greenwich are committed to implementing aggressive energy efficiency measures that would enhance the longevity of the proposed solution.

Description of the Proposed Modified Project

Q. What are the principal elements of the Proposed Modified Project, which is described in detail in *Exhibit A* to the Petition for Reconsideration?

A. The principal elements of the Proposed Modified Project are:

- Build a new, open-air Greenwich Substation at 290 Railroad Ave. with two 60 MVA 115-kV / 13.2-kV transformers, surrounded by a 15' high brick veneer wall.
- Relocate seven existing 13.2-kV underground feeders currently feeding the existing Prospect Substation, to the proposed Greenwich Substation at 290 Railroad Avenue.
- Remove the four 27.6/13/2-kV transformers and associated switchgear at the existing Prospect Substation, leaving intact the ties to the 27.6-kV feeders serving certain large customers and the 27.6-kV network.
- Add a new 115-kV terminal at Cos Cob Substation to support the termination of two new circuits feeding the new Greenwich Substation, leaving intact the existing three 115-kV to 27.6-kV transformers (with nameplate ratings of 50.4 MVA, 46.7 MVA, and 46.7 MVA) and the existing space for an additional 115-kV to 27.6-kV mobile transformer.
- Build two "hybrid" 115-kV radial transmission circuits from Cos Cob Substation to the new Greenwich Substation, each consisting of:
  - two segments of cross-linked polyethylene (XLPE) underground conductor, originating at each of the Cos Cob and Greenwich Substations, totaling approximately 0.6 miles in length, and
  - an overhead segment approximately 1.5 miles long, supported by a common set of structures constructed adjacent and parallel to the Metro North Railroad (MNR) tracks, primarily on the south side of the tracks, utilizing the MNR right-of-way (ROW).

A one-line diagram of the Proposed Modified Project is provided below:

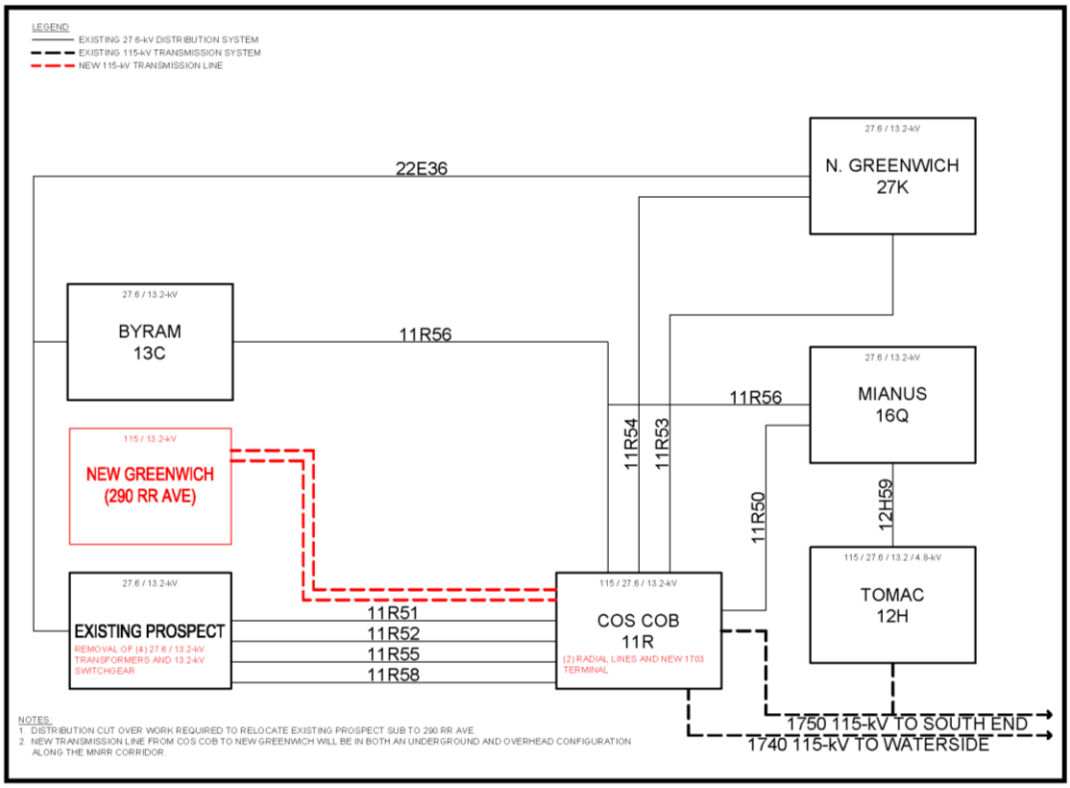

Figure 5, Proposed Modified Greenwich Substation and Line Project

Q. Does the Proposed Modified Project resolve the existing reliability problems you previously described of overloaded distribution feeders and insufficient transformation capacity?

A. Yes, it does. The addition of the two new 115-kV supply lines to the new Greenwich Substation provides ample feeder capacity, and the addition of the two new transformers at the new Greenwich Substation, together with the existing transformers at Cos Cob, provides ample transformation capacity. The four existing 27.6-kV distribution feeders will be off-loaded in this configuration, which will provide redundancy for the Greenwich secondary network under all load conditions.

Q. Does the Proposed Modified Project resolve the inability of the existing system to transfer load between substations in the event of transformer losses?

A. Yes. In the event of the failure of a single transformer at the new Greenwich Substation, the remaining transformer would be capable of serving the load until the failed transformer was returned to service, even under peak conditions, so there would be no need for transferring load to another substation. In the event of the loss of a single transformer at Cos Cob under peak conditions, load would be automatically transferred to the new Greenwich Substation, and the capacity of the remaining

transformers at Cos Cob and the transformers in the new Greenwich Substation would be sufficient to serve 100% of the load. In the event that two transformers were lost at either Cos Cob or Greenwich Substations, approximately 80% of the load would automatically be transferred to other substations and the remaining 20% of the load could be restored quickly by operator adjustments.

Comparison of the Proposed Modified Project to the Original GSLP

Q. What is the estimated cost of the Proposed Modified Project as compared to that of the GSLP, which the Council found to be unreasonably expensive?

A. We estimate the capital cost of the Proposed Modified Project as proposed to be approximately $78 million. A breakdown of that cost by the principal components of the project is provided in *Exhibit A* to the Petition, *Section A.4.5*. By comparison, the estimated cost of the original GSLP provided in Docket 461 was $140 million. The preliminary estimate of the capital cost of the Hybrid Alternative that Eversource developed in that proceeding was $118 million. (*See*, FOF No. 465).

Q. What accounts for this cost reduction of $62 million, as compared to the original GSLP and $40 million as compared to the Hybrid Alternative?

A. The principal factors for the reduction in cost are:

- The reduction in the capacity requirement of the new Greenwich Substation resulted in a change from three to two new transformers, and from six circuit breakers to one, and a reduction in other terminal equipment.

- A change from a GIS to an open-air design further reduced the cost of the new Greenwich Substation.

- Underground construction of the transmission lines was reduced from 2.3 miles in difficult locations, including a horizontal directional drill (HDD) to cross the MNR, to 0.6 mile in less challenging terrain, with no HDD. Although the specification of the cable type changed from high pressure fluid hilled (HPFF) cable to solid XLPE cable, which can be more expensive, the segment of cable required is short enough to avoid the need for cable splicing and associated vaults, which reduces the XLPE cost significantly.

- No modifications to the Byram Substation are proposed as part of this petition. Eversource recognized the Council's concerns with the original GSLP in regard to costs and determined that the Byram equipment can be upgraded in the future (as needed) by one or more distribution projects. Since modifications to this 27.6-kV to 13.2-kV substation would not be within the Council's jurisdiction, these modifications could be made without further proceedings before the Council.

The reduction in the estimated cost of the Hybrid Alternative (now the Proposed Modified Project) was also due, in part, to more detailed data developed since the GSLP proceeding in a more rigorous design and cost analysis that was made possible by the additional time afforded for them.

Of the approximately $62 million reduction in estimated costs as compared to the GSLP, approximately $23.5 million relates to the substation cost and approximately $38.5 million to transmission supply line costs.

Q. Are you confident that the Proposed Modified Project can be constructed?

A. Yes. Since the close of the previous proceeding, Eversource has worked extensively with MNR to confirm that the new transmission lines can be constructed within the available railroad ROW. This effort has required a 30% design of the overhead segment of the transmission lines, which has confirmed that there is sufficient room on the south side of the tracks to construct the lines without conflicts with the operation of the railroad, provided certain construction conditions are resolved. Because construction of the line within the MNR ROW on the south side of the tracks may be constrained by a Town of Greenwich sewer force main in one location, Eversource has designed a project variation that would move a portion of the line on the north side of the tracks. I discuss this "Force Main Variation" later on in this testimony.

Q. Will any easements from private property owners be required for the Proposed Modified Project?

A. When the line design and construction plans are completed, we may find that we will require temporary easements for construction in some locations, but we do not anticipate the need for any permanent easements from private landowners.

Q. Are the proposed improvements necessary for the reliability of the electric system of the State, as well as that of Greenwich?

A. Yes. Greenwich is part of the State of Connecticut, and the State's electric system cannot be considered reliable unless all of its cities and towns are served reliably. The residents of Greenwich and the businesses located there are important contributors to the economy and to the political and cultural life of the State, not just to those of Town of Greenwich. These contributions require reliable electric service in order to flourish.

Environmental Effects of the Proposed Modified Project

Q. Please summarize the anticipated effects on the natural environment of the Modified Project, which are discussed in detail in Petition *Exhibit A, Sections B* and *C*.

A. The Proposed Modified Project will not result in any permanent adverse effects on the natural environment. By using a combination of the existing MNR ROW and local roads, the Proposed Modified Route addressed several of the environmental concerns raised in Docket 461.

The proposed transmission pole near the intersection of the northern MNR ROW and Indian Field Road will require approximately 1,077 square feet of temporary impacts to a small wetland to accommodate a construction work pad. We plan to use timber mats to protect this wetland resource during construction activities. After construction, the timber mats will be removed and the affected wetland restored to its original condition. In two other locations along the MNR ROW, impacts to wetlands/watercourses will be avoided altogether by spanning them.

Clearing would be necessary along the southern MNR ROW, adjacent to the I-95 corridor, to provide construction equipment the necessary overhead clearances to work safely and to comply with conductor blowout clearance requirements. Approximately 5.5 acres of vegetation removal would occur within the MNR ROW and approximately 3.4 acres would be cleared in adjacent ConnDOT Highway ROW areas, avoiding residential properties. Those areas proposed for vegetation removal are developed with the transportation corridors and are heavily influenced by human disturbances. As such they have little wildlife habitat value.

The overhead transmission lines will need to be pulled approximately 73 feet between two (2) new transmission structures across Indian Harbor over the existing bridge within the elevated MNR ROW. No work within the water or along its banks is necessary to construct these two structures or to pull the lines.

Some portions of the Proposed Modified Route will extend through coastal boundary areas and flood zones, but its construction and operation will not result in any permanent adverse effects to these resources.

Q. Are the visual impacts of the Proposed Modified Project presented in the Petition?

A. Yes, *Exhibit A, Section C* discusses the visual effects of the Proposed Modified Project and *Appendix 5* in Petition *Volume 2* provides a set of visual simulations showing the pre-and post-construction appearance of key areas where the overhead segments of the transmission lines will be constructed, and a visual simulation of the new Greenwich Substation as proposed.

Q. What has Eversource done to mitigate the visual impacts of the overhead section of the transmission lines?

A. The most visually prominent component of the overhead line as proposed is the approximately 105-foot high western transition structure, which is proposed to be located in the vicinity of Steamboat Road. In the GSLP as originally proposed, this structure would have been approximately 25 feet east of Steamboat Road. The Town of Greenwich has requested that this structure be moved as far

away from Steamboat Road as possible. (See Findings of Fact Nos. 293 and 294 in the prior proceeding.) The Proposed Modified Project design locates this structure approximately 250 feet east of Steamboat Road. Visual simulations showing the structure and its surroundings at the location originally proposed and at the new proposed location are provided in Petition *Appendix 6* in Petition *Volume 2*. In addition, the section of line that is proposed to be constructed within the railroad ROW will be located on the south side of the tracks, where it will be proximate to I-95, municipal and commercial land uses, rather than on the north side of the tracks, where it would be adjacent to residential properties. The new transmission monopole structures will be constructed alongside existing railroad catenary support structures and lattice towers used for both railroad electrical and communications lines.

Electric and Magnetic Fields

Q. Has Eversource provided the measurements and calculations required by Council's Application Guidelines for electric transmission and substation applications?

A. Yes. A complete electric and magnetic field (EMF) characterization in conformity with those guidelines is provided in the Petition *Exhibit A, Section D.*

Q. Please summarize the magnetic fields that will be associated with the Proposed Modified Project.

A. The new line will be constructed underground in part. As the Council has recognized, magnetic fields associated with underground lines fall off very sharply with distance, thus minimizing exposures to nearby homes and other land uses. The overhead section will use a double circuit configuration with best phasing, which is similar to a "split-phased" configuration of a single circuit with respect to the EMF cancellation effect. Moreover, the overhead segment of the line will be constructed for most of its length between a railroad ROW and a limited access public highway, with the nearest residences on the opposite side of the railroad corridor. The overhead section of the line will not be adjacent to any private or public schools, licensed child day care facilities, licensed youth camps, or public playgrounds. As shown in the Petition *Exhibit A, Section D*, the new lines will have a negligible incremental effect on electric and magnetic field levels along the railroad corridor. Finally, magnetic fields from the new and upgraded substations will be below background levels beyond the substation property lines.

Development of the Proposed Modified Project

Q. Please describe how the Proposed Modified Project was developed.

A. After Eversource received the Council's denial without prejudice of our original proposal in May 2016, I convened a new team to develop a modified project that would conform to the guidance in

the Council's Opinion. I was and am the head of that team, and working directly under me are Farah Omokaro, who has significant competence and experience in both system planning and siting, and Jason Cabral, who has significant competence and experience in project design and construction. We also called upon cost estimation expertise of Eversource engineers and consultants. Our first task was to understand the guidance that the Council provided in its Opinion. The two principal messages that we saw in the Opinion were first, that the modified project must be substantially smaller and less expensive than that originally proposed; and second, that we should endeavor to work with the Town of Greenwich on demand side measures (DSM) to mitigate future load growth. We were also guided by the Council's strong opinion that we avoid a route through Bruce Park and that we attempt to reach agreement with the Town's representatives on the solution to be implemented.

We then made the decision, which I have already mentioned, to design a solution that would meet applicable reliability criteria assuming the 2013 peak load on the Greenwich 27.6-kV system of 130.5 MVA. This decision was premised on our recognition that any robust solution for the 130.5 MVA peak load would likely also provide some margin for growth, on our anticipation that regional growth forecasts were likely to be revised downward; and on an assumption that DSM could be implemented to mitigate future peak load growth. On that basis, we moved forward to reconsider both distribution and transmission solutions that would meet the redefined need, and to engage the Town both with respect to the design of the modified project that would be proposed and the implementation of DSM. Although we made progress with the Town with respect to DSM, we were unable to agree on the preferred solution.

Eversource determined that the most cost effective and reliable solution would be a 115-kV project substantially similar to the Hybrid Alternative that was preliminarily examined in the prior proceeding at the suggestion of the Council. (*See*, Docket 461 Opinion, pp. 6, 8). The Town prefers an all underground solution with the new Greenwich Substation enclosed in a structure designed to resemble a multiple unit residential building and located at 281 Railroad Avenue. This "Alternate Modified Project" is described in detail in *Exhibit B* to the petition.

Q. Given that the Council's Opinion suggested further development of the Hybrid Alternative, why did you go back to the drawing board to start over with the consideration of distribution alternatives?

A. We had two reasons: First, we wanted to make sure that we were not overlooking a more cost-effective solution that would be feasible given the changed condition of a lower peak load assumption. Second, we learned in an early stage of our consultations with the Town of Greenwich that the Town had a strong preference for a distribution solution, particularly one that would include supply lines installed underground. Accordingly, we decided that if we could develop an underground distribution solution that offered system benefits that were equivalent to those of a transmission solution

(which we recognized would most likely be the Hybrid Alternative) at a comparable cost to ratepayers, we could accommodate the Town's preference. That accommodation would have meant, of course, pursuing the distribution alternative without the need to return to this Council.

Q. Were you able to identify a feasible and practical distribution alternative to the Proposed Modified Project?

A. No, we were not. Even with a lower load, distribution solutions were not practical or cost effective, in comparison to a transmission solution. In particular, efforts to improve the electrical path between the Prospect and Cos Cob Substations by adding feeders or upgrading the existing feeders failed to prevent overloads because of the structural problem of the different impedances discussed previously.

Q. Did you consider whether any other type of non-transmission solution would be practical and feasible, given the lower load peak load assumption used for the design of the Proposed Modified Project?

A. Yes, at the request of the Town, we reconsidered whether some combination of distributed generation, energy storage, and demand response could substitute for a project that would require transmission improvement. As we did initially, we concluded that there was no practical or cost-effective non-transmission alternative.

Eversource's Efforts to Work with the Town of Greenwich

Q. Please describe Eversource's efforts to work with the Town of Greenwich in order to identify a mutually acceptable solution for the deficiencies of the Town's electric supply system.

A. Shortly after the Council's May 2016 ruling, we reached out to the Town and on June 28, 2016, we had a kick-off meeting that was followed by many project work sessions – approximately one a month, as well as conference calls, and correspondence – with the last meeting taking place on April 21, 2017. At the first meeting, we agreed to work on project design and energy efficiency/distributed generation issues on separate tracks, and proceeded to do so. Accordingly, in addition to the project meetings, there were a number of meetings and joint activities between Eversource and Town personnel concerning demand side measures. The project design meetings and related communications did not result in an agreement with respect to a project to be presented to the Siting Council. Nevertheless, Eversource worked with the Town to optimize the Alternate Modified Project that the Town prefers and agreed to present that project to the Council as a practical and feasible alternate to the Proposed Modified Project.

Q. Who participated in the project meetings?

A. For Eversource, Jason Cabral attended all of the meetings, and I attended all of them except for the first and last one and a small group technical meeting. Farah Omokaro also attended most

of the meetings. In addition, Eversource engineering and community relations personnel attended the early meetings, and Ronald Araujo, an energy efficiency representative attended the first meeting, before the separate track for the DSM meetings was established. For Greenwich, the Town Administrator, Director of Planning, Commissioner of Public Works, and Conservation Director attended all of the meetings except the small group technical meeting; First Selectman Tesei attended all of the meetings except the first and the small group technical meetings; and the Town's consultant, Mitchell Mailman attended all but the first meeting. Each side also had other representatives at some meetings.

Q. Please briefly summarize the matters discussed and actions taken at the project meetings, as well as the actions taken between meetings in support of the effort to agree on a preferred solution to the Greenwich reliability problems.

A. The meetings were very substantive and rather intense. Eversource made numerous presentations and answered many pointed questions concerning such subjects as the deficiencies of the Greenwich electric supply system; distribution and transmission reliability criteria; the comparative reliability of overhead and underground lines; the pros and cons of the two sites under consideration for the new Greenwich Substation; and many potential solutions that Eversource studied on its own initiative or at the request of the Town. These included at least eight potential distribution solutions with variations, all of which Eversource found to be impractical, ineffective, or unreasonably expensive. For its part, the Town provided critiques of Eversource's proposal of the GSLP and the modified transmission projects that Eversource presented to it. Until January of this year, the Town opposed any form of a transmission solution.

On January 13, 2017, at a small group "technical meeting" of Town representatives with Eversource engineers, the parties moved much closer together. In the course of that meeting, Eversource presented its perspective that all distribution solutions were inferior to a transmission solution from a reliability perspective and, in fact, were also comparable or more expensive in costs. Ultimately, the Town representatives stated that the Town would support either a transmission or a distribution solution that met certain essential criteria, including:

- All supply lines would be installed underground.
- The new substation would need to be entirely indoor and located on the north side of Railroad Avenue.
- The supply line route could traverse Bruce Park provided that it would be installed in the center of paved roadways, with no more than one set of vaults, with no construction in parkland, no tree removal or trimming, and the affected roads would be paved curb to curb after construction.
- No horizontal directional drilling would be used in the project.

Eversource thereafter proceeded, with assistance from the Town, to design, engineer, and evaluate a transmission project that would meet the Town's requirements, which the Town clarified and elaborated as the effort proceeded. The result is presented in this petition as the Alternate Modified Project. On March 27, 2017, Eversource made its final presentation to the Town in which it provided a detailed comparison of the two potential projects and informed the Town that it would be proposing the Proposed Modified Project to the Council and presenting the Town's Alternate Modified Project as a practical and feasible alternative. Further, Eversource wished to continue working with the Town to resolve remaining issues with the construction of both projects. The Town expressed its strong preference for the Alternate Modified Project and expressed several objections to the Proposed Modified Project, specifically:

- The visibility of the overhead section of the transmission line, particularly the western transition structure, is unacceptable to the Town.
- The proposed location of the overhead segment of the line conflicts with the existing Town sewer force main, which the Town will be required to maintain in place as a back-up after it is replaced by a new force main.
- The proposed substation location at 290 Railroad Avenue is near to a facility where propane and other industrial gasses are stored and sold.
- The Proposed Modified Project requires vegetation removal within the southern portion of the MNR ROW as well as adjoining, off-ROW areas; in total, nearly 9 acres.

For its part, in the course of the meeting and in correspondence, Eversource expressed its concerns about the Town's project preferences, specifically Eversource questioned whether:

- It could secure ConnDOT approval for attaching the cables to the Indian Field Road I-95 overpass.
- Anticipated significant opposition to the Town's preferred substation site from residential abutters could be overcome.
- Construction of the pedestrian bridge in Bruce Park and use of the Arch Street parking lot for a splice vault would be approved by the RTM.
- The opposition of state officials and the Council with respect to a transmission line route through Bruce Park could be overcome by confining construction to the park roads.
- The Town's stringent requirements concerning construction activities within Bruce Park were practical.
- The significant difference in the cost of the Town's preferred project as compared to that of the fully developed Hybrid Alternative outweighed the small advantages of the Town project.

Q. What are the principal components of the Alternate Modified Project?

A. The Alternate Modified Project meets the stipulations of the Town of Greenwich. The work at the Cos Cob and Prospect Substations would be the same as with the Proposed Modified Project. The electrical components of the new Greenwich Substation would be the same as in the Proposed Modified Project, but the substation would be located at 281 Railroad Avenue, and would be an "indoor" substation, for the most part enclosed by a structure that would resemble an apartment building, as illustrated by the simulation provided as *Appendix 10* found in Petition *Volume 2*. The supply lines connecting the Cos Cob and new Greenwich Substations would be constructed entirely underground, beneath public streets, including streets traversing Bruce Park, with the stipulations listed in the previous answer. *Exhibit B* to this Petition provides a detailed description of the Alternate Modified Project.

Q. What is Eversource's evaluation of the Alternate Modified Project?

A. The Alternate Modified Project is feasible and generally constructible. It would provide reliability equivalent to that of the Proposed Modified Project. Its transmission lines, being all underground, would not be visible. The Town's idea of using a direct route through Bruce Park while minimizing impacts to the park by installing solid dielectric cables (with no fluids) in roadways is a good one. On the other hand, the substation site specified for this project, 281 Railroad Avenue, would be located close to residences. Eversource would prefer to locate the new Greenwich Substation at 290 Railroad Avenue, the so-called "Pet Pantry" site, where the adjacent land uses are all commercial or industrial. Most significantly, the estimated cost of the Alternate Modified Project is substantially more than that of the Proposed Modified Project.

Q. What is the cost difference between the proposed and alternate projects?

A. The estimated cost of the Alternate Modified Project is approximately $100 million, which is approximately $22 million, or 28% more than the estimated cost of the Proposed Modified Project, which is approximately $78 million.

Q. You said that the Modified Alternate Project would be "generally" constructible. What reservations do you have with respect to its construction?

A. I am concerned that we would not be able to fully comply with the conditions that the Town has stipulated as part as of the project. In particular,

- *Construction in Bruce Park*

The Town would require not only that the transmission line be installed beneath the paved surface of roads through Bruce Park, but also that no construction activity whatsoever take place off of the roadways and that there not be any tree trimming or vegetation removal whatsoever. We would exercise our best efforts to confine construction to the roads and to avoid or minimize vegetation removal. However, for example, the contractor may well be required to remove a branch overhanging the road

that interfered with the passage or operation of equipment, or a vehicle may need to move partially off of the roadway to get by another vehicle.

- *Vault Location*

The Town stipulates that all vaults must be installed beneath paved road surfaces. However, Arch Street is a state road, and the state's policy is to require vaults to be installed in the shoulders of the road or otherwise away from the main travel surface. Therefore, the set of two vaults that would otherwise be required by the Town's stipulations to be constructed within Arch Street would need to be installed in an adjacent parking lot owned by the Town, for which an easement from the Town would be required. Approval of the Representative Town Meeting (RTM) would be required for the grant of the easement.

- *I-95 Bridge Attachment*

The Town proposes that the line cross I-95 by attaching to the underside of the Indian Field Road overpass, which would require an encroachment agreement from ConnDOT. We originally proposed to install the cable underground using pipe jacking construction for this crossing because we are aware that ConnDOT is reluctant to enter into such agreements when there is any other way to make the crossing. The Town believes that it could assist us in obtaining ConnDOT approval in this instance. However, if that attempt were unsuccessful, we would have to revert to the jack and bore approach, which would add approximately $2.8 million to the project cost.

- *Pedestrian Bridge Attachment*

The Town proposes that we avoid an HDD underneath Indian Harbor by constructing a pedestrian bridge approximately 180 feet long, parallel to the existing Davis Avenue Bridge (which is planned to be removed and replaced in the near future.) The cables would be installed beneath the travel surface of the bridge. The abutments at each end of the bridge would have to be constructed on Town property outside of a paved roadway, for which Eversource would require an easement. Approval of the RTM would be required for the easement.

Q. How does the cost of the proposed pedestrian bridge compare to that of a cofferdam traversing Indian Harbor?

A. We estimate that the cost of the bridge (not including any design amenities that might be added in the D&M stage) would be approximately $ 2.9 million, whereas the cost of the cofferdam would be approximately $1.1 million.

Q. Finding of Fact No. 258 in the original proceeding states that in order to develop the 281 Railroad Avenue as a substation site, Eversource would have to acquire adjacent developed properties. Would that be the case for the Alternate Modified Project?

A. We do not believe so. The substation would be smaller than originally proposed and so could be fitted to the existing site. In addition, since the substation would have less noise generating equipment and would be almost entirely enclosed by a building, it should be possible to comply with

applicable noise regulations at the property boundaries without enlarging the parcel. However, we would still expect that substation noise would be perceptible at neighboring residences.

Q. Is there an argument that the Alternate Modified Project would provide more system reliability than the Proposed Modified Project?

A. Yes, although I believe that they provide essentially the same reliability improvement. It is true that that underground supply lines are less susceptible than overhead lines to faults caused by external sources, such as falling trees, lightning strikes, or vehicle collisions with support structures. But, on the other hand, overhead lines can be repaired relatively quickly, whereas outages of underground lines are typically lengthy because of the time required to locate and repair faults. It is also the case that two circuits on a single set of overhead support structures are somewhat more vulnerable to a common mode failure than two underground circuits in a common duct bank. However, separating the new circuits between Cos Cob and the new Greenwich Substation would not eliminate this vulnerability because the Cos Cob Substation is itself currently supplied by two circuits that are on common structures for a distance of 3.7 miles along the MNR, which is a pre-existing condition that is applicable to both the Proposed Modified and Alternate Modified Projects.

Q. Please provide a comparison of the principal components and characteristics of the GSLP, the Proposed Modified Project, and the Alternate Modified Project.

A. We have provided such a comparison in tabular form in the Petition, as summarized in *Table P-2*.

Demand Side Management Work with the Town of Greenwich

Q. Please summarize the activities that Eversource undertook to assist the Town in identifying and implementing demand side measures to inhibit future load growth.

A. Mr. Ronald Araujo, Eversource Manager – Energy Efficiency, and David Ferrante, Manager- Distributed Energy Resources and Technology, met with Denise Savageau, Town resident C. Jefferson A. Parker Jr., and Urling Searle, Chairperson of the Greenwich Conservation Commission Energy Committee to review energy conservation measures and energy alternatives, including microgrids, and available sources of funding. Thereafter, an Eversource team working under Mr. Araujo's direction developed an Energy Conservation Action Plan to increase adoption of energy efficiency by town residents, businesses and Town facilities. This action plan includes joint marketing and outreach with the Town to its residents for a light bulb swap and engaging single family homeowners in energy efficiency efforts through the Home Energy Solutions program. Eversource and the Town continue to work together on energy efficiency outreach efforts and have events planned in April 2017 in conjunction with Earth Day.

Eversource also completed an energy benchmarking analysis of 19 town buildings and 15 Board of Education properties. Upon completion of the benchmarking activity, Eversource began conducting a detailed audit of efficiency opportunities at the Town Hall. Eversource also worked with the Town to apply for subsidies from the CT Green Bank for implementation of efficiency measures at one of its schools. The Town and Eversource continue to work together to implement practical energy efficiency measures and to obtain any available subsidies for them. The Town has also introduced members of Mr. Araujo's team to the design team of the Bruce Museum in order to assist them in incorporating efficiency measures in the construction of their new addition.

Outreach and Notification Efforts

Q. Please describe Eversource's outreach and notification efforts to public officials and residents potentially affected by the Proposed Modified Project and the Alternate Modified Project.

A. As part of the Municipal Consultation Process, prior to the filing of the original application, Eversource hosted two Open Houses, briefed federal and state elected officials and met with individual customers upon request. In support of the Petition for Reconsideration, the Project notified property owners along the routes of both the Proposed Modified Project and the Alternate Modified Project and abutters of the proposed and alternate locations of the new Greenwich Substation that the Petition would be filed. Additionally, Project team members kept federal and state elected officials apprised on the proposed Project changes.

Potential Variations of the Modified Project

The DOT Variation

Q. Please describe the potential DOT Variation to the proposed transmission lines that is discussed in further detail in *Exhibit A* to the Petition.

A. This variation would extend the underground portion of the transmission line by approximately 700 feet, to avoid an overhead crossing of Interstate Route 95. The extended segment of the line would be installed adjacent to Sound Shore Drive as that street passes underneath the I-95 overpass. This variation was developed at the request of the Connecticut Department of Transportation.

Q. What is the estimated incremental cost of this variation?

A. The incremental cost would be approximately $2.2 million.

Q. What is Eversource's evaluation of the DOT variation?

A. It is feasible and constructible. However, we felt that the incremental cost was not in keeping with our efforts to reduce the cost of the project in response to the Siting Council's guidance, and the overhead crossing of I-95 would not be unusual.

The Force Main Variation

Q. Please describe the Force Main Variation and why you have included it as a potential element of the Proposed Modified Project.

A. In the Docket 461 proceeding, the Town made known its plans for replacing a sewer force main within the MNR ROW. At that time, the Town's position was that if the Council approved the GSLP, it should require that the transmission lines be constructed along the hybrid route. Accordingly, the Town offered to cooperate with Eversource in coordinating the construction of the new force main to resolve any conflicts with Eversource's transmission facilities, and I testified that I expected that Eversource would be able to avoid or resolve any conflict between the transmission line and the force main. However, in our discussions that preceded the filing of this petition, the Town has maintained that construction of the overhead transmission line along the MNR as proposed would require the relocation of the existing force main, at a cost of many millions of dollars. Upon further investigation, we learned that the Town is in the process of contracting for the replacement of the existing main by the construction of a new main in a different location that would not conflict with the proposed line. However, the Town recently advised us that it must maintain the existing line in place after it is replaced, so that there is a conflict after all. It is the case that if the existing line had to be maintained in place, approximately 1,500 feet of it would conflict with the foundations for proposed structures 1406 through 1409. If the Town is indeed obligated to build a new force main in the MNR ROW, while still maintaining the old one there, Eversource would consider relocating the conflicting section of the old force main to another position within the MNR ROW that would avoid the conflict, which would require the cooperation of ConnDOT and MNR. The Town has advised us that it doubts that such a relocation would be technically feasible, but we have not independently evaluated its feasibility because we have insufficient information from the Town to do so.

Accordingly, to provide for the potential of an irreconcilable conflict between the existing force main and the proposed line, Eversource has designed the Force Main Variation. This variation would entail spanning approximately 1,850 feet across the entire area of conflict and Indian Harbor along the south side of the tracks. This would reduce the number of support structures from six to two, however, those two proposed structures would be approximately 195 feet tall. The Force Main Variation is described in detail in *Section F* of Petition *Exhibit A.*

Q. What is the estimated incremental cost of the Force Main Variation?

A. Eversource estimates the incremental cost of the Force Main Variation as approximately $0.7 million.

Q. What is your evaluation of the Force Main Variation?

A. The Force Main Variation would alter the visual effects of the Proposed Modified Project by introducing two support structures that would be approximately 70 feet higher than the typical structures. Some homes on Circle Drive and Woodside Drive would have partially screened views of the taller Force Main Variation structures. This increase in height could also result in a Federal Aviation Administration requirement to install lights at the tops of the structures. The combination of increased height and lights raises the potential for adding an incremental visual impact throughout portions of the Project Area. On the other hand, this variation would remove four proposed new structures along the MNR ROW, and would avoid creating views of those structures from several residential properties.

The Prior Proceedings Support Approval of the Modified Project

Q. Do the Findings of Fact that the Council made in the previous proceeding on Eversource's original Project have continuing validity and relevance, as applied to the Proposed Modified Project?

A. Yes, many of them are applicable, although they need to be supplemented by findings concerning the changed conditions that have occurred and submissions that have been made since the Findings of Fact were issued. *Attachment A* to this testimony provides a guide to the continuing validity and application of the original Findings of Fact. Many Findings of Fact that have particular continuing significance have been specifically incorporated by reference or quoted in the Petition and its Exhibits as well as in this testimony.

Q. In your opinion, has Eversource heeded the guidance provided by the Council in its Opinion and Decision and Order in which it denied Eversource's initial application "without prejudice?"

A. Yes. Eversource has:

- reduced the cost of the proposed project from approximately $140 million to approximately $78 million by reducing the scope of its proposed solution, while still meeting current and future needs for reliability improvements in the Greenwich electric supply system, which is an important part of the state's system;
- reduced substation costs by reducing capacity and not using GIS technology;
- fully developed and evaluated the Hybrid Alternative identified by the Council in Docket 461, including its cost, visual impact, and EMF characterization;
- engaged in outreach to residents affected by the proposed overhead lines;
- worked with the Town of Greenwich to implement energy conservation measures;

- minimized the environmental effects of the proposed project, including by avoiding a route through Bruce Park;

- made a major effort to agree on a solution with the Town of Greenwich, and when that proved to be not possible, designed an alternate project that would meet the Town's requirements and presented that project to the Council.

Eversource respectfully submits that its Proposed Modified Project provides needed system reliability at the lowest reasonable cost to consumers while minimizing the project's environmental effects, all in conformity with the Council's Opinion in Docket 461. Based on the Town's submissions in Docket 461, the Council concluded that the Town would likely support a project similar to the Hybrid Alternative, with some modifications. (*See*, Finding of Fact No. 379, Opinion p. 6). This turned out not to be the case. Nevertheless, Eversource worked hard to develop an Alternate Modified Project that would be acceptable to the Town, and Eversource is prepared to construct it, should the Council determine that the Alternative is consistent with the requirements of the Public Utilities Environmental Standards Act. In that case, Eversource would likely seek relief from some of the strictures that the Town would prefer to impose on construction of the project.

Attachment A to Bowes Pre-filed Testimony

Analysis of Application of Findings of Fact in Docket 461

FOF	SUBJECT	COMMENT
1-8	Introduction	These findings are relevant and accurate statements of historical facts and proceedings
9-25	Council Procedures	
26	State Agency Comment	
28-32	System Planning and Mandatory Reliability Standards	
33-130	**Project Need**	
33-48	Needs Assessment	These findings remain accurate and relevant, Statements concerning the GSLP are historical and do not refer to the Proposed Modified Project (PMP) or the Alternate Modified Project. (AMP)
49-62	Greenwich Area Electric System	These findings accurately describe the existing Greenwich Area electric system.
63-69	Electric System Interim Measures	These findings are accurate statements of historic fact.
70-94	Current Electric System Reliability and Capacity Issues	These findings remain accurate characterizations of existing reliability issues, except for No. 81, which is a projection of future load that is not relevant to the changed circumstances of this proceeding.
95-108	Load Forecasting	These findings remain accurate and relevant
109-130	GSLP Reliability and Capacity Improvements	Findings 109-112,114, 118-120, 122- 124, and 126-129 remain accurate and relevant. As applied to the PMP and AMP, Finding113 should refer to two new larger capacity transformers; the permissible load capacity stated in Finding 115 would be 67 MVA; Finding 116 would be inaccurate because no transformers will be removed at Byram, with the result that only 55 MVA of capacity will be retired; Findings 121 and 125 and 130 do not apply to the PMP or AMP.
131-210	**Project Alternatives**	
131	No Action Alternative	This finding remains relevant and accurate.
132, 133	Transmission Alternatives	These findings remain relevant and accurate
134-137	Non-Transmission Alternatives	These findings remain relevant and accurate.
138-142	Distribution Alternatives	These findings accurately describe the analysis of distribution alternatives to the original GSLP and the cost of the

		distribution alternatives considered. Since the PMP and AMP have a lesser capacity and a lower cost than the original GSLP, the comparisons are not exact as applied to the them.
143-148	Existing Substations in Greenwich	These finding remain relevant and accurate.
149-155	Load Transfers Between Existing Substations in Greenwich	These findings remain relevant and accurate.
156-159	Existing Substations in Stamford	These findings remain relevant and accurate.
160-166	Load Transfer Between Existing Substations in Stamford	These findings remain relevant and accurate.
167-175	Larger Transformers at Cos Cob Substation	These findings remain relevant and accurate.
176-181	Generation Alternatives	Findings 176, 179, 180, and 181 remain accurate and relevant. Less generation capacity would be required to match that provided by the PMP than stated in Findings 177 and 178 with respect to the original GSLP.
182-185	Renewable Generation Alternatives	These findings remain relevant and accurate.
186-189	Microgrids	These findings remain relevant and accurate.
190, 191	Generation Interconnection Alternative	This finding remains relevant and accurate.
192-196	New York Interconnection Alternatives	These findings remain relevant and accurate
197-206	Demand Side Management Alternatives	These findings remain relevant and accurate.
207-210	Energy Efficiency	These findings remain relevant and accurate.
211-346	Project Description	This section describes the previously proposed GSLP, not the PMP or the AMP and so these Findings are largely irrelevant and superseded. However, some Findings have continuing validity and application to the PMP, as stated below.
212-247	Proposed Greenwich Substation – 290 Railroad Avenue	Findings 212-233 remain accurate and relevant to the PMP. Findings 234-240 are superseded by the project description in Exhibit A to the Petition.
252-258	Alternate Site – 281 Greenwich Ave.	Findings 252-255 and 257 remain accurate and relevant. Since no property acquisition would be required for a substation at this site as part of the PMP or AMP, Finding 256 and a portion of Finding 258 do not apply to the current proposal.
259-262	330 Railroad Avenue	These findings continue to be relevant and accurate.
263-269	Old Track Road	These findings continue to be relevant and accurate.

270-273	Cos Cob Substation Modifications	Finding 270 continues to be relevant and accurate as applied to the PMP and AMP. Findings 271 – 273, describing the modification work remain generally accurate but are superseded by the project descriptions in Petition Exhibits A and B.
274-275	Byram and Prospect Substations	The description in Finding 274 of the work at Prospect substation remains generally accurate as applied to the PMP and AMP but is superseded by the Project Description in Petition Exhibits A and B. Finding 273 is inapplicable to the PMP and AMP.
279-281	Preferred Route	While these findings have historical relevance, they do not apply to the PMP or AMP.
282, 283	Northern Alternative	While these findings have historical relevance, they do not apply to the PMP or AMP.
284-286	Southern Alternative	While these findings have historical relevance, they do not apply to the PMP or AMP.
287-303	Hybrid Alternative	While the Hybrid Alternative is the basis for the transmission line and route proposed as part of the PMP, and the description of it in these Findings is generally consistent with that of the PMP. There are many differences in detail due to the extensive engineering and design work that has been done since the decision in Docket 461. Therefore, the project description in Exhibit A to this petition supersedes these Findings, except to the extent that any are explicitly referenced and adopted in that description.
304-308	New 115-kV Transmission Line – Other Routes Examined and Rejected	These Findings are accurate statements of historical fact but do not apply to the PMP or AMP.
309-317	Underground Transmission System Design	These Findings have no application to the PMP or AMP.
318-346	**GSLP Construction Procedures**	
318-327	(General Procedures)	These Findings remain relevant and accurate as applied to both the PMP and AMP.
328-341	Underground HPFF Transmission System Construction	These Findings do not apply to the PMP or AMP and are relevant only in that they provide information about the original GSLP.
342-346	Horizontal Directional Drilling	These Findings do not apply to the PMP or AMP and are relevant only in that they provide information about the original GSLP.
347-367	Public Safety	These Findings remain accurate as applied to both the PMP and AMP.
368-446	**Environmental Considerations**	These Findings are generally superseded by the detailed analyses in Sections C and D of Petition Exhibit A (Proposed Modified Project) and Exhibit B (Alternate Modified Project). However, some Findings remain accurate and relevant as

		applied to the PMP and AMP as stated.
368-371	(General)	Findings 368-370 remain relevant and accurate as applied to both the PMP and AMP.
371-381	Land Use	Findings 372-375 remain accurate as applied to both the PMP and AMP.
381-394	Soil and Earthwork	Findings 382-390 remain accurate and applicable to the PMP and the AMP.
395-407	HDD and XLPE Work Considerations	These Findings do not apply to either the PMP or AMP.
408-426	**Water Resources**	
408-418	Coastal Area Resources	Findings 408, 409 are accurate and relevant to both the PMP and AMP.
419-421	Inland Wetlands and Watercourses	Finding 421 remains accurate and relevant to both the PMP and AMP.
422-423	Flood Hazard Areas	Finding 422 remains accurate and applies to the PMP. Finding 423 remains accurate and applies to the AMP.
424-426	Groundwater	Findings 424 and 425 remain accurate and apply to both the PMP and AMP. Finding 426 remains accurate and applies to the AMP.
427-431	Vegetation	Findings 427 and 430 remain accurate and apply to both the PMP and AMP.
432-437	Fish and Wildlife	Findings 432, 433 and the conclusion of no impact in Finding 434 remain accurate and relevant to both the PMP and AMP.
438-439	Historic Resources	These Findings remain accurate and relevant to both the PMP and AMP
440, 441	Air Quality	Finding 441 remains accurate and relevant to both the PMP and AMP.
442-446	Noise	Findings 442 and 446 remain accurate and relevant to both the PMP and AMP.
447-464	Electric and Magnetic Fields	Findings 447-454 and 456-458, which concern EMF generally, remain accurate and are relevant to both the PMP and AMP. EMF characterizations for the PMP and AMP are provided in Petition Exhibits A and B, respectively. Those for the PMP supersede Findings 455 and 459 – 464, which are specific to the project configurations considered in Docket 461.
465-471	**Project Cost and Cost Allocation**	To the extent that they relate to the estimated cost of the original GSLP, these findings have historic relevance. They are not relevant to the PMP or AMP. Estimated costs of the PMP and AMP are provided by this testimony and in Petition Exhibits A and B.

Attachment B to Bowes Pre-filed Testimony

Resumes from Ken Bowes, Farah Omokaro, Jason Cabral, Mike Libertine, Chris Soderman, Ron Araujo and John Case.

BIOGRAPHICAL INFORMATION

Kenneth B. Bowes

Kenneth B. Bowes is Vice President – Transmission Performance of Eversource Energy. He is responsible for the leadership and direction of the Eversource transmission business unit with respect to short and long term customer impacts and benefits as measured by transmission performance indicators, development of plans for compliance with FERC and state regulatory requirements, and compliance of transmission operations with regulatory requirements and Eversource benchmarks. He serves as a technical consultant for various large transmission projects, and provides expert testimony in regulatory proceedings concerning them.

A native of New Hampshire, Bowes joined Eversource in July 1984 in the System Test department. He has held several engineering and management positions in the Energy Delivery organizations becoming the Director – Transmission and Distribution Maintenance in 1999, Director – Transmission Construction, Test, and Maintenance in 2002, Director – Transmission Projects in 2004, Vice President – Customer Operations in 2008, and Vice President of Energy Delivery in 2010, Vice President of Engineering in 2014.

Bowes earned a Bachelor of Electrical Engineering degree from the University of New Hampshire and a Master's Degree in Electrical Engineering from Rensselaer Polytechnic Institute. Bowes is the past Chairman of the Edison Electric Institute's Transmission Committee and presently serves on the EEI Transmission and EEI Security Committees. He was inducted into the University of Connecticut Academy of Distinguished Engineers in 2016, and was elected to the Connecticut Academy of Science and Engineering in 2017.

PUBLICATIONS AND PREVIOUS TESTIMONY

Kenneth B. Bowes

Publications:

- Bowes K., Beehler M., "Defining the Value of the Grid", IEEE, The Sixth Annual IEEE PES Conference on Innovative Smart Grid Technology, February, 2015
- Bowes K., Hogan J., "CL&P Explores Sustainable Solutions", Transmission & Distribution World Magazine, January 2012, Volume 64, Number 1, pp. 24-31.
- IEEE Working Group on Nonsinusoidal Situations, "Practical Definitions for Powers in Systems with Nonsinusoidal Waveforms and Unbalanced Loads: A Discussion", 95 WM 040-6 PWRD, 1995
- IEEE Working Group on Nonsinusoidal Situations, "A Survey of North American Electric Utility Concerns Regarding Nonsinusoidal Waveforms", 95 WM 036-4 PWRD, 1995
- Bowes, K. B., "The Effects of Temporary Overvoltage (TOV) on Consumer Products", POWER QUALITY '91 USA, Official Proceedings of the Third International Power Quality Conference, Universal City, CA, September 22-27, 1991
- Bowes, K. B., Lorusso, A., "Harmonic and Power Characteristics of Electronic Ballasts for Fluorescent Lighting Applications", POWER QUALITY '90 USA, Official Proceedings of the Second International Power Quality ASD Conference, Philadelphia, PA, October 21, 29, 1990
- Anderson, L.M., Bowes, K.B., "The Effects of Power-line Disturbances on Consumer Electronic Equipment", IEEE Transactions on Power Delivery, Volume 5, Number 2, pp. 1062-65, April 1990
- Bowes, K. B., "The Effects of Power-line Disturbances on Electronic Products", POWER QUALITY '89 USA, Official Proceedings of the First International Power Quality Conference, Long Beach, CA, October 15-20-1989 (Also edited and reprinted in Power Quality Magazine - Premier V Issue)

Mr. Bowes has testified extensively in many cases in a variety of forums, including;

- Connecticut Siting Council Docket No. 461 – Eversource Energy application for a Certificate of Environmental Compatibility and Public Need for the construction, maintenance, and operation of a 115-kilovolt (kV) bulk substation located at 290 Railroad Avenue, Greenwich, Connecticut, and two 115-kV underground transmission circuits extending approximately 2.3 miles between the proposed substation and the existing Cos Cob Substation, Greenwich, Connecticut, and related substation improvements.
- Connecticut Siting Council Docket No. 292 – The Connecticut Light & Power Company application for a Certificate of Environmental Compatibility and Public Need for the construction and operation of 8.7 miles of new underground 115-kilovolt electric transmission cables extending from CL&P's existing Glenbrook Substation in the City of

Stamford, through the Town of Darien, to CL&P's existing Norwalk Substation in the City of Norwalk;

- Connecticut Siting Council Docket No. 302 – Northeast Utilities Service Company, on behalf of The Connecticut Light and Power Company (CL&P) application for a Certificate of Environmental Compatibility and Public Need for the construction, maintenance and operation of the proposed Killingly 2G Substation at 193 Tracy Road and 227-257 Park Road in the Towns of Killingly and Putnam, and the proposed connections to the existing #347 345-kV line and the existing #1607 and #1505 115-kV lines;
- Connecticut Siting Council Docket No. 311 – Northeast Utilities Service Company, on behalf of The Connecticut Light and Power Company (CL&P) Application for a Certificate of Environmental Compatibility and Public Need for the construction, maintenance and operation of the proposed Wilton 35A Substation at 53 Old Danbury Road in the Town of Wilton;
- Connecticut Siting Council Docket No. 326 – The Connecticut Light and Power Company application for a Certificate of Environmental Compatibility and Public Need for the construction, maintenance, and operation of a proposed substation located at Stepstone Hill Road, Guilford, Connecticut; and
- Connecticut Siting Council Docket No. 327 – The Connecticut Light and Power Company application for a Certificate of Environmental Compatibility and Public Need for the construction, maintenance, and operation of a proposed substation located off Commerce Drive, Oxford, Connecticut.
- Connecticut Siting Council Docket No. 352 – The Connecticut Light and Power Company application for a Certificate of Environmental Compatibility and Public Need for the construction, maintenance, and operation of a proposed substation located at 264 Rood Avenue and 25 Shelley Avenue, Windsor, Connecticut;
- Connecticut Siting Council Docket No. 461 - Eversource Energy application for a Certificate of Environmental Compatibility and Public Need for the construction, maintenance, and operation of a 115-kilovolt (kV) bulk substation located at 290 Railroad Avenue, Greenwich, Connecticut, and two 115-kV underground transmission circuits extending approximately 2.3 miles between the proposed substation and the existing Cos Cob Substation, Greenwich, Connecticut, and related substation improvements.

- State of New Hampshire, Before the Site Evaluation Committee, Docket No. 2015-06, Joint Application of Northern Pass Transmission LLC and Public Service Company of New Hampshire d/b/a Eversource Energy For A Certificate of Site and Facility To Construct A New High Voltage Transmission Line And Related Facilities In New Hampshire.

- Commonwealth of Massachusetts, Energy Facilities Siting Board, EFSB 07-4/D.P.U. 07-35/07-36, Petition of Russell Biomass, LLC. and Western Massachusetts Electric Company for a proposed project consisting of (1) an approximately 5.3-mile, 115 kilovolt transmission line from the proposed Russell Biomass generating facility in Russell to Western Massachusetts Electric Company's ("WMECo") transmission system in Westfield, and (2) a new switching station facility in Westfield.

- Connecticut Superior Court, Allyn vs. CL&P, CV-96-0109273-S;
- Connecticut Superior Court, Scanlon vs. CL&P, CV-96-0536911S;
- Connecticut Superior Court, Segalla vs. CL&P, X-04-CV-98-0117225S;
- DSV MR. SONNY: Damage to submarine electric cables in Long Island Sound. Complex, multi-party limitation of liability proceeding in U.S. District Court for the Eastern District of New York. Settled at mediation;
- Connecticut DPUC Docket No. 94-05-35 - DPUC Investigation Into Stray Voltage On Dairy Farms;
- Connecticut DPUC Docket No. 08-02-06, DPUC Investigation into The Connecticut Light and Power Company's Billing Issues;
- Connecticut DPUC Docket No. 09-12-05 - Application of The Connecticut Light and Power Company to Amend Its Rate Schedules;
- Connecticut DPUC Docket No. 10-03-08 – Investigation of the Service Response and Communications of The Connecticut Light and Power Company (CL&P) and The United Illuminating Company (UI) Following the Outages from the Severe Weather over the Period of March 12 through March 14, 2010;
- Connecticut DPUC Docket No. 10-05-09 - DPUC Investigation of the Safety of the Connecticut Light and Power Company Underground Electric Distribution System in Waterbury;
- Connecticut PURA Docket No. 11-03-07, PURA Investigation Into The Appointment Of A Third Party Statewide Utility Telephone Pole Administrator For The State Of Connecticut; and,
- Connecticut PURA Docket No. 11-09-09 - PURA Investigation of Public Service Companies' Response to 2011 Storms;
- Connecticut PURA Docket No. 12-01-07 – Application for Approval of Holding Company Transaction Involving Northeast Utilities and NSTAR;
- Connecticut PURA Docket No. 12-01-10 - Investigation into the Tree Trimming Practices of CT Utility Companies;
- Connecticut PURA Docket No. 12-06-09 - PURA Establishment of Industry Performance Standards for Electric and Gas Companies;
- Connecticut PURA Docket No. 12-07-06RE01 – Application of the Connecticut Light and Power Company For Approval of its System Resiliency Plan – Expanded Plan;
- Connecticut PURA Docket No. 12-06-12 – PURA Investigation of the Feasibility of the Establishment of a Program to Reimburse Residential Customers for Spoilage Loss of Food items or Refrigerated Medications Caused by a Lack of Refrigeration During Electric Service Outages;
- Connecticut PURA Docket No. 12-09-13 – PURA Investigation of the Best Practices of Other State Public Utility Commissions, Public Utility Companies and Municipal Utilities' Emergency Management Best Practices;
- Connecticut PURA Docket No. 12-11-07, PURA Investigation into the Performance of Connecticut's Electric Distribution Companies and Gas Companies in Restoring Service Following Storm Sandy;

- Connecticut PURA Docket No. 13-03-23, Petition of the Connecticut Light and Power Company for Approval to Recover its 2011-2012 Major Storm Costs;
- Connecticut PURA Docket No. 14-05-06 – Application of the Connecticut Light and Power Company To Amend Rate Schedules;
- Connecticut PURA Docket No. 14-07-18 – PURA Report to the General Assembly Concerning its Review of Each Electric Distribution Company's Vegetation Management Practices;
- Connecticut PURA Docket No. 15-01-27 - Attorney General and Office of Consumer Counsel Request for Investigation of Northeast Utilities Facilities Closures in Connecticut
- Connecticut PURA Docket No. 15-12-20 – PURA Review of Electric Companies' and Electric Distribution Companies' Plans for Maintenance of Transmission and Distribution Overhead and Underground Lines
- Public Act 15-5 - Section 103 - Grid-Side System Enhancements Demonstration Projects

Farah Simplice Omokaro

farah.omokaro@eversource.com

SUMMARY

Professional engineer for 14 years in the electric utility industry including 10 years in system planning at Eversource Energy. Performed and obtained stakeholder approval of numerous transmission system planning studies, which led to construction of system improvements across New England.

EDUCATION

Worcester Polytechnic Institute, Worcester, Massachusetts
Master of Science, Electrical and Computer Engineering, May 2010

Rensselaer Polytechnic Institute, Troy, New York
Bachelor of Science, Electrical and Computer Engineering, May 2002

EXPERIENCE

EVERSOURCE ENERGY Hartford, Connecticut

Manager of Project Solutions 2017-Present

- Responsible for developing solutions for transmission projects by aligning strategy and vision, driving business and system requirements, and managing the overall project(s) across multiple teams.
- Integrate cross functional groups or teams to initiate and implement projects.
- Establish guiding principles relating to the development of electrical solutions, project scope and cost.
- Provide technical leadership to planning, project management, engineering and procurement through application of guiding principles.
- Review of studies, solutions and alternatives prepared by system planners for alignment with company vision

Senior Engineer, Transmission Siting.....2015-2016

- Manage and assume overall responsibility for siting strategies and schedules for specific transmission projects in CT and MA. Self-driven and accountable for projects siting execution in line with strategic business and organizational objectives.
- Lead the development of documentation on system need and alternatives for various siting filings in CT and MA.
- Guide project managers and technical subject matter experts in preparation of applications, petitions and other siting documents to ensure seamless filing with siting agencies.
- Manage the interrogatory response process and data requests from siting agencies
- Coordinate associated inputs, testimony and data request responses by technical disciplines

Senior Engineer, Transmission System Planning.....2005-2015

- Managed and assumed overall responsibility for analyzing, determining scope and approval for various transmission projects.
- Performed comprehensive evaluation of the New Hampshire transmission system, which resulted in multiple projects totaling up to $500 million. Projects included new and upgrades to 345 and 115-kV lines, installation of synchronous condensers, and upgrades to various substations.
- Supervised and reviewed system analysis for the second 345/115-kV Deerfield autotransformer project in New Hampshire.
- Develop transmission line and substation equipment reinforcement plans to comply with the North American Electric Reliability Corporation's and ISO New England transmission planning standards.

- Performed extensive power flow analysis to determine alternatives to potential transmission system problems. Performed thermal, voltage, transient stability and short circuit analysis for all alternatives to make sure the alternatives have no adverse impact on the New England transmission system.
- Represented Eversource as the member of the ISO New England Transmission Task Force, a technical group whose tasks are to establish assumptions and methods for steady state and short circuit analysis, assess thermal and voltage performance, and review studies required for proposed plans under sect 1.3.9 of the ISO tariff.
- Developed and sponsored numerous transmission and distribution projects through the ISO New England process by performing necessary analysis, presenting, and obtaining approval from various technical and stakeholder committees.
- Modeling of computer models for generators, transmission networks and customer load using PSSE (Power System Simulator for Engineering) software.
- Research and evaluate new technology and its application to solving specific system problems.
- Supported projects through engineering, siting and construction phases by reviewing project design and providing documentation on needs and system alternatives.

Associate Engineer, Transmission Asset Management.....2003-2005

- Co-led the development and maintenance of the five (5) year, three (3) state capital programs. Worked with cross functional group to Identified, categorized and prioritized list of capital project to be included in the capital program.
- Developed a database for prioritizing projects based on asset qualifications, performance and obsolescence. The prioritized projects served as an aid in creating the yearly capital program and assuring the projects with the most significant benefits to the system are funded.
- Performed asset benchmarking by gathering data on transmission assets and O&M costs for several utility companies in the Northeast. Proposed areas of improvement based on analysis completed and utility best practices.
- Provided technical and financial support documentation for management committee and NU board packages such as project description, cost and potential risk.
- Assisted in the development of a technical and financial review process. Defined the charter, roles and responsibilities of the committees.
- Sponsored asset improvement projects through technical and financial approvals. Created need and justification reports.
- Co-Led the development of an internal generator interconnection process. Worked with internal and external legal teams.
- Negotiated System Impact Study Agreements, Facility Study Agreements, Interconnection Agreements, Construction Agreements and Termination Agreements with customers and ISO New England.
- Facilitated generator interconnection projects through the ISO New England process by seeking approval from various committees.
- Provided technical and financial support documentation for the 2004 Public Service of New Hampshire (PSNH) rate case.

PROFESSIONAL AFFILIATIONS

National Society of Black Engineers, 1998
Society of Women Engineers, 2003
Hartford Young Professionals and Entrepreneurs, 2008

JASON CABRAL, PE

Lead Project Manager

Mr. Cabral serves Burns & McDonnell as a lead project manager specializing in transmission siting, permitting, engineering, procurement and construction. His responsibilities include project management, design management, subcontract administration, cost control and scheduling.

A summary of his experience at Burns & McDonnell and prior to his hire in 2006 is provided below.

EDUCATION

- BS, Civil Engineering
- MS, Civil Engineering

REGISTRATIONS

- Professional Engineer (CT)

11 YEARS WITH BURNS & MCDONNELL

14 YEARS OF EXPERIENCE

Greenwich Substation and Line Project | Eversource Energy
Connecticut | 2017 - Present

Lead project manager Mr. Cabral is serving as a lead project manager for the Greenwich Substation and Line Project that includes a new substation in downtown Greenwich, an approximately 2.5-mile transmission line, and upgrades to an existing substation. He leads a team of professionals performing siting, permitting, engineering, community relations, real estate acquisition, procurement, cost control, scheduling, safety, and construction management.

Greater Hartford Central Connecticut Portfolio | Eversource Energy
Connecticut | 2015 - 2016

Lead project manager Mr. Cabral is serving as a lead project manager for a $357 million capital transmission portfolio that consists of 26 transmission and substation projects throughout Connecticut. He leads a team of over 30 professionals performing siting, permitting, engineering, community relations, real estate acquisition, procurement, cost control, scheduling, safety, and construction management.

Large Transmission Projects Program | FirstEnergy
Ohio | 2012-2014

Program manager Mr. Cabral is served as the program manager for a $1 billion capital transmission portfolio that consists of over 30 transmission and substation projects throughout FirstEnergy's five state service territories. He led a team of over 80 professionals performing siting, permitting, engineering, community relations, real estate acquisition, cost control, scheduling, environmental compliance, and construction management.

The New England East-West Solution Project | Northeast Utilities
Massachusetts & Connecticut | 2010-2012

Project Manager Mr. Cabral was serving as the project manager for the overhead transmission line construction on the Greater Springfield Reliability Project, one of the four projects of the $1.5 billion New England East-West Solution Program. He was responsible for coordinating construction activities between the Burns & McDonnell staff, Northeast Utilities and the various contractors.

BURNS McDONNELL

JASON CABRAL, PE

(continued)

The Susquehanna-Roseland Project | PPL Electric

Pennsylvania | 09/2008-2010

Overhead Transmission Project Manager Mr. Cabral served as the overhead engineering project manager on this 100+ mile, $500 million 500 kV transmission project. He was responsible for coordinating activities with the client, contractors, project managers and engineers to manage design, procurement, construction, budget, schedule and quality control.

Middletown-Norwalk 345 kV Transmission Line Project | Northeast Utilities

Southwest Connecticut | 04/2006-09/2008

Assistant Project Manager Mr. Cabral served as an assistant project manager on a $700 million transmission project and was responsible for coordinating with both field superintendents and engineers to manage design, procurement, construction, budget, schedule, and quality control on the overhead portion of the Project. Overhead lines were completed approximately one year ahead of schedule and $10 million below budget.

Garfield Avenue Bridge over Mill Brook | Town of Newington*

Newington, Connecticut | 01/2005-03/2005

Mr. Cabral was responsible for a hydraulic and hydrologic study of a 1.55 sq. mi. watershed for the replacement of the Garfield Avenue Bridge over Mill Pond Brook. As part of the study, the FEMA flows were checked against the USGS Regression Equations (with urbanization). The hydraulics were analyzed for two proposed bridge types, a proposed culvert, the natural channel, and the existing conditions using HEC-RAS. Scour was assessed using HEC-18. Also performed the structure type study for three alternatives to replace the existing structure.

New Haven Harbor Crossing Improvements, Contract C-1, Project 43-122 | Connecticut Department of Transportation*

East Haven, Connecticut | 04/2004-04/2006

Project Engineer Mr. Cabral served as a project engineer. This project involved the reconstruction and widening of approximately 1.6 miles of I-95. Responsibilities included inspection, management, and documentation of the construction of a three span steel girder bridge carrying 8 lanes of I-95 over Route 1 and Amtrak. Duties included the inspection of excavation, installation of shot crete walls, demolition, concrete formwork, concrete pours, rebar installation, installation and compaction of granular fill and pervious structure backfill, installation of micro-piles, erection of steel girders, and other miscellaneous operations involved in the construction of the bridge. He also performed quality assurance testing of concrete, grout, and compaction tests for granular fill and pervious structure backfill. He utilized site manager construction recording system to enter daily work reports and for testing documentation.

District 1 and District 4 Guide Rail Upgrade | Connecticut Department of Transportation*

Connecticut | 12/2003-04/2004

Mr. Cabral's responsibilities included preparation of contract documents to upgrade guide railing on NHS Routes in District 1 and 4. Duties included the design of the structural modifications that need to be performed at the bridge structures for the proposed guide railing. Work included endblock modifications, reconstruction of parapets, and construction of new end blocks.

JASON CABRAL, PE

(continued)

Access Improvements at the Mark Twain House, Project 63-578 | Connecticut Department of Transportation*

Hartford, Connecticut | 11/2003-02/2004

Project Engineer Mr. Cabral served as project engineer. This construction project involved site work to the new convention center/museum. This work included construction of stone veneer walls, sidewalks, and landscaping. Duties included daily inspection, project documentation, testing, and project closeout.

Route 68 and Maple Hill Road Intersection Improvements, Project 87-135 | ConnDOT*

Naugatuck, Connecticut | 09/2003-11/2003

Inspector Mr. Cabral served as inspector. This project involved the rehabilitation of plate arch culvert with new concrete flow line invert and baffles. Added new endwall, wingwalls, and vortex weir to raise stream water elevation as per DEP permits plates. Also milled and overlayed Route 68, replaced drainage structures, installed RB-350 guiderail and replaced traffic control and signals at intersections of Route 68 and Maple Hill Road. Performed Maple Street full depth roadway replacement. Responsibilities included inspection and documentation of rock/earth excavation, drainage, cofferdam and dewatering, structure excavation, concrete for structures, rebar, paving, subgrade, sub-base and electrical items for intersection improvements.

Q-Bridge Flood Plain Analysis | Connecticut Department of Transportation*

New Haven, Connecticut | 06/2003-09/2003

Mr. Cabral performed a flood plain analysis in the vicinity of the proposed new Q-Bridge. His responsibilities included performing and checking hydrology and hydraulic calculations as well as checking the HEC-RAS inputs.

Moses Wheeler Hydraulic Study | Connecticut Department of Transportation*

Stratford-Milford, Connecticut | 06/2003-09/2003

Mr. Cabral performed a scour analysis for the construction of the new Moses Wheeler Bridge. His responsibilities included performing and checking hydrology and hydraulic calculations as well as checking the steady and unsteady state HEC-RAS inputs and outputs.

Demolition of West River Bridge | Connecticut Department of Transportation*

New Haven/West Haven, Connecticut | 05/2002-06/2003

Mr. Cabral performed the cost estimates and prepared the contract documents for the demolition of the existing West River Bridge.

I-95 over Fulton Terrace Bridge | Connecticut Department of Transportation*

New Haven, Connecticut | 05/2002-06/2003

Mr. Cabral worked on the final design of two bridges over Fulton Terrace. Both are single span bridges with steel plate girders. His responsibilities included plan preparation, quantity calculations, ratings, and geometry calculations.

VMS Standard Drawings*

Connecticut | 05/2002-06/2003

Mr. Cabral prepared the contract documents for the cantilever, overhead and bridge mounted VMS structures.

BURNS McDONNELL

JASON CABRAL, PE

(continued)

Moses Wheeler Bridge Project, I-95 over Housatonic River*

05/2002-06/2003

Mr. Cabral worked on the final design of two bridges over Route 1 (East & West). Route 1 West structure is 55m with welded steel plate girders. Route 1 East structure is 29m with NEBT girders. His responsibilities included plan preparation and quantity calculations.

Michael Libertine, LEP
Vice President
Director of Siting and Permitting

All-Points Technology Corporation, P.C.
3 Saddlebrook Drive
Killingworth, CT06419
860-663-1697 Ext. 102
mlibertine@allpointstech.com

General Background

Mr. Libertine joined All-Points Technology Corporation in 2012 as an owner of the firm. He has over 25 years of professional experience in the environmental field. His expertise includes regulatory siting, permitting and compliance consulting; environmental assessments/impact statements; NEPA compliance; aesthetic evaluations; site assessments and field investigations for property transfers; remedial strategy development; environmental due diligence; Brownfields redevelopment projects; and remedial investigations at RCRA facilities and state and federally recognized hazardous waste sites. Mike has assisted clients in the siting and permitting of new and modified telecommunication facilities, renewable energy projects, bulk power substations, and transmission line corridors. Mike is a Licensed Environmental Professional in Connecticut and has completed/supervised over 2000 environmental site assessments and field investigations throughout New England.

Representative Projects

Environmental Permitting Services for Wireless Telecommunications Clients, New England & NY

Mike has been providing environmental siting, land planning and permitting services on behalf of various telecommunications clients throughout New England and New York since 1997. He has testified on behalf of clients in front of local municipalities and the Siting Council on nearly 400 projects. Representative services include: due diligence and land use evaluations; preliminary site screenings; preparation of environmental compliance documentation, environmental assessments to fulfill NEPA requirements; Phase I ESAs and Phase II field investigations; remedial planning and oversight; wetlands and vernal pool assessments; vegetative/biological surveys; noise analyses; visibility analyses; graphic support; securing regulatory permits; and, environmental monitoring during and post-construction.

Environmental Siting and Permitting Services, Commercial Solar Farms, Connecticut

Since 2014, Mike has served as Project Manager on eight approved commercial solar projects ranging in size from 2 MW to 20 MW. Mike was responsible for the preparation of environmental assessments to support Petition filings to the Connecticut Siting Council and applications to municipalities. Services included: environmental due diligence investigations Phase I Environmental Site Assessments; wetland delineations; vernal pool studies and impact evaluations; habitat and wildlife assessments; breeding bird surveys; noise analyses, visibility assessments; archaeological surveys; consults and coordination with state agencies; and, development of protective measures for natural resources. Mike and his team have also provided environmental compliance monitoring during construction of these facilities.

Environmental Land Planning, Siting and Permitting Services – Electrical Service Providers

Since 2004 Mike has been managed numerous electrical transmission projects in Connecticut involving the assessment, siting and permitting of: new bulk power substations; modifications to existing substations, upgrades to transmission line corridors; replacement/installation of support structures and underground utilities; and, other facilities. These projects required extensive coordination with numerous team members, including his clients' in-house discipline managers and engineers, outside consultants, legal counsel, staff, and subcontractors. Services included overseeing civil engineering feasibility studies, pre-acquisition due diligence evaluations, natural resources inventories, habitat evaluations, wetland delineations, noise analyses, hazardous waste investigations, site survey, layout and design drawings, landscape architecture, visual analyses, preparation of technical documents (including submissions to the CT Siting Council), consultations with federal, state and local agencies, regulatory permitting, and providing expert witness testimony.

ALL-POINTS TECHNOLOGY CORPORATION

MICHAEL LIBERTINE *Vice President, Director of Siting & Permitting*

Environmental Siting and Permitting Services, Proposed Fuel Cell Installation, South Windsor, CT
The siting process for this 4.98 megawatt fuel cell generation facility required the preparation of an environmental assessment to document existing conditions and evaluate the project's potential impacts on the surrounding area. The environmental study included assessments of water resources, vegetation and wildlife, rare species, historic and cultural resources, noise, air quality, scenic and recreational areas, and other natural resources. Mike also coordinated the site design activities and Development and Management Plan efforts.

Environmental Evaluations and Regulatory Permitting, Wind Farm Colebrook, Connecticut
Mike served as the Project Manager for environmental evaluations associated with the development of Connecticut's first commercial wind farm. He supervised due diligence investigations, natural resource studies and environmental permitting activities, including the evaluation of: wetlands and watercourses; flora and fauna; potential noise impacts and flicker phenomena; and, visual/aesthetic considerations. Mike provided expert testimony at local and state public hearings and assisted in preparing the Development and Management Plan and pre-construction coordination efforts of the 3.2 MW project.

Environmental Assessment, Constructability Review, and Permitting Support Services
New England East-West Solution Projects, Massachusetts and Connecticut
Mike was Project Manager for components of the New England East-West Solution (NEEWS), a group of related transmission projects designed to increase the reliability of electric power in southern New England and the region overall**.** Mike was responsible for overseeing the assessment of environmental permitting and construction feasibility challenges associated with the installation of a new 345-kV overhead transmission line and upgrades to existing electrical infrastructure associated with three of these major projects. Project tasks included: conducting natural resources inventories; evaluating potential environmental impacts to wetlands and watercourses, wildlife habitat, and visibility from nearby residences; assessing existing and new access/service roads and construction pad locations to determine their viability as adequate construction routes; developing and implementing data collection and management methodologies; and, providing a GIS geo-database and mapping depicting compiled field data. Mike also assisted the client on environmental permitting and compliance-related issues associated with the reconfiguration of substations along the routes. He was responsible for preparing Location Review documents and acted as liaison with local officials during the technical review process. and assisted in securing letters of support from the First Selectman, Planning and Zoning and Inland Wetlands Commissions.

Education	University of Connecticut, B.S. Natural Resources Management, December 1990 Stonehill College, B.A. Marketing, May 1981
Licenses	Licensed Environmental Professional, State of Connecticut, LEP No. 345

Work (860) 728-6172
Email: christopher.soderman@eversource.com

Christopher Paul Soderman, P.E.*

Education:

Rensselaer Polytechnic Institute (Troy, NY)
Bachelor of Science Degree in Mechanical Engineering

Worcester Polytechnic Institute (Worcester, MA)
Master of Science in Electrical Engineering

University of Hartford (West Hartford, CT)
Master of Engineering (Civil Engineering)

University of Hartford (West Hartford, CT)
Master of Business Administration

Relevant Work Experience:

2/2003-Present Eversource Energy Service Company
Lead Engineer – Transmission Line & Civil Engineering: Engineering and support for design of new transmission lines and operation and maintenance of existing transmission lines.

Current Engineering Assignments:

- Team Lead – Transmission Line Engineering
  - Lead a team of 6 engineers, designers and drafters with engineering support of transmission line construction, operation and maintenance
- PLS-CADD Subject Matter Expert
- Wind Induced Conductor Motion Subject Matter Expert
- Direct Embedded Pole Design Subject Matter Expert
- Electric and Magnetic Fields Subject Matter Expert
- Grounding and Lightning design for Transmission Lines Subject Matter Expert
- Electromagnetic Compatibility/Interference Subject Matter Expert

EMF Project Experience:

- Seacoast Reliability Project (2014-Present; Madbury-Newington, NH)
- Southwest Connecticut Reliability Project (2016; Bethel/Brookfield, CT)
- Greenwich Substation and Line Project (2014-Present, Greenwich, CT)
- Stamford Reliability Cable Project (2013; Stamford, CT)
- 1990 Line Structure Replacement Project (2013: Monroe-Watertown, CT)
- Maine Power Reliability Project (2011; Eliot, ME)

Selected Transmission Project Experience:

- Interstate Reliability Project (2004-2014, AC/Electromagnetic Interference Study)
- 1990 Line Rebuild (2010-2014 – Project Engineer)
- Greater Springfield Reliability Project (2006-2013 – T-Line Engineer)
- Middletown-Norwalk 345-kV Transmission Line Project (2003-2008 – Transmission Line Engineer (T-Line Engineer), CT)
- Barbour Hill 345-kV Substation Project (2005-2008 – T-Line Engineer, CT)
- 1466 Line Rebuild between Carpenter Lane Junction and North Wallingford S/S (2/2007-8/2007 – Project Engineer, T-Line Engineer)
- Mansfield 69-kV Terminal Uprate (5/2006-9/2006 – Proj Engineer, T-Line Engineer, CT)
- Glenbrook 115-kV Cables Project Siting (2004-05 – Transmission Line Engineering Support, CT)
- University of Connecticut Interconnection 69-kV (2005 – Project Engineer, CT)

2/2002-2/2003 Tech-Aid Corporation for ESCO

Project Coordinating Engineer (Contract): Coordinated engineering efforts of consultants and internal engineering staff for the Middletown-Norwalk 345-kV transmission Line. Performed route analyses and prepared reports for submittal to the Connecticut Siting Council. Field contact for customer questions regarding project.

5/2001-2/2002 Tech-Aid Corporation for ESCO

Mechanical Engineer (Contract): Perform energy balance analysis, heat transfer and HVAC System studies. Perform tests to check for compliance with the 1995 CABO Model Energy Code and US Department of Energy Star™ Homes program.

Publications:

Chisholm, W. A., Martin-Sturmey, K., Soderman, C.P., Bologna, F; *"Results of Transient Resistivity Testing On Steel Lattice, Wood and Steel Pole Towers",* International Conference on Grounding and Earthing & 7th International Conference on Lightning Physics and Effects, Porto de Galinhas, Brazil, June 2016.

Testifying Experience:

- Connecticut Siting Council
  - Docket 426 – Third Taxing District of Norwalk: Fitch St Substation (6/14/2012)
  - Docket 431 – South Norwalk Electric Works: SONO Substation (12/11/2012)
  - Docket 435 – Connecticut Light & Power Co.: Stamford Reliability Project (3/28/2013)
  - Docket 466 – Connecticut Light & Power Co.: Frost Bridge – Campville 115-kV Line (2/23/2016)
  - Docket 468 – Connecticut Light & Power Co.: Southwest CT Reliability Project (9/22/2016)
- Maine Public Utilities Commission
  - Docket 2008-255 – Public Service of New Hampshire – Maine Power Reliability Project (1/11/2012)

Professional Registrations:

- Licensed Professional Engineer in the State of Connecticut (Lic. # PEN.24928)
- Certified Level II User of CDEGS Specializing in Electromagnetic Interference from Transmission Lines (http://www.sestech.com/Training/CertifiedUsersII.htm)

* Professional Engineer's License is in Connecticut Only

Ronald J. Araujo, P.E.
(860) 665-4751 (W)
Email: ronald.araujo@eversource.com

Profile

Mr. Araujo has more than 30 years of experience in the energy industry working in various roles within Eversource Energy. His broad background includes work in operations and delivering energy services to commercial and industrial customers. Mr. Araujo is the manager of Energy Efficiency in Connecticut for Eversource and manages the electric and natural gas energy efficiency programs delivered to Eversource customers.

Relevant Experience

Eversource Energy **April 1984 - Present**

Manager – Energy Efficiency, **December 2004 – Present**

- Developed strategies and implemented plans to achieve energy saving goals established in filed and approved Conservation and Load Management plans.
- Led between energy efficiency team in achieving energy efficiency and demand response objectives.
- Established Stamford Energy Efficiency office to serve lower Fairfield County

Senior Project Manager/Project Manager **November 1999 – November 2004**
Sales Manager **July 1998 – November 1999**
Product Platform Marketing Manager – Energy Services **May 1997 – July 1998**
Market Management Team Leader – National Accounts **October 1995 – May 1997**
Senior Consultant/EMS Consultant **April 1984 – October 1995**

- Established measurement and verification protocols, reporting templates for use across all branch offices.
- Was a key contributor to the Federal Energy Management Program Annual Report template and Measurement &Verification Plan template, working with multiple government agencies and private consultants.
- Key presenter on energy management for 4 nationally broadcast US Chamber of Commerce satellite television seminars regarding electric industry restructuring and energy management.
- Launched an energy consulting service and developed a software energy analysis tool.
- Provided energy efficiency and energy use consultation to large commercial and industrial customers. .

Education / Professional Training

Bachelor of Science in Mechanical Engineering
University of Massachusetts, Amherst, MA

Professional Engineer
State of Connecticut, Registration No. 15782

Certified Energy Manager
Association of Energy Engineers

Professional Memberships

Board Member 2006 to Present
Energy Efficiency Board/Energy Conservation Management Board

Board Member, Vice President, President June 2007 to 2014
Northeast Energy Efficiency Partnerships

JOHN C. CASE

42 Warren Glen
Burlington, CT 06013

H: (860) 673-2447
W: (860) 728-4695

PROFESSIONAL EXPERIENCE

Manager - Transmission Line Engineering 2014 - Present
Eversource Energy – Hartford, CT

Direct Management of 3 Engineering Departments that including 25 engineers, designers, drafters and estimators with responsibility for all Transmission Line and Civil Engineering capital projects, standards and specification development, construction and maintenance support and new project development (2015 Capital Expenditures of $500M).

Manager – Transmission Estimating 2013 - 2014
Northeast Utilities Service Company - Hartford, CT

Direct Management of a team of 7 estimators with responsibility to generate estimates for all Transmission Projects, including alternatives analysis, bid review and Transmission Cost Allocation filings and life-cycle analysis. Responsibilities include presentations of Projects for regulators. Directly involved in the oversight of estimates and project scope for large area planning studies in the Greater Boston, Southwest Connecticut and Greater Hartford areas.

Lead Project Manager – NEEWS Engineering 2007 - 2013
Northeast Utilities Service Company - Hartford, CT

Responsible for the oversight and management of all aspects of engineering on the New England East-West group of projects. Projects involve significant reliability upgrades in the Southern New England area, totaling an estimated $1.5 billion. This position involved the coordination of the System Planning and Engineering functions to establish the most cost-effective solutions for the project needs, establishing the base estimate for all projects, review of all siting and engineering documents, management and coordination of the engineering effort (internal and consulted), engineering responsibilities in the procurement effort and oversight of the final outage planning and commissioning for the projects.

Project Manager – Transmission Projects 2006 - 2007
Northeast Utilities Service Company - Berlin, CT

Overall management responsibility over all aspects of assigned transmission projects, including schedule, risk analysis and mitigation, siting and permitting, budget, contracting and closeout. Projects ranged in magnitude from $500,000 substation upgrades to $5,000,000 transmission line projects.

Construction Manager – Transmission Construction, Test and Maintenance 2003 - 2006
Connecticut Light and Power Company - Newington, CT

Responsibility for Owner's oversight and management of the construction effort on portions of the Bethel – Norwalk project including contractor coordination, site safety, compliance to specifications and contracts, outage clearance tag holder and change order negotiation. This was a $350,000,000 project to construct a 20+ mile transmission line in Southwest Connecticut. This project involved 345-kV and 115-kV overhead and XLPE underground cable, 345-kV HPFF cable, 3 intermediate 345-kV transition stations and two significant 345-kV GIS substation expansions.

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Senior Engineer- Transmission Line and Civil Engineering 1990 - 2003
Northeast Utilities Service Company - Berlin, CT

Project Engineer on a variety of construction projects involving all tasks associated with engineering, design, estimating, securing regulatory approvals, and drafting construction specifications.

EDUCATION

Master of Business Administration May, 1998
University of Connecticut - West Hartford, CT
Bachelor of Science degree in Civil/Environmental Engineering May, 1990
Clarkson University - Potsdam, NY
Associates of Science degree in Engineering Sciences May, 1988
Broome Community College - Binghamton, NY

HONORS AND ACTIVITIES

Major Project Achievements:

- Engineering New Record – Project of the Year Winner; New England
  - Greater Springfield Reliability Project – Engineering Project Manager
- Edision Electrical Institute Award
  - Bethel – Norwalk 345-kV line – Lead Project Engineer, Construction Manager
- Chairman's Award Nominee
  - NEON / NU Fiber optic backbone system – 250 miles fiber optic installation– Lead Project Engineer in CT and MA
- President's Award Winner
  - North Bloomfield – Agawam – Emergency reconductor of 18 miles of 115-kV double-circuit transmission line
- World Construction Record
  - Devon Station Generation - Connect emergency gas turbine generators to system