DOCKET NO. 19

AN APPLICATION BY NORTHEAST UTILITIES FOR THE HARTFORD ELECTRIC LIGHT COMPANY FOR A CERTIFICATE OF ENVIRONMENTAL COMPATIBILITY AND PUBLIC NEED FOR THE RECONSTRUCTION UNDERGROUND OF TWO EXISTING 345 KV TRANSMISSION LINES AND ONE EXISTING 115 kV TRANSMISSION LINE WHICH CROSS THE CONNECTICUT RIVER BETWEEN MIDDLETOWN AND EAST HAMPTON AT SCOVILL ROCK.	: : :	CONNECTICUT SITING COUNCIL October 1, 1981

FINDINGS OF FACTS

1. The Hartford Electric Light Company (HELCO) acting by its agent, the Northeast Utilities Service Company, in accordance with the provisions of Section 16-501 of the General Statutes of Connecticut, Revision 1958, revised to 1981, as amended applied to the Power Facility Evaluation Council (PFEC) now the Connecticut Siting Council (CSC) on December 4, 1980, for a certificate of environmental compatibility and public need for the reconstruction underground of three existing electric overhead transmission lines which cross the Connecticut River between Middletown and East Hampton at Scovill Rock near the Haddam town line. For convenience purpose all exhibits will be noted as PFEC exhibits.
2. The fee prescribed in section 16-50v-1(b) of the Regulations of Connecticut State Agencies accompanied the application.
3. The application was accompanied by proof of service as required by section 16-501(b) of said General Statutes of the State of Connecticut.
4. Affidavits of newspaper notice as required by Statute and section 16-501-1 of the Regulations of Connecticut State Agencies were also filed with the application. (Record)
5. Pursuant to section 16-50m of said General Statutes of the State of Connecticut, the Power Facility Evaluation Council, after giving due notice thereof, held a public hearing at the Old School Meeting House, and the Town Hall, Main Street, Haddam,

Connecticut on January 6, 7, 8, 13, 23, 26, 1981, and March 18 and 20, 1981. Evening sessions were held on January 8, and March 18, 1981 at the Old School Meeting House. (Record)

6. The parties to the proceedings are the applicant, the Hartford Electric Light Company, and those other persons and organizations whose names are listed in the Decision and Order which accompanies these findings. (Record)

7. Upon receipt of the application the Council retained Power Technologies Incorporated to present reports regarding technical aspects of constructing and operating underground transmission lines. (Record)

8. The following state agencies filed written comments with the Council pursuant to section 16-50j(f) of the General Statutes of the State of Connecticut: The Department of Environmental Protection, the Office of Policy and Management Energy Division, the Department of Economic Development, the Department of Health Services, and the Department of Transportation. (Record)

9. On November 14, 1980, members of the Council made a ground inspection of the proposed route and alternate routes for the proposed line. (Record)

10. On October 17, 1980, members of the Council made an inspection of the Scovill Rock section of the river by boat. (Record)

11. The Connecticut Water Resources Commission in 1966 conditioned its approval of two 345 kV line crossings at Scovill Rock to require the circuits to be placed underwater or constructed elsewhere within five years. (WRC Certificate 2444, 6/23/66, Middletown Exhibit 5)

12. The Connecticut Supreme Court in 1972 affirmed the conditions imposed by the WRC. (Tr. p.48, 1/6/81, Department of Environmental Protection Decision and

Order p.3, 6/29/73, Middletown Exhibit 5)

13. The Connecticut Department of Environmental Protection in 1973 conditioned its continuation of the WRC certificate for five years to require undergrounding of the two transmission lines crossing at Scovill Rock, including both 345 kV circuits and the single 115 kV circuit, along with several provisions concerning other transmission line river crossings. (Department of Environmental Protection Decision and Order, 6/29/73, Middletown Exhibit 5)

14. The Department of Environmental Protection and other parties entered into an agreement with HELCO in 1976 to revise the undergrounding proposal at Scovill Rock to approximate the configuration in the immediate proceeding, and changing or removing several provisions regarding the other river crossings, conditioned on receipt by HELCO of all other necessary permits, application for which HELCO would diligently prosecute. (Department of Environmental Protection Stipulation and Agreement 3/12/76, Middletown Exhibit 6)

15. Northeast Utilities filed application with the Power Facility Evaluation Council in 1976 to underground the three transmission circuits at Scovill Rock. (Docket No. 10 Application, Middletown Exhibit 1)

16. The 1976 application was dismissed by the Council for lack of jurisdiction, a decision which was overturned by the Superior Court in 1980. (NU Exhibit 14, p.8)

17. The 1976 Stipulation and Agreement was amended in 1980 allowing HELCO to withdraw its 1976 application to PFEC and simultaneously file an amended application, as HELCO's compliance with its obligation to submit plans and specifications for undergrounding, to release the Department of Environmental Protection's Commissioner from his

obligation to convey land to HELCO for a forced cooling station, and to change the reconstruction date of the Stipulation and Agreement to May 31, 1983 from June 30, 1981. (Amendment to Stipulation and Agreement, August 5, 1981, NU Exhibit 2)

18. Two overhead 345 kV lines and one overhead 115 kV line presently cross the Connecticut River at Scovill Rock. (Tr. p.127, 1/6/81)

19. A total of twenty-one wires cross the river at Scovill Rock. The 115 kV line has three energized conductors and two ground wires, and each of the 345 kV lines has six active wires and two static wires. (Tr. p.129, 1/6/81)

20. The proposed project involves the reconstruction of the two 345 kV and one 115 kV lines underground and the removal of the existing overhead lines across the Connecticut River. The project consists of placing six 115 kV cables and twelve 345 kV cables underground for approximately 4200 feet. The cables would be constructed underground from a terminal on the west bank 400 feet to the river's edge, 1300 feet under the river, and then 2500 feet up the east river bank to a terminal on the east bank. (Tr. p.136 1/6/81; NU Exhibit 14, p.18)

21. The 115 kV cable system would consist of two 3-phase, 115 kV cable circuits in parallel, each consisting of three self-contained oil-filled cables. (NU Exhibit 14, p.21)

22. The underground replacement of the 345 kV overhead lines consists of two cable systems, one system for each overhead line. Each 345 kV cable system would consist of six single conductor, self-contained, oil-filled cables. (NU Exhibit 14, p.18)

23. The 115 kV cable system would consist of two 3-phase, 115 kV cable circuits in parallel, each consisting

of three self-contained oil-filled cables. (NU Exhibit 14, p.21)

24. The underground replacement of the 345 kV overhead lines consists of two cable systems, one system for each overhead line. Each 345 kV cable system would consist of six single conductor, self-contained, oil-filled cables. (NU Exhibit 14, p.18)

25. The proposed project would require two overhead to underground terminals, one on the west side of the river and one on the east side, the construction and modification of approximately 0.6 mile of distribution lines to supply station service power to the westerly terminal, and the construction of access and construction roads to each terminal. (NU Exhibit 14, p.18)

26. Each terminal facility would occupy slightly less than 6 acres including a buffer zone. (NU Exhibit 14, p.44)

27. The terminals would be approximately 320 feet long and 170 feet wide, and would contain terminal structures with a maximum height of 95 feet. Each terminal would be surrounded by an eight foot high chain link fence. (NU Exhibit 14, pp.23,24; Tr. p.137, 1/6/81)

28. Construction of the east terminal would require blasting of bedrock and the removal of a 1 acre perched swamp. (NU Exhibit 14, p.51)

29. The west terminal site has sparse ground cover. No clearing is required, and no net addition or removal of soil is necessary for the terminal. (NU Exhibit 14, p.50)

30. Oil reservoirs and monitoring equipment would be required at the west terminal, and a back-up oil system would be provided to supply oil should the system experience a leak. Also, a concrete pit would be constructed under the enclosed oil

pressurizing facilities at the terminals to contain accidental oil spills. (N.U. Exhibit 14, pp.19,22, N.U. Exhibit 15, 11/15/80, Q. 23)

31. Vehicular access to the east bank from Route 151 in East Hampton is first over a half mile of rural, semi-residential town road, then 3500 feet of the Hurd Park entrance road, and finally 3000 feet of unpaved existing wood road between the paved entrance road and the right of way. In addition a 400 foot long access road would be constructed between the end of the wood road and the east terminal site. (NU Exhibit 14, p.24)

32. Improvement and widening of the 3000 foot wood road from 10 feet to 18 feet would require clearing, grading, leveling, straightening, establishing side slopes, side drainage, ditches, culverts and the construction of passing points. Similar improvements would be needed along an access road between the east terminal and the river. (NU Exhibit 14, pp.24,25; Tr. p.5, 1/7/81).

33. Improvements to the existing access road along the right of way on the upper east bank would require blasting because the bedrock is generally zero to three feet beneath the surface. (NU Exhibit 14, p.52)

34. In Hurd Park the proposed construction would improve an existing wood road which may be used to approach a possible camping area in George Dudley Seymour Park. (NU Exhibit 14, p.44,45)

35. Delivery of materials to the east bank area would require 1375 round trips, assuming the use of 20 cubic yard capacity trucks. (NU Exhibit 14, p.46)

36. The Hurd State Park paved access road would not withstand the heavy truck usage necessary to this project without substantial deterioration. (Department of Environmental Protection comments, 12/1/80, p.1)

37. Access to the west terminal would be access road and a private driveway off Road in Haddam. This access must be wid improved for a distance of approximately l (NU Exhibit 14, p.25)

38. A permanent access road must be established f the west terminal area down to and along the State's Valley Railroad to the construction area at the river bank. (NU Exhibit 14, p.25)

39. The proposed underground construction would require clearing the river banks and exposing the open right of way on both sides of the river. (Department of Environmental Protection comments, 12/1/80, p.4; NU Exhibit 14, p.42 Tr. p.11, 1/7/81)

40. Clearing would include removal of all vegetation along the proposed cable route for the trench and the work areas immediately alongside it. Additional clearing may be necessary for material storage, vehicular parking, and equipment laydown areas (NU Exhibit 14, p.28,29)

41. A minimum width of approximately 95 feet must be cleared from the east terminal to a point approximately 230 feet east of the river where the clearing would be widened to 300 feet at the east bank. (NU Exhibit 14, p.28)

42. On the upper east bank approximately four and one half acres would be completely cleared for the trench, construction areas, and access roads. (NU Exhibit 14, p.52)

43. The proposed underground facility would require clearing approximately four additional acres on the east bank. Three of these acres would be near the river on the lower east bank. (NU Exhibit 15, Q. 65; N.U. Exhibit 14, p.53)

44. On the west side of the river a cleared area about 290 feet wide at the river's edge and about 250 feet

wide near the top of the bank would be required. No clearing would be required for the west terminal. (NU Exhibit 14, p.28,50)

45. Clearing of the trees on the lower river banks would result in a noticeable change in the appearance of the area. (NU Exhibit 14,15, p.53)

46. The cleared areas on each river bank would be riprapped to an elevation of 10 feet or 11 feet. (NU Exhibit 14, p.43)

47. The 300 feet of riprap along each bank of the river would detract from the natural setting of the river. (Department of Environmental Protection comments, 12/1/80, p.4)

48. Clearing trees and some understory on the east side of the river would eliminate some wildlife habitat and create some new habitat. (NU Exhibit 14, p.51,52)

49. Construction of the trench would require blasting in the river and removing rock from the river. (Tr. p.7, 1/8/81)

50. Blasting for the cable trench in the river would require the removal of approximately 6100 cubic yards of rock from the channel area on the west shore and approximately 2700 cubic yards of rock near the east shore. (NU Exhibit 14, p.30)

51. The trench on the east bank would be approximately 2500 feet long with a width varying from 35 feet to 225 feet. (Tr. p.6, 1/7/81)

52. The cable route along the east bank is located to avoid major areas of bedrock near the surface and to accommodate access and construction requirements. (NU Exhibit 14, p.26)

53. Excavation of the trench at the lower east bank would require the elimination of a foundation, an old road, steps, and landscaping associated with a previous use of the same property. (NU Exhibit 14, p.46)

54. The excavation of the trench on the east bank would require blasting and the removal of approximately 15000 cubic yards of rock and approximately 7500 cubic yards of earth. (NU Exhibit 14, p.31; Tr. p.6, 1/7/81)

55. A proposed soil disposal area east of the east terminal would be necessary for disposal of material excavated from the cable trench along the east bank. The disposal area would accomodate 22,500 cubic yards of excavated material. (N.U. Exhibit 14, p.31,25,51)

56. The spoil disposal area on the east bank is located at the top of a drainage basin. The rock spoil would be sufficiently permeable to allow upstream water to pass through. (NU Exhibit 14, p.51)

57. Undergrounding the cable on the west bank would require excavation of a trench about 400 feet long with a width varying from 180 feet to 225 feet. (Tr. p.5, 1/7/81; NU Exhibit 14, p.29)

58. Excavation on the west bank would require removing approximately 13,000 cubic yards of material, and blasting and removing approximately 8800 cubic yards of rock. (Tr. p.6, 1/7/81)

59. Material excavated from the west bank area would be deposited and graded in the land area owned by HELCO near the west terminal. (NU Exhibit 14, p.29)

60. The rock removed from the west bank and most of the rock from the channel area would be placed on barges and dumped in an approved dumping area in Long Island Sound. (NU Exhibit 14, p.30, Tr. p.16, 1/7/81)

61. The applicant proposed blasting in the river starting soon after June 15, 1982 and extending to September, 1982. Under the stipulation and agreement made with the Department of Environmental Protection, the applicant is not permitted to do any work within the river from April 1 to June 15. (NU

Exhibit 14, p.28)

62. Since the stipulation and agreement, the Department of Environmental Protection has suggested that blasting in the river should be done after October 31 to minimize impacts on fisheries. (Tr. p.13, 1/7/81)

63. Adherence to the Department of Environmental Protection's time limit for blasting in the river would require blasting 24 hours per day for half the originally scheduled time, or extending the project over two years. (Tr. p.13, 1/7/81)

64. The National Marine Fishery Service has suggested to the Army Corps of Engineers that blasting in the river should not occur until after November 30th. (Tr. p.14, 1/7/81)

65. If blasting in the river is not permitted until after November 30, there would be essentially no time available for blasting. (Tr. p.155, 3/18/81, Tr. p.14, 1/7/81)

66. The construction impacts of the undergrounding option would include blasting in the river, the noise and disturbance of heavy machinery, more than 1400 truck trips through Hurd Park, a reduction in the wildlife carrying capacity of the area affected by construction, and erosion potential until some revegetation occurs on the river banks. (Department of Environmental Protection comments, 12/1/80, p.4)

67. Cuts through the rock, some leveling of the ground, modification of the river's edge, and the relocation of a stream would be the permanent and irreversible signs remaining from construction in this area. (NU Exhibit 14, p.54)

68. Rehabilitation consisting of grading, topsoiling, riprapping, and seeding would eliminate most visible construction scars. (NU Exhibit 14, p.43)

69. On land, the cable trench and terminals would be located mostly within an existing overhead

transmission right of way. Additional land rights are to be provided by the state. (NU Exhibit 14, p.44)

70. The proposed project would require obtaining from the State of Connecticut a right of way over a one quarter acre parcel of land and additional rights on the existing right of way, specifically underground rights through the park. (Tr. p.145, 1/13/81; Department of Environmental Protection comments 12/1/80, p.1)

71. Conveyance of property from the State of Connecticut to HELCO for the east terminal area would require a Special Act of the General Assembly. (Department of Environmental Protection comments p.1, 12/1/80)

72. The proposed project presents no conflicts with the Regional Development Guide for the Midstate Region, and the Midstate Regional Planning Agency supports the application to underground the transmission lines. (Midstate RPA letter 1/7/81, p.5; (Midstate RPA letter 1/19/81, Attachment; Tr. p.120, 1/8/81)

73. The proposed underground construction is consistent with the stated findings and purpose of the Connecticut River Gateway Commission which favors the proposed undergrounding. (Connecticut River Gateway Commission letter 1/26/81; (Tr. p.119, 1/8/81)

74. The Scovill Rock area of the Connecticut River is not under consideration for inclusion as a recreation river under the National Wildlife and Scenic Rivers Act. (Tr. p.40, 3/18/81)

75. The existing crossing has no effect on hydrology, fishery resources, water quality, public access to the river, and acquisition of key lands and scenic easements in the gateway conservation zone. (Tr. p.136, 1/6/81)

76. After the underwater section of the cable is completed, there would be no further constraints on

the use of the river for boating, fishing, and transportation other than precautionary measures that are standard for any underwater crossing. (NU Exhibit 14, p.44)

77. The existing conductors and static wires are suspended from six lattice steel towers on the east and west banks of the river. The three structures on the west bank are 155, 165, and 185 feet tall for an average of 168 feet high, and the tree structures on the east bank are 155, 210, and 210 feet tall for an average of 192 feet high. (Tr. p.129, 1/6/81; NU Exhibit 14, Figure II-2)

78. The west bank structures are approximately 180 feet from the river's edge, and the east bank structures are approximately 292 feet from the river's edge. (Tr. Vol. 1, p.129)

79. Some or all of the existing structures at Scovill Rock are visible from selected locations on Route 9, the southbound exit of Route 9 onto Aircraft Road, Dublin Road, and Aircraft Road. (NU Exhibit 15, 11/25/81, Q. 26)

80. The existing crossing is visible at Scovill Rock, from the Higganum and Maromas portions of the river, from points within Hurd State Park and Seymour State Park, from four houses south of the crossing on the west bank of the river, and from an additional twenty homes in the Higganum and Higganum Landing area. (Tr. p.129,133,135, 1/6/81)

81. The Scovill Rock crossing intrudes upon a tranquil setting in one of the most scenic stretches of the Connecticut River and affects the visual enjoyment of this scenic area. (Department of Environmental Protection comments, 12/1/80, p.3; Tr. p.135, 1/6/81)

82. The proposed undergrounding would reduce but not eliminate the visual impact of transmission facilities because both the east and west terminals would be visible from land views. (Tr. p.12, 1/7/81)

83. The east terminal would be visible from viewpoints within Hurd State Park and from residences on the west bank of the river. (NU Exhibit 14, p.43; Tr. p.168, 1/13/81)

84. The take-off towers in the east terminal would be partially visible from the river. (NU Exhibit 14, p.42)

85. The western terminal would be visible from the river through the 250 foot wide opening in the trees at the top of the west bank and from Split Rock Lookout in Hurd State Park. (NU Exhibit 14, p.43; Tr. p. 134, 1/6/81)

86. The trench and cleared areas would remain visible after rehabilitation. (NU Exhibit 14, p.43)

87. Travellers along the river and the occupants of the several residences in Higganum would be the principle beneficiaries of the proposed construction. (NU Exhibit 14, p.41)

88. The aesthetic improvements at Scovill Rock would result from removing three towers and associated conductors on both sides of the river. (Tr. p.10, 1/7/81; Department of Environmental Protection comments, 12/1/80, p.4)

89. The removal of the three existing transmission line structures on each side of the river would partially restore the uninterrupted appearance of the skyline in the Scovill Rock area. (NU Exhibit 14, p.41)

90. The presence of transmission lines may present a hazard to bald eagles, although there is no definitive evidence. Bald eagles are known to occur in the vicinity of the Scovill Rock Crossing and the loss of one of these birds, which are on the Federal Endangered Species list, would be significant. (Tr. p.29-39, 1/13/81, NU Exhibit 40)

91. The cables would be imbedded in the sandy portions of the river by fluidization jetting. (NU Exhibit 14, p.23)

92. The burial of the cables in the sandy river bottom would temporarily disturb 6.5 acres of sandy river bottom. (NU Exhibit 14, p-47)

93. Water flowing through the Scovill Rock area created a sand bar along the easterly edge of the river which would facilitate cable installation and reduce the likelihood of sand being washed down the river. (NU Exhibit 14, p.30)

94. Construction in the river would cause sediment to be suspended in the water and would result in the transport of some material downstream. (NU Exhibit 14, p.48)

95. The proposed action would have some adverse impacts on fish and wildlife. (U.S. Department of Interior, Fish and Wildlife Service letter, 12/30/80)

96. Underwater blasting and rock removal could cause significant adverse long term effects on fishery resources. (NU Exhibit 14, p.47)

97. Construction in the river and on the banks would cause some destruction of fish habitat consisting of shallow beds of eelgrass, bulrushes, and wild rice along the east shore. (NU Exhibit 14, p.48)

98. Construction would cause temporary disturbance to some shallow water habitat used by catfish, eels, yellow perch, sunfish, carp, suckers, and spottail shiners. (NU Exhibit 14, p.49)

99. The proposed project would require relocating a seasonal stream on the lower east bank to the Higganum Meadow area. This would require excavating a new channel and lining it with riprap. (Tr. p.129-131, 1/13/81; NU Exhibit 14, p.31,54)

100. Relocation of the stream would alter the alluvial shoreline and would represent a small loss of good fish habitat. (NU Exhibit 14, p.54)

101. The scope of blasting involved at Scovill Rock far exceeds that which was necessary to bury the single East Haddam line which resulted in repeated fish

kills. (Department of Environmental Protection comments, 4/28/81, p.8)

102. The proposed underground construction has the potential to damage important anadromouns species, such as shad and Atlantic Salmon, as well as species indigenous to the Scovill Rock area. (Department of Environmental Protection comments, 12/1/80, p.2)

103. Both the shortnose and Atlantic Sturgeon inhabit the Connecticut River in the Scovill Rock area. The shortnose sturgeon is on the U.S. Endangered Species list while the Atlantic Sturgeon is a U.S. threatened species. (Department of Environmental Protection comments, 4/28/81, p.7)

104. The Scovill Rock area is one of the most favorable and likely areas for Atlantic Salmon to inhabit. There is a spring and fall run of salmon, so late spring and fall fish would be in the river through the summer. (Department of Environmental Protection comments 4/28/81, p.8)

105. The salmon restoration program is at a sensitive and fragile stage; the species is vulnerable if the few fish on which the program currently rests are threatened. (Department of Environmental Protection comments, 4/28/81, p.8)

106. Construction in the river, beginning after June 15, should result in no appreciable effect upon fish with relatively large populations such as shad or alewife, but a minor local disturbance to glut herring spawning may occur. (NU Exhibit 14, p.48)

107. An oil leak from the proposed cables would not present a serious problem to fish. (Tr. p.160, 1/13/81)

108. Operation of the proposed underground cables would not influence migrating fish. (Tr. p.164, 1/13/81)

109. Recreational activities in the Scovill Rock area may be interrupted during construction, especially if

cable-laying is conducted during weekends. (NU Exhibit 14, p.46)

110. There are approximately eight thousand to ten thousand boat crossings per year at Scovill Rock. (Tr. p.131, 1/6/81)

111. Burying the cables across the river would require a total of twenty eight interruptions in river traffic. Each interruption would last eight to twelve hours. (NU Exhibit 14, p.45)

112. Fishing in the immediate vicinity of construction would be affected for one season. (NU Exhibit 14, p.46)

113. The proposed undergrounding of existing overhead tranmission lines at Scovill Rock would have adverse impacts upon potentially significant archaeological resources. (Tr. p.100, 1/7/81; Tr. p.133, 1/13/81)

114. Numerous archaeological remains are located within the Hurd and Seymour State Parks transmission line rights of way. (State Historic Preservation Office letter 10/17/80, p.1)

115. Noise levels for typical construction machinery to be used range from seventy to ninty five dBA (decibels weighted in the A scale) at fifty feet from the source. This is fifteen to forty dBA higher than the 55 dBA limit permitted in residential zones by the state noise regulations. (NU Exhibit 14, p.46)

116. There would be no permanent sources of noise at the proposed installation. (NU Exhibit 14, p.27)

117. Construction of the project is planned to commence approximately four months after receipt of all regulatory approvals and would take an estimated seventeen months. (NU Exhibit 14, p.27)

118. Construction in the river would take two to three months. (NU Exhibit 14, p.45)

119. The in-service date of the underground cable system would be May 31, 1983. The removal of the existing

overhead circuits and crossing towers would take place not later than eighteen months after the new cable systems are placed in commercial operation. (NU Exhibit 14, p.28,34)

120. The applicant presented four alternatives, A,B,C, and D, to the proposed construction. (NU Exhibit 14, p.55-59)

121. Alternative A involves the reconstruction of the 345 kV lines which cross the river at Scovill Rock as overhead lines so one runs north from Haddam Neck through East Hampton and Portland to the river crossing at Paper Rock and then south through Middletown to the Scovill Rock Switching Station, and the other runs south from Haddam Neck through East Haddam to the river crossing in Haddam and then across Haddam to Oxbow and Chestnut Junctions and finally to the Scovill Rock Switching Station. The 115 kV line crossing at Scovill Rock would be placed under the river or reconstructed as an overhead line adjacent to the 345 kV line relocated through East Hampton, Portland, and Middletown. (NU Exhibit 14, p.55,56)

122. Alternative A would require the acquisition of new rights of way for approximately 3.4 miles and widening of a railroad right of way for approximately 2.65 miles and would impact a total of approximately 27 miles of right of way. (NU Exhibit 14, p.55; Tr. p.43, 1/7/81)

123. Alternative A would require the acquisition of approximately 276 acres of new right of way, possibly two buildings, and clearing approximately 326 acres of land. (NU Exhibit 15, p.3)

124. Alternative A would affect approximately five existing transmission line-road intersections and would create approximately seven new transmission line-road intersections. (NU Exhibit 15, p.2, maps)

125. Alternative A would require placing under the river the 115 kV line presently crossing the river at Haddam-East Haddam and widening portions of the existing right of way through Haddam by as much as 100 feet. (NU Exhibit 14, p.56)

126. Alternative B involves the reconstruction of both 345 kV lines which cross the river at Scovill Rock as overhead lines from Haddam Neck through East Hampton and Portland to the river crossing at Paper Rock where one 345 kV line would be routed north to Ames Junction and the other would cross the river and run southerly to the Scovill Rock Switching Station. It would also be necessary either to underground or to reconstruct elsewhere the existing 115 kV crossing at Scovill Rock to eliminate all crossings at that location. (NU Exhibit 14, p.57)

127. Alternative B would affect approximately fifteen existing transmission line-road intersections and would create approximately seven new transmission line-road intersections. (NU Exhibit 15, p.2, maps)

128. Alternative B would require the acquisition of approximately 220 acres of new right of way, possibly four structures, and clearing approximately 224 acres of land. (NU Exhibit 15, p.3)

129. Alternatives A and B involve creating substantial amounts of both new and expanded rights of way and the installation of 33 miles and 27 miles of new overhead cable respectively. (Department of Environmental Protection comments, 12/1/80, p.3)

130. Both Alternative A and B routes would encroach on established and new residential developments by creating a new right of way for a distance of approximately 3.7 miles from Haddam Neck Fair grounds in Haddam to the Junction of Route 66 and 16 in East Hampton. (NU Exhibit 15, p.14)

131. Alternatives A and B would have serious adverse

environmental impacts on the town of Portland. (Portland Conservation Commission letter, 2/5/81)

132. A two to seven mile long section of the Alternative A and B routes follows a narrow twisting railroad embankment from East Hampton into Portland. Structures along this section of the two alternate routes would probably be seen from the river and would be visible from numerous nearby residences. (NU Exhibit 15, p.14)

133. Many historic structures exist along the Alternative B route and the northerly section of the Alternative A route in the towns of East Hampton and Portland. (NU Exhibit 15, p.14, Attachment 13-1, p.1-4)

134. Both Alternatives A and B contain elements with highly disruptive environmental and land use consequences which conflict with the Regional Development Guide for the Midstate Region. (Midstate RPA letter, 1/7/81, p.5)

135. Reconstuction of only the 115 kV line under the river at Scovill Rock would require a minimum clearing width of approximately 70 feet from the east terminal to a point approximately 50 feet easterly of the river bank where the clearing would be widened to 100 feet at the easterly edge of the river. On the west edge of the river, clearing would range from 90 feet at the river's edge to approximately 100 feet near the top of the bank. (NU Exhibit 15, p.12)

136. The trench width for only the 115 kV line would be approximately 10 feet on the east bank widening to 25 feet at the east edge of the river. The trench width at the west edge of the river would be approximately 25 feet and would widen out to about 35 feet at the top of the bank. (NU Exhibit 15, p.12)

137. Unusable excavated material resulting from underground construction of only the 115 kV line

would be deposited and graded around the west terminal. Approximately 4500 cubic yards of excavated material on the east side of the river would be deposited in the spoil disposal area near the east terminal. (NU Exhibit 15, p.12)

138. Alternative C-1 offers the replacement of the three existing lattice type structures on each bank at Scovill Rock with a single tubular steel-pole H-frame structure. The two 345 kV circuits and 115 kV circuit would be suspended in a vertical configuration from the three crossarms. (NU Exhibit 14, p.57)

139. The top of the Alternative C-1 towers would be 295 feet high (375' above sea level) on the east side and 240 feet high (295' above sea level) on the west side. (NU Exhibit 15, p.6; NU Exhibit 3)

140. The Alternative C-1 towers would be approximately 60 to 85 feet taller than the existing river crossing structures and would be visible from areas where the existing towers cannot be seen. (NU Exhibit 14, p-58; Tr. p.52, 1/7/81)

141. Alternative C-2 involves reducing the height of the Alternative C-1 towers to a height of 200 feet on the east bank and 185 feet on the west bank by using extra high tension cables. This would require replacing six existing steel anchor towers with stronger towers. (NU Exhibit 3; NU Exhibit 15, p.7, 11/25/81, Q. 48)

142. Alternative C-3 involves the replacement of each existing river crossing lattice structure with a steel pole, H-frame structure on each side of the river and the use of high tension conductors. This would reduce the height of the river crossing structures on the east bank from 155 feet to 100 feet, 210 feet to 150 feet, and 210 feet to 155 feet, and on the west bank from 155 feet to 105 feet, 165 feet to

120 feet, and 185 feet to 140 feet. This Alternative would require the replacement of six existing anchor towers. (NU Exhibit 15, p.7,9; 11/25/81, Q. 50)

143. The six new anchor towers required with Alternative C-2 and C-3 would appear similar to the existing anchor towers. (Tr. p.62, 3/18/81)

144. The top of the east bank alternative C-1 tower would be approximately 109 feet higher than the Split Rock lookout; the C-2 tower would be approximately 19 feet higher than the Split Rock lookout, and the C-3 towers would be approximately 26 feet lower than the Split Rock lookout. (Tr. p.134-135, 1/13/81)

145. Reducing the height of the Alternative C-1 tower would increase the environmental benefits obtained by using an Alternative C type tower. (Tr. p.133-135, 1/8/81)

146. Construction of alternative C type towers would require fewer parking areas and equipment laydown areas. The magnitude of the project would be substantially less; access to the river bank would not be necessary, the spoils area and access to it would not be necessary, and no terminal would be needed. (Tr. p.138-139, 1/13/81)

147. Alternative C would eliminate the need for a trench on both banks of the river and associated staging areas and spoil disposal areas. (NU Exhibit 14, p.58)

148. Clearing, foundations, and access road requirements associated with Alternative C would be negligible compared to those required for undergrounding. (NU Exhibit 14, p.58)

149. No significant clearing would be required for construction of alternative C towers. (NU Exhibit 15, Q. 65)

150. Alternative C would improve the view from Split Rock in Hurd Park compared to the view associated with

undergrounding. (NU Exhibit 14, p.58)

151. Alternative C-1 and C-2 minimize the number of towers on both sides of the river and present a slimmer and neater appearance. Alternative C-3 presents a lower profile. (NU Exhibit 14, p.58; Tr. p.511, 1/7/81; N.U. Exhibit 13)

152. Use of the Alternative C structures would preserve the present wooded banks along both sides of the river, and would avoid any disruption of the river itself. (NU Exhibit 14, p.58; Tr. p.52, 1/7/81)

153. Alternative C provides visual benefits with little or no environmental disruption and poses no conflict with the Regional Development Guide for the Midstate region. (Midstate Regional Planning Agency letters, 1/19/81 Enclosure 3; 1/7/81, p.6)

154. Alternatives which propose the replacement of the existing towers with a single or double pole tower would not adversely impact archeological resources. (Tr. p.136, 1/13/81)

155. An Alternative C project would involve substantially fewer environmental costs than the proposed project and alternative A and B. (Department of Environmental Protection comments, 12/1/80, p.4)

156. Alternative C type towers are consistent with the Federal Power Commission "Guidelines for the Protection of Natural Historic Scenic and Recreational Values in the Design and Location of Rights of Way and Transmission Facilities." (Tr. p.303, 3/18/81)

157. Alternative C type towers would not pose an undue hazard to persons or property along the area traversed by the line. (Tr. p.303, 3/18/81)

158. Repainting the existing towers, as proposed in alternative D, does not require Council certification. (NU Exhibit 15, Q. 55)

159. Estimated cost for the 1980 project of undergrounding is $26.46 million (1982 dollars). (Tr. 1/7/81, p.15; NU Appl., NU Exhibit No. 14, p.36-40)

160. The cost estimate includes the cost of self-contained cable provided by a Nowegian company named Standard Telefan og Kabelfabrik (STK) which has engaged in 1,100 underwater cable crossings, and is considered a reliable company. (Tr. 1/7/81, p.18; NU Exhibit 3, Tr.Vol. II, p.121)

161. Cable estimates by European manufacturers indicate prices for self-contained oil filled cable to be comparable with those costs associated with intensive cooled cable as used in the 1976 application. (PTI, PFEC Exhibit 1, p.13)

162. The costs of cables of comparable Extremely High Voltage (EHV) cables of the U.S. pipe type designs, and the differences between costs by Japanese vs. European manufacturers for the self-contained oil filled cables, reflect the extreme price sensitivity of cables world wide. (PTI, 12/80, PFEC Exhibit 1, p.13)

163. The cost of Alternative A: one 345 kV line and one 115 kV line north from Haddam Neck Switching Station to Paper Rock Crossing and one 345 kV line south from Haddam-East Haddam Crossing to Oxbow Junction would be $21,254,000-$22,739,000 (1982 dollars) depending on the disposition of the 115 kV line. (Tr. 1/7/81, 1/7/81, p.40-43; NU Exhibit 3)

164. The cost of Alternative B relocation of both 345 kV lines north through East Hampton and Portland to Ames Junction and Paper Rock ranges from $16.5 million to $18.0 million (1982 dollars) depending on the disposition of the 115 kV line. (Tr. 1/7/81, p.44-45; NU Exhibit 3)

165. Alternative C-1 would replace the three existing lattice type structures on each bank with a single steel pole H-frame cost: $1.23 to $1.4 million (1982 dollars). Alternative C-2 would use high tension cable thereby reducing the tower height by 45-50 feet. The installation, including anchor towers,

costs $1.8 million (1982 dollars). Alternative C-3 uses three steel H-frame towers on each bank with high tension cable reducing the height of the towers 55-60 feet, on the east bank and 45-50 feet on the west bank. The installation, including anchor towers, costs $1.9 million (1982 dollars). (Tr., 1/7/81, p.51-54; NU Exhibit 3; Tr. Vol. VII, p.28-29)

166. The "C" alternatives preserve the same capacity and reliability of the existing crossing. (Fox, Tr. 1/7/81, p.57)

167. The salvage gross value of six lattice towers is $43,000 (1982). (Derewianka, Tr. 3/18/81, p.62)

168. Anchor towers (six) cost $100,000 each. (Derewianka, tr. 3/18/81, p.62)

169. A comparison of the December 1980 cost estimates by PTI and NU for the high pressure oil-filled pipe type project indicates the following results expressed in 1982 dollars, (millions):

Table 1

Item	Estimate PTI	Estimate NU	Difference between PTI and NU	PTI as percent of NU Estimate
1. Excavation, backfill materials & labor	$4.57	$8.34	$-3.77	45.2%
2. Contracted materials & labor				
345 kV -	$ 5.87	5.97	- 0.10	- 1.7%
115 kV -	1.33	1.23	+ 0.10	+ 8.1%
Total	$11.77	$15.54	- 3.77	24.3%
Miscellaneous Expenses	3.03	4.04	- 1.01	-25.0%
Rounded Total (construction costs)	$14.80	$19.58	$- 4.78	24.3%

PTI did not use costs for thermal sand; used a narrower trench; and did not use excavation and backfill estimates in the river costs. A correction for the PTI estimate for materials is increased by $302,400 to total $2,242,400. (N.U. Exhibit 22 and CSC computations)

170. The cost for undergrounding in 1980 using high pressure oil filled type cable by PTI estimation was $14.8 million, and by NU estimation, $19.6 million (1982 dollars). PTI did not include labor costs for excavation and backfill in the river. (NU Exhibit No. 22)

171. A self-cooled pipe type cable installation would require more pipes in the river than in the 1976 application. (Fox, Tr. 3/18/81, p.48)

172. The amount of avoidance of the cost to comply with the DEP 1973 order by constructing the Scovill Rock Crossing underground as proposed at the time the stipulation and agreement was made, was estimated to be $5.298 million. (Fitzgerald, Tr. 3/18/81, p.130-131; NU Exhibit 15, Ans. to Q. 46)

173. The 1976 application used intensive-cooled pipe type cable whereas the 1980 PTI comparative proposal used self-cooled, non-pumping pipe-type cable and NU's 1980 application used self-contained oil-filled cable. (DeBrigard, Tr. 3/18/81, p.49 & NU No. 32)

174. Estimated costs in 1976 using high pressure oil-filled pipe type cable over a 4200' distance was a $12.56 million estimation by HELCO and $10.25 million by PTI, a $2.31 million difference from the 1976 HELCO proposal before the 7.5% Connecticut sales tax was added. (PTI Exhibit 1, 12/80, Table IIA)

175. Cost comparisons indicated the 1976 proposal estimates were:

mates were:	HELCO	CAHN Engineers
1976 dollars	$6.4 million	$6.8 million
1978 dollars	$7.6 million	$8.0 million
(using 7.5% escalation per year)		

(CAHN Report 1976, Table II, p.31; Middletown Exhibit 1)

176. The cost presented in HELCO's 1976 application report was reasonable and does not overstate the costs of the proposed underground construction. (CAHN Report 1976, pp.2,28,29; Middletown Exhibit 1)

177. The table below is a compilation of cost estimates extracted from the 1976 NU application.

Table 2

1976 Cost Estimates Summary (1978 Dollars)

Location	Underground Trenching	Alternative A Relocation E.Hampton-Portland E.Haddam-Haddam	Alternative B Relocation E.Hampton-Portland	Alternative C Tower Replacement
A. Scovill Rock	$10,076,000	$8,325,000	$5,835,000	$870,000
1. Under-grounding 115 kV	-	2,405,000	2,405,000	
2. Reconstruc-tion 115 kV	-	730,000	730,000	
Total		$9,055,000-$10,730,000	$6,565,000-8,240,000	$870,000

(NU Appl. 1976, Middletown Exhibit 1, pp.29,44-47)

178. The original 1972 undergrounding at Scovill Rock would at the lowest cost option be approximately $4.5 million (1967 dollars). Additional options ranged to about $9.7 million (1972 dollars). (Curry, Middletown Exhibit 4, No. 73; Lufkin, Middletown No. 5, p. 13)

179. Costs for alternative "A" reconstruction and rerouting ranged from $4.9-$7.5 million (1972 dollars)

- costs of alternative "B" reconstruction and rerouting ranged from $5.7-$7 million.
- alternative "C" would be $475,000.
- alternative "D" would be $36,000.

Various other alternatives including trenching or underground tunneling at Scovill Rock were cited from $9.7 million to $43.5 million. (Middletown Exhibit 7, 1972 River Crossings p.23-32; Curry, Middletown Exhibit 4, pp. 68-139)

180. The Table below is a compilation of cost estimates extracted from the 1972 NU application for various proposals.

Table 3
1972 Cost Estimates Summary
(1972 Dollars)

Location	Underground Trenching Alone	Underground Tunneling Alone	Relocation (A)	Modification Overhead Structure
Scovill Rock	$9,650,000	$19,800,000	$5,700,000 (Cobalt-Haddam)	$475,000
Bodkin Rock	$3,200,000	$ 6,750,000	$8,60,000 (to Paper Rock)	no change
Haddam	$4,000,000 or	$ 6,550,000	none	$345,000
(with tunneling)	$4,175,000			

Based on an annual carrying charge of 13.85% for undergrounding and 13.99% for overhead depreciation charges and equaling $2,011,000, the total cost in 1972 dollars over the 50 years estimated life the facility would be $27,700,000 for the Haddam Crossing and $66.8 million for the Scovill Rock Crossing. (1972 Appl., Middletown Exhibit 1, pp.31-32)

Table 4
Comparison of Proposal Costs at Scovill Rock Crossing
(Million Dollars)

Technology Main Proposal	1972[1] (1972 $) Intensive Cooled Pipe-Type	1976[2] (1978 $) Intensive Cooled Pipe-Type	1980[3] (1982 $) Self-Cooled Pipe-Type Oil Filled	1980[4] (1982 dollars) Self Contained Cable
Original 345 kV underground 115 relocation	$4.5-9.6	$10.076	$22.0 - 25.0	$26.46

Table 4A Alternative Proposals

Alternative A	$4.9-7.5	9.1-10.7	-	21.3-22.7
Alternative B	5.7-7.0	6.6- 8.2	-	16.5-18.0
Alternative C				
C-1	$.475	$.830	-	$ 1.2
C-2	-	-	-	1.8
C-3	-	-	-	1.9
Alternative D	$36,000	$45,000	-	$45,000

1 Curry, Middletown No. 4 pp. 68--139
2 NU application, Middletown No. 1 pp.45-47,29
3 Moran Tr. 1/8/81 p. 290 & Tr. 1/7/81 p.22
4 NU Exhibit 3 & NU Exhibit 14, p.36, 55-59

181. Of the costs of construction evaluated by PTI for the portion of the project involving undergrounding including labor and materials, PTI originally concluded NU overestimated $7 million of the $12.5 million undergrounding only costs. (O'Neill, Tr. 1/6/81 p.29; Fox Tr. 1/7/81 p.20,22)

182. PTI notes that expenditures for taxes, engineering, administration, and general expenses have changed in format since the 1976 application. (PTI, 12/80; PFEC Exhibit 1, p.12)

183. PTI had difficulty rationalizing the estimated cost of cable installation and equipment accessories at NU's $5.9 million figure. PTI's estimates for the self-contained cable installation totaled about $2.0 million leaving $3.9 million unresolved in the cost comparison. (PTI, PFEC Exhibit 1, p.15)

184. NU indicated that PTI's estimate did not include the cost of jetting which is about $1.5-$1.8 million. (Moran, Tr. 1/8/81 p. 288; (PTI, PFEC Exhibit 1, p. 14-15)

185. If the NU figure for jetting is accurate, the differences in the estimates of the excavation costs converge by $1.5 million leaving $2.4 million unresolved. (Moran, Tr. 1/8/81, p. 288)

186. The cost of pipe-type cable installation is roughly comparable to self-contained cable. The cost of constructing the crossing now as proposed in 1976 using intensive-forced cooling, is estimated to be $18 million (1982 dollars). If pipe-type cables were used in 1982, it would not be the intensively cooled system of 1976, but a self-cooled system, costing $22 to $25 million dollars (1982). (Fox, Tr. 1/7/81, p.22)

187. Either self-contained cable or pipe-type self cooled would cost between $22 and $26 million (1982 dollars), which is an estimate due to the fluc-

tuations in the world cable markets. (Moran, Tr. 1/8/81, p. 262-290)

188. The total costs of undergrounding using self-contained cable and the costs of using pipe-type cable were estimated to be within 10-15% or about $3.0 million of each other. (Moran,Tr. 1/8/81, p. 290, 297)

189. PTI concluded that computational discrepancies based upon the different methods used by NU and PTI would indicate that the NU cost projections of $22-25 million for pipe-type cable and $26 million for self contained cable were reasonable. (Moran, Tr. 1/8/81 p. 290)

190. The estimates of PTI and NU for the costs of contracted materials, labor, accessories, and installation for both the 345 kV and 115 kV systems were 2 percent apart. Differences in excavation estimates varied for other factors involved in the construction project, and accounted for other discrepancies. (Moran, Tr. 1/8/81, p. 288)

191. The cost of undergrounding self-contained cable and the cost of undergrounding pipe-type cable are within about 15%, or $3 million, of each other. (Moran Tr. 1/23/81, 78-79; Tr. 1/8/81, p. 297)

192. Cost of construction using self-contained cable (1982) was computed reasonably according to PTI. (Moran, Tr. 1/23/81 86-136; Tr. 1/8/81, 265,289)

Table 5
Project Annual Carrying Charges

	Project Cost (1982 dollars)	Annual Carrying Charge (1982 dollars)
Original Proposal	$26.46 million	$5.5 million
Alternative A	$21.3-22.7 million	$4.5 million
Alternative B	$16.5-18.0 million	$3.5 million
Alternative C-1	$ 1.23 million	$249,000
Alternative C-2	$ 1.8 million	$395,000
Alternative C-3	$ 1.9 million	$395,000

(Fox Tr. 1/7/81, p.33,45,52; Fox Tr. 3/18/81, p.304)

193. The reasons why NU chose the self-contained oil-filled cables versus the 1976 intensive forced-cooled pipe-type cable were as follows:

- need to avoid thermomechanical bending (TMB) produced by high conductor temperatures;
- migration of the conductors;
- energy used to operate the refrigeration equipment needed in pipetype installations;
- refrigeration is not needed in self-contained cable;
- reliability of refrigeration equipment over the long run is unknown;
- maintenance of refrigeration equipment is more intense than self-contained systems;
- refrigeration is noisy while self-contained cable is silent;
- self-contained systems have half-capacity capability in loss of one or more cables, whereby the former systems do not;
- direct burial of self-contained cable restrains movement in the ground;
- the proposed system will be splice free from terminal to terminal.

(NU Appl. 1980, p. 35,36; NU Exhibit 41)

194. PTI states only pressurized oil impregnated paper insulated cables, either of the high pressure oil-filled pipe type or the self-contained oil filled type, are considered of sufficiently proven reliability for underground and underwater circuits above 138 kV. (PTI 12/80, PFEC Exhibit 1)

195. 345 kV self contained cable of the type proposed by STK of Norway was not manufactured by any company in the USA at the time the proposal was submitted in 1980. (Tr. Vol. 1/7/81, p. 116)

196. PTI received price estimates of 345 kV pipe-type for a comparable construction application elsewhere from Phelps Dodge, Pirelli Cable-US, Olconite Company, Pirelli-England, Pirelli-Milan, and BICC, which were used for studying the 1980 proposal. (Moran, Tr. 1/8/81, 1/8/81, p.20)

197. Price estimates for a different proceeding in Massachusetts was obtained from a Japanese firm, Sumitomo Electric Industries which could only supply cable in 1400' lengths, which are unacceptable for this project. (Moran, Tr. 1/8/81, p. 20,223,273; NU Exhibit 30; Luther, Vol. VI, p. 350)

198. Price quotes from STK equaled $112.00 per foot for 4200' lengths. Sumitomo of Japan estimated $90.00 per foot in 1400' lengths for self-contained cable. (Luther, NU Exhibit 31)

199. Sumitomo estimated the costs of the project to total $8.6 million for self-contained cable and accessories. (NU Exhibit 30)

200. Due to the configuration needed for the self-contained oil filled cables within the river, the spacing is 17 feet apart and totals 225 feet at the edge of the river. Because of rock outcroppings on the bank, the cable layout in the 1980 project differs slightly from the 1976 project due to the angle of the cable emerging from the water. This involves 6 times more blasting for the trenches than required by the pipe cable layout. (Moran, Tr. 1/8/81, p. 304)

201. The self-contained cable is less rugged than the pipe-type due to its construction. Armored lead wrapped, self-contained cable is easily fractured. It would be more susceptible to damage such as anchor dragging, and therefore would have to be entrenched deeper than pipe-type. It would be easier to retrieve for repair than pipe-type but

would be more susceptible to damage. (Moran, Tr. 1/8/81, p. 305-306)

202. The previous opinion (1976) that the pipe-type and self-contained cable are equally reliable is subject to "several caveats" and interpretation. (Moran, Tr. 1/23/81, p. 73, 89)

203. The Northfield TMB/migration repair problem situated at two different locations for each of the two 345 kV pipe-type cables, cost $100,000-$150,000 to repair. This expense would have been greater in the event of electrical failure. (Luther, Tr. 3/18/81, p. 35, 36)

204. No one can assure that any system design would give reasonable assurance of a TMB and migration free system. It would entail risk to put in underground pipe cable. (Fox, Tr. 3/18/81, p. 52)

205. Due to construction difficulties and difficulties in obtaining material, lead time up to one year may be necessary to replace faulty underground cables. (Luther, Tr. 3/18/81, p. 53)

206. The loss of up to three of the six cables would still provide half-capacity capability with self-contained cable. (Luther, Tr. 3/18/81, p. 54,55)

207. Pipe-type cable would lose all the conductors in one pipe in case of failure. (Fox, Tr. 3/18/81 p. 55)

208. Using alternative "C" tower arrangements would keep construction outages at a minimum since the C-1 or C-2 towers could be spotted between two of the existing circuits. (Fox, Tr. 3/18/81, p. 55)

209. The reliability of undergrounding cable would be suspect due to higher repair costs, and would take longer to repair, due to retrieval procedures. (Fox, Tr. 1/6/81, p. 13-15, 3/18/81, p. 153-155)

210. Cable damage across Long Island sound in 1979 had yet to be repaired by the March 18, 1981, hearing date. (Luther, Tr. 3/18/81, p. 53)

211. The 1976 crossing proposal was engineered on a consulting basis by Power Technologies, Inc. (PTI) for NU. It called for the use of intensively forced-cooling pipes to permit higher conductor loadings, thereby reducing the number of pipes needed, and theoretically minimizing the cost of the crossing. NU now contends that operational problems of the refrigeration equipment associated with intensively forced cooling are severe, and that such cooling exacerbates the thermomechanical bending (TMB) problem which is known in 345 kV pipe type. (HELCO response to preliminary statement of City of Middletown et al. 1/6/81, p.2)

212. The technology available in 1976 included self-cooled cable, but the intensive-cooled pipe was chosen because it offered significant economic advantages over self-contained cable at that time, and because the suppliers could have been from the U.S. The intensive-cooled pipe was considered equally reliable and less expensive than self-cooled pipe. (Tr. 1/7/81, p. 163)

213. In 1976, intensive-cooled cable technology was perceived to be more advantageous over pipe-type cable in high load situations since it allowed more power through a conductor of any given size. Since then, interest in forced cooling has diminished due to the number of conductors experiencing TMB problems, the migration of cable, the high cost of recovery and loss, and the increasing operating expenses of running the refrigeration equipment. (Moran, Tr. 1/8/81, p.31)

214. Armoring and reinforcing joints of pipe-type cable can improve the TMB and migration problems but would increase the costs of the cable. (Moran, Tr. 1/8/81, p. 45)

215. Trenching in the sandy portion of the river, as pro-

posed in 1976, no longer appears to be practical in 1982 because the width of the trench required for the eighteen cables is 225-250'. The trench would be filled on the bottom by sandbags to insure a smooth bottom and the cable covered with a layer of rockshield. Backfilling of the trench on land requires a layer of thermally suitable sand covering the cable. The preferred method of cable installation now, using self-contained cable, is fluidized jetting. (NU Appl. 1980, p. 27,30,32)

216. Northeast Utilities estimates the cost per consumer if the proposal for the $26.5 million undergrounding at Scovill Rock were approved, by determining what it calls the annual level premium (ALP) of revenue requirements, which totals $5.5 million (1982 dollars). By company breakout, this would represent 52% or $2.85 million/year for CL&P and 30% or $1.6 million/year. Broken down by consumer class, estimated costs to the consumers would be estimated as follows if the rates were approved by the Department of Public Utility Control Authority:

Estimated Costs to Consumers

Table 6

(1982 Dollars)

CL&P

Class	Dollars/year (millions)	Number Customers	Average[1] Cost/year	Average[1] Cost/month
Residential	1.37	571,000	$ 2.40	$ .20
Commercial	.69	52,000	$ 13.27	$ 1.11
Industrial	.46	3,000	$153.33	12.78
Total	2.52	626,000		

HELCO

Class	Millions Dollars/Year	Number Customers	Average Cost/year	Average Cost/month
Residential	.62	298,000	2.08	$ .17
Commercial	.71	24,000	29.58	$ 2.47
Industrial	.27	1,000	270.00	$22.50
Total	1.60	323,000		

((1) computed from: NU Exhibit 23)

(NU Exhibit 23; NU Exhibit 15 Ans. to Q. 39)

217. The NU estimated cost per consumer per month over the projected life of the facility based upon a $5.5 million annual revenue requirement, would be computed as follows, if the proposal and the rates were approved.

1982
Table 7

Class	20 year	30 year	50 year
Residential	$ .19	$ .19	$ .20
Commercial	1.48	1.48	1.56
Industrial	15.32	15.33	16.13

(NU Exhibit 15, Ans. to (PFEC) CSC Q.39)

218. The NU estimated annual cost of undergrounding the 345 kV Scovill Rock Crossings would approximate $800,000 for 1972, of which amount $615,000 would be borne annually by NU and the United Illuminating Company. Of the $403,900 NU portion, $265,500 would be charged annually to CL&P and $138,400 to HELCO customers. (Curry No. 76, 1973; Middletown Exhibit 4)

219. For 1972, the NU estimated annual cost to NU customers of the undergrounding crossing would compare to the NU estimated 1982 customer cost, as follows:

Annual Costs
Table 8

	CL&P		HELCO	
Type	1972 (1)	1982 (2)	1972 (1)	1982 (2)
Residential	$ .58	$ 2.40	$ .48	$ 2.08
Commercial	2.73	13.27	4.61	29.58
Industrial	34.10	153.33	45.70	270.00
Street Lighting	6.96		35.60	

(1) Curry finding No. 97, Tr. 1973, p. 911-913; Middletown Exhibit 4
(2) Calculated from NU Exhibit No. 23; (Table 6: Average cost/year for the 50 year life of facility

220. Inflation factors for 1980 on indicate construction costs for substations increasing at 9.7% year and underground line costs increasing at 10.5% per year. (HELCO Exhibit 15 Ans. 21)

221. The value of the undergrounding in 1982 dollars if backed down to 1980, the time the 1976 proposal would have been in service, would be reduced by approximately 18 or 19% to around $20-21 million, compound averaging about 9% per year. (Tr. 1/7/81, p.16)

222. The value of the C-3 towers reduced by an assumed 9% annual compound inflation rate would have been $1.74 million in 1981; $1.35 in 1978; $1.13 million in 1976. (computed from NU answers to PFEC Questions, NU Exhibit 15, answers 21,44,46. & Derewianka Tr. 3/18/81, p.4-7)

223. The cost of the Docket No. 10 pipe-type technology, 1976 proposal in 1978 dollars, was about $10 million which was identified as approximately $18.4 million in 1982, a 16% per year increase. (Tr. 3/18/81, p.4, & NU Appl; NU Exhibit 14, p.7)

224. A second computation included two years at 16% and two years at 9% and totaled $16.1 million. (Derewianka Tr. 3/18/81 p.4, & Tr. 1/7/81, p.22, 112)

225. A comparison of the two methods stated above is as follows:

Table 9

Effects of inflation on the $10,076,000 cost of 1976 proposal comparing computational methods (1978 dollars)

Year	Percent Yearly Growth	Total	Percent Yearly Growth	Total
1978	-	$10,076,000	-	$10,076,000
1979	16%	11,688,000	16%	11,688,000
1980	16%	13,558,000	16%	13,558,000
1981	9%	14,779,000	16%	15,728,000
1982	9%	16,109,000	16%	18,244,000

(computed from Derewianka, Tr. 3/18/81, p.4)

226. The cost of the project in 1972 dollars as ordered by the Department of Environmental Protection Commissioner in 1973, with two 345 kV undergroundings and using high pressure pipe-type with relocation

of the 115 kV Bodkin Rock Crossing, would have been $7.8 million. Computing from a compound inflation growth rate of 9%, the cost would have escalated to $18.5 million in 1982 dollars. (NU Exhibit 15, Ans. 46, Reference to Handy-Whitman Index; Derewianka, Tr. 3/18/81, p. 4-6; p. 21-22)

Table 10

Effects of inflation on the Department of Environmental Protection Commissioner's 1973 order (1972 dollars in millions)

Year	Total of Undergrounding 345 kV lines	=	Scovill Rock Undergrounding 345 kV	(plus)	Relocation of Bodkin Rock 115 kV
1972	$ 7.830		$ 6.940		$ .890
1974	9.303		8.243		1.060
1976	11.053		9.794		1.259
1978	13.132		11.636		1.496
1980	15.602		13.825		1.777
1981	17.006		15.069		1.937
1982	18.536		16.425		2.111

(assumed 9% compound growth rate. Derewianka, Tr. 3/18/81 p. 4-7,11; NU Exhibit 15, A.44,46; Tr. 3/20/81, p.21-22)

227. Construction costs per the stipulation and agreement of 1973, in 1972 dollars, using the intensive cooling pipe-type technology, would have inflated from $5.3 million to $12.5 in 1982, assuming a 9% annual compound rate. (computed from NU Exhibit 15, Ans.46;

Reference to Handy-Whitman Index; Derewianka, Tr. 1/7/81, p.4-6, Tr. 3/20/81, p.21-22)

Table 11

Effects of inflation on construction costs per 1973 stipulation and agreement (1972 dollars in millions)

	Total	=	Scovill Rock Undergrounding 345 kV	(plus)	Underground 115 kV Same Route
1972	$ 5.298		$ 4.360		$ .938
1974	6.295		5.130		1.115
1976	7.479		6.155		1.324
1978	8.885		7.312		1.573
1980	10.557		8.688		1.869
1981	11.507		9.470		2.037
1982	12.542		10.322		2.220

(computed from assumed 9% compound growth rate used by NU, Derewianka, Tr. 3/18/81, p.4-7,11; NU Exhibit 15 Ans. 44,46; Tr. 3/18/81, p.21-22)

228. Project A in 1972 involved undergrounding two 345 kV lines at the Scovill Rock Substation to Hurd Park, using double circuit intensive cooled pipe-type cable. The Bodkin Rock 115 kV crossing was to be relocated overland to the Paper Rock Crossing. This proposal was ordered by the Department of Environmental Protection Commissioner. Project B was contemplated by the stipulation and agreement of 1973 and involved the undergrounding of two 345 kV lines from the west bank gravel pit to Hurd Park with the undergrounding of the 115 kV line over the same route. Project A cost about $7.830 million (1972 dollars) and Project B about $5.298 million (1972 dollars). The savings of "B" over "A" is $2.532 million. When inflated by a 9% compound yearly growth rate, this equals $5.994 million in 1982 dollars, an increase of 237 percent.

Table 12

Effects of inflation on savings between projects A & B

1972	$2,532,000
1974	3,008,000
1976	3,574,000
1978	4,246,000
1980	5,045,000
1981	5,499,000
1982	5,994,000

(computed from NU Exhibit 15 Ans. 46 assumes 9% compound yearly growth rate; Derewianka Tr. 3/18/81, p.4-7,11; Tr. 3/20/81, p-21-22)

229. NU states all 1972 undergrounding cost figures appear low because of an underestimation of marine excavation costs. The difference in the cost between the project ordered by the commissioner and the project stated by the stipulation and agreement in 1982 dollars would be $6.3 million. (NU Exhibit 15, Ans. 46; Tr. VII, p.44-45; Tr. VIII p.21-22)

Table 13

Effects of inflation on underestimated marine excavation costs (1972 dollars in millions)

1972	$2.659
1974	3.159
1976	3.753
1978	4.459
1980	5.298
1982	6.294

(computed from NU Exhibit 15 Ans. 46, assumed 9% compound yearly growth; Derewianka Tr. 3/18/81, p.4-7,11; Tr. 3/20/81, p.21-22)

230. A comparison of the effects of inflation on undergrounding proposal costs is demonstrated as follows:

Table 14

Effects of inflation on undergrounding costs by year
(million dollars)

Year	1972 Proposal (1972 dollars)	1973 Commissioner Order (1972 dollars)	1973 Stipulation Agreement (1972 dollars)	1976 Proposal (1978 dollars)
1972	$ 4.45 - 9.65			
1973	4.86 - 10.52	$ 7.80	$ 5.30	
1974	5.29 - 11.47	8.50	5.78	
1975	5.76 - 12.50	9.27	6.30	
1976	6.28 - 13.62	10.10	6.86	
1977	6.85 - 14.85	11.01	7.48	
1978	7.46 - 16.18	12.00	8.15	$10.08
1979	8.13 - 17.64	13.08	8.89	10.98
1980	8.87 - 19.22	14.26	9.69	11.97
1981	9.66 - 20.96	15.54	10.56	13.04
1982	10.53 - 22.85	16.94	11.51	14.22

(assumed 9% annual compound growth rate as used by NU; Exhibit 15, Ans.46; Derewianka, Tr. 3/18/81, p.4-7,11, 21-22)

Table 15

Effects of inflation since 1972 on 1980 proposals (million dollars)

	1972(1) Reconstruction (1972 dollars)	1972(1) Reconstruction (1978 dollars)	1972 Reconstruction (1981 dollars)	1972 Reconstruction (1982 dollars
Alternative A				
Relocate 345 kV lines	$4.86	$ 8.32	$11.74	$12.80
Underground 115 kV lines	NA	2.40	3.11	3.39
Relocate 115 kV lines	NA	.73	.95	1.03
Total	$4.86	$ 9.06-10.72	$12.69-14.85	$13.83-16.19
Alternative B				
Relocate 345 kV	$3.34	$ 5.84	$ 7.55	$ 8.23
Underground 115 kV	NA	2.40	3.11	3.39
Relocate 115 kV	NA	.73	.95	1.03
Total	$3.34	$6.57-8.24	$8.50-10.67	$9.26-11.63
		8.24	10.67	11.63
Alternative C				
Singular Tubular Steel H Tower	.475	.870	1.13	1.23
Alternative D				
Repaint	$36,000	$45,000	$58,300	$63,500

((1) NU Application 1976, Middletown No. 1, P. 45-46)

(Inflation rate assumed to be 9% as used by NU Exhibit 15, Ans. 46, and carried forward to 1982; by CSC computation. Derewianka, Tr. 3/18/81, p.4-7,11; Tr. 3/20/81, p.21-22)

Table 16

Comparative costs of Alternative "C" replacement towers reduced by deflation from 1982 - 1972. (1982 dollars in millions)

Year	Singular Tubular Steel H-Frame Normal Tension	Single Tubular Triple Circuit High Tension	6 New H-Frame High Tension Conductors
1982	$1.400	$1.800	$1.900
1981	1.284	1.651	1.743
1980	1.178	1.515	1.599
1978	.992	1.275	1.346
1976	.835	1.073	1.133
1974	.703	.903	.954
1973	.645	.829	.874
1972	.591	.760	.803

(Assuming 9% annual compound inflation rate from NU Exhibit 15, Ans. 44,46, and Derewianka Tr. 3/18/81 p.4-7,11; deflated by $\frac{100.0}{109.0} = .917431$ per year. NU Application; NU Exhibit 14, p.56-59; Tr. 3/20/81 p.21-22)

231. Removal of blasting debris would involve 1400 truck trips through Hurd State Park. (Fox, Tr. 1/7/81, p. 13)

232. The blasting schedule proposed by the DEP would cut the available blasting time by one half requiring a 24 hour work schedule, floodlighting, and a doubling of the costs. (Fox, Tr. 1/7/81, p.13)

233. A delay in the river blasting operation would also delay the in-service date of the underground installation by about a year, which would increase the costs by approximately $3 million a year over and above any increased blasting costs. (Fox, p. 15; Tr. 1/7/81, p.14)

234. Because of the DEP extension request, blasting in the river would have to be started after November 30, allowing very little time to complete it. (Fox, Tr. 1/7/81, p.14)

235. Blasting and riverwork would interfere with commercial barge delivery of fuel oil in November. (deBrigard, Tr. 3/18/81 p.155)

236. Interuptions in river use by blasting and cable installation would total 28 days of 8-12 hours duration each, or 224-336 total hours. This stoppage would require advance notices to commercial users such as shippers, distributors, petroleum deliverers, boaters, etc. (NU Exhibit 14, p.45)

237. In 1982, 8,800 cubic yards of rock would be blasted at the peak of the shad and Atlantic Salmon migration, April-October. Blasting after October 31 would increase blasting costs by $3 million. (Fox, Tr. 1/6/81, p.13-15, DEP comments p.2, Exhibit)

238. Commercial shad fishing industry revenues were quoted at $7 million by NU and $400,000 by DEP in 1974. (Cahn Report, September, 1976, p. 13; Middletown Exhibit 1, p.9)

239. The administrative cost to NU for the Scovill Rock undergrounding project from November, 1972, to January 15, 1981 totaled $545,205. (NU Exhibit 29)

240. Council's consultant, Power Technologies Inc., is engaged in a study of TMB transfer if restraining cables are used. This study will cost the utility industry $1.8 million by 1983. (EPRI Authorization Rosenberg 1; Moran, Tr. 1/8/81, 58, 74)

241. NU estimates the escalation costs of labor intensive components at 10 percent compounded per year for 30 years. This labor involves cable maintenance and operations. (Fox Tr. 3/20/81, p. 29,30)

242. Basic operating expenses for the maintenance of the system were estimated to be $218,000 for 1984, escalating thereafter at 10% per year. (NU Exhibit 28, p.2)

243. Property tax structures approximated $750,000 in 1984. Taxes were escalated at 2 percent per year. (Fox, Tr. 3/20/81, p.29,30; NU Exhibit 29,p.2)

244. The annual revenue requirement was computed by NU at $7,490,000 for 1984. (NU Exhibit No. 28, p.1)

245. Every year the state delays in appropriating the $5.0 million promised for scenic easement acquisition in the Gateway will further reduce the value of this appropriation in the property rights that can be purchased. (NU Appl., NU Exhibit 14, p.16)

246. The existing 345 kV circuits at Scovill Rock are principal routes for transmission of electric power produced at NU generating facilities east of the Connecticut River to load centers west of the river. (NU Exhibit 14, p.6, Tr. 1/6/81, p.128)

247. The existing 115 kV circuit serves the Pratt and Whitney substation in Middletown and is a secondary source of supply to the Connecticut Yankee Nuclear Power Plant in Haddam. (NU Exhibit 14, p.6)

248. The lines crossing the river at Scovill Rock are not certificated and are now under the Department of Environmental Protection orders for removal. (NU Exhibit 2, Middletown Exhibit 6)

249. A certificate from the Council to modify the crossing overhead would supercede the Department of Environmental orders to underground. (Tr. p. 87-91, 1/6/81)

250. The proposed modification would preserve existing transmission system capacity and reliability requirements. (Tr. p.57, 1/7/81)

251. Modification of the existing facility would serve the interests of electric system economy if the Department of Environmental Protection enforced its order of 1973 in the absence of a Council certificate. (NU post hearing brief, p.14)