February 3, 2005

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

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

Dear Ms. Katz:

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

With this filing, the Company has completed responding to all of the interrogatories requested during this proceeding.

Response to D-W-05 Interrogatories dated 09/10/2004
D-W - 069 *

Very truly yours,

Anne B. Bartosewicz
Project Director - Transmission Business

ABB/tms
cc: Service List

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

CL&P/UI
Docket No. 272

Data Request D-W-05
Dated: 09/10/2004
Q- D-W-069

Witness: **Allen W. Scarfone**
Request from: **Towns of Durham and Wallingford**

Question:
Reference pages 22 to 24 of the Report of the Reliability and Operability Committee (“ROC”) dated August 16, 2004. As described therein, one of the 345-kV cables in the Bethel to Norwalk Project is removed from service in Case 7 in an effort to raise the point of first system resonance above 3.0:

(a) Has the ROC studied any additional modifications to the Bethel to Norwalk Project ("Modifications") in an effort to increase the amount of undergrounding potentially available in the Middletown to Norwalk Project?

(b) If the answer to the question posed in (a) is "yes," please describe each such Modification in detail and the effect of each such modification on the amount of undergrounding potentially available in the Middletown to Norwalk Project. Provide any reports prepared in connection with such studies.

(c) Please identify what other Modifications would potentially alleviate the current restrictions on undergrounding of the Middletown to Norwalk Project, and the potential extent of such alleviation.

Response:
a) Yes, the ROC group has studied whether additional modifications to the Bethel to Norwalk Project would enable additional underground construction in the Middletown to Norwalk Project.

b) General Electric performed frequency scans to determine the impact of the Bethel to Norwalk Project being constructed mostly overhead, with 4 miles of XLPE cables. The exact configuration is documented in the attached report on pages 1 and 2. Table 4 on page 8 demonstrates that the impact of this modification on the resonant frequency is minimal.

c) Additional overhead 345-kV circuits between Norwalk and Plumtree substations would reduce the amount of impedance between Norwalk and Plumtree substations, and would not add significant additional line charging (capacitance) to the area. This would allow for much better system performance during an outage of the 345-kV line between Norwalk and Plumtree substations, but would be expected to provide minimal improvement in an "all lines in" condition.

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

NU MN XLPE PN-OVHD Report.pdf

Connecticut Cable Resonance Study for XLPE Alternative in Middletown to Norwalk Project - Case 5 with Overhead Lines Between Plumtree and Norwalk

Summary Report
October 2004

Prepared for:
Northeast Utilities

GE Energy
NU MN XLPE PN-OVHD Report.doc

Connecticut Cable Resonance Study for XLPE Alternative in Middletown to Norwalk Project - Case 5 with Overhead Lines Between Plumtree and Norwalk

Summary Report
October 2004

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Foreword

This document was prepared by General Electric Company in Schenectady, New York. It is submitted to Northeast Utilities (NU). Technical and commercial questions and any correspondence concerning this document should be referred to:

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Introduction

GE Energy's Energy Consulting group has performed a resonance study of an XLPE alternative in the Northeast Utilities (NU) Middletown to Norwalk 345 kV transmission cable project that is proposed in southwestern Connecticut. In this study, the two cables between Norwalk and Singer and the two cables between Singer and East Devon were represented as 3000 kcmil XLPE cable, but the connections between Plumtree and Norwalk are all overhead 345 kV and 115 kV lines except for two short sections of 345-kV 1750-kcmil XLPE cables.

The objective of this study was to investigate the change in the first resonance with the overhead lines between Plumtree and Norwalk as compared to the previously studied underground cable configurations.

The study has been performed with the Electromagnetic Transients Program (ATP/EMTP), which is recognized as an industry standard for simulating the transient performance and frequency response of electric utility systems [www.emtp.org].

System Representation

The system model used in this study still includes the two cables between Norwalk and Singer and the two cables between Singer and East Devon represented as 3000 kcmil XLPE cable. However, the circuits between Plumtree and Norwalk were removed (including HPFF cable) and replaced by overhead line and XLPE cable sections. The following parameters were used for the 345 kV and 115 kV circuits between Plumtree and Norwalk (per circuit in pu on a 100 MVA base):

<u>Overhead 115-kV line from Norwalk to Peaceable - 10.4 miles</u>
Rpos=0.0060818 pu
Xpos=0.061309 pu
Bpos=0.0076538 pu
Rzero=0.044496 pu
Xzero=0.16647 pu
Bzero=0.0053206 pu

<u>Overhead 115-kV line from Peaceable to Plumtree - 9.6 miles</u>
Rpos=0.0056126 pu
Xpos=0.056379 pu
Bpos=0.0070957 pu
Rzero=0.041065 pu
Xzero=0.15358 pu
Bzero=0.0048947 pu

<u>Plumtree-Norwalk 345-kV Section 1 – 2.1 mile 1750 kcmil XLPE cables</u>
Rpos=0.00008 pu
Xpos=0.00058 pu
Rzero=0.0006248 pu

Xzero=0.0004342 pu
Bposzero=0.22161 pu
(data is for each of two cables)

Plumtree-Norwalk 345-kV Section 2 – 4.9 mile overhead lines
Rpos=0.000132 pu
Xpos=0.002310 pu
Bpos=0.04499 pu
Rzero=0.002131 pu
Xzero=0.007806 pu
Bzero=0.027318 pu

Plumtree-Norwalk 345-kV Section 3 – 2.1 mile 1750 kcmil XLPE cables
Rpos=0.00008 pu
Xpos=0.00058 pu
Rzero=0.0006248 pu
Xzero=0.0004342 pu
Bposzero=0.22161 pu
(data is for each of two cables)

Plumtree-Norwalk 345-kV Section 4 – 10.9 mile overhead lines
Rpos=0.0002938 pu
Xpos=0.005138 pu
Bpos=0.10007 pu
Rzero=0.00474 pu
Xzero=0.017365 pu
Bzero=0.06077 pu

Table 1 shows the capacitor bank data for this study, and indicates the total MVAR at each bus and the capacitor bank MVAR in service under peak and light load conditions. This study considered only two conditions: the "All In" condition in which all capacitor banks shown in column 4 of the table are in service, and the "All Out" condition in which all those capacitor banks are out of service.

Table 2 shows the generators included in the original ASPEN file, and the modified status originally provided for the Middletown to Norwalk (M/N) project, which indicates the generators that are on or off during peak and light load conditions. An additional generator dispatch scenario is given for "Light Post-Project," which depicts a more realistic scenario with more local generation off. This study considered the original light load dispatch of generators and the Light Post-Project dispatch with more local generation off.

Table 1. Shunt Capacitor Conditions for System Model

Shunt Capacitors			**All Banks**	**Peak Load**	**Light Load**
Substation	**Voltage (kV)**	**# Units**	**MVAR (total)**	**MVAR**	**MVAR**
Southington 1	115	3	157.2	157.2	
Southington 2	115	3	157.2	157.2	
Frost Bridge	115	5	262.0	262.0	
Berlin	115	3	132.0	132.0	
Plumtree	115	2	92.2	0	
Glenbrook	115	5	190.8*	151.2	
Darien	115	1	39.6	39.6	
Waterside	115	1	39.6	39.6	
Norwalk	115	0	0	0	
East Shore	115	2	84.0	84.0	
No. Haven	115	1	42.0	42.0	
Sackett	115	1	42.0	42.0	
Rocky River	115	1	25.2	25.2	
Stony Hill	115	1	25.2	25.2	
Cross Sound Filters	200	3	103.0 (61 – 25^{th}, 32 – 41^{st}, 10 – 21^{st})	103.0	103.0

* Actual maximum including Glenbrook Statcom is 335 MVAR (additional MVAR not included in analysis)

Table 2. Modified Generator Conditions for System Model

GENERATOR	KV	ID	ST	STATUS (PEAK)	STATUS (LIGHT)	Light Post-Project	IDENTIFI-CATION NOTES
MILLSTON	22.8	1	1	on	on	On	
MILLSTON	22.8	1	1	on	on	On	
RESCO	115	1	1	on	on	On	Bridgeport
ROCKY RV	13.8	1	1	on	on	Off	
ROCKY RV	13.8	1	1	on	on	Off	
ROCKY RV	13.8	1	1	on	on	Off	
STEVENSO	6.9	1	1	off	off	Off	
NORWALK	27.6	1	0	off	off	Off	
BULLS BR	27.6	1	1	on	on	Off	
FORESTVI	13.8	1	1	on	on	On	
brdgphbr	18.4	2	1	off	off	Off	
brdgphbr	20.2	3	1	on	on	Off	
brdgphbr	13.68	jt	1	off	off	Off	
COSCOBGE	13.8	1	1	off	off	Off	
COSCOBGE	13.8	2	1	off	off	Off	
COSCOBGE	13.8	3	1	off	off	Off	
DEVON 11	13.8	1	1	off	off	Off	
DEVON 12	13.8	1	1	off	off	Off	
DEVON 13	13.8	1	1	off	off	Off	
DEVON 14	13.8	1	1	off	off	Off	
English	13.68	8	1	off	off	Off	
English	13.68	7	1	off	off	Off	
ESHOREGE	13.8	1	1	on	on	Off	New Haven
G1/G2	13.8	1	1	off	off	Off	Wallingford
G3/G4	13.8	1	1	off	off	Off	Wallingford
G5	13.8	1	1	off	off	Off	Wallingford
GT1 (11)	16	1	1	off	off	Off	BE
GT2 (12)	16	1	1	off	off	Off	BE
Middleto	22	1	1	on	off	Off	Middletown
Milford	20.9	1	1	on	on	Off	
Milford	20.9	1	1	off	off	Off	
one (Meriden)	21	1	1	on	off	Off	Meriden
Shepaug	13.8	1	1	on	on	Off	
so norwa	4.8	1	1	off	off	Off	
so norwa	4.8	1	1	off	off	Off	
so norwa	13.8	1	1	off	off	Off	
ST1 (10)	16	1	1	off	off	Off	BE
Temp Gen (Waterside)	13.8	3	0	off	off	Off	Waterside
Temp Gen (Waterside)	13.8	1	0	off	off	Off	Waterside
Temp Gen (Waterside)	13.8	2	0	off	off	Off	Waterside
three (Meriden)	21	1	1	on	off	Off	Meriden

GENERATOR	KV	ID	ST	STATUS (PEAK)	STATUS (LIGHT)	Light Post-Project	IDENTIFI-CATION NOTES
two (Meriden)	21	1	1	on	off	Off	Meriden
Unit 10	13.8	1	1	off	off	Off	Devon 10
Unit 6J- (Norwalk)	17.1	1	1	off	off	Off	Norwalk-1
Unit 6J- (Norwalk)	13.8	1	1	off	off	Off	Norwalk -10
Unit 6J- (Norwalk)	19	1	1	off	on	Off	Norwalk-2
Unit 7	13.2	1	1	on	off	Off	Devon
Unit 8	13.2	1	1	on	off	Off	Devon
walrecge	4.16	1	1	on	off	Off	

Resonance Results

The resonance effects were analyzed by evaluating the driving-point impedance versus frequency at various locations, with all capacitor banks in and out of service, and with the original light load and light post-project generator (local generation off) dispatches.

Table 3 shows the cases that were performed and the resonant frequencies that were observed along with the corresponding impedance value at those frequencies. The resonant frequency is indicated by its harmonic number (HN), in per unit of 60 Hz, and impedance magnitude is in ohms. The corresponding driving-point impedance plots are provided in Appendix A. Figure 1 shows a comparison plot at Plumtree 345 kV for this configuration and the Case 5 configuration (having a 9.7-mi HPFF cable section between Plumtree and Norwalk).

Table 3. Resonant Frequencies for M/N-XLPE Project
Plumtree-Norwalk Almost All Overhead

				Resonant Frequency & Impedance (pu of 60Hz, Ohm)					
Case	Location	Capacitor Banks	Generation Dispatch	Low		Middle		High	
				HN	Z(Ω)	HN	Z(Ω)	HN	Z(Ω)
M/N-XLPE-PNOH_1B	Plumtree 345 kV	All In	Light Load Generation	2.9	117			15.6	1405
M/N-XLPE-PNOH_1C	Plumtree 345 kV	All Out	Light Load Generation	3.7	199			12.5	478
M/N-XLPE2-PNOH_1B	Plumtree 345 kV	All In	Local Generators Off	2.6	95			15.6	1312
M/N-XLPE2-PNOH_1C	Plumtree 345 kV	All Out	Local Generators Off	3.4	147			12.4	430
M/N-XLPE-PNOH_2B	Plumtree 115 kV	All In	Light Load Generation	2.9	16			12.0	105
M/N-XLPE-PNOH_2C	Plumtree 115 kV	All Out	Light Load Generation	3.7	21			12.4	131
M/N-XLPE2-PNOH_2B	Plumtree 115 kV	All In	Local Generators Off	2.5	13			11.9	96
M/N-XLPE2-PNOH_2C	Plumtree 115 kV	All Out	Local Generators Off	3.3	17			12.4	120
M/N-XLPE-PNOH_3B	Norwalk 345 kV	All In	Light Load Generation	2.9	146	5.8	284		
M/N-XLPE-PNOH_3C	Norwalk 345 kV	All Out	Light Load Generation	3.7	291				
M/N-XLPE2-PNOH_3B	Norwalk 345 kV	All In	Local Generators Off	2.6	120	5.8	281		
M/N-XLPE2-PNOH_3C	Norwalk 345 kV	All Out	Local Generators Off	3.4	211				
M/N-XLPE-PNOH_4B	Norwalk 115 kV	All In	Light Load Generation	2.9	15	4.6	17		
M/N-XLPE-PNOH_4C	Norwalk 115 kV	All Out	Light Load Generation	3.7	19	8.3	24	15.8	39
M/N-XLPE2-PNOH_4B	Norwalk 115 kV	All In	Local Generators Off	2.6	13	4.5	16		
M/N-XLPE2-PNOH_4C	Norwalk 115 kV	All Out	Local Generators Off	3.4	17	8.1	23	15.7	37
M/N-XLPE-PNOH_5B	Southington 345 kV	All In	Light Load Generation	2.9	81			12.5	116
M/N-XLPE-PNOH_5C	Southington 345 kV	All Out	Light Load Generation	3.7	75			10.6	259
M/N-XLPE2-PNOH_5B	Southington 345 kV	All In	Local Generators Off	2.6	66			12.4	113

M/N-XLPE2-PNOH_5C	Southington 345 kV	All Out	Local Generators Off	3.3	63			10.4	239
M/N-XLPE-PNOH_6B	Southington 115 kV	All In	Light Load Generation	2.8	12	5.4	37	9.4	128
M/N-XLPE-PNOH_6C	Southington 115 kV	All Out	Light Load Generation	3.6	10			10.3	29
M/N-XLPE2-PNOH_6B	Southington 115 kV	All In	Local Generators Off	2.5	10	5.3	30	9.4	120
M/N-XLPE2-PNOH_6C	Southington 115 kV	All Out	Local Generators Off	3.3	9			10.1	28
M/N-XLPE-PNOH_7B	East Shore 345 kV	All In	Light Load Generation	2.8	66	6.2	225	14.6	523
M/N-XLPE-PNOH_7C	East Shore 345 kV	All Out	Light Load Generation	3.6	69			10.3	242
M/N-XLPE2-PNOH_7B	East Shore 345 kV	All In	Local Generators Off	2.5	72	6.1	250	14.2	391
M/N-XLPE2-PNOH_7C	East Shore 345 kV	All Out	Local Generators Off	3.3	74			10.2	272
M/N-XLPE-PNOH_8B	Devon 115 kV	All In	Light Load Generation	2.8	11				
M/N-XLPE-PNOH_8C	Devon 115 kV	All Out	Light Load Generation	3.7	14				
M/N-XLPE2-PNOH_8B	Devon 115 kV	All In	Local Generators Off	2.6	13				
M/N-XLPE2-PNOH_8C	Devon 115 kV	All Out	Local Generators Off	3.3	15				
M/N-XLPE-PNOH_9B	Frost Bridge 115 kV	All In	Light Load Generation	2.9	19	5.4	40	8.5	31
M/N-XLPE-PNOH_9C	Frost Bridge 115 kV	All Out	Light Load Generation	3.6	13			10.3	28
M/N-XLPE2-PNOH_9B	Frost Bridge 115 kV	All In	Local Generators Off	2.6	15	5.3	38	8.5	33
M/N-XLPE2-PNOH_9C	Frost Bridge 115 kV	All Out	Local Generators Off	3.3	11			10.1	27
M/N-XLPE-PNOH_10B	Glenbrook 115 kV	All In	Light Load Generation	2.9	17	4.6 5.9	32 42		
M/N-XLPE-PNOH_10C	Glenbrook 115 kV	All Out	Light Load Generation	3.7	17	8.3	44	15.9	58
M/N-XLPE2-PNOH_10B	Glenbrook 115 kV	All In	Local Generators Off	2.6	15	4.5 5.8	30 38		
M/N-XLPE2-PNOH_10C	Glenbrook 115 kV	All Out	Local Generators Off	3.4	16	8.1	42	15.8	55
M/N-XLPE-PNOH_11B	Singer 345 kV	All In	Light Load Generation	2.9	147	5.8	337		
M/N-XLPE-PNOH_11C	Singer 345 kV	All Out	Light Load Generation	3.7	298				
M/N-XLPE2-PNOH_11B	Singer 345 kV	All In	Local Generators Off	2.6	121	5.8	333		
M/N-XLPE2-PNOH_11C	Singer 345 kV	All Out	Local Generators Off	3.5	217				
M/N-XLPE-PNOH_12B	Devon 345 kV	All In	Light Load Generation	2.9	142	5.8	313		
M/N-XLPE-PNOH_12C	Devon 345 kV	All Out	Light Load Generation	3.7	284				
M/N-XLPE2-PNOH_12B	Devon 345 kV	All In	Local Generators Off	2.6	118	5.8	309		
M/N-XLPE2-PNOH_12C	Devon 345 kV	All Out	Local Generators Off	3.4	208				
M/N-XLPE-PNOH_13B	Beseck 345 kV	All In	Light Load Generation	2.9	72			12.5	286
M/N-XLPE-PNOH_13C	Beseck 345 kV	All Out	Light Load Generation	3.7	86			10.6	249
M/N-XLPE2-PNOH_13B	Beseck 345 kV	All In	Local Generators Off	2.6	59			12.5	277
M/N-XLPE2-PNOH_13C	Beseck 345 kV	All Out	Local Generators Off	3.4	69			10.4	227

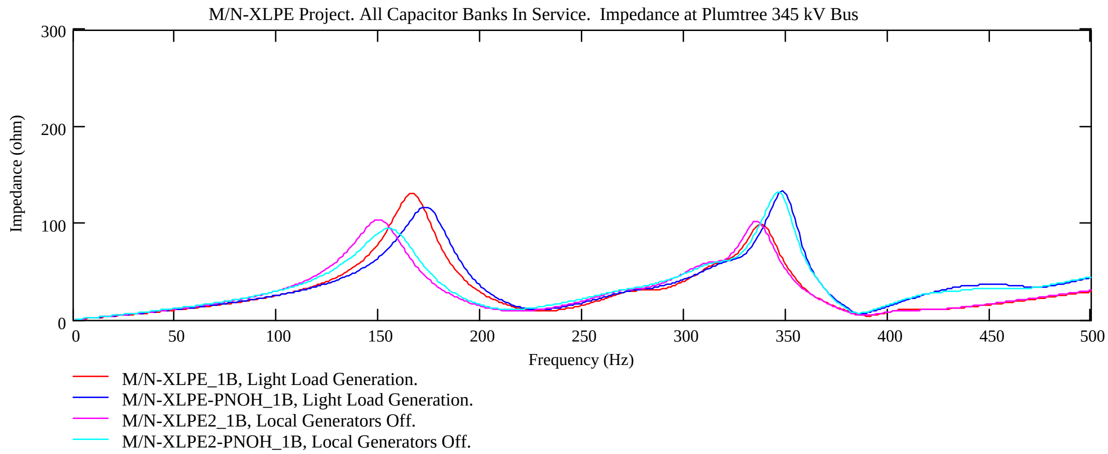


Figure 1. Impedance vs. Frequency at Plumtree 345 kV Bus

Conclusions

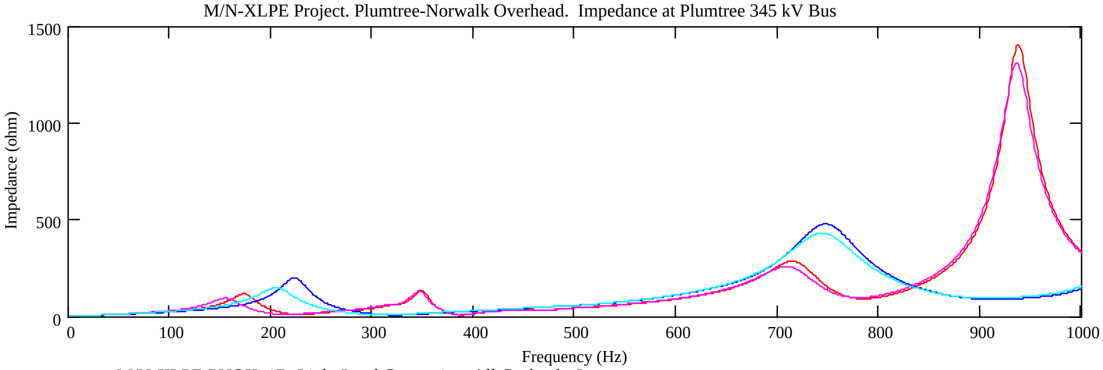
Table 4 summarizes the variation in frequencies of the first resonance points for the XLPE alternative, with a 9.7-mi HPFF cable section between Plumtree and Norwalk that was studied before (Case 5) and with the 345 kV circuit between Plumtree and Norwalk consisting mainly of overhead lines as described in this report. As expected, the first resonance frequency is increased slightly in the order of 0.1-0.2 pu (7-12 Hz), with the removal of HPFF cable charging capacitance. The impedance magnitude of the first resonance is slightly lower at Plumtree and about the same at other buses when compared to Case 5.

Table 4. Variation in Frequency of First Resonance Points (pu 60 Hz)

115 kV Capacitor Bank Conditions	M/N-XLPE Project with HPFF Cable (Original Light Load Generator Dispatch) (Case 5)	M/N-XLPE Project with HPFF Cable (Local Generators Off) (Case 5)	M/N-XLPE Project without HPFF Cable (Original Light Load Generator Dispatch)	M/N- XLPE Project without HPFF Cable (Local Generators Off)
All in service	2.7-2.8 (161Hz-167Hz)	2.4-2.5 (145Hz-151Hz)	2.8-2.9 (168Hz-174Hz)	2.5-2.6 (152Hz-156Hz)
All out of service	3.4-3.5 (203Hz-212Hz)	3.1-3.3 (186Hz-196Hz)	3.6-3.7 (214Hz-224Hz)	3.3-3.5 (195Hz-207Hz)

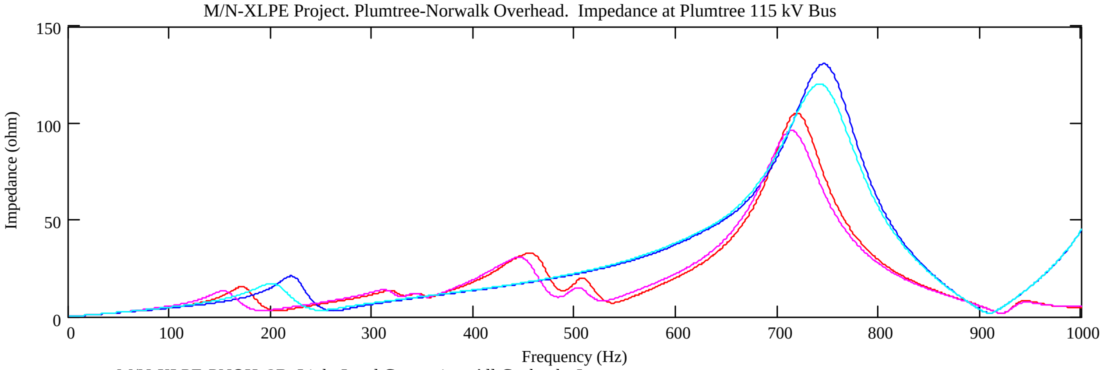
Appendix A Driving-Point Impedance Plots

M/N-XLPE Project. Plumtree-Norwalk Overhead. Impedance at Plumtree 345 kV Bus



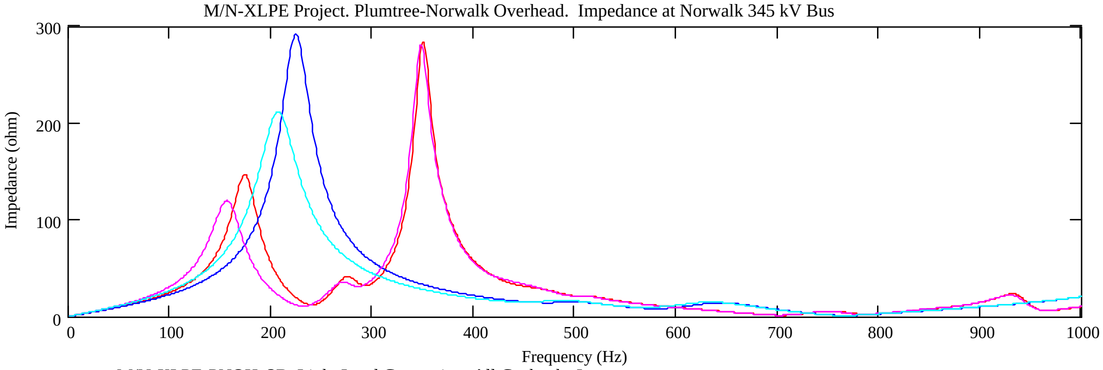
M/N-XLPE-PNOH_1B, Light Load Generation. All Capbanks In.
M/N-XLPE-PNOH_1C, Light Load Generation. All Capbanks Out.
M/N-XLPE2-PNOH_1B, Local Generators Off. All Capbanks In.
M/N-XLPE2-PNOH_1C, Local Generators Off. All Capbanks Out.

M/N-XLPE Project. Plumtree-Norwalk Overhead. Impedance at Plumtree 115 kV Bus



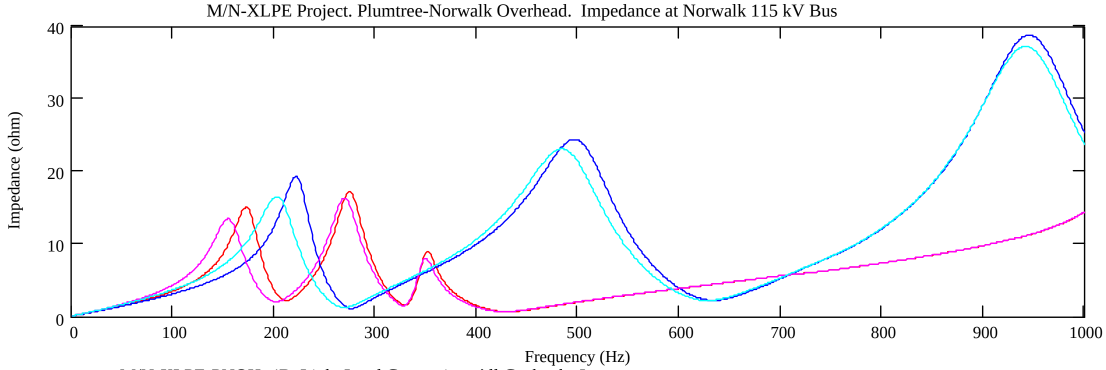
M/N-XLPE-PNOH_2B, Light Load Generation. All Capbanks In.
M/N-XLPE-PNOH_2C, Light Load Generation. All Capbanks Out.
M/N-XLPE2-PNOH_2B, Local Generators Off. All Capbanks In.
M/N-XLPE2-PNOH_2C, Local Generators Off. All Capbanks Out.

M/N-XLPE Project. Plumtree-Norwalk Overhead. Impedance at Norwalk 345 kV Bus



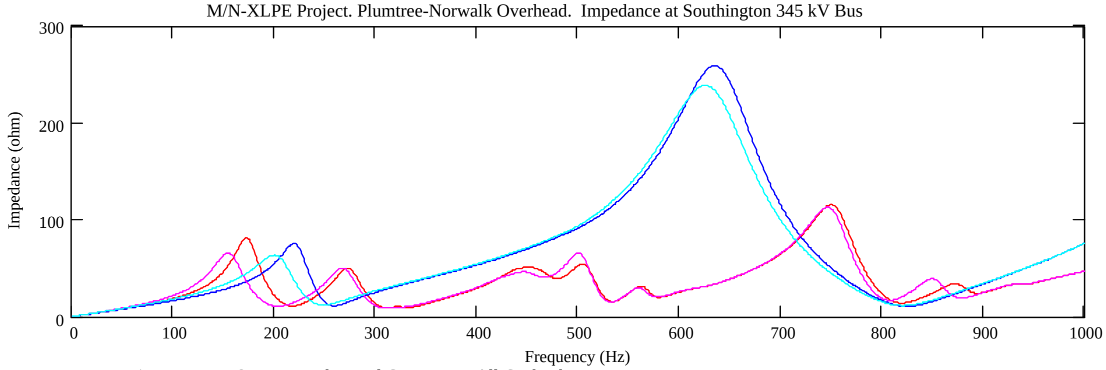
M/N-XLPE-PNOH_3B, Light Load Generation. All Capbanks In.
M/N-XLPE-PNOH_3C, Light Load Generation. All Capbanks Out.
M/N-XLPE2-PNOH_3B, Local Generators Off. All Capbanks In.
M/N-XLPE2-PNOH_3C, Local Generators Off. All Capbanks Out.

M/N-XLPE Project. Plumtree-Norwalk Overhead. Impedance at Norwalk 115 kV Bus



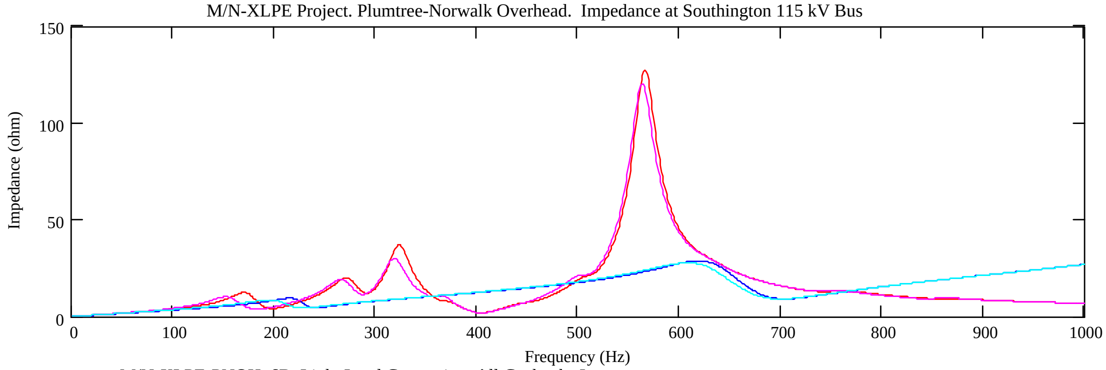
M/N-XLPE-PNOH_4B, Light Load Generation. All Capbanks In.
M/N-XLPE-PNOH_4C, Light Load Generation. All Capbanks Out.
M/N-XLPE2-PNOH_4B, Local Generators Off. All Capbanks In.
M/N-XLPE2-PNOH_4C, Local Generators Off. All Capbanks Out.

M/N-XLPE Project. Plumtree-Norwalk Overhead. Impedance at Southington 345 kV Bus



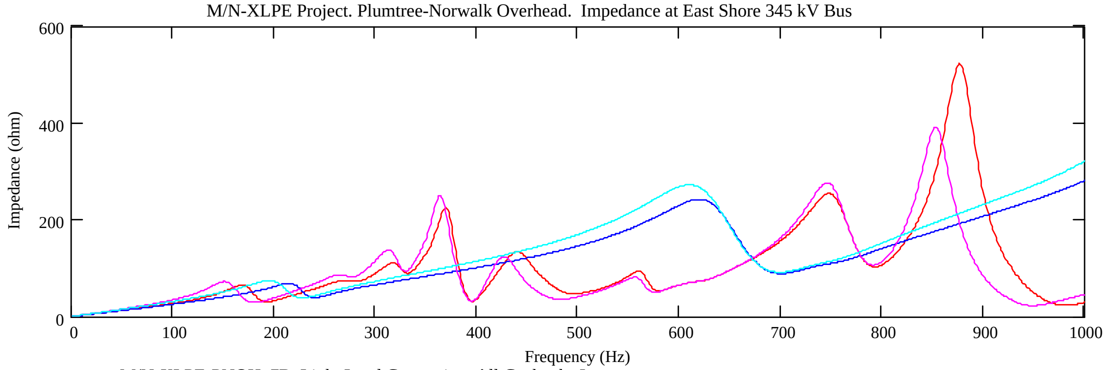
M/N-XLPE-PNOH_5B, Light Load Generation. All Capbanks In.
M/N-XLPE-PNOH_5C, Light Load Generation. All Capbanks Out.
M/N-XLPE2-PNOH_5B, Local Generators Off. All Capbanks In.
M/N-XLPE2-PNOH_5C, Local Generators Off. All Capbanks Out.

M/N-XLPE Project. Plumtree-Norwalk Overhead. Impedance at Southington 115 kV Bus



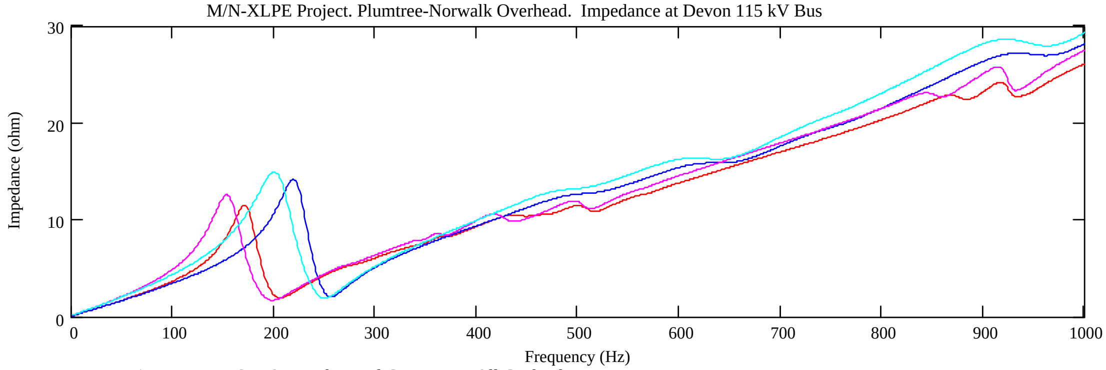
M/N-XLPE-PNOH_6B, Light Load Generation. All Capbanks In.
M/N-XLPE-PNOH_6C, Light Load Generation. All Capbanks Out.
M/N-XLPE2-PNOH_6B, Local Generators Off. All Capbanks In.
M/N-XLPE2-PNOH_6C, Local Generators Off. All Capbanks Out.

M/N-XLPE Project. Plumtree-Norwalk Overhead. Impedance at East Shore 345 kV Bus



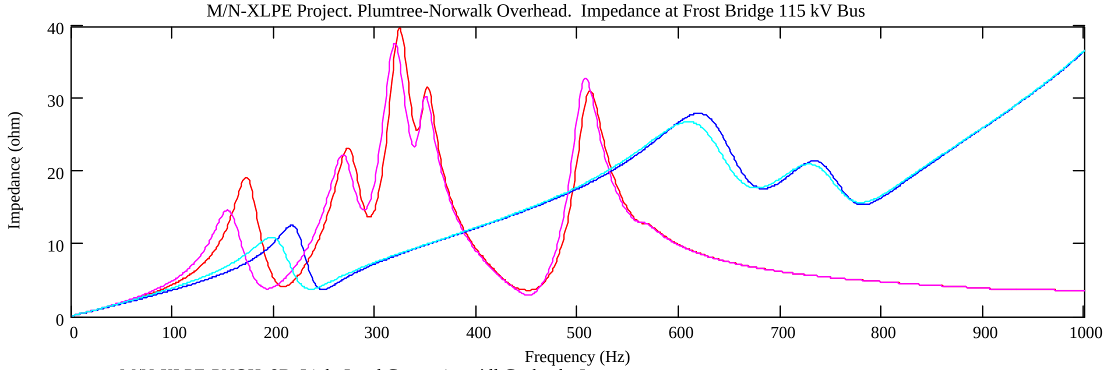
M/N-XLPE-PNOH_7B, Light Load Generation. All Capbanks In.
M/N-XLPE-PNOH_7C, Light Load Generation. All Capbanks Out.
M/N-XLPE2-PNOH_7B, Local Generators Off. All Capbanks In.
M/N-XLPE2-PNOH_7C, Local Generators Off. All Capbanks Out.

M/N-XLPE Project. Plumtree-Norwalk Overhead. Impedance at Devon 115 kV Bus

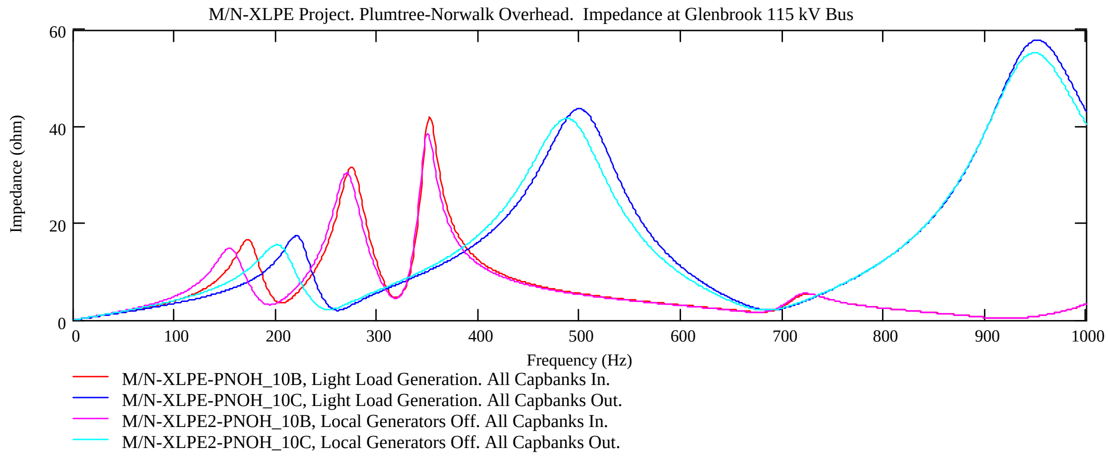


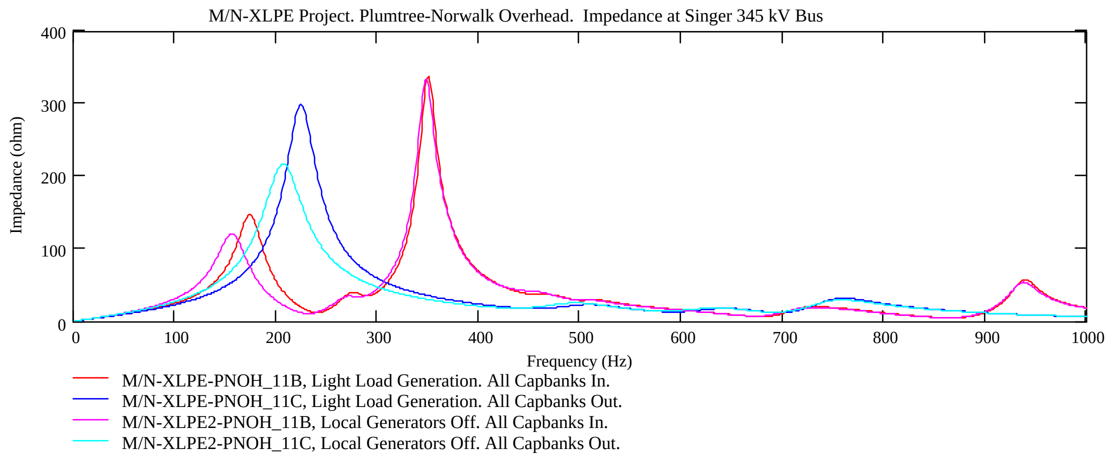
M/N-XLPE-PNOH_8B, Light Load Generation. All Capbanks In.
M/N-XLPE-PNOH_8C, Light Load Generation. All Capbanks Out.
M/N-XLPE2-PNOH_8B, Local Generators Off. All Capbanks In.
M/N-XLPE2-PNOH_8C, Local Generators Off. All Capbanks Out.

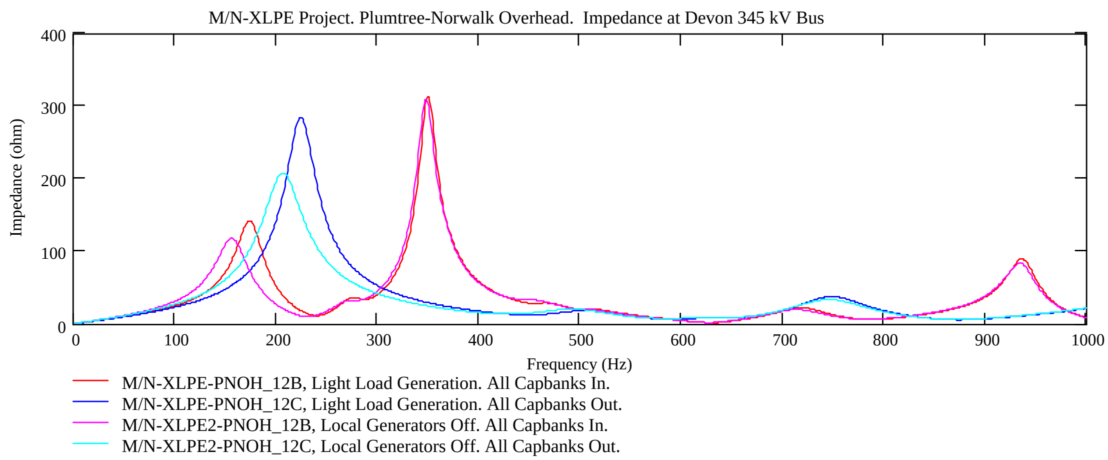
M/N-XLPE Project. Plumtree-Norwalk Overhead. Impedance at Frost Bridge 115 kV Bus

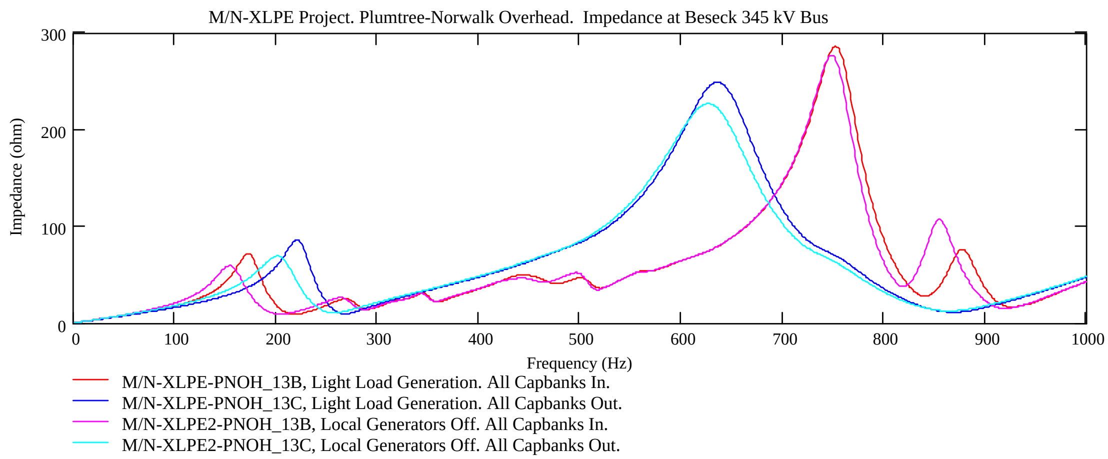


M/N-XLPE-PNOH_9B, Light Load Generation. All Capbanks In.
M/N-XLPE-PNOH_9C, Light Load Generation. All Capbanks Out.
M/N-XLPE2-PNOH_9B, Local Generators Off. All Capbanks In.
M/N-XLPE2-PNOH_9C, Local Generators Off. All Capbanks Out.


M/N-XLPE Project. Plumtree-Norwalk Overhead. Impedance at Glenbrook 115 kV Bus
Impedance (ohm)
60
40
20
0
0
100
200
300
400
500
600
700
800
900
1000
Frequency (Hz)
M/N-XLPE-PNOH_10B, Light Load Generation. All Capbanks In.
M/N-XLPE-PNOH_10C, Light Load Generation. All Capbanks Out.
M/N-XLPE2-PNOH_10B, Local Generators Off. All Capbanks In.
M/N-XLPE2-PNOH_10C, Local Generators Off. All Capbanks Out.


M/N-XLPE Project. Plumtree-Norwalk Overhead. Impedance at Singer 345 kV Bus
Impedance (ohm)
400
300
200
100
0
0
100
200
300
400
500
600
700
800
900
1000
Frequency (Hz)
M/N-XLPE-PNOH_11B, Light Load Generation. All Capbanks In.
M/N-XLPE-PNOH_11C, Light Load Generation. All Capbanks Out.
M/N-XLPE2-PNOH_11B, Local Generators Off. All Capbanks In.
M/N-XLPE2-PNOH_11C, Local Generators Off. All Capbanks Out.


M/N-XLPE Project. Plumtree-Norwalk Overhead. Impedance at Devon 345 kV Bus
Impedance (ohm)
400
300
200
100
0
0
100
200
300
400
500
600
700
800
900
1000
Frequency (Hz)
M/N-XLPE-PNOH_12B, Light Load Generation. All Capbanks In.
M/N-XLPE-PNOH_12C, Light Load Generation. All Capbanks Out.
M/N-XLPE2-PNOH_12B, Local Generators Off. All Capbanks In.
M/N-XLPE2-PNOH_12C, Local Generators Off. All Capbanks Out.



M/N-XLPE Project. Plumtree-Norwalk Overhead. Impedance at Beseck 345 kV Bus
Impedance (ohm)
300
200
100
0
0
100
200
300
400
500
600
700
800
900
1000
Frequency (Hz)
M/N-XLPE-PNOH_13B, Light Load Generation. All Capbanks In.
M/N-XLPE-PNOH_13C, Light Load Generation. All Capbanks Out.
M/N-XLPE2-PNOH_13B, Local Generators Off. All Capbanks In.
M/N-XLPE2-PNOH_13C, Local Generators Off. All Capbanks Out.