STATE OF CONNECTICUT

SITING COUNCIL

Re:	The Connecticut Light and Power Company and The United Illuminating Company Application for a Certificate of Environmental Compatibility and Public Need for the Construction of a New 345-kV Electric Transmission Line and Associated Facilities Between Scovill Rock Switching Station in Middletown and Norwalk Substation in Norwalk, Connecticut Including the Reconstruction of Portions of Existing 115-kV and 345-kV Electric Transmission Lines, the Construction of the Beseck Switching Station in Wallingford, East Devon Substation in Milford, and Singer Substation in Bridgeport, Modifications at Scovill Rock Switching Station and Norwalk Substation and the Reconfiguration of Certain Interconnections	)	Docket 272 June 18, 2004

INFORMATION PROVIDED BY APPLICANTS WITNESSES AT THE HEARING ON JUNE 17, 2004

The Connecticut Light and Power Company ("CL&P") and The United Illuminating Company ("UI") (together, the "Companies") submit the following information provided by the Companies' witnesses at the June 17, 2004 hearing held in this docket.

1. Updated Cable Fault Rate Information, provided by Brian Gregory
2. Approximate Evaluation of the Effectiveness of a Damped "Type C" 3rd Harmonic Filter to Mitigate System Resonance Between 2nd and 3rd Harmonic, provided by Reigh Walling

Respectfully Submitted,

The Connecticut Light and Power Company

Anne Bartosewicz

By: Anne Bartosewicz
Project Director, CL&P

cc: Service List

June 17, 2004

Calculation of Fault Rate Data for EHV XLPE Circuits

1.0 Background

The period of time that has elapsed since the data for EPRI report 1001846 was collated in mid 2002 is 2 years. The additions to the data are based on conversations within the year 2003 with Engineers within the cable industry. The results of such questioning has generally confirmed good service performance, however this qualitative data is taken as optimistic. A small number of new faults is known to have occurred, some of which have been attributed to mechanical damage, these have been included as a balance to the optimistic qualitative data. It should be emphasized that the additional data is based on best estimates and that the EPRI survey has not been formally updated.

2.0 Updated Fault Statistics Data

The selected EHV XLPE projects and the analysed fault rates are given in Table 1. Service life is calculated by multiplying the length of each single phase cable circuit by the number of years in service, giving the unit [km. years] or [mile. years]. The cumulative service life is obtained by adding each of the [km. years].

Installation Type	Country	Utility/ Operator	System [kV]	Cable Length. Single circuit [km]	No. of Faults	Years in Service	Service [Km.Years]	Circuit Fault Rate	
								faults/100km.year	faults/100mile.year
Trough	UK	Bechtel	400	0.23	1	6.75	1.55	64.52	103.2
Tunnel	Germany	BEWAG 1	400	6.3 6.3	1	5	63	1.6	2.6
Tunnel	Germany	BEWAG 2	400	5.5 5.5	0	3	33	0	0
Direct buried	Copenhagen	Copenhagen Electricity	400	12 9	0	6	126	0	0
Direct buried	Copenhagen	Copenhagen Electricity	400	12	0	4	48	0	0
Tunnel	Taiwan	-	345	21	2	1	21	9.5	15.2
Trough	UK	NGC	275	0.67	1	3	2.01	149.25	238.8
Trough	UK	PP	275	1.5	2	1	1.5	133.3	213.3
Direct buried	Singapore	PowerGrid	230	20	7	5	100	7	11.2
Direct buried	Singapore	PowerGrid	230	42	1	4	168	0.6	1.0
Duct	USA	LADWP	230	8.7	0	2	17.35	0	0
Duct	USA	APS	230	2.8	0	3	8.4	0	0
Tunnel	Spain	Union Fenosa	220	20	2	5	100	2	3.2

Total data	-	-	-	173.5	17	3.75 Av	689.8	2.46	3.9
Table 1. Individual circuit failure rate, (number of failures/100km.year) up to end 2003									

The basis of the selection of data for analysis is:

Faults are defined as a) electrical failure during commissioning and in service and b) as detection of partial discharge during commissioning and in service.
Electrical faults that were said to be associated with mechanical damage have been included.
To concentrate on the circuits containing joints as these are more at risk.
To concentrate on circuits containing pre-fabricated joints as field molded joints are not considered practical designs for direct buried and duct installations, this excludes the majority of the Japanese 275kV and 500kV experience.
If it is known that a termination failed to include the data even if there are no joints.
Circuits are excluded that are still in installation or that were scheduled to commission in early 2004.

3.0 Sensitivity Study

One of the 20km long 230kV 2000mm^2 circuits installed in Singapore experienced a high failure rate of the pre-molded one-piece joints. The effect of this adverse experience on the selected project worldwide fault rates is given in Table 2.

Sensitivity	Case	Cable Length [single circuit km]	No. of Faults	Km. Years	Circuit Failure Rate [failures/100km.year]	Circuit Failure Rate [failures/100mile.year]
If no Singapore data	optimistic	153.5	10	589.8	1.69	2.7
All data	realistic	173.5	17	689.8	2.46	3.93
Only Singapore data	pessimistic	20.0	7	100	7	11.2

Table 2. Sensitivity study of including and excluding the Singapore 230kV failures

4.0 Estimation to Allow for Changing Rate with Time

The factor of x 0.59, as taken from the analysis of the 2001 fault rates, is also applied to moderate the calculation of the 2003 fault rates, Table 3. This assumes that the majority of faults will be in accessories and that the rate will reduce with time as a) the joints with defects above the stress threshold will fail and b) action is likely to be taken to identify and replace unfailed suspect joints and terminations.

Case	Fault Rates per 100 mile. years	Moderated by x 0.59
Optimistic	2.71	1.6
Realistic	3.94	2.3
Pessimistic	11.2	6.6

Table 3 Moderated fault rates to allow for reduction with time in service

5.0 Comparison of Fault Rate Figures Between 2001 and 2003

The reduction in fault rates is shown in Table 4. Since the previous calculation the following changes have been made to the selection of the data:

Time in service has been incremented by two years.
The number of circuits included has been increased from to 5 to13.
The service experience that has field molded joints has been deleted.

Case	Faults per year per 100 miles	
	Calculated on 2001data	Calculated on 2003 data
Optimistic	2.1	1.6
Realistic	4	2.3
Pessimistic	10.9	6.6

Table 3 fault rates up to the end of 2001 and the end of 2003

Approximate Evaluation of the Effectiveness of a Damped "Type C" 3rd Harmonic Filter to Mitigate System Resonance Between 2nd and 3rd Harmonic

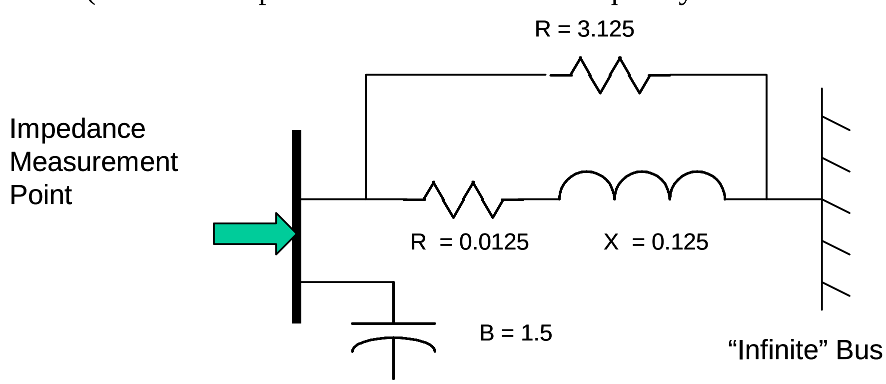
Reigh A. Walling
GE Energy
June 17, 2004

This document describes analysis of an equivalent circuit generally, and most approximately, resembling the Southwest Connecticut transmission system, from the standpoint of harmonic impedance characteristic. This is called the "base system" in this document. To evaluate the effectiveness of the third harmonic filter concept suggested by KEMA, one-third of the shunt capacitance of the base system was converted to a "Type C" damped 3rd harmonic filter. The damping factor of this filter is similar to that described in the KEMA paper.

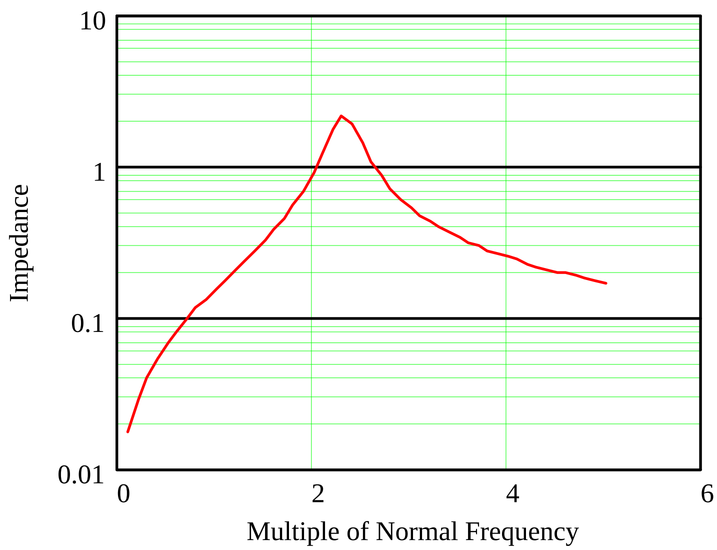
Base System Assumptions:

Short circuit capacity: 8 GVA
Fundamental frequency impedance angle: 82 degrees.
Cumulative charging capacitance: 1600 MVAR

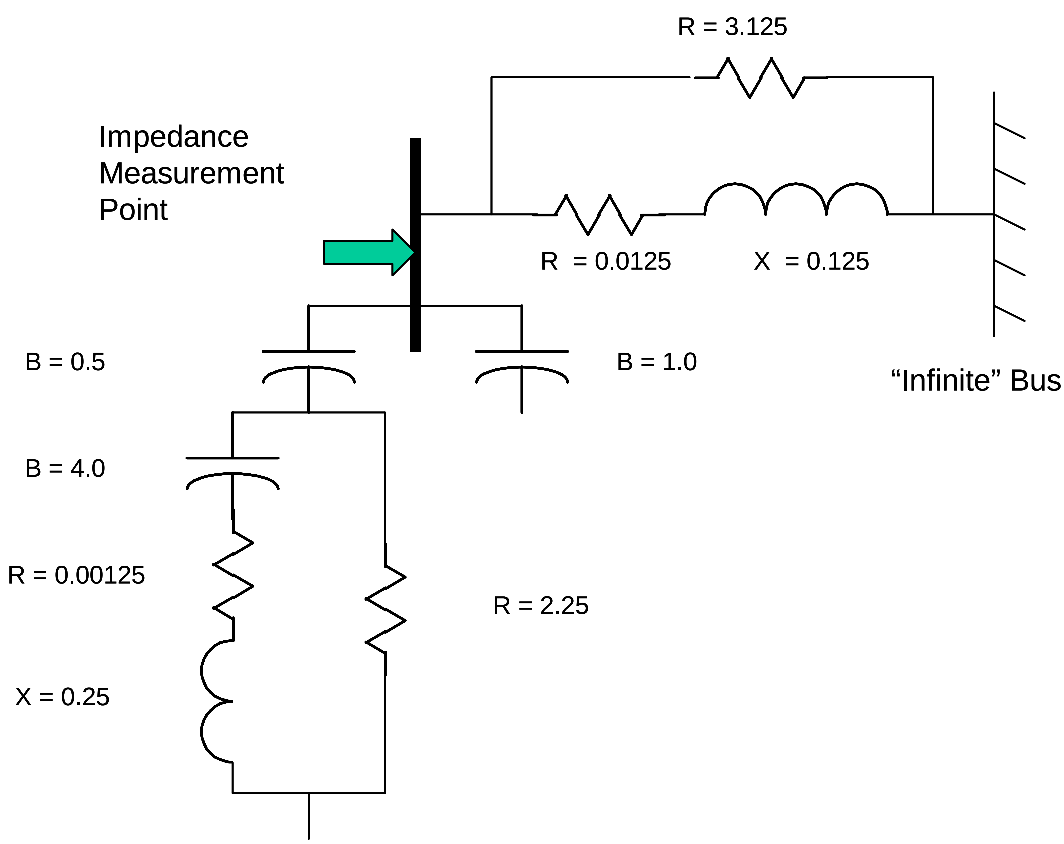
System model (all values in per-unit at fundamental frequency on a 1GVA base):



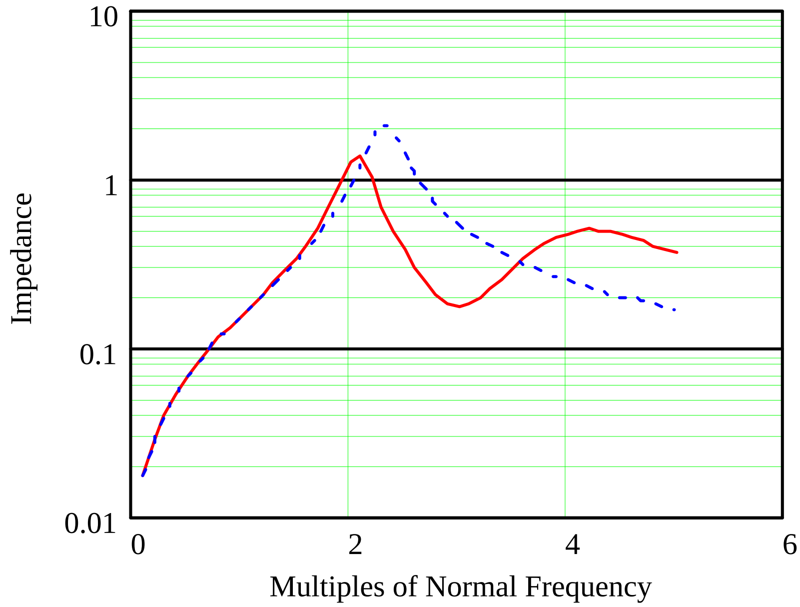
Impedance of Base System



System Model with Damped 3rd Harmonic Filter



Comparison of Impedance Performance



Dashed line is the impedance of the base system, the solid line is the system impedance with one-third of the total system capacitance converted to a damped 3rd harmonic filter.

Conclusions

In a system having a strong impedance resonance at approximately 2.3 times fundamental, conversion of approximately one-third of the system capacitance to a damped third harmonic filter causes the first system resonance to appear at even a lower frequency. In this case, the shift of the first resonance was from 2.3 to approximately 2.1 times fundamental. Although the peak magnitude of the impedance at resonance is marginally reduced by the filter, this is not expected to yield significant improvement in system transient and harmonic behavior.