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

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This document describes analysis of an equivalent circuit <u>generallyand most approximately</u> 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.
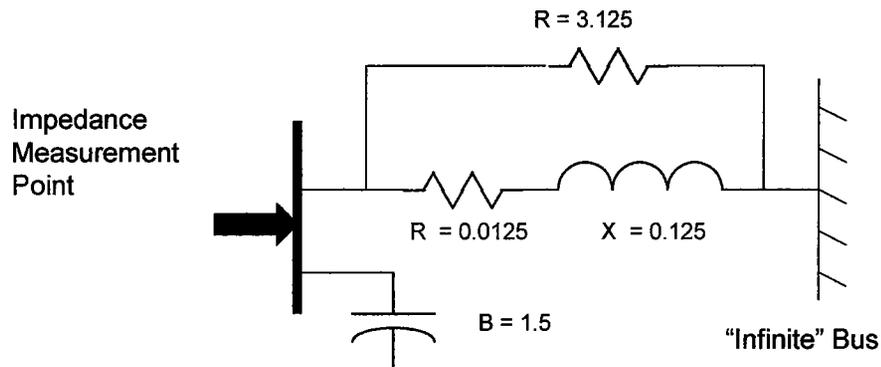
Base System Assumptions:
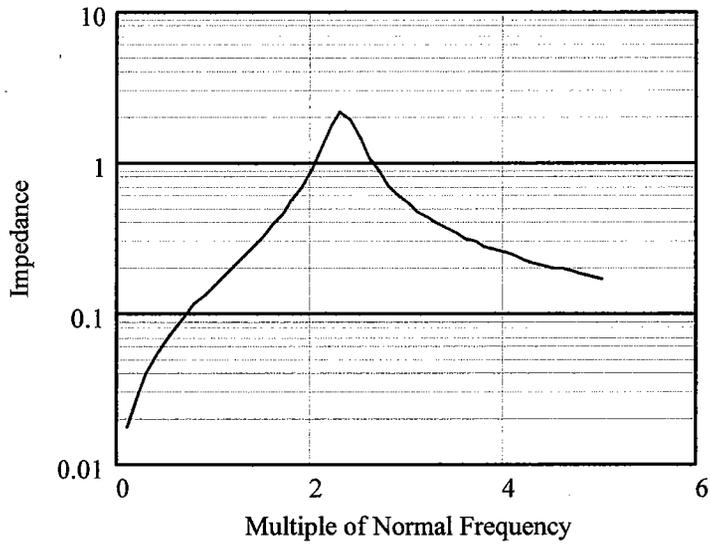
Short circuit capacity: 8 GVA
Fundamental frequency impedance angle: 82 degrees.
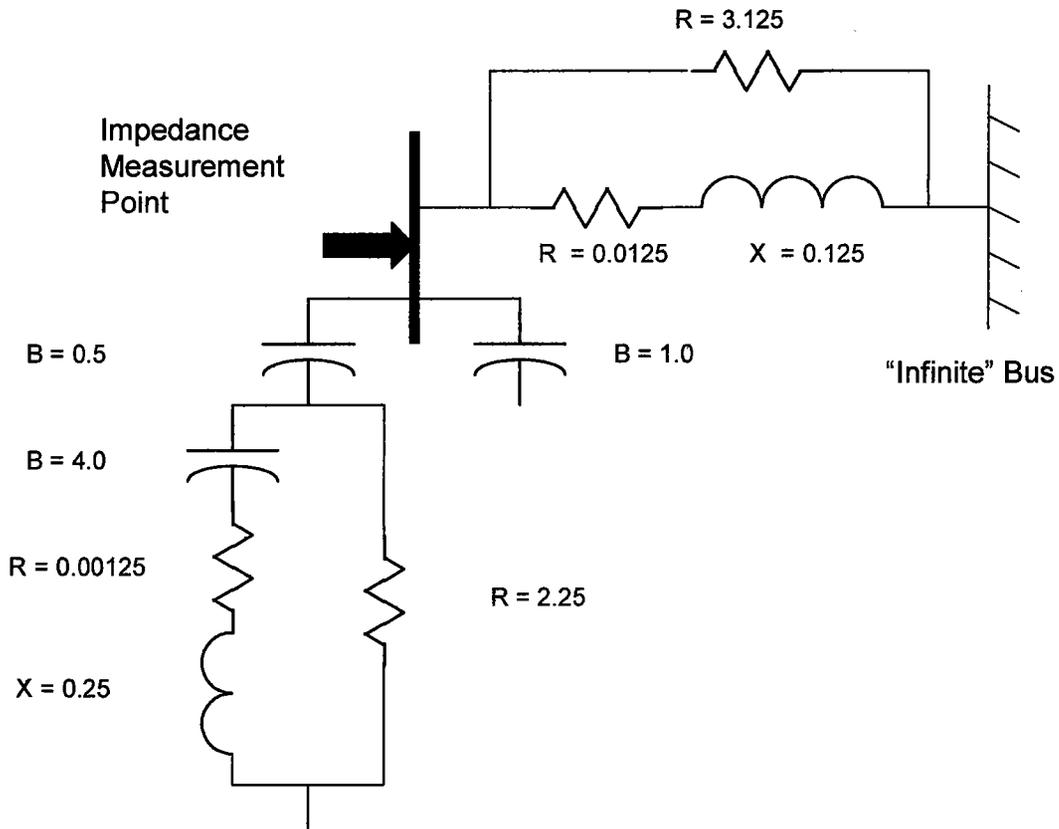Cumulative charging capacitance: 1600 MVAR

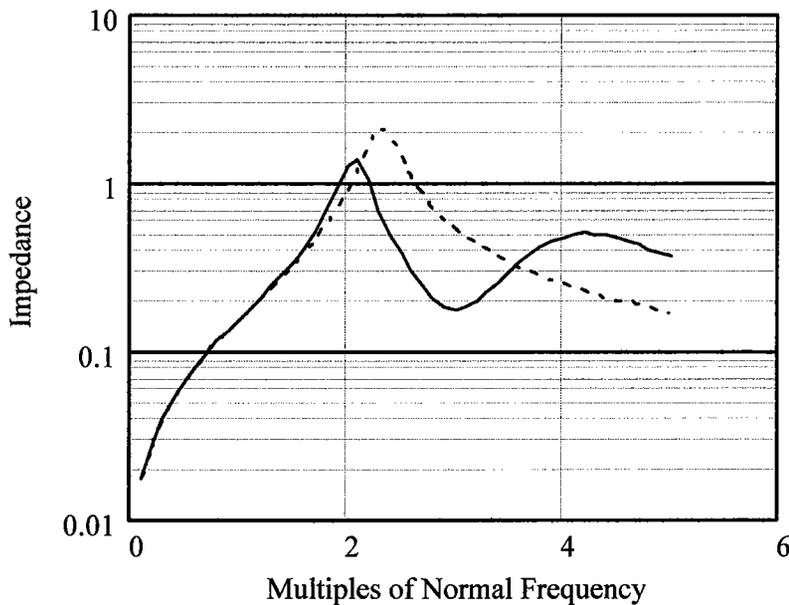System model (all values in per-unit at fundamental frequency on a 1GVA base):

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.