

## Why Bus Bar Connections Should Be Specified

### The interconnection of components with cable in capacitor/harmonic filter banks can lead to bank failure

Bank failures can occur due to cable fatigue associated with magnetic forces during bank energization. Single-bank and back-to-back capacitor bank switching transients can approach peak current magnitudes that exceed system fault levels. These transient currents result in high magnetic forces which act upon the cable. Much like bending a paper clip back and forth, magnetic forces during energization cause cables to move, and can lead to premature cable stress failures.

ANSI C37.32-1972 provides equations for magnetic forces exerted between two current carrying conductors. The force is a function of current magnitude, decrement rate, the shape and arrangement of conductors, and the natural mechanical frequencies of the complete assembly. The standard provides the basic equation shown below.

$$F = \frac{8[5.4 \times I^2]}{S \times 10^7}$$

Where:  
F = Pounds per foot of conductor  
S = Spacing between centerlines of conductors in inches  
I = Current in amperes (symmetrical)

Current magnitudes (I in above equation) associated with capacitor bank switching can be obtained on the last page of our transient inrush reactor literature. [LINK HERE](#)

During bank energization, current magnitudes can reach well over 10,000 amps. For a typical capacitor bank with components interconnected with cable having a spacing of 3 inches, forces on the order of 144 pounds per foot of cable will be experienced. Over many energization cycles, this force will eventually fail the cable. For this reason, NEPSI's makes every attempt to hard bus all components within our capacitor banks and harmonic filter banks.

In addition to cable fatigue, some manufacturers at the 15kV and above voltage level strap or lay tiger/jumper cable over grounded surfaces or tie wrap them together. As the cable is not shielded, localized dielectric stresses (corona) occur on the surface of the cable. Over time the dielectric stress leads to breakdown and eventual cable faulting. NEPSI's designs and builds capacitor banks with the philosophy that for the life of the equipment, air clearance should be utilized as the insulation medium and not tiger/jumper cable as it is more prone to faulting.



Above two pictures shows how NEPSI interconnects components with Silver or Tin-plated Copper Bus Bar. This method of interconnection is not prone to failures associated with forces during capacitor bank energization. Over the life of the equipment, air provides the best insulation medium as it does not allow for tracking or treeing that is common with solid dielectric cables. See the following link for further information on Phase and Ground Bus System.

**[Link to NEPSI's Phase and Ground Bus Web Page](#)**

## Two of Our Competitors



The above pictures show a couple of our competitor's incoming compartments and extensive use of "tiger cable" or jumper cable". Note the long runs of cables, and places where cable fatigue can occur. Also note lack of steel barrier between incoming compartment and capacitor compartment and the use of tie wraps to hold current transformer secondary wires. Remember that tie wraps can be expected to fail within one to two years.

Northeast Power Systems, Inc.  
66 Carey Road  
Queensbury, New York 12804  
Phone: 518-792-4776  
Fax: 518-792-5767  
E-mail: sales@nepsi.com  
Website : www.nepsi.com

Copyright © 1999 - 2012 Northeast Power Systems, Inc.