How does OpenDSS interpret Z1, Z0 for 1-Phase Lines?

From OpenDSSWiki

Question

I have some data from CYMDIST that gives symmetrical component data (R1, X1, R0, X0) for a single-phase line. How does OpenDSS interpret such data?

Answer

Obviously, there is really no such thing as the positive- and zero-sequence impedance for single-phase lines. Symmetrical components technically apply only to balanced 3-phase lines (not even unbalanced 3-phase lines!). You may be surprised at this answer, but I encourage you to check it out.

However, it has been the practice in distribution system analysis programs for 40 years (that's as long as I've been doing this) to enter all line branch impedances using symmetrical components. Since it is technically incorrect, each program must come up with its own definition of how it is going to handle the data. There is usually some kluge code in the program that detects the 1-phase line and does something different with the symmetrical component impedances. What one usually wants is the single-phase impedance of the line, not the positive- or the zero-sequence impedance.

For 1-phase lines, the OpenDSS ignores the R0 and X0 entry and internally set R0 and X0 equal to R1 and X1. Then it computes the elements of the impedance matrix -- there's only one -- through the normal algorithm for lines. The result is that the OpenDSS assumes that the single-phase impedance is the same as what you specify for R1 and X1 (and C1).

This works for a simple single-phase line like one might encounter on a lateral off the main feeder. However, we have found CYMDIST data where the user has described secondary triplex cable as a 1-phase line with R1, X1, R0, and X0. Converting this to an OpenDSS 1-phase line where only the 240V load is modeled, as is sometimes done, will NOT be correct. The R1, X1 values will have to be doubled to get the right impedance for down one phase and back the other.

Of course, if you model the triplex in detail as either a 2-phase or "3-phase" line with the detailed transformer and load connections, the OpenDSS will automatically get the correct impedance. You can take the TriplexLineCode file supplied in the Scripts folder and model the service drop with all three conductors or use the Kron=yes option to eliminate the neutral. That will give the right answer.

In general, with the OpenDSS, it is better to use symmetrical component impedance data for only 3-phase lines. Otherwise, the interpretation may not be what you expect.

To check out what the program does, define a line with your symmetrical component data and then do a solution. Then look at the properties using the combo drop down boxes at the top of the window in the EXE. You can see what the program has computed for Rmatrix and Xmatrix. That's the data the program actually uses. This will let you know if the program has interpreted the data as you intended.

--Rdugan 22:10, 23 February 2011 (UTC)
