Computer Tools for Transients Analysis

The most widely used computer programs for transient's analysis of power systems are the Electromagnetic Transients Program, commonly known as EMTP, and its derivatives such as the Alternate Transients Program (ATP). EMTP was originally developed by Hermann W. Dommel at the Bonneville Power Administration (BPA) in the late 1960s15 and has been continuously upgraded since. One of the reasons this program is popular is its low cost due to some versions being in the public domain. Some of the simulations presented in this book have been performed with a commercial analysis tool known as PSCAD/EMTDC, a program developed by the Manitoba HVDC Research Center. This program features a very sophisticated graphical user interface that enables the user to be very productive in this difficult analysis. Some power system analysts use computer programs developed more for the analysis of electronic circuits, such as the well-known SPICE program16 and its derivatives.

Although the programs just discussed continue to be used extensively, there are now many other capable programs available. We will not attempt to list each one because there are so many and, also, at the present rate of software development, any such list would soon be outdated. The reader is referred to the Internet since all vendors of this type of software maintain websites.

Nearly all the tools for power systems solve the problem in the time domain, re-creating the waveform point by point. A few programs solve in the frequency domain and use the Fourier transform to convert to the time domain. Unfortunately, this essentially restricts the addressable problems to linear circuits. Time-domain solution is required to model nonlinear elements such as surge arresters and transformer magnetizing characteristics. The penalty for this extra capability is longer solution times, which with modern computers becomes less of a problem

each day.

It takes considerably more modeling expertise to perform electromagnetic transient's studies than to perform more common power system analyses such as of the power flow or of a short circuit. Therefore, this task is usually relegated to a few specialists within the utility organization or to consultants.

While transients programs for electronic circuit analysis may formulate the problem in any number of ways, power systems analysts almost uniformly favor some type of nodal admittance formulation. For one thing, the system admittance matrix is sparse allowing the use of very fast and efficient sparsity techniques for solving large problems. Also, the nodal admittance formulation reflects how most power engineers view the power system, with series and shunt elements connected to buses where the voltage is measured with respect to a single reference.

To obtain conductances for elements described by differential equations, transients programs discretize the equations with an appropriate numerical integration formula. The simple trapezoidal rule method appears to be the most commonly used, but there are also a variety of Runge-Kutta and other formulations used. Nonlinearities are handled by iterative solution methods. Some programs include the nonlinearities in the general formulation, while others, such as those that follow the EMTP methodology, separate the linear and nonlinear portions of the circuit to achieve faster solutions. This impairs the ability of the program to solve some classes of nonlinear problems but is not usually a significant constraint for most power system problems

Source: http://nprcet.org/e%20content/Misc/e-Learning/EEE/IV%20YEAR/EE1005%20-%20POWER%20QUALITY.pdf