Computer Code Abstract

TWIGL

1. Name of Code: TWIGL[1]
2. Computer for which Program is Designed: CDC-6600
   Programming Language: FORTRAN IV
3. Nature of Physical Problem Solved: TWIGL solves the two-dimensional, two-group, space-time neutron diffusion equations in rectangular or cylindrical geometry in the presence of temperature feedback. The neutron diffusion and delayed precursor equations are differenced in both space and time. The thermal-hydraulic description is based on a no-boiling, one-pass model formulated in terms of regionwise-averaged coolant and fuel metal temperature.
4. Method of Solution: The program uses the cyclic Chebyshev polynomial method[2] to solve the spatial difference equations for each time step.
5. Restrictions on the Complexity of the Problem: The maximum number of allowable spatial mesh points is 37 in the x (or r) direction and 37 in the z direction. All problems use two energy groups. Up to six groups of delayed neutrons may be employed. The program accepts a maximum of 20 different material compositions and 100 thermal-hydraulic regions for which the average temperatures are defined.
6. Related and Auxiliary Programs: This program solves two-dimensional problems similar to the one-dimensional problems solved by the WIGL2 program.[3] However, the methods of solution differ. The PDQ-7 program[4] may be used to generate initial flux distributions that can be saved on a disk file and read into the TWIGL program.
7. Running Time: Absolute running times per mesh point per time step are not quotable since the convergence of the spatial difference equations at each time step is a function of the type of transient (subcritical, supercritical, etc.) being analyzed, the time step size being employed, and the desired degree of accuracy. A cylindrical reactor transient problem with 15 radial and 21 axial mesh points took 223 sec for 150 time steps. One group of delayed neutrons was employed and the time step size was 0.001 sec for all time steps.
8. Unusual Features: This program solves transient neutron diffusion problems that are initiated by specified time variations of the reactor material parameters or by specified changes in the core inlet coolant temperature or flow rate. All transient problems are assumed to start from equilibrium, and TWIGL will, by either of two options, generate the steady-state fluxes and average temperatures. The initial flux distributions may be input by punched cards or read from a PDQ-7 disk file[4] via the file manager subroutines.[5]
9. Status: The program is in the process of being put into production.
10. Machine Requirements: The program was written for a CDC-6600 with a central memory of at least 64K.
11. Operating System: The appropriate software and hardware associated with the system for which this program was written is contained in Ref. 5. This particular version of the program was constructed within the SCOPE 2.0 operating system.
12. Other Programming or Operating Information or Restrictions: None.
13. *References*:

[1] J. B. YASINSKY, M. NATELSON, and L. A. HAGEMAN, "TWIGL—A Program to Solve the Two-Dimensional, Two-Group, Space-Time Neutron Diffusion Equations with Temperature Feedback," WAPD-TM-743, Bettis Atomic Power Laboratory (February 1968).

[2] R. S. VARGA, *Matrix Iterative Analysis*, Prentice Hall, Inc., Englewood Cliffs, NJ (1962).

[3] A. F. HENRY and A. V. VOTA, "WIGL2—A Program for the Solution of the One-Dimensional, Two-Group, Space-Time Diffusion Equations Accounting for Temperature, Xenon, and Control Feedback," WAPD-TM-532, Bettis Atomic Power Laboratory (October 1965).

[4] W. R. CADWELL, "PDQ-7 Reference Manual," WAPD-TM-678, Bettis Atomic Power Laboratory (1967).

[5] C. J. PFEIFER, "CDC-6600 FORTRAN Programming—Bettis Environmental Report," WAPD-TM-668, Bettis Atomic Power Laboratory (January 1967).

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