NUCLEAR SCIENCE AND ENGINEERING: 18, 419-420 (1964)

Computer Code Abstracts

P3MG1

1. Name of Program: P3MG1
2. Computer for which program is designed: Philco-2000
   Programming system: TAC
3. Nature of problem solved: P3MG1 is a one-dimensional multigroup program which treats fast neutrons by a spherical harmonics approximation up to P_3, and thermal neutrons by a double-P_1 approximation. P3MG1 solves the same problem as P1MG2 does on the IBM-704 with the extension of the fast group representation to include the P_3 terms and the thermal group representation in a double-P_1 approximation, equivalent to a SLOP-1 one-velocity approximation. P_3 elastic scattering is treated exactly for hydrogen only, with the option of including the P_2 and P_3 components of the scattering cross section for other isotopes in the total and transport cross sections. The formulation of the equations permits three geometries—rectangular, cylindrical, and spherical.
4. Method of solution: For P_1 approximation problems, the P_0 and P_1 first-order differential equations are combined to form a single second-order equation which is solved, in each multigroup, for the flux using difference equations in a manner similar to that employed in WANDA-5. The P_0 and P_1 slowing down is computed between multigroup flux calculations from the first-order Grueling-Goertzel equations. The inelastic scattering is also computed between multigroups. For P_3 approximation problems, the P_2 and P_3 flux-component equations are combined to form another second-order differential equation in each multigroup. This equation is of the same form as the other flux equation and is solved in the same manner. The pair of equations is solved iteratively within each multigroup to a specified convergence before proceeding to the next multigroup. Extrapolation of the source is used to accelerate the convergence of the source iterations.
5. Basic physics approximations: For heavy elements, P_2 and P_3 components of the scattering cross section can be included in the total cross sections of the P_1 and P_3 flux equations, but there are no P_2 and P_3 heavy-element slowing-down computations. The restrictions of the MILC library apply here, also. All four P_3 components of the slowing-down density are source terms in the double-P_1 thermal group equations.
6. Restrictions on the complexity of the problem: Limited to 80 multigroups (one of which is the thermal group), 15 isotopes per composition, 49 compositions, 42 regions and 333 points. If one maximum value is taken on, the others must of necessity be reduced considerably.
7. Typical running time (Philco-2000-212): 6 minutes for a one iteration, P_3-approximation shielding problem of 290 points and 55 multigroups.
8. Unusual feature of the program: WANDA-5, as a segment of the program, can be used to compute a source guess which is passed on to P3MG1. The program will operate in three modes: (1) P_1, (2) P_3 and (3) a quasi-P_3 approximation where there are no inner iterations between the two second-order equations in each multigroup.
9. Present status: In use
10. *Reference:*
    H. Bohl, Jr., E. M. Gelbard, B. L. Anderson, A. P. Hemphill and B. P. Peterson, "P3MG1 - A One-Dimensional Multigroup P-3 Program for the Philco-2000 Computer," WAPD-TM-272, (September 1963).
11. Material Available to Domestic Users from Philco:
    Binary program deck
    Symbolic program tape
    Referenced document

H. Bohl, Jr.

Westinghouse Electric Corporation
Bettis Atomic Power Laboratory
Pittsburgh, Pennsylvania
Received November 18, 1963