3. Nature of problem solved: The KATE-1 program determines the spectrum of thermal neutrons according to the Wigner-Wilkins theory and averages cross sections and related quantities over this spectrum.
4. Restrictions on the complexity of the problem: This program is intended to operate within the BKS System.
5. Typical running time: 3 sec
6. Present status: In use
7. *References:* H. J. Amster and J. B. Callaghan, KATE-1—A program for calculating Wigner-Wilkins and Maxwellian averaged thermal constants on the Philco-2000. WAPD-TM-232 (October 1960).
   R. B. Smith and C. H. Hunter, The BKS system for the Philco-2000. computer. WAPD-TM-233 (April 1961).
8. Material available from Philco:
   Binary program deck
   Symbolic program tape
   Referenced documents

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PDQ-4

1. Name of program PDQ-4
2. Computer for which program is designed: Philco-2000 Programming system: TAC
3. Nature of problem solved: PDQ-4 solves the few-group, time-independent, neutron-diffusion equations over a rectangular region of the x-y or r-z plane. Either a zero flux or a zero gradient condition may be applied along each external boundary and a 180° rotational symmetry condition may be applied along the top boundary. In addition, a logarithmic derivative condition may be applied at internal boundaries for control rod description.
4. Method of solution: A nonuniform mesh is imposed on the region of solution, with mesh intervals chosen so that all region interfaces coincide with mesh lines. The differential equations are replaced by five-point difference equations at the mesh points, and the resulting matrix equation for each group is solved by a successive two-line overrelaxation iteration technique. The convergence of the source iterations is accelerated by a procedure based on Chebyshev polynomials.
5. Restrictions on the complexity of the problem: Limited to four groups, 255 compositions, 200 mesh points in each coordinate direction, and a total of 20,000 mesh points. This program is intended to operate within the BKS System.
6. Typical running time: Running time is a function of many variables. Convergence occurs when $\lambda_{max} - \lambda_{min} < 2\lambda\epsilon^2$ where λ_{max} and λ_{min} are the maximum and minimum pointwise values of the eigenvalue and ϵ is an input quantity. Typically, $\epsilon = 0.05$. On a model 211 computer with 2 or more assembler units, using $\epsilon = 0.05$, the time in minutes is approximately (groups) × (points)/400. Some four-group 20,000-point problems have been observed to run as long as five hours.
7. Present status: In use
8. *References:* W. R. Cadwell, PDQ-4—A program for the solution of the neutron-diffusion equations in two dimensions on the Philco-2000. WAPD-TM-230 (June 1961).
   W. R. Cadwell and H. P. Henderson, Input preparation for diffusion-depletion programs on the Philco-2000 computer. WAPD-TM-238 (January 1961).
   R. B. Smith and C. H. Hunter, The BKS System for the Philco-2000 computer. WAPD-TM-233 (April 1961).
9. Material available from Philco:
   Binary program deck
   Symbolic program tape
   Referenced documents

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TURBO

1. Name of program: TURBO
2. Computer for which program is designed: Philco-2000 Programming system: TAC
3. Nature of problem solved: This two-dimensional few-group nuclear depletion calculation is composed of four sections plus input and output as follows. Macroscopic cross sections required in the few-group diffusion equations are computed from nonuniform isotopic number densities of the materials present and few-group fitted microscopic cross sections. The resulting two-dimensional diffusion equations are solved in xy or rz geometry for the neutron flux and eigenvalue. A power shape is generated and used to normalize the flux to a specified power output. The first-order ordinary differential equations describing the buildup and depletion of isotopic number densities are solved over an interval of time in which the flux shapes can be considered constant. The entire process is repeated to continue further in time.
4. Method of solution: The PDQ-4 spatial calculation is used to approximate the eigenvalue and fluxes by solving standard 5-point difference equations used to represent the diffusion equations in a rectangular region of the plane. Zero flux or normal derivative conditions can be applied along the outer boundaries or a 180-deg periodic boundary condition can be applied along one edge. Provision is included for special calculations in which the usual symmetry is temporarily lost, such as stuck rod problems. In solving the depletion equations quadratic approximations are used for the fuel isotope equations while higher order procedures are used for the burnable poisons and fission products. During a time-step, partial account can be taken of the effect of fuel depletion on the power by renormalizing the thermal flux at specified times to maintain constant power assuming the fast fluxes to remain constant.
5. Basic physics approximations in the problem formulation: Thirteen time-dependent isotopes are allowed including U^{235}, U^{236}, U^{238}, Pu^{239}, Pu^{240}, Pu^{241}, Pm^{149}, Sm^{149}, I^{135}, Xe^{135}, B^{10}, and two gross fission products. If U^{238} is absent, four isotopes of hafnium can be studied, namely, Hf^{177} through Hf^{180}.