number of different solutions to the two-dimensional (x,y) solutions. The "stacking" is performed by deriving flux-weighted averaged quantities (diffusion constants, macroscopic cross sections and leakages) from the x,y solutions for input to the ZIP programs which solve the one-dimensional (z) equations.

4. Method of solution: The flux-weighted averaged constants are obtained either by evaluating polynomials as functions of fuel fraction (ZIP-2) or by using Lagrange interpolation and extrapolation in a table of of flux-weighted averaged constants which are functions of fuel fraction (ZIP-3). These constants are used in the WANDA spatial calculation to determine the eigenvalue and fluxes. A search through several rod configurations may be done to obtain a specified eigenvalue by varying either the position of interfaces separating various regions and/or by changing rod configurations.
5. Basic physics approximations used: Five time-dependent isotopes are allowed including I^{135}, Xe^{135}, Pm^{149}, Sm^{149}, and U^{235}. U^{235} is not used explicitly but rather the fraction of U^{235} remaining is used in the depletion calculations. Provisions are made to allow a time-dependent weighting of Xe^{135} and Sm^{149} absorptions to be added into the macroscopic absorption cross section obtained as a function of U^{235} fraction. Maximum xenon calculations may be performed at any time.
6. Restrictions on the complexity of the problems: Limited to 400 mesh intervals, 50 subregions, 50 compositions, and 50 rod configurations. The programs are intended to operate within the BKS system.
7. Typical running time: 4 min per time step
8. Present satus: In use
9. *References:* 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).
   O. J. Marlowe and M. C. Suggs, WANDA-5—A one-dimensional neutron diffusion equation program for the Philco-2000 computer. WAPD-TM-241 (November 1960).
   O. J. Marlowe, Nuclear reactor depletion programs for the Philco-2000 computer. WAPD-TM-221 (January 1961).
   C. J. Pfeifer and F. R. Urbanus, ZIP-2—A one-dimensional few-group synthesis nuclear reactor depletion program for the Philco-2000 computer. WAPD-TM-228 (November 1961).
10. Material available from Philco:
    ZIP-3 binary program deck
    ZIP-3 symbolic program tape
    Referenced documents

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CURF-1

1. Name of program: CURF-1
2. Computer for which program is designed: Philco-2000
   Programming system: TAC
3. Nature of problem solved: CURF-1 determines the real coefficients of a polynomial of the form

$$F(x) = A_0 + a_1x + a_2x^2 + \cdots + a_{n-1}x^{n-1} + a_nx^n \quad (n \leqq 9)$$

   It is used to process the output from the TURBO program to generate input for the ZIP program.
4. Method of solution: Using the method of least squares, the program selects the curve which minimizes the sum of the squares of the vertical deviations of the given points from the curve such that the standard deviation $\mu \leqq \epsilon$, where ϵ is specified by the user.
   If the minimizing coefficients have been determined then the standard deviation

$$\mu = \sqrt{\sum_{i=1}^{m} \frac{[y_i - F(x_i)]^2}{m}}$$

   will satisfy the given requirements, namely $\mu \leqq \epsilon$.
5. Restrictions on the complexity of the problem: CURF-1 accepts a maximum of 400 data points. The user may specify the exact degree of the polynomial to which the given data points are to be fitted. If the exact degree is not specified, CURF-1 will determine the polynomial of smallest degree ($\leqq 9$) which best fits the given data points under the restrictions imposed.
6. Typical running time: Running time, for a fourth degree polynomial fitting 37 data points, is 1.5 sec.
7. Present status: In use
8. *References:* A. V. Pace, CURF-1—A least squares polynomial fitting program for the Philco-2000. WAPD-TM-226 (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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BAFL-1

1. Name of program: BAFL-1
2. Computer for which program is designed: Philco-2000
   Programming system: TAC
3. Nature of problem solved: This program calculates by finite difference approximations small deflections of thin elastic rectangular plates under transverse loading.
4. Method of solution: The finite difference equations approximating the partial differential equations are solved by the two-line cyclic Chebyshev semi-iterative method.
5. Basic physics approximations in the problem formulation: The classical bending theory of thin plates.
6. Restrictions on the complexity of the problem: The program is limited to a uniform mesh of up to 1600 points. Boundary conditions allow each of the four sides to be either clamped (built-in), simply supported (hinged), symmetric (floating clamped), or free. The plate loading may be a combination of a uniform load and pointwise loads. This program is intended to operate within the BKS system.

7. Typical running time: If the estimate of the spectral radius of the iteration matrix has been well chosen, the running time could vary from less than one minute to over one-half hour. This wide variance depends on the boundary conditions, the number of mesh points, and the convergence criterion.
8. Present status: In use
9. *References:* J. B. Callaghan, P. H. Jarvis, and A. K. Rigler, BAFL-1—A program for the solution of thin elastic plate equations on the Philco-2000 computer. WAPD-TM-255 (April 1961). R. B. Smith and C. H. Hunter, The BKS system for the Philco-2000 computer. WAPD-TM-233 (April 1961).
10. Material available from Philco:
    Binary program deck
    Symbolic program tape
    Referenced documents

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SPAN-3

1. Name of program: SPAN-3
2. Computer for which program is designed: Philco-2000 Programming system: TAC
3. Nature of problem solved: This shielding design program calculates uncollided gamma fluxes, total gamma dose rates, and total energy absorption at points outside of sources of gamma rays. It also calculates fast neutron dose rates and thermal neutron fluxes at points outside of fission neutron sources. The basic geometry is cylindrical. Source strengths may be specified over a sector of a cylinder in the form $S(r,z)S(\theta)$. Sources are in the form of sectors of cylindrical annuli contained in the region of source strength specification. Shield regions are in the form of cylindrical annuli cut by planes normal to the axis and semi-infinite slabs. Gamma energies are limited to 30 energies from 0.5 to 10 Mev. A library contains cross sections and buildup parameters for most common elements found in shields.
4. Method of solution: Three-dimensional Gaussian quadrature is used in the integration of the exponential point kernel over the source region.
5. Basic physics approximations in the problem formulation: Total gamma dose rates and energy absorption are given by a product of an uncollided factor which can be calculated by exponential attentuation with a buildup factor which can be represented as the sum of two exponentials. Fast neutron dose rates and thermal neutron fluxes are given by empirical kernels which are in the form of sums of two or three exponentials. Neutron doses and fluxes can only be calculated in water regions or in voids beyond water regions. For thermal neutron flux the temperature of this water must satisfy either $60°F \leqq T \leqq 180°F$ or $450°F \leqq T \leqq 650°F$.
6. Restrictions on the problem: This program requires a 32K Philco-2000 computer and must be run within the BKS system.
7. Typical running time: 5 to 30 sec to calculate the flux at one field point due to one source at one or more energies. This number is relatively independent of the number of energies and depends most heavily on the number of shield regions between source and field point. Roughly, a 20 shield region might lead to a 20 sec running time. These times per field point are in addition to setup time which is negligible in problems running over one minute.
8. Present status: In use
9. *References:* W. H. Guilinger, N. D. Cook, and P. A. Gillis, SPAN-3—A shield design program for the Philco-2000 computer. WAPD-TM-235 (February 1962).
    R. B. Smith and C. H. Hunter, The BKS system for the Philco-2000 computer. WAPD-TM-233 (April 1961).
10. Material available from Philco:
    Binary program deck
    Symbolic program tape
    Referenced documents

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