five-point difference equations at the mesh points, and the resulting matrix equation is solved by Peaceman-Rachford iteration technique.

5. Restrictions on the Complexity of the Problem: Contact resistances are not specifically included in the program computations, but must be approximated by use of thin regions of a low-conductivity material. Heat-generation rates, boundary film coefficients, and boundary sink temperatures are assumed to be known. The program is intended to handle up to 99 regions, 5000 mesh points, 250 mesh points in each coordinate direction. This program is intended to operate within the BKS System.
6. Typical Running Time: 5 min, Philco-2000-212.
7. Present Status: In production.
8. *Reference:*

   R. B. Smith and J. Spanier, "HOT-1: A Two-Dimensional Steady-State Heat Conduction Program for the Philco-2000," WAPD-TM-465, (July 1964).
9. Authors of Program:

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1. Names of Programs: RECAP-1, RECAP-2, RECAP-3
2. Computer for which Programs are Designed: Philco-2000

   Programming System: TAC and FORTRAN
3. Nature of Problem Solved: Monte Carlo estimation of epithermal-resonance capture rates and interference effects in systems containing several spatially distinct regions composed of several resonance absorbers. The geometries available are: 1) a repeating array of slabs (RECAP-1); 2) a hexagonal or square array of circular cylinders (RECAP-2); and 3) rectangular and 60° parallelogram geometry (RECAP-3).
4. Method of Solution:

   The energy range of interest may be arbitrarily subdivided into a maximum of 100 groups. To permit a detailed cross-section description, each group, for example g, may be further subdivided into a maximum of 1000 energy intervals. Doppler-broadened cross sections are calculated at each energy point and retained on magnetic tape. In the resolved energy range, resonance parameters obtained experimentally are used; and in the unresolved energy range, Porter-Thomas statistical distributions are used for the required resonance parameters. The number of groups to be treated statistically is isotope-dependent.

   All neutron histories are processed for each group as follows: For group g, the cross sections are obtained from magnetic tape and stored in rapid memory. All events (scattering, absorption, and lengths of free flight) are determined through the use of pseudo-random number sequences until the energy of each neutron falls below the lower cutoff of that group. This condition terminates the history for group g and the emergent parameters for all neutrons are retained on magnetic tape. For the g+1 group, cross sections are obtained from tape and stored in rapid memory. The calculation of this group is then performed by reading the emergent parameters from tape and continuing the tracking process until all neutrons degrade in energy below the lower cutoff of the g+1 group. The calculations of subsequent groups are similar.

   To calculate the absorption rates, the Σ_a/Σ_T estimator is used. Smooth and resonance absorption edits are performed for each isotope per region per energy group. The probable error is computed at the end of each history for each quantity tallied.
5. Unusual Features:
   1) Smooth and resonance absorptions are edited separately. These edits are convenient in arriving at L-factors (self-shielding factors) for slowing-down programs such as MUFT. To calculate L-factors, the 'heterogeneous resonance integral' is obtained from the resonance capture rates.
   2) To start a neutron in the energy range under consideration, the slowing-in-source is computed analytically, i.e. it is not necessary to extend the energy range of interest in order to achieve an asymptotic slowing-in-source.
   3) An approximate sampling method was formulated so as to put the unresolved-resonance cross sections in the same form as those for the resolved resonances; i.e. a fixed tabulation of cross sections stored on magnetic tape for a given temperature.
   4) A 'two-isotope' method is used either for editing fissions and captures separately or for treating elements with their natural isotopic abundances.
   5) In addition to elastic scattering, the program permits a 'delta scatterer.' The use

of the delta-scattering process can result in large reductions of probable errors in capture rates in regions which have a low probability of neutron reaction on any given neutron flight through the region.

6. Restrictions on the Complexity of the Problem:

	RECAP-1	RECAP-2	RECAP-3
No. of Energy Groups	100	100	100
No. of Energy Intervals/Group	1000	1000	1000
No. of Resonance Nuclides	5	5	5
No. of Nonresonance Nuclides	5	5	5
No. of Resonances per Isotope	50	50	50
No. of Regions	6	4	400
No. of Compositions	6	4	25
Boundary Conditions	Repeating	Symmetry	Symmetry: Rot. Symmetry; Comb. of the Above
Machine Requirements	32K core storage with 10 tape units (This includes system tapes, scratch tapes, file tapes, and input-output tapes).		

7. Typical Running Time: Variable, depending on the number of groups, complexity of the problem, and accuracy desired. Average problems may run 10-30 min on Philco 2000 (Model 212).
8. *References:*

N. R. Candelore and R. C. Gast, "RECAP-1—A Monte Carlo Program for Estimating Epithermal Capture Rates in Slabs," WAPD-TM-407, (October 1963).

N. R. Candelore and R. C. Gast, "RECAP-2—A Monte Carlo Program for Estimating Epithermal Capture Rates in Rod Arrays," WAPD-TM-427, (May 1964).

N. R. Candelore and R. C. Gast, "RECAP-3—A Monte Carlo Program for Estimating Epithermal Capture Rates in Rectangular or 60° Parallelogram Geometry," WAPD-TM-437, (March 1964).

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1. Name of Program: TXY01
2. Computer for which Program is Designed: Philco 2000
   Programming System: FORTRAN
3. Nature of Problem Solved: TXY01 solves the monoenergetic neutron transport equation in a rectangular region. The program solves source problems only, and does not consider anisotropic scattering. The program imposes reflecting boundary conditions on two adjacent boundaries and allows a choice of vacuum or reflecting boundary conditions on the remaining two boundaries (individually).
4. Method of Solution: The program uses a two-dimensional generalization of the discrete-ordinates procedure used in CTS-3 (Ref. 1), described in Ref. 2. Successive overrelaxation is used to accelerate the convergence of the iteration scheme.
5. Restrictions on the Complexity of the Problem:
   a. At most 50 mesh lines of constant x and at most 50 of constant y are permitted, their intersections defining a mesh of at most 2500 points and 2500 rectangles. The mesh intervals need not be constant.
   b. The program allows at most 25 regions of different composition and at most 25 regions of constant source. Each region is a set of mesh rectangles.
   c. A maximum of 16 discrete angles per octant (4 azimuthal and 4 polar) are allowed.
6. Typical Running Time: Running time for typical problems vary from 0.02 to 0.20 h.
7. Present Status: In production.
8. *References:*

[1]J. H. Bennett, "CTS-3, A Multi-Group Transport Program for Infinite Cylinders," WAPD-TM-390, (Sept. 1963).

[2]J. H. Bennett, "TXY01: A One-Group Transport Program for x-y Geometry," WAPD-TM-482, (October, 1964).

9. Material available to Domestic Users from Philco:

   Binary Program
   FORTRAN Source Deck
   WAPD-TM-482

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