NUCLEAR SCIENCE AND ENGINEERING: **32,** 150-151 (1968)

Computer Code Abstracts

STRIP

1. Name of Code: STRIP

2. Computer: Philco 2000/211.
   Language: FORTRAN IV.

3. Nature of Problem Solved: Capture and fission resonance integrals are calculated by a fast method in the resolved resonance range, taking explicit account of overlap and interference between resonances in a mixture of resonance absorbers. The resonance integrals are calculated over arbitrary energy bands. Optionally, the neutron flux as a function of energy in one or two regions may be printed out.

4. Method of Solution: The neutron flux is calculated in two regions as a function of energy by solving two coupled integral slowing down equations, using first-flight collision probabilities based on a flat-flux approximation. To meet design requirements for a rapid and accurate cross-section program with a complete treatment of a large number of resonances, several computational aids have been incorporated, the two most important improvements being the calculation of the slowing down source by a recurrence relation, and the use of non-constant fine-energy group widths, which are automatically calculated taking into account the rate of change of the cross sections and the relatively higher importance of the low-lying resonances with respect to their contribution to the total resonance integral.

   The Doppler-broadened resonance cross sections are calculated using a single-level, Breit-Wigner formula. The capture and fission cross sections may be corrected by a set of tabulated smooth correction terms. The scattering is assumed to be isotropic in the CM system.

5. Restrictions on Complexity of the Problem: Number of regions allowed is one or two. In a two-region problem, the inner region may have the shape of an infinite cylinder, an infinite slab, or a sphere. The flux in the outer region may be computed or forced to be $1/E$. The maximum number of elements, each of which may appear in one or two regions, is ten. Three of these elements may include resonances. Each element may contain any number of isotopes within the limit of a total number of 15 isotopes. The maximum total number of resonances is 500. Permissible number of energy points for smooth cross-section correction is 100, and 100 broad energy groups are allowed.

6. Typical Running Time: To calculate the resonance integral of ThO_2 below 4 keV, including 228 resolved resonances, to an accuracy of 0.1%, the running time is about 3 min. For this particular calculation, 2400 fine-energy groups were utilized.

7. Status: In use. Available from Argonne Code Center, Argonne, Illinois 60439.

8. *References:*

J. HELHOLTZ and D. H. ROY, "STRIP—Resonance Absorption Program Treating Overlap and Interference," TP-332, Babcock & Wilcox Company (September, 1967).

J. HELHOLTZ and D. H. ROY, "Resonance Integral Calculations Treating Overlap and Interference," *Trans. Am. Nucl. Soc.*, **10,** 579 (1967).

J. Helholtz
D. H. Roy

The Babcock & Wilcox Co.
Atomic Energy Division
Lynchburg, Virginia 24505

Received October 24, 1967

RAUMZEIT

1. Name of Code: RAUMZEIT[1]

2. Computer for which Code is Designed: CDC 6600 (64 K memory).
   Programming Language: FORTRAN IV.

3. Nature of Problem Solved: The program solves systems of one-dimensional, time-dependent, multigroup diffusion-type equations using either of two treatments of the time dependence (finite differencing or the time-integrated approach[2]).

4. Method of Solution: The code solves a basic source problem by forward elimination, backwards substitution. In an eigenvalue calculation the program iterates on the fission source. The source in a transient calculation is a function of quantities calculated at previous time steps.

5. Restrictions on Complexity: In its present form the code will handle 6 energy groups (6 coupled diffusion-type equations), 300 mesh points, 40 different material compositions, and 6 delayed-neutron groups.

6. Unusual Features: RAUMZEIT is a modification of the static, one-dimensional code RAUM.[3] All the features of the original program are intact. The diffusion and removal terms are input as square matrices, allowing the code to be used for multi-energy-mode calculations as well as with conventional multigroup problems. A transient calculation is preceded by an eigenvalue calculation which normalizes the fission cross sections to obtain a critical configuration at the beginning of the time-dependent problem. The transient may be induced

by changing individual cross sections, rearranging compositions, or moving an interface between regions. An option is available to neglect the prompt-neutron lifetime (prompt-jump approximation). The code does not permit a time-dependent, externally specified neutron source.

7. Running Time: A 2-group, 240 mesh point calculation with 6 delayed-neutron groups took 24 sec for the eigenvalue problem and 16 time steps.

8. Status: Production. The FORTRAN source deck is available. However, the user must supply his own matrix inversion subroutine.

9. *References:*

[1]C. H. ADAMS and W. M. STACEY, Jr., "RAUMZEIT—A Program to Solve Coupled Time-Dependent Neutron Diffusion Equations in One Space Dimension," KAPL-M-6728 (CHA-WMS-1), Knolls Atomic Power Laboratory (July 1967).

[2]W. M. STACEY, Jr. and C. H. ADAMS, "The Time-Integrated Method: A Quasi-Static Neutron Space-Time Approximation," *Trans. Am. Nucl. Soc.*, **10**, 261 (1967).

[3]F. D. FEDERIGHI, "RAUM—Solution of One-Dimensional Coupled Diffusion—Type Equations on the Philco-2000," KAPL-M-FDF-1, Knolls Atomic Power Laboratory (February 1962).

C. H. Adams
W. M. Stacey, Jr.

Knolls Atomic Power Laboratory*
Schenectady, New York 12301

Received October 30, 1967

*Operated by the General Electric Company for the USAEC.

M0899

1. Name or Designation of Program: M0899, A Digital Computer Program for Nuclear Reactor Design Water Properties.[1]

2. Computer for Which Program is Designed and Programming Language Used: Written for the CDC-6600 in FORTRAN IV. However, it uses the INP routines for input,[2] which requires the equivalencing of real and integer arrays and a routine for packing and unpacking words. Input is very minimal so that FORTRAN formatted input could easily be used as a replacement.

3. Nature of Physical Problem Solved: By making calls on a subroutine called HOH, M0899 edits thermodynamic and transport properties of water over the range (14.5 to 2538 psia and up to 608 F deg below saturation and 932 F deg above saturation). All data are taken from Ref. 3.

4. Method of Solution: The thermodynamic data are stored as tables and values are obtained by bilinear interpolation in pressure and temperature.

5. Related and Auxiliary Programs: M0899 is an extension of subroutine HOH. It makes calls on HOH to get properties for pressure and temperatures supplied and then edits the properties. HOH can be used apart from M0899 by any other FORTRAN IV program to obtain water properties.

6. Typical Running Time: Less than one minute.

7. Unusual Features of the Program: Only 800 entries are required for the thermodynamic tables of enthalpy and specific volumes to get values that lie within the experimental tolerances.

8. Status: In production and may be obtained by domestic users from the Argonne Code Center.

9. Machine Requirements: A FORTRAN IV compiler plus about 3000 locations for subroutine HOH and 10 000 locations for the main program.

10. Operating System or Monitor Under Which Program is Executed: M0899 operates under the SCOPE 2.0 system. It requires the FCHIP, CARDS, and INP routines described by Pfeifer.[2]

11. *References*:

[1]L. L. LYNN, "A Digital Computer Program for Nuclear Reactor Design Water Properties," WAPD-TM-680, Bettis Atomic Power Laboratory (1967).

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

[3]*National Engineering Laboratory Steam Tables*, prepared by R. W. BAIN, Her Majesty's Stationery Office, Edinburgh (1964).

L. L. Lynn

Westinghouse Electric Corporation
Bettis Atomic Power Laboratory
P.O. Box 79
West Mifflin, Pennsylvania 15122

Received November 8, 1967