RSIC Newsletter

RADIATION SHIELDING INFORMATION CENTER

OAK RIDGE NATIONAL LABORATORY

OPERATED BY UNION CARBIDE CORPORATION • FOR THE U.S. ATOMIC ENERGY COMMISSION

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You can use showmanship, enthusiasm, imagination, perseverance, pride, and self-discipline; but none of these are any good without work.

.....Ray Mears

KIAMESHA LAKE PROCEEDINGS AVAILABLE

The proceedings of the National Topical Meeting on New Developments in Reactor Physics and Shielding held at Kiamesha Lake, New York, September 12-15, are available. Sessions were held on: neutron and reactor physics in the thermal energy range, reactor theory, reactor shielding, fast critical experiments and delayed neutron effects, fast reactor physics and neutron physics in the resolved and unresolved resonance range. Many of the papers were invited. The report is bound in two volumes; total price: paper copy $15, microfiche $0.95 from the National Technical Information Service, Springfield, Va. 22151, as CONF-720901.

ANS MEETING IN WASHINGTON NOVEMBER 12-17

The American Nuclear Society winter meeting in Washington, D.C., November 12-17, has the theme "International Conference on Nuclear Solutions to World Energy Problems." Morning plenary sessions will be held on Nuclear Energy and the Quality of Life, Fast Breeder Reactors, Safety and Siting of Established Power Reactor Types, Fuel Cycles, and Thermal Power Reactor Systems. Sessions of special interest to the shielding community are: Cross Sections for Radiation Transport, High Energy Radiation Transport, Shielding and Radiation Transport Applications, Dosimetry and Spectroscopy.

CSEWG SHIELDING SUBCOMMITTEE MET AT ORNL

The Shielding Subcommittee of the Cross Section Evaluation Working Group (CSEWG) met at ORNL September 27-28 to discuss and act on topics related to nuclear cross sections for shielding work. Subjects included benchmark work,

status of shielding data, processing codes, format proposals, scope of the committee, and "standard" photon group structure. E. M. Oblow and D. E. Bartine discussed recent cross section sensitivity studies at ORNL which were reported at the Kiamesha Lake Conference (Book 1, pp 512-523). Minutes of the meeting may be requested from the Chairman, R. J. LaBauve, Los Alamos Scientific Laboratory.

NOTE ON THE JOINT DEVELOPMENT OF CCC-180/TDA, Time-Dependent ANISN

The TDA Code is documented in LA-4557, ORNL-4662 and SIA-70-125. The three document numbers (for the same report) indicate the "joint effort" in creating this code. The code was originally written by W. W. Engle, Jr. of ORNL for the IBM 360 machine and was subsequently adapted to the CDC 6600 by K. G. Adams of Sandia Laboratories. K. G. Adams had to partially rewrite the code and his name has been omitted by mistake from the list of authors in LA-4557. Subsequently, TDA has been tested extensively by J. H. Renken of Sandia Laboratories and H. A. Sandmeier of LASL, as well as S. A. Dupree then at the Naval Weapons Evaluation Facility (NWEF) in Albuquerque, New Mexico.

CODE PACKAGE ABSTRACT DISTRIBUTED WITH NEWSLETTER

In order to reduce the delay in distributing code package abstracts, we are distributing new abstracts with the Newsletter. An abstract for the code package CCC-169/CAVEAT may be removed from the back of this Newsletter and placed in your ORNL-RSIC-13 binder, Abstracts of Digital Computer Code Packages Assembled by the Radiation Shielding Information Center. The binders, Vol. I and III, are available from RSIC. The contents of Vol. II are available, but the supply of binders has been exhausted.

ADDITIONS TO THE COMPUTER CODE COLLECTION

Operable, tested with a sample problem, and available for distribution are the following new code packages:

CCC-186A/FSCATT — Discrete Ordinates Gamma-Ray Transport Code in Plane Geometry, contributed by Systems, Science and Software, La Jolla, Calif. References: DASA-2418, DASA-2618; FORTRAN IV, UNIVAC 1108.

CCC-187A/SAM-CE — Monte Carlo Time-Dependent Three-Dimensional Complex Geometry (Combinatorial) Code System - ENDF Formatted Cross Sections, contributed by Mathematical Applications Group, Inc. (MAGI), Elmsford, New York. Reference: DNA-2830F (MR-7021); FORTRAN IV, CDC 6600.

CCC-188A/MOMENT I — Moments Method Neutron Transport Code contributed by U.S. National Bureau of Standards. The codes calculate moments only. Reference: NBS Tech Note 725; FORTRAN IV, UNIVAC 1108.

UPDATE TO EXISTING CODE PACKAGE

CCC-127D/MORSE — An extensively revised version of the multigroup MONTE CARLO code MORSE with combinatorial geometry for the UNIVAC 1108 has been received from the original contributor, Science Applications, Inc. It is suggested that those who have received this code request the revised version.

CHANGES TO THE DNA WORKING CROSS SECTION LIBRARY

An evaluated data set for tritium has been added to the DNA library by L. Stewart of Los Alamos Scientific Laboratory. Refer to this as DNA MAT 4169, MOD 0, Tritium.

The current contents of the DNA library are listed below. The list is followed by a brief description of the latest modifications.

In requesting data from RSIC, several things should be specified.

1. If you can accept a blocked tape, the entire library can be written on one magnetic tape. Blocked tapes will be written FB, LRECL=80, BLKSIZE=3200, unless the user specifies otherwise. If written as unblocked, three tapes are required.

2. Indicate whether you want the entire library on a single physical tape file or each material on a physical file by itself.

3. The U-235, U-238, H, T, Be-9, and Ta-181 data are available with elastic scattering represented either as tabulated probability distributions or Legendre polynomial expansion coefficients. Please specify which form you want. Note: All other materials have Legendre expansion only.

MATERIAL	EVALUATORS	MAT	MOD	DATE
Nitrogen	Young, Foster - LASL	4133	3	2-72
Oxygen	Young, Foster - LASL	4134	1	2-72
Aluminum	Foster, Young - LASL	4135	2	2-72
Lead	Fu, Perey - ORNL	4136	3	8-72
Hydrogen	Stewart, LaBauve, Young - LASL	4148	1	2-72
Silicon	Drake, Kinsey - BNL	4151	1	2-72
Calcium	Fu, Perey - ORNL	4152	2	5-72
Beryllium	Howerton, Perkins - LLL	4154	0	2-72
Sodium	Paik, Pitterle, Perey - WARD, ORNL	4156	0	2-72
Tritium	Stewart - LASL	4169	0	9-72
Tantalum	Howerton, Perkins, MacGregor-LLL	4179	0	2-72
Iron	Penny, Kinney, Wright, Perey, Fu - ORNL	4180	1	8-72
U-238	Howerton, MacGregor - LLL	4187	0	7-72
U-235	Howerton, MacGregor - LLL	4188	0	7-72

The lead, calcium, and iron evaluations have been modified as summarized below:

1. Lead - MAT 4136 - ORNL
   MOD 3 - August 1972

   The energy range covered by File 4 inelastic scatter from discrete levels was made to conform to the energy range covered in File 3. This was done by changing the highest energy in File 4 to correspond to the highest energy in File 3 for a given level.

2. Calcium - MAT 4152 - ORNL
   MOD 2 - May 1972

   a. Lower energy range extended to 10^{-5} eV.
   b. Reevaluation of file 3 cross sections above 9 MeV for (n,n'), (n,p), (n,α), (n,n'p), and (n,n'α) reactions.
   c. Reevaluation of file 5 secondary neutron energy distributions.
   d. File 12 gamma-ray multiplicities for (n,γ), (n,n'), (n,p), and (n,α) are now given separately rather than being combined.
   e. File 12 multiplicities added for (n,n'p) and (n,n'α).

3, Iron - MAT 4180 - ORNL
MOD 1 - August 1972

a. Point values are given in File 3 rather than resonance parameters.
b. File 1 references are changed.
c. Results from preliminary ORELA measurements have been included for many minima in the total cross sections.
d. All cross sections have been extended to 20 MeV.
e. New reactions have been introduced - (n,n'α) and (n,n'p).
f. The (n,2n), (n,p), MT=51 and MT=91 reactions have been revised.
g. The elastic angular distributions have been revised to include Barnard's data.
h. The File 5 (n,2n) distributions have been revised and are tabulated in 200 keV secondary energy bins.
i. The MT=91 File 5 distributions are revised and are tabulated in 50 keV secondary energy bins from theshold to 7.1 MeV, in 100 keV bins from 7.1 to 9 MeV, and in 200 keV bins from 9 to 20 MeV.
j. The capture gamma rays have been revised based on John White's most recent computation.
k. All gamma-ray energy distributions have been thinned so that there are no non-zero values "less than 0.001" of the maximum.

PERSONAL ITEMS

Richard E. Faw, professor of nuclear engineering and a faculty member for ten years at Kansas State University, Manhattan, has been appointed head of the nuclear engineering department there. He succeeds Curtis G. Chezem, who has accepted an industrial position in New Orleans, La.

VISITORS TO RSIC

Visitors to RSIC during the month of September were: R. K. Disney, Westinghouse Advanced Reactors Division, Pittsburgh, Pa.; S. A. W. Gerstl, Argonne National Laboratory, Argonne, Ill.; W. H. Harless, Jr., General Electric, Sunnyvale, Calif.; L. Harris, Jr., Gulf Radiation Technology, San Diego, Calif.; D. C. Kaul, Defense Nuclear Agency, Washington, D.C.; O. Ozer, Brookhaven National Laboratory, Upton, N. Y.; K. L. Rooney, Sargent & Lundy, Chicago, Ill.; G. L. Simmons, Babcock & Wilcox, Lynchburg, Va.

REACTOR AND WEAPONS SHIELDING

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Compound Nucleus Formulation of Reaction Matrix Theory.
Cook, J.L.; Bertram, W.K.
February,1972
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Application of Petrography to Radiation Shielding Concrete.
Mather, K.
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AEEW-M-1010
SPECTRA: A Cross-Section Condensation and Spectrum Recycling Scheme for Carrying Out Whole-Reactor Transport Calculations.
Kendall, K.C.; Cobley, T.H.
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ANL-7291(Rev.1)
Radiation Safety Technician Training Course.
Moe, H.J.; Lasuk, S.R.; Schumacher, M.C.; Hunt, H.M.
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ANL-7763
Techniques and Analyses of Fast-Reactor Neutron Spectroscopy with Proton-Recoil Proportional Counters.
Bennett, E.F.; Yule, T.J.
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Concrete Radiation Shields.
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D140E1 Radial Shield and Pressure Vessel Aerothermal Analysis.
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Front Shield Fabrication: XNJ140E-1.
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APEX-742
Rear Shield Fabrication.
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Gamma-Emission in Radiative Capture on Intermediate Neutrons.
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Gamma-Ray Transport in Air Above Fallout Fields of 24-Na, 60-Co and 137-Cs.
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Some Engineering Design Considerations for a Thermonuclear Power Plant.
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Use of the MORSE Monte Carlo Code to Solve Shielding Criticality Problems of Spent Fuel Casks.
Morrison, G.W.; Odegaarden, R.W.
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National Topical Meeting on New Developments In Reactor Physics and Shielding, September 12-15,1972.
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NTIS Books 1 and 2 $15.00 HC, $0.95 MF

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Influence of Fission Neutron Spectra on Integral Nuclear Quantities of Fast Reactors.
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HEDL-TME-72-99
Analysis of Errors in Computed Integral Cross Section Due to Fluctuating Resonance Parameters.
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Status of the Monte Carlo Development.
Schmidt, F.A.R.
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A Generalized, Finite-Differenced, Diffusion Equation for Neutron-Transport Computations.
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Two-Dimensional Coupled Neutron-Gamma Sn Transport from a 14.1-MeV Neutron Source in Air Over Ground Using the LASL TWOTRAN-FC Program.
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Kiwi-B1A Gamma Dose Rate Measurements.
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Foundations of S-Matrix Theory. I. Theory and Measurement.
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Neutron Scattering From Supporting Structure of SNAP 8 Shield-Reactor Package.
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Analysis of the STF Neutron Transmission Measurements (Initial Measurements).
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Fast Neutron Flux Through the SNAP 10A Shield as Computed by Several Methods.
Belcher, J.A.; Farr, W.M.
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SNAP-10A Component Development Summary. Volume III. Shield, Ground Test Assembly, and Materials Applications.
Kurzeka, W.J.(ed.)
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Legislation in the Field of Radiation Protection.
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A Study of Fission Products in the Molten-Salt Reactor Experiment by Gamma Spectrometry.
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Investigation of the Adequacy of Nitrogen Cross-Section Sets: Comparison of Neutron and Secondary Gamma-Ray Transport Calculations with Integral Experiments.
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SDT1. Iron Broomstick Experimental Check of Neutron Total Cross Sections.
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SDT2. Oxygen Broomstick Experiment - An Experimental Check of Neutron Total Cross Sections.
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Time-Dependent Neutron and Secondary Gamma-Ray Transport in Infinite Homogeneous Air -- Comparison of Two Cross-Section Sets.
Engle, W.W.,Jr.; Mynatt, F.R.
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Fast Reactor Shielding Methods Development.
Mynatt, F.R.; Gritzner, M.L.
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Comparison of the Background Spectra in Eight German Whole-Body Counters and a Model Structure with Layered Shield.
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Proton Simulation of Displacement Effects Induced in Metals by 14-MeV Neutrons.
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Neutron Spectra Emitted by 239-Pu, 238-U, 235-U, Pb, Nb, Ni, Al, and C Irradiated by 14-MeV Neutrons.
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A.R.T. Research Corp., Los Angeles, Calif.
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Brookhaven National Lab., Upton, N.Y.
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U.S. Army Ballistic Research Lab., Aberdeen Proving Ground, Md.
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CEA-CEN, Saclay, France
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By Korthoven, P.J.M.
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Japan Atomic Energy Research Institute, Tokyo, Japan
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By Tasaka, K.
Japan Atomic Energy Research Institute, Tokyo, Japan
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By Hiroshi, T.
Los Alamos Scientific Lab., Los Alamos, N.Mex.
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Akademiya Nauk, Leningrad, USSR
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By Kivikas, T.
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By Marshall, A.A.
Stanford University, Calif.
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Neutron Spectrometer using Organic Scintillators
By Jones, D.W.; Toms, M.E.
Naval Research Lab. Washington, D.C.
FORTRAN
AVAIL: NTIS

ORNL-TM-3598 October 1971 GAINCALB
GAINCALB: A Program Package to Determine the Gain Used with Organic Scintillation Detectors
By Zobel, W.; Hall, M.E.
Oak Ridge National Lab., Oak Ridge, Tenn.
FORTRAN IV; IBM 360
AVAIL: NTIS

PEL-213 October 1971 PELSHIE
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By de Beer, G.P.
Atomic Energy Board, Pretoria, South Africa
FORTRAN IV
AVAIL: NTIS (U.S. Sales Only)

PG Report 834(W) 1968 GASPAN
GASPAN: An Advanced Computer Code for the Analysis of High Resolution Gamma-Ray Spectra
By Barnes, V.
UKAEA Technical Dept. Windscale, England
FORTRAN IV; IBM 360
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UCRL-51061(Vol. 2) December 1971 GAMANAL
Computerized Quantitative Analysis by Gamma-Ray Spectrometry. Vol. II- Source Listing of the GAMANAL Program
By Gunnink, R.; Niday, J.B.
Lawrence Livermore Lab., Livermore, Calif.
LRLTRAN
AVAIL: NTIS

RSIC CODE PACKAGE CCC-169

1. NAME AND TITLE OF CODE

CAVEAT: General Purpose Monte Carlo Radiation Transport Code in Complex Geometry

AUXILIARY ROUTINES

CSIR - ENDF/B tape handling routine for cross-section libraries in CAVEAT.

LEGWORK - Computes an average differential elastic scattering distribution over a given neutron energy range for the library routines in CAVEAT.

2. CONTRIBUTOR

Teledyne Brown Engineering, and Space Sciences Laboratory, NASA George C. Marshall Space Flight Center, Huntsville, Alabama.

3. CODING LANGUAGE AND COMPUTER

FORTRAN IV, Assembly Language:

A. IBM 7094
B. IBM 360 (tested version)

4. NATURE OF PROBLEM SOLVED

CAVEAT is a general purpose Monte Carlo computer code which treats the transport of neutrons, gamma rays, and secondary gamma rays in evaluating radiation shielding requirements. CAVEAT routines solve the general quadratic surface equations with the additional features of time dependence, exponential density, atmosphere model, variable dimensioning and disk storage of data for completion of a shielding problem from source generation to analysis of fluence and/or dose in a series of job steps for third generation computers.

5. METHOD OF SOLUTION

CAVEAT employs the logic of random walk processes in the Monte Carlo numerical techniques for solving radiation shielding problems in complex geometry. Isotropic inelastic and anisotropic elastic scatterings are treated. Exponential transformation and Russian roulette procedures are available as importance sampling techniques.

One method of analysis in CAVEAT calculates the fluence and/or dose collided and uncollided contribution at point detectors as a function of time, energy, polar angle, and azimuthal angle. Analysis may also be done by using estimates of the average track length within each geometric region.

Source parameter description are selected for energy, angle, spatial coordinates, time and weight either from a fixed or discrete probability table. Secondary gamma-ray generation is accounted for.

A stepwise typical procedure for a CAVEAT shielding problem may be:

S01 - Neutron source particle generation
H01 - Transport of neutron source particles
A01 - Analysis of neutron response
S02 - Secondary gamma generation
H01 - Transport of secondary gamma particles
A01 - Analysis of gamma response

6. RESTRICTIONS OR LIMITATIONS

As a result of the variable dimensioning technique, a judicious tradeoff with data parameters between detailed geometry description, point cross section table values, and other library data for anisotropic scattering and inelastic scattering data needs to be exercised by the code user.

A restriction on computer execution time may be above average for similar problems performed by CAVEAT than another Monte Carlo program.

CAVEAT has no capability in performing the adjoint method of solution to a radiation shielding problem.

7. TYPICAL RUNNING TIME

For comparatative purposes the Benchmark Experiment Number 1 of Ref. 4 required 15 minutes of computer CP execution time to perform the radiation transport from source generation to analyze 5000 histories.

Sample problem:

Code	IBM 360/91 CPU Time	Core Size GO STEP (bytes)	Tapes/Direct Access Devices in Addition to I-O
S01	18 sec	124K	2
H01	1.64 min	188K	5
A01	3 min	182K	4

8. COMPUTER HARDWARE REQUIREMENTS

IBM 360/75/91.

A maximum of 5 tapes or direct access devices are required in addition to I-O. However, with variable dimension the program storage size is only limited by computer storage capability and the proper alteration to the blank COMMON statements in CAVEAT.

The computer clock is sampled in the random walk procedure.

9. COMPUTER SOFTWARE REQUIREMENTS

The code is operable on the IBM 360/75/91 Operating System using OS-360 FORTRAN H Compiler. The OVERLAY feature is used with some of the codes in this package.

Three special routines:

Random Number Generator
IDAY
TIME

are used and have been included on master tape.

10. REFERENCES

a. Included in package:

1. N. R. Byrn, "CAVEAT: A Revised Version of the General Purpose Monte Carlo Program, COHORT. Volume I - Theory and Techniques," Technical Note SE-290 (October 1969).

2. N. R. Byrn, "CAVEAT - A Revised Version of the General Purpose Monte Carlo Program, COHORT. Volume II - User's Manual," Technical Note SE-290 (August 1969).

b. Background Information

3. H. T. Smith, "Preliminary Results of CAVEAT Verification on Benchmark Problems," SDM-SSL-1130 (April 1970).

4. A. E. Profio, *ed.*, "Shielding Benchmark Problems," ORNL-RSIC-25 (1969).

11. CONTENTS OF CODE PACKAGE

The package contains the following items:

a. the referenced documents listed in 10a,

b. a reel of magnetic tape on which is written in several files: Version A - source only. Version B - the source decks, input for the sample problems, and output listings from running the sample problems.

12. HOW TO OBTAIN PACKAGE

Inquiries or requests for the code package may be mailed to

CODES COORDINATOR
Radiation Shielding Information Center
Oak Ridge National Laboratory
Post Office Box X
Oak Ridge, Tennessee 37831

or telephoned to

Area Code 615, 483-8611, extension 3-6944, or to

FTS xx-615-483-6944.

Persons requesting the code package should send a reel of magnetic tape to the above address.

13. DATE OF ABSTRACT

September, 1972.