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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CURRENT WORK AND PROBLEMS

In this issue we shall report current efforts in Europe which the RSIC staff members encountered on their recent trip abroad. Necessarily much of this information is seond and third hand. There may be a number of inaccuracies--certainly many omissions. But we think, overall, it has substantial news value to the shielding community. We shall be happy to publish clarifying material that may be sent to us.

England - The shielding group at Harwell (John Butler) is investigating Monte Carlo methods. This group has done most of the work on the Spinney method (removal-diffusion) and have developed an imposing battery of codes comprehending the system. The COMPRASH code (FORTRAN) combines several related programs SHARN, RASH, GASH, MENDIP to perform Spinney method calculations. The outstanding shielding problem for which they would like to see progress is streaming through ducts in power reactors. They are also interested in seeing more work published on codes comparisons and more work on Monte Carlo variance reduction techniques.

The Aldermaston group (K. Parker) in the compilation of the UKAE Data File is placing an increasing emphasis on cross sections of interest in shielding.

West Germany - The Gesellschaft fur Kernenergieverwertung in Schiffbau und Schiffahrt, Institut fur Reaktorphysik (GKSS) is working on problems related to nuclear ships. This organization has developed a code called SHOP for optimizing material and geometric configurations in ship shields. They have modified Martin's Monte Carlo GMCM9 to use in shielding cell calculations for both neutron and gamma ray problems.

GKSS is at this time computing (R. Fiebig) neutron penetration of iron. Theoretical work is being carried on to develop discrete ordinate matrix solutions of the Boltzmann equation (D. Bunemann).

There is a 5MW reactor with beam hole available for shielding experiments. At present work is being carried on to measure kernels associated with monodirectional beams. It is intended to develop a methodology for combining such information to determine the effects of more complicated source distributions.

The Arbeitsgruppe fur Bautetechnischen Strahlenschutz-Technische Hochschule-Hannover (ABS) does shielding consultation work (H. Schultz). They do some

experimental work at the GKSS facility. At present they are working with EURATOM on the SABINE code. Most of their work relates to concrete.

The Institute fur Kernenergetik der Technischen Hochschule of Stuttgart (H. Siegert and G. Hehn) is developing computer codes to be used in design of shields for space vehicle power systems.

France - The Service d'Etudes de Protection de Piles (P. LaFore) is working on a number of shielding problems. The systems which they shield include large graphite power reactors, water moderated research and naval reactors, and fast reactors. They have a shield computation technique comprised of a two group synthetic diffusion method mocking up core, reactor, and shield. No general claims are made for the method, but with careful choice of parameters it has been found useful in some cases. The diffusion code PENELOPE is used in this method. Other codes used by this group include SIDEF, a Monte Carlo for neutron heating and slowing down; SIGAM, a gamma ray heating Monte Carlo for cylindrical and spherical geometries.

Streaming through ducts is considered to be an outstanding unresolved problem. For cylindrical ducts with important reflection they have produced two codes: CAMA and DOMINO. Also for this problem they have developed a Monte Carlo code CUPIDON and a one velocity code ALBEDO.

The Service de Calcul Electronique Fontenay-aux-Roses (Y. Caseau) has analyzed and flow charted the generalized geometry routine, GEOM (from the 05R system). We of Oak Ridge feel we owe Mme. Caseau a special debt of gratitude for this.

Sweden - The Research Institute for National Defense (M. Leimdorfer) has a number of shielding codes. Their Monte Carlo coding system SUPER has many advanced features. Their Sn codes contain both anisotropic differential cross sections and time dependence. Their Monte Carlo code SALOMON contains some advanced importance sampling techniques. They have a set of high energy charged particles transport codes which includes SWISS CASCADE, PROTOS, and a cosmic ray transport system using Bertini's data. Their program GAP does optical model parameter fitting. This group has a Spinney method system called NRN which does the same sort of problem as the British COMPRASH.

Denmark - The Atomic Energy Commission Research Establishment at Roskilde (P. Kirkegaard) carried on a shielding program. They are now working on a multi-slab--volume distributed source--gamma ray Monte Carlo code and an advanced Spinney method code called REMDIFF. They already have in operation a Spinney method system comprised of REMTHERM, PRIGAM, and SEGAM.

Netherlands - Research Centrum Nederland divided its shielding work between two locations. Theoretical work is carried on at Petten (K. Verschuur) where work is being done on a successive scattering Monte Carlo after the manner of Berger and Doggett. Only energies and angles are selected randomly. Shield design and experimental work is carried on at the Hague (N. Dekker). A fission plate shield facility is now being designed.

The larger interests of the Netherlands groups are ship and electric power reactors.

Italy - Nuclear energy development work in Italy is under the Comitato Nationale per l'Energia Nucleare (CNEN). CNEN has a number of centers: Scole di Roma; Centro di Casaccio with two reactors, a TRIGA and ROSPO, an experimental, zero power, organic moderated reactor; Centro di Frascati with a cyclotron; Centro di Trisara; Centro di Saluggia, the FIAT experimental facility; and the Centro di Bologna which has the Centro di Calcolo.

The Centro di Calcolo at Bologna (R. Manzini) has an experimental laboratory with the RB1 and RB2 reactors, a nuclear data laboratory where section evaluations are performed, a health physics laboratory, a computer service group, a mathematics group, a management group, and a EURATOM liaison section.

FIAT has installations at Sorin where there is a 5 MW swimming pool reactor, Saluggia where there is a Lid Tank--the extra facility, and at Vercelli where shielding experiments are conducted.

The Instituto Superiore di Sanita (ISS) in Rome (M. Ageno) has responsibility for matters of radiation health and safety.

RECENT VISITORS TO RSIC

The following people visited RSIC during the month of July: Mark Cutter, Fluor Corporation, Ltd., Los Angeles, California; Ken Cowser, Stephen Kaye, Health Physics Division, ORNL; G. W. Ray and Mason Watson, Aerospace Corporation, San Bernardino, California; and Milo Solomito, Neutron Physics Division, ORNL.

NEW SOLAR FLARE HAZARD CODE

Hemma E. Francis, RSIC code section staff member, and W. Wayne Scott, summer participant and Head of Physics at Chattanooga State Technical Institute, were recent visitors (July 18-19) to the NASA, Langley Research Center, at Hampton, Virginia. They met with Harry Orr of the Structures Research Division to discuss the computer code, STORM, developed by Republic Aviation Corporation under NASA contract. The code, which has now been placed in the RSIC collection, was designed to perform a solar flare radiation hazard analysis to earth-orbiting vehicles anywhere in the geomagnetic field.

STORM is now operable at RSIC, the sample case provided has been compiled and executed. All available information concerning the theory and utilization has been documented in one volume and is available in the computer code package on request.

NEW CODE PACKAGES AVAILABLE

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

CCC-63/OPEX	Shield optimization code, contributed by Atomics International
CCC-64/LPSC	Proton shielding code, contributed by NASA Lewis Research Center
CCC-65/CHAD	Legendre Scattering Coefficient Code, contributed by Atomics International
CCC-66/BIGGI-3P	Gamma Transport Code, contributed by EURATOM through the ENEA Computer Programme Library

PHOEBE DOCUMENTATION COMPLETED

Formal documentation has been completed for PHOEBE, an auxiliary routine in the RSIC computer code package CCC-60/SDC. It is published as ORNL-3931, "PHOEBE- A Code for Calculating Beta and Gamma Activity and Spectra for ^{235}U Fission Products" by E. D. Arnold. The document is available through usual channels or from RSIC.

CORRECTION TO LPPC

A note of importance to the Lockheed LPPC Code users: an error has been noted in connection with using the option of calculating a monoenergetic flux of primary protons. In the version distributed by RSIC one card from the original program was missing. The RSIC master has now been corrected. Instructions for updating LPPC as formerly distributed may be secured from the Codes Coordinator.

JULY ACCESSION LIST OF LITERATURE

The following accession list consists of literature which the RSIC obtained through its usual scanning procedures. This literature will be examined for assignment to various files or for possible rejection. The accession list is divided into three fields of (1) reactor and weapons shielding, (2) space and accelerator shielding, and (3) shielding computer codes.

RSIC is not a documentation center. Hard copies of the literature cited below must generally be obtained elsewhere. In most cases, however, we will be able to supply microfiche copies upon request. There may be a delay if a microfiche original is not available and we must produce one. This will be the case with ordered and newly obtained literature only. Naturally, we cannot supply copies of literature which is copyrighted or whose distribution is restricted.

Reactor and Weapons Shielding

ORNL-IIC-8

Reactor Yield Calculations for 81 Radioisotopes Produced by (n,γ) Reactions at Fluxes of 10^{7} to 10^{16} n/cm^2 sec for Irradiation Times of 30 Minutes to One Year
T. C. Whitson and C. W. Friend - April 1966

AD-621441

Monte Carlo Calculations of Gamma-Ray Albedo
C. M. Huddleston and N. F. Shoemaker - September 6, 1965

AD-621269

Neutron Transport Calculations of the Air Force Nuclear Engineering Test Facility Core
Donald Lloyd Norman - August 1965

HI-518-RR (Vol. 1 and 2)

Environmental Effects of Nuclear Weapons
Robert U. Ayres - December 1, 1965

AD-621473

Calculation of the Energy-Angular Relationship for Neutrons from a Neutron Generator
C. M. Huddleston and N. F. Shoemaker - September 2, 1965

RHEL/R-106

The Measurement of Radiation Absorbed by Particle Accelerator Structural Components
C. E. Chapman and R. Sheldon - July 1965

CEX-65.01

Feasibility Study: Intense 14-Mev Neutron Source for Operation Henre
T. G. Provenzano, E. J. Story, et al. - September 1965

DC-61-3-69

Data Report of Radiation Level Measurements within and behind Beryllium
P. W. Schreiber and F. D. Kodras - February 14, 1961

AD-624019

Pulsed X-Ray Prompt Gamma Simulator
F. C. Ford, D. Martin, and B. Bernstein - November 29, 1965

AFWL-TR-65-209

Investigation of Analytical Methods, Solution Sensitivity and Structural Scattering in Neutron Transport
J. M. Norwood, E. E. Jones, D. A. Goodwin and P. L. Kleinjan - March 1966

KN-684-66-29A

Hardening Requirements and Neutron Effects Studies Volume II: A Comparison of Monte Carlo Calculations and Threshold Foil Measurements of 14-MeV Neutron Attenuation in Borated Polyethylene
D. E. Wood and D. E. Heagerty - January 20, 1966

Nukleonik, 8(2), 101-08 (1966)

An Improved Double P_L Method Applied to Gamma Transport
S. A. W. Gerstl

Nucl. Sci. Eng., 25(1), 85-92 (May 1966)

Dose Buildup Factors of Plane Parallel Barriers for 60-Co Plane Monodirectional Source
Y. Furuta, S. Miyasaka, Y. Kanemori, A. Tsuruo, and K. Tamura

Nucl. Sci. Eng., 25(1), 66-74 (May 1966)

Dose Attenuation in Two-Legged Concrete Ducts for Various Gamma-Ray Energies
J. M. Chapman and C. M. Huddleston

Nucl. Eng. and Design, 3, 476-477 (1966)

Lead Concrete - First Extra-High-Density Shielding Suitable for Installation by Mass Production Methods
W. C. Hall

Health Phys. 12, 793 (1966)

Meanings of First Collision Dose
F. H. Attix

J. Nucl. Energy, Pts. A/B, 20(4), 318 (April 1966)

Use of the Method of Moments for Solving Neutron Thermalization Equations for an Infinite Medium
M. V. Fedulov

J. Nucl. Energy, Pts. A/B, 20(5), 381 (May 1966)

Angular and Energy Characteristics of the Emission of ^{235}U Fission Neutrons
M. V. Blinov, N. M. Kazarinov and A. N. Protopopov

J. Nucl. Energy, Pts. A/B, 20(5), 390 (May 1966)

Attenuation of Reactor Radiations by Serpentine Concrete
G. A. Vasil'ev, A. P. Veselkin, Yu. A. Egorov, V. A. Kucheryaev and Yu. V. Pankrat'ev

J. Nucl. Energy, Pts. A/B, 20(5), 404 (May 1966)

An Exact General Solution of Boltzmann's Equation in Spherical Harmonics
G. Ya. Rumyantsev

Health Phys. 12, 673 (1966)

Scattering of Gamma Radiation from Semi-Infinite Slabs
W. R. Hendee and J. L. Ellis

Atompraxis, 13(3), 123 (1966)

Prompt and Delayed Gamma-Radiation in Nuclear Fission
H. P. Axmann, P. Weinzierl

BOOK

Nuclear and Radiation Standards of Importance to the National Atomic Energy Program
Nuclear Cross Section Advisory Group - 1966

N66-16568 (NASA-CR-54794)

Gamma Spectral Data for Shielding and Heating Calculations
J. Celnir, et al. - November 30, 1965

CEX-62.13

Post Pulse Gamma-Radiation Spectrum--Operation BREN
J. H. Thorngate and E. T. Loy -- June 1966

CEX-64.7

Neutron and Gamma-Ray Leakage from the Ichiban Critical Assembly
J. H. Thorngate, D. R. Johnson and P. T. Perdue - June 1966

USNRDL-TR-1018

Energy and Angular Distribution of Gamma Rays Scattered in Aluminum
J. G. Dardis and N. E. Scofield - December 22, 1965

ORNL-TM-1448

Point-Set Representation of 238-U Cross Sections; Values and a Fortran Program for Computation
J. Wallace Webster - June 1966

Shielding Computer Codes

UNC-5093 August 1964 UNC-SAM

A Fortran Monte Carlo System for the Evaluation of Neutron or Gamma-Ray Transport in Three-Dimensional Geometry
by B. Eisenman and F. R. Nakache
Fortran for CDC-1604-A Computer

NASA CR-54904
UNC-5148 March 1966 ATHENA

A System of Fortran Programs for Radiation Transport and Heating Calculations in Complex Reactor Geometries
by D. Spielberg
Fortran IV for IBM-7094 computer and Fortran 63 for CDC-1604-A Computer

NDA-15C-87 December 1955 NUPAK

Operating Instructions for NUPAK
by J. Certaine and M. Sullivan
SAP, IBM 704

ORNL-TM-1212 January 1966 OGRE-G

OGRE-G, an OGRE System Monte Carlo Code for the Calculation of Gamma-Ray Dose Rate at Arbitrary Points in an Arbitrary Geometry
by D. K. Trubey and M. B. Emmett
Fortran, IBM 7090 and CDC 1604

ORNL-3805 April 1966 OGRE

OGRE, A Monte Carlo System for Gamma-Ray Transport Studies, Including an Example (OGRE-P1) for Transmission through Laminated Slabs
by S. K. Penny, D. K. Trubey and M. B. Emmett
Fortran, IBM 7090 and CDC 1604

EUR-
Private Communication April 1966 BIGGI 3P

Provisory Description of the Gamma Transport Program
by H. Penkuhn
Fortran, IBM 7094

ORNL-TM-1241 November 1965 LEGENDRE

LEGENDRE, A Program to Calculate Legendre Coefficients from Angular Distributions
by D. C. Irving, W. E. Kinney, and Pat Rea
Fortran, CDC 1604 and IBM 7090

WAPD-TM-54 January 1957 POLYPHEMUS

POLYPHEMUS - A Monte Carlo Study of Neutron Penetrations through Finite Water Slabs
by F. Obenshain, A. Eddy, and H. Kuehn
FAP, IBM 704

ER-7777 April 1966 FLARE
DOSE-mod.

Data Compilation and Evaluation of Space Shielding Problems: Vol. III Radiation Hazards in Space
by C. W. Hill, W. B. Ritchie, and K. M. Simpson, Jr.
FORTRAN IV, IBM 7094 and 360/50 (FLARE)
FORTRAN II and FAP, IBM 7094 (DOSE-mod.)

AFWL-TR-65-10 May 1965 THREATEN

A Computer Program Incorporating the Whitaker Threat Model into the Space Radiation Environment and Shielding Computer Program
by J. A. Barton, W. R. Doherty, and P. G. Hahn
FORTRAN

NAA-SR-MEMO-7347 April 1962 MACE

A Monte Carlo Evaluation of Fast Neutron Collimators
by R. E. Kaiser, W. J. Roberts, and K. L. Rooney
Fortran IBM 7090

AFWL-TR-65-171, Vol. I and Vol. II March 1966 PHOTRAN

A General Purpose Photon Transport Program in Complex Geometry
by C. D. Zerby, J. Agresta, T. H. George, C. R. Marotta, D. E. Ladd, R. W. Taylor, C. Currie, E. Imperator, and F. Tessler
Fortran IV

CORRECTION TO QAD P-5

R. E. Malenfant, LASL, and Lloyd Burns, General Electric NMPO, have notified RSIC of a correction to QAD P-5. The program can be corrected by replacing the two cards including Statement 330 in the Source Subroutine with the following instructions:

```
330   DØ 340 M=1, MAX
      F(M,N)=(FNC(CSØ(M+1,N))-FNC(CSØ(M,N))+
     1 XI*(CSØ(M+1,N)*FNS(CSØ(M+1,N))
     2 -CSØ(M,N)*FNS(CSØ(M,N))))/XI**2
```

instead of:

```
330   DØ 340 M=1,MAX
      F(M,N)=((1.0+XI*CSØ(M+1,N))*FNC(CSØ(M+1,N))-(1.0+
     1 XI*CSØ(M,N))*FNC(CSØ(M,N)))/XI**2.0
```

The error results in an erroneous power distribution along the radial coordinate in a cylindrical system when the power density distribution is specified with the cosine function having $\xi_1 \neq 0.0$.

The RSIC code package has been updated.

ENDF/B FORMAT AVAILABLE FROM RSIC

As noted in the RSIC Newsletter No. 20, dated July 1966, a recent meeting was held to lay plans for implementing a common computer format for handling cross sections. The Center has made a number of copies of the preliminary draft of this format and will distribute copies to those persons who are truly interested.