RSIC Newsletter

RADIATION SHIELDING INFORMATION CENTER

OAK RIDGE NATIONAL LABORATORY

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

POST OFFICE BOX X •
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As plants are suffocated and drowned with too much moisture,
and lamps with too much oil,
so is the active part of the understanding with too much study.
--M. E. deMontaigne

GAMMA-RAY SPECTRA ARISING FROM THERMAL-NEUTRON CAPTURE

In the March 1969 issue (No. 52) preliminary thermal-neutron capture gamma-ray spectra due to Maerker and Muckenthaler were given. Their report[1] has now been issued and a summary of their results which include additional nuclides are given in Table 1. The data are based on analyses of experiments performed at the ORNL Tower Shielding Facility.

A REMINDER

The degree to which the Radiation Shielding Information Center is successful obviously depends on the cooperation of the shielding community itself. You are reminded that we may overlook your new information, so will you please assume responsibility for notifying us about it?

The above lines, written by E. P. Blizard in 1962 for our brochure, are as pertinent now as when they were written. We appreciate very much being placed on your distribution list for shielding reports or being sent your journal reprints. Otherwise, it is very possible that your information may be overlooked.

PHOTON INTERACTION DATA AVAILABLE

Photon interaction data based on the new Livermore evaluation (UCRL-50174, Sec. II, April, 1969) are available from RSIC on tape. The elements are Z = 1-83,

[1] R. E. Maerker and F. J. Muckenthaler, "Gamma-Ray Spectra Arising from Thermal-Neutron Capture in Elements Found in Soils, Concretes, and Structural Materials," ORNL-4382 (Aug. 1969), available from CFSTI.

TABLE 1. GAMMA-RAY SPECTRA FROM THERMAL-NEUTRON CAPTURE

Energy (MeV)	Silicon	Calcium	Potassium	Sodium	Barium	Iron	Aluminum
	Photons/100 Captures						
1-1.5	15.3	20.9	35.0	14.8	63.4	5.0	18.6
1.5-2	0	79.6	25.6	11.9	34.6	15.0	10.4[a]
2-2.5	23.0	41.5	37.2	26.9	34.3	3.9	13.1
2.5-3	4.6	14.3	23.5	47.6	24.3	6.0	20.5
3-3.5	5.4	7.9	16.7	14.2	17.6	9.2	15.9
3.5-4	76.6	13.5	23.2	34.0	16.0	3.5	14.3
4-4.5	0.8	19.4	20.2	6.4	28.1	7.2	16.1
4.5-5	70.3	6.6	7.7	2.65	12.6	3.3	17.6
5-5.5	6.4	2.5	16.2	2.2	7.6	1.0	6.8
5.5-6	0.2	12.1	17.3	5.9	9.5	9.9	2.8
6-6.5	12.2	40.0	0.95	21.5	4.0	10.1	6.0
6.5-7	0.8	0	2.15	0	1.0	0.5	2.2
7-7.5	9.7	0	0.45	0	1.0	5.5	0.7
7.5-8	0	0	5.65	0	1.0	50.6	32.4
8-8.5	2.2	0	0	0	0.3	0.3	0
8.5-9	0	0	0	0	0.2	0.5	0
9-9.5	0	0	0	0	0.45	3.3	0
$\%\overline{BE}^{\#}$	104	100	96	89	97	95	95

$\overline{BE}$ = total amount of energy available to the photon from capture in the naturally occurring element.
#Includes small contribution below 1 MeV to binding energy previously determined by others.
[a]Does not include the ~100 1.78-MeV gamma rays following β-decay of 28-Al.

TABLE 1. (continued)

Energy (MeV)	Copper	Titanium	Zinc	Chlorine	Nickle	Sulfur	Stainless Steel
	Photons/100 captures						
1-1.5	11.3	83.8	52.1	45.2	6.3	1.7	14.5
1.5-2	11.6	25.7	30.5	45.4	2.2	3.1	9.7
2-2.5	6.4	3.6	25.4	14.3	2.2	43.9	6.1
2.5-3	9.3	5.0	18.2	19.3	3.1	22.8	4.4
3-3.5	8.8	6.2	22.8	12.3	2.0	29.4	7.4
3.5-4	8.2	4.6	13.8	9.1	1.6	3.0	3.7
4-4.5	10.5	0.7	14.4	6.5	1.1	7.0	5.8
4.5-5	4.6	9.5	13.9	9.0	1.3	15.3	3.2
5-5.5	9.2	0.4	12.4	3.4	3.4	61.9	3.5
5.5-6	2.3	1.0	10.4	11.7	4.3	3.9	9.4
6-6.5	5.2	33.1	7.4	26.2	4.2	0.4	7.5
6.5-7	9.0	56.0	13.1	18.3	11.2	1.0	4.1
7-7.5	16.0	0.9	5.4	12.4	2.9	1.0	8.5
7.5-8	40.5	0.18	14.1	10.0	10.4	3.5	33.6
8-8.5	0	0.32	1.0	0	7.6	0.5	3.6
8.5-9	0	0	0.1	3.2	48.0	2.0	12.2
9-9.5	0	0.21	1.2	0	0	0	3.7
	101	106	105	108	92	94	96

86, 90, 92 and 94 and the energy range is 1 keV to 100 MeV. The data were made available to us by R. J. Howerton of LRL, Livermore.

The data are available in two formats. The package DLC-7 has total, coherent, incoherent, pair production, and photoelectric cross sections in ENDF/B format and includes an edit routine. The package DLC-4 has the pair production and photoelectric cross sections in OGRE format and includes an edit and data handling routine described in ORNL CF-69-7-60.

PROCEEDINGS OF THE ANS SESSIONS ON GAMMA-RAY PRODUCTION AND TRANSPORT AND ON CIVIL DEFENSE SHIELDING NOW AVAILABLE

The Proceedings of the American Nuclear Society Shielding and Dosimetry Division special sessions of the 1967 winter meeting in Chicago are now available. These proceedings, edited by E. A. Straker of ORNL and published by the AEC Division of Technical Information Extension, are titled "Special Sessions on Gamma-Ray Production and Transport, and on Civil Defense Shielding," ANS-SD-7 (Aug. 1969).

A limited number of copies of this document are available free to Shielding and Dosimetry Division members upon request to ANS headquarters. Otherwise, the document is available at CFSTI for $3.00.

PERSONAL ITEMS

W. E. (Bill) Edwards, formerly with General Electric, Cincinnati, is now with Battelle Memorial Institute, Columbus, Ohio.

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Zolin G. Burson (EG&G) is in Oak Ridge on temporary assignment with the DOSAR group of the ORNL Health Physics Division.

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Conesco Division of Flow Corporation is now CGS Scientific Corporation and is located at Alexandria, Va. Conesco was previously located at Springfield, Va.

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Congratulations to Capt. Wayne Coleman of the U. S. Army Nuclear Defense Laboratory on his recent promotion.

VISITORS TO RSIC

Visitors to RSIC during the month of August were: Zolin Burson, EG&G, on temporary assignment with Health Physics Division, ORNL; Arnaldo Chiarini and Georgio Casa dei, Centro di Calcolo, CNEN, Bologna, Italy; Ennis H. Rosamond, DASA Information Analysis Center, Santa Barbara, Calif.; Millard Wohl and Pat Flanigan, NASA Lewis Research Center, Cleveland, Ohio; and a group of college professors.

SEPTEMBER ACCESSION LIST OF LITERATURE

The RSIC is now aware of the literature cited in the following list. This literature has either been obtained by RSIC or has been placed on order. When received, this material will be examined and assigned to various files if suitable for our information system. The accession list is divided into three fields (1) reactor and weapons shielding, (2) space and accelerator shielding, and (3) shielding computer codes. These titles are announced before processing and indexing so that there will be no delay and can serve as a prompt announcement of current literature.

RSIC is not a documentation center. Copies of the literature cited must generally be obtained from the author or from a documentation center such as the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151.

RSIC maintains a microfiche file of literature entered into its information system. Computer searches of this system (which produces a special bibliography) and duplicate microfiche copies of the literature in our file are available upon request. Naturally, we cannot supply copies of literature which is copyrighted (such as books or journal articles) or whose distribution is restricted. Neither service is yet available for the codes literature.

REACTOR AND WEAPONS SHIELDING

AD-476 572 — *March 1964*

Biological and Radiological Effects of Fallout from Nuclear Explosions. Chapter 1: The Nature of Fallout; Chapter 2: Formation of Fallout Particles.
C. F. Miller
Available: CFSTI

AD-681 729 — *August 16, 1968*

Gamma-Ray Spectra of the Products of Thermal-Neutron Fission of 235-U at Selected Times After Fission
L. R. Bunney, D. Sam
Available: CFSTI

AEEW-M-857 April, 1969

Estimation of Collision Probabilities in Complicated Geometries
M. J. Roth
Available: AEC Depository Libraries, CFSTI, UK ls. 3d

AHSB (S) R 169 1969

Revised Fission Cross Section Evaluations for the Energy Range 1 keV to 15 MeV
W. Hart
Available: HMSO 5s. 6d. Net

ANS-SD-7 (CONF-671140) November 1967

Proceedings of the Special Sessions on Gamma-Ray Production and Transport and on Civil Defense Shielding
E. A. Straker, Editor
Available: CFSTI

ARC-68-75 January 31, 1968

Fallout Computational Techniques
J. S. Petty, G. B. Curtis, D. E. Wendland
Available: CFSTI as AD-683 778

EGG-1183-1406 October 4, 1968

Angular Differential Photoelectric Cross Sections
J. W. Churchill, L. H. Ziegler
Available: AEC Depository Libraries; CFSTI

IAE-1612 (In Russian) 1968

Relaxation Lengths in Water
Kh. Sh. Abdullaev, V. D. Nikitin, G. Ya. Trukhanov
Available: AEC Depository Libraries

LA-4052 October 1968

The Photon Energy Response of Several Commercial Ionization Chambers, Geiger Counters, and Thermoluminescent Detectors
B. J. Krohn, W. B. Chambers, E. Storm
Available: CFSTI

LA-4121 February 1969

Radiation Leakage Through Pinhole Collimators
B. M. Moore
Available: AEC Depository Libraries; CFSTI

LA-DC-9756

Tailored Spectra from 14 MeV Sources
D. B. Smith
H. O. Menlove

NWEF Report 1035 (Limited Distribution) May 1, 1969

Photon Transport Calculations Using the Method of Discrete Ordinates. Volume I. Theoretical Considerations
S. A. Dupree, H. A. Sandmeier

ORNL-4382 August 1969

Gamma-Ray Spectra Arising from Thermal-Neutron Capture in Elements Found in Soils, Concretes, and Structural Materials
R. E. Maerker, F. J. Muckenthaler
Available: CFSTI

ORNL-TM-2586 June 17, 1969

Comparisons of Monte Carlo Calculations to Measurements of Neutron Leakage from the TSF-SNAP Reactor
V. R. Cain

ORNL-TR-2043 (CEA-N-915 in French) 1968

Decay of Photoneutrons Produced by the Gammas of the Fission Products of U-235 in Heavy Water
H. Winter, H. Deledicq
Available: AEC Depository Libraries; CFSTI

ORNL-TR-2152 (SZS-17/68 in German)

Primary Literature in the Field of Radiation Protection
H. Scheel
Available: AEC Depository Libraries; CFSTI

RT/FI-(69)15 1969

Monte Carlo Calculation of the Energy Loss Spectra for Gamma Rays in Cylindrical NaI(Tl) Crystal
M. Giannini, P. Oliva, M. C. Ramorino
Available: AEC Depository Libraries

RT/FI-(69)17 1969

Monoenergetic Neutron Transport Theory for Multilayer Systems and Associated Shielding Problems
V. C. Boffi, F. Premuda
Available: AEC Depository Libraries

SGAE-R-3/1968 January 1969

Astra Flux Calculations with Large Scale Computer Programs
H. Bruneder, J. Harrington, D. Bochskanl, F. Putz
Available: AEC Depository Libraries

SC-DC-69-1671 1969

Use of the Method of Discrete Ordinates for Photon Transport Calculations
J. H. Renken

UJV-2129-R (In Czech) *February 1969*

Multigroup Cross Sections Calculation for Use in S_N
J. Rataj
Available: AEC Depository Libraries

USNCEL-TR-599 *October 1968*

Nuclear Radiation Shielding in the Design of Hardened Structures
C. M. Huddleston, D. R. Doty, W. C. Ingold
Available: CFSTI as AD-843 583

USNRDL-TRC-69-13 *March 1969*

The Accuracy of the Engineering Method for Calculating Structure Shielding
A. L. Kaplan

USNRDL-TRC-69-9 (NRSS-10, AD-689 520) *June 1969*

Comparison of Scattered Portion of Gamma Radiation Penetrating Ribbed and Plane Slabs
G. R. Thayer, G. Dubois, R. W. Roussin, A. B. Chilton
Available: CFSTI as AD-689 520)

USNRDL-TRC-69-10 (KEES-SR-82) *January 31, 1969*

Measurement of Angular and Energy Spectra of Wall Transmitted Radiation
R. E. Faw, R. M. Rubin, J. M. Royer, M. J. Coolbaugh

Y-1675 *June 19, 1969*

Properties of Tungsten and Tungsten Alloys for Reactor Shielding Applications
T. D. Watts
Available: AEC Depository Libraries; CFSTI

Atomnaya Energiya, 26, 269-278 (1969) (In Russian)

Buildup of Slowing-Down Neutrons in Reactor Shield
A. P. Veselkin, Yu. A. Egorov, M. E. Netecha, Yu. V. Pankrat'ev, V. I. Piskunov

Brit. J. Radiol, 42(499), 522-529 (1969)

Calculations of the Absorbed Dose in a Phantom from Photon Fluence and Some Applications to Radiological Protection
J. M. Sidwell, T. E. Burlin, B. M. Wheatley

Nucl. Eng. Design, 9(3), 281-301(March 1969)

Investigation of the Accuracy of Different Shielding Codes in Water-Iron Shields
R. Fiebig, F. Frisius, R. Nicks, H. Penkuhn, C. Ponti

Nucl. Eng. Design- 9(3), 357-362 (March 1969)

Single Scattering of Gamma Radiation from Monoenergetic, Plane Isotropic Sources in Infinite and Semi-Infinite Media
E. E. Morris

Nucl. Instrum. Methods, 69, 245-53 (April 1969)

Study of the Neutron Cascade in Iron
F. Hajnal, M. Awschalom, J. E. McLaughlin, K. O'Brien, P. D. Raft, W. Schimmerling

Nucl. Sci. Eng., 37(2), 232-242 (August, 1969)

Transmission Measurement of the ^{252}Cf Fission Neutron Spectrum
L. Green

Nucl. Sci. Eng., 37(2), 278-287 (August 1969)

A New Non-Multigroup Adjoint Monte Carlo Technique
L. B. Levitt, J. Spanier

Nucl. Sci. Eng., 37(2), 288-298 (August 1969)

The Synthetic Method as Applied to the S_n Equations
E. M. Gelbard, L. A. Hageman

Nucl. Sci. Eng., 37(3), 410-422 (Sept., 1969)

Monte Carlo Integration of the Adjoint Neutron Transport Equation
B. Eriksson, C. Johansson, M. Leimdorfer, M. H. Kalos

Nukleonik 11 (3), 156-7 (June 1968)

Fast Neutron Reflection by Steel Rods Introduced in a Water Reflector
Y. Elmeshad

Nukleonik, 12, 67-75 (January 1969)

Methods for Albedo Matrix Calculation
P. Vertes

Phys. Med. Biol., 14, 255-67 (April 1969)

Gamma-Ray Doses for All Points in Spheres and Cylinders with Uniformly Distributed Sources
L. B. Hubbard, F. S. Williamson

Soviet Phys. Uspekhi, 10(4), 559-99 (January 1968)

Nuclear Fission
A. I. Obukhov, N. A. Perfilov

BOOK (*In German*) *1968*

Article: Results of Radiation Measurements in the Concrete Shield of the Gundremmingen Nuclear Plant in the Spring of 1967
H. Schultz
In: *Probleme Des Bautechnischen Strahlenschutzes. III.*
pp 73-123
H. Schultz, editor
Munich, Verlag Karl Thiemig KG

BOOK (*In German*) *1968*

Article: Principles for the Shielding of Fast Breeder Reactors
K. Hornyik
In: *Probleme Des Bautechnischen Strahlenschutzes. III.*
pp 157-69
H. Schultz, editor
Munich, Verlag Karl Thiemig KG

SPACE AND ACCELERATOR SHIELDING

FTD-MT-24-378-67 (AD-682 812, N69-24516) *January 1968*

Solar Wind, Magnetosphere and Van Allen Radiation Belt, (U)
G. A. Skuridin, V. D. Pletnev, V. P. Shalimov

JINR-P2-4510 (*In Russian*) *1969*

Meson-Nucleon Cascade Interactions with Emulsion in the Energy Range 50 to 80 GeV
I. Z. Artykov, V. S. Barashenkov
Available: AEC Depository Libraries

NASA-CR-1377 *July 1969*

Investigation of Bremsstrahlung Production in Spacecraft Materials
W. E. Dance, W. J. Rainwater

NASA-CR-10119 (N69-26322) *February 1969*

A Measurement of the Spectrum of Cosmic Ray Electrons Between 20 MeV and 4 BeV in 1968. Further Evidence for Extensive Time Variations of this Component
J. Rockstroh, et al

NASA-CR-98420 (RR-331) *March 1969*

Solar Flare Radiation Protection Requirements for Passive and Active Shields
F. W. French
Available: CFSTI as N69-25369

ORNL-TM-2669 July 21, 1969

High-Energy (<18 GeV) Muon Transport Calculations and Comparison with Experiment
R. G. Alsmiller, Jr., J. Barish

ORNL-TR-2174 (JINR-P1-4077 *in Russian*) 1968

Experimental Investigation of the Development of Electron-Photon Showers at an Energy from 1 to 2 GeV
Z. Ogrzeval'skii, Z. S. Strugal'skii

ORNL-TR-2178 (*Izv. Vyssh. Ucheb. Zaved., Fizika Section, 10, 147-9 (1968) [In Russian]*)

Study of Energy and Angular Distributions of Electrons Behind Barriers of Different Thickness
B. A. Kononov, E. A. Gusev

ORNL-TM-2630 June 23, 1969

Calculation of the Residual Photon Dose Rate Due to the Activation of Concrete by Neutrons from a 3-GeV Proton Beam in Iron
T. W. Armstrong, J. Barish

J. Nucl. Sci. Technol. (Tokyo), 6, 170-81 [April, 1969])

Proton Shield Weight Optimization
J. R. Rosen

IEEE, Trans. Nucl. Sci., NS-16, 560-7 (June 1969)

Tables for the Determination of the Lateral Shielding Requirements of High Energy Electron and Proton Accelerators
K. O'Brien

IEEE, Trans. Nucl. Sci., NS-16, 618-19 (June 1969)

The Radiation Shielding and Beam Dumps for the NAL 100-GeV Proton Storage Rings
M. Awschalom

Kerntechnik, 11, 212- (1969)

Radiation Shielding for Electron Linear Accelerator of Central Bureau for Nuclear Measurements
H. Horstman

Nucl. Instrum. Methods, 69, 245-53 (April 1969)

Study of the Neutron Cascade in Iron
F. Hajnal, M. Awschalom, J. E. McLaughlin, K. O'Brien, P. D. Raft, W. Schimmerling

Nucl. Instrum. Methods, 70, 349-351 (May 1969)

Transverse Shielding Calculations for High-Energy Photon Beams
K. O'Brien

Nucl. Sci. Eng., 37(3), 337-342 (Sept. 1969)
(ORNL-2557)

Calculation of the Radiation Hazard at Supersonic Aircraft Altitudes Produced by an Energetic Solar Flare
T. W. Armstrong, R. G. Alsmiller, Jr., J. Barish

SD-68-637 *August 1, 1968*

Calculated Dose Rates in Jupiter's Van Allen Belts
J. W. Haffner

COMPUTER CODES LITERATURE

CTC-INF-952 *August 1969* *DOT II*

Development of Two-Dimensional Discrete Ordinates Transport Theory for Radiation Shielding
by F. R. Mynatt, F. J. Muckenthaler, and P. N. Stevens

IKF-20 (ORNL-tr-2126) *1968* *MCELHE*

A Universal Monte Carlo Method for the Solution of Electron Transport Problems
by Siegmar Wittig

ORNL-TM-1967 *February 1969* *05R - MC/PLS*

Monte Carlo Path Length Selection Routines Based on Some Specific Forms of the Importance Function
by V. R. Cain, E. A. Straker, and G. Thayer

ORNL-TM-2393 *November 1968* *RIBDOR*

A Computer Program for Handling and Comparing Fission Product Data from RIBDOR for Mixtures of Reactor Fuels Irradiated Under Different Conditions - Application to Atomics International LMFBR Fuel
by W. Davis, Jr., and H. F. Soard

ORNL-TM-2601 *May 1969* *05R*

An Amplification of Selected Portions of the 05R Monte Carlo User's Manual
by D. C. Irving, V. R. Cain, and R. M. Freestone, Jr.
FORTRAN

RCN-94 (mf) October 1968 MICROFLUX-2

MICROFLUX-2 - A Program for the Calculation of Thermal Group Constants by Solving the Energy and Space Dependent Integral Transport Equation for Slabs, Cylindrical Cells and for Hexagonal and Square Lattices
by A. Tas, D. Van Ligten, and A. W. den Houting
ALGOL for PHILIPS-ELECTROLOGICA X8

UCRL-50532 October 1968 SORS

SORS Monte Carlo Neutron-Transport Code for the CDC-6600
by John Kimlinger and Ernest F. Plechaty
FORTRAN for CDC 6600