CURRENT WORK AND PROBLEMS

The Japan Atomic Energy Research Institute has summarized recent work in shielding in Japan in the report "Progress Report of Shielding Investigations in Japan," M. Shindo (Editor), (JAERI-4038).

A special purpose Monte Carlo program called BREVl calculates gamma ray penetration of double layer slab geometries for point or plane sources, isotropic, monodirectional, or cosine distributed.

EOS-1 is a Legendre polynomial expansion solution of the Boltzmann equation for gamma rays in a slab geometry. It is said to resemble NJOE in some features.

SELENE is a program which solves the gamma ray problem using the S method. It is particularly recommended in cases where there are sharp peaks in the fluxes. (That is, it is believed this program will perform better than EOS-1 in such cases.) Examples would be monoenergetic or monodirectional source cases.

All three of the above programs were written for the NEAC-2206 computer.

Exploratory studies of invariant imbedding applied to gamma ray transport are being made. Also investigations are being made of empirical forms suitable for representing multilayer gamma ray buildup factors and of leakage from simple geometric shapes (after Rockwell).

Experimental studies of buildup factors have been made in multilayer iron, water, lead shields using a 60-Co source. Gamma ray energy spectra penetrating iron-polyethylene shields from a 60-Co source were measured also. Gamma ray energy albedos for polyethylene and for aluminum have been measured with the use of 137-Cs and 60-Co sources. The backscattered flux density was found to consist principally of singly scattered radiation.

A system of programs called RAC has been devised to do neutron removal-diffusion problems. RAC is programmed for a 7044 computer.

EOS-2 is a Legendre polynomial expansion for neutrons as EOS-1 is for gamma rays.
A computation has been made to determine the photoneutron flux density at deep penetrations of a water shield around a reactor.

Experimental studies of neutron penetrations of iron-water laminations have been made using as a source a fission plate driven by a TRIGA reactor in a lid tank arrangement. Other neutron measurements in iron-water shields have been made with the Hitachi Training Reactor.

Removal cross sections were measured in a slab shield of iron, aluminum, and concrete using as a source 2.5 MeV (D-D) and 14 MeV (D-T) neutrons from an accelerator. No energy dependence of the removal cross section was noted.

Shield optimization studies for the ship reactor shield are being made at the JRR. Mockup shield tests are also being made with special attention to the streaming problem.

An experimental program has been carried on to study streaming through ducts in polyethylene, vinyl-chloride, iron, and lead. These measurements were carried on at the TRIGA lid tank facility at St. Paul's University. Various calculational methods for analyzing ducts are also under study.

**REACTOR-WEAPONS SHIELDING ABSTRACTS UPDATED**

Inserts for ORNL-RSIC-6, Abstracts of the Literature Examined by the Radiation Shielding Information Center, Vol. I, have recently been mailed to persons on the reactor-weapons shielding distribution. These inserts provide revisions and additions to the abstracts previously issued. A total of 1135 abstracts have now been issued for Vol. I.

**RECENT VISITORS TO RSIC**


**JANUARY 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 of (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 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.

Reactors and Weapons Shielding

Health Phys., 12(10), 1503 (Oct. 1966)
Shielding for Small Neutron Generators
J. S. Bevan

Health Phys., 12, 1327 (1966)
Some Factors for Calculation of Infinite-Plane Exposure Rates from Gamma Radiation
G. R. Crockert, M. A. Connors and D. T. K. Wong

Health Phys., 12(9), 1311 (Sept. 1966)
A Review of Aperture and Ceiling-shine Effects in Fallout Shielding Technology
Arthur B. Chilton

Sov. J. Atomic Energy, 18(5), 685 (May 1965)
Attenuation of Neutron Tissue Dose by Thin Layers of Hydrogenous Materials
G. V. Miroshnikov

Sov. J. Atomic Energy, 18(5), 681 (May 1965)
Attenuation by Iron and Polyethylene of Tissue Dose of Neutrons Incident Obliquely on the Shielding
G. V. Miroshnikov

Sov. J. Atomic Energy, 18(5), 669 (May 1965)
Parabolic Approximation of the Total Attenuation Coefficients of \( \gamma \)-Quanta in the Energy Range from 0.03 to 10 MeV
C. S. Marenkov and R. S. Derzhimanov

Dose Buildup Factors of Low-Energy Gamma-Rays for Homogeneous and Heterogeneous Barriers
D. B. Pozdneev
Ref. 7. Atomic Energy, 21(3), (Sept. 1966)
Reflection of Low-Energy Gamma Radiation by Finite Homogeneous Barriers
D. B. Pozdneev

Sov. J. Atomic Energy, 18(5), 608 (May 1965)
Propagation of Neutrons in Iron
V. I. Golubev, A. V. Zvonarev, M. N. Nikolaev, M. Yu. Orlov, V. V. Penenko,
and C. P. Uznadze

Elastic Scattering of 0.5 MeV Gamma Rays by Heavy Elements
U. Hauser and B. Mussgnug

Gamma-Ray Absorption from Point Monodirectional Gamma Source by Plane Geometry

Nucl. Instr., 44, 160 (1966)
Monte Carlo Calculations of Source-to-Detector Geometry
I. R. Williams

Radiation Research, 29(2), 166 (1966)
A Method of Gamma-Ray Transport Simulation in Inhomogeneous Media
G. K. Bahr, D. R. Jones, H. Perry, and J. G. Kerciaxes

Mag. Concr. R., 18, 95 (1966)
A Radioactive Method for Measuring Variations in Density in Concrete
Cores, Cubes, and Beams
D. G. Harland

X-Rays and Electrons Emitted in Coincidence with Fission of Cf-252
R. A. Atnesen, T. D. Thomas, W. M. Gibson and M. L. Perlman

BNL-324, Vol. IIB, Supplement No. 2
Neutron Cross Sections, Volume II B, Z = 41 to 60
M. D. Goldberg, S. F. Mughabghab, S. N. Purohit, B. A. Magurno, and V. M.
May - May 1966

ORNL-tr-1499 (Translated from Kernenergie 9(5), 165-168 (1966)
Optimization of a Shield for Mixed Radiation
F. W. Krueger

NDL-TR-68 (AD-643538)
Scattered Radiation (Skyshine) Contribution to an Open Basement Located
in a Simulated Fallout Field (Final Report)
Control-Cab Design for ML-1A Nuclear Power Plant: Human Engineering Considerations
October 1965

Neutron Transport Calculations on Air Force Nuclear Engineering Test Reactor
D. R. Floyd - March 1966

Simulation Devices for Use in Studies of Protective Constructive
J. A. Mahoney - Feb. 1966

Spectra of Fast Neutrons in Heavy Media and Water
D. L. Broder, A. S. Zhilkin, and A. A. Kutuzov

Measurement of Radioactive Fallout by Field Total Absorption Gamma Ray
Spectroscopy Report No. 5
R. S. Foote - Nov. 26, 1965

The Weight-Effectiveness Index of Two-Component Materials Used for Shielding
Against Neutrons and Gamma Rays
G. A. Lisochkin and F. A. Predovskii

Numerical Calculations on the Penetration of γ-Quanta through Matter
V. S. Galisheev

Spatial Energy Distribution and Dose Rate of γ-Radiation from Unidirectional
and Isotropic Co-60 Sources at the Ground-Air Interface
S. M. Ermakov, B. A. Efimenko, V. G. Zolotukhin, Y. A. Kolesov, and
V. I. Kukhtovich

Induced γ-Activity in Polyethylene as a Result of Neutron Irradiation
N. A. Dubinskaya, A. Y. Lyul', and L. L. Pelekis

An Exact General Solution in Spherical Harmonics of the Boltzmann Equation
G. Ya. Rumyantsev
Sov. J. Atomic Energy, 18(5), 672 (May 1965)
The Effect of Boron-Containing Blocking on the Yield of Capture \( \gamma \)-Radiation
S. A. Kozlovskii, V. S. Kyz'yurov, K. K. Popkov, and D. N. Lebedev

Sov. J. Atomic Energy, 19(6), 1498 (December 1965)
Use of Concretes for High-Temperature Shielding of Nuclear Reactors
V. B. Dubrovskii, N. V. Krasnoyarov, M. Ya. Kulakovskii, B. K. Pergamenshchik,
M. S. Pinkhasik, and V. I. Savitskii

Sov. J. Atomic Energy, 19(6), 1507 (Dec. 1965)
Applicability of Various Approximations of the Method of Spherical Harmonics
for Calculating the Transmission of Neutrons through Shields
N. A. Artem-eva, K. K. Popkov, S. M. Rubanov, and L. S. Shkorbatova

Sov. J. Atomic Energy, 19(6), 1509 (Dec. 1965)
Determination of the Surface Relief of Materials by Means of Reflected
Gamma Radiation
P. L. Gruzin, V. N. Afanas'ev, and V. O. Gaiduchik

ORNL-3967 (Vol. 2-6)
Differential Neutron Current Albedos for Concrete in the Incident Energy
Range 0.5 eV to 200 keV. Results of Monte Carlo Calculations for an Incident Angle of 0 deg. (Vol. 2), 45 deg. (Vol. 3), 60 deg. (Vol. 4), 75 deg. (Vol. 5), 85 deg. (Vol. 6).
W. A. Coleman and R. E. Maerker - November 1966

FZK-511
Analysis of Slant- incident Radiation Through Ducts and Voids in Shields
J. B. Eggen and F. O. Leopard - Dec. 20, 1966

ApDA-NUS-8
Flux Mapping Measurements to Determine the Location of the Permanent
Detectors in the Enrico Fermi Reactor
E. M. Page, R. E. Horne - September 1966

WAPD-TM-609
A Simple Method to Improve the Efficiency of the \( \Sigma_{t} \) Estimator in
Certain Monte Carlo Programs
H. M. Steen - Oct. 1966

WAPD-Trans-40
Moderation of Neutrons Emitted by a Pulsed Source, and Neutron Spectrometry
Based on Slowing-Down Time
A. A. Bergman, A. I. Isakov, M. V. Kazarnovskii, Yu. P. Popov, and F. L. Shapiro
Concrete as a Radiation Shielding
R. Vinkeloe

BOOK

Soviet Progress in Neutron Physics
P. A. Krupchitskii (Editor), Consultant Bureau (Publisher)

The Build-up Factor B in Attenuation Calculations of \( \gamma \) Radiation
Silvia Dumitrescu, V. Marghitu


Energy Spectrograms of Point Sources of \( \gamma \) Rays
V. A. Artsybashev and G. A. Ivanyukovich


Measurements of Dose Buildup Factors in Slab Materials for \( \text{Co-60} \) Isotropic Source
Yoshihiko Kanemori

At. Energy (USSR), 20, 76 (January 1966) RUSSIAN

Optimum Ratio of Neutron and Gamma Dose Behind Reactor Shielding
L. N. Veselovskii, V. G. Kuznetsov, and V. A. Sokovich

At. Energy (USSR), 20, 78-80 (January 1966) Russian

Shielding Calculations for Cylindrical Sources
E. E. Kovalev, D. F. Osanov

At. Energy (USSR), 20 (January 1966) Russian

Shielding Properties of Iron-Serpentine Concrete
A. P. Veselkin, Ya. A. Egorov, V. A. Kucheryaev

Nippon Genshiryoku Gakkaishi, 8(6), 304-8 (June 1966)

Some Considerations of Buildup Factors in Gamma-Ray Penetration for Multiple Layers
M. Kitazume

Kerntechnik, 8: 82-5 (1966)

Methods of Calculation in Neutron Shielding
D. Nachtigall

Atomkernenergie, 11, 247-50 (May-June 1966)

Radiation Field of a Disk Source in a Homogeneous Absorbing Half-Space
H. Schultz, C.-D. Wüneke
Atomkernenergie, 10: 432-5 (Nov.-Dec. 1965)
Double $P_1$-Approximation for Gamma-Rays
S. A. W. Gerstl

Nippon Genshiryoku Gakkaishi, 7: 634-44 (Nov. 1965)
Gamma-Ray Transmission Through Multiple Layers
Iwao Kataoka

At. Energ. (USSR), 19: 460-2 (Nov. 1965)
Changes of Spectra of Fast Neutrons after Their Passage through Aluminum, Paraffin, and Aqueous Media
G. G. Doroshenko, V. A. Fedorov, E. S. Leonov

AECL-2626
Neutron Spectrum Measurements in Non-Multiplying and Multiplying Media
R. A. Jong and K. J. Serdula - August 1966

USNRDL-TR-1045
Experimental and Calculated Estimates of the Shielding Effectiveness of Compartmented Structures Exposed to Fallout
B. W. Shumway - July 19, 1966

N66-27941 (NASA-CR-75629; FZK-176-1)
Monte Carlo Calculations of Energy Depositions and Radiation Transport Vol. 1 Validation of Cohort Codes
D. G. Collins, T. W. DeVries - Dec. 21, 1963

DL-72
The Intense Neutron Generator
W. B. Lewis - October 1966

AECL-2635
Some Neutron Measurements with Simulated Ing Targets
J. Walker
June 1966

CEX-65.5
Experimental Evaluation of Techniques for Improving Fallout Protection in Home Basements
R. L. Summers and E. G. Durson - Dec. 1966

REIC Report No. 44
The Effect of Nuclear Radiation on Capacitors
C. L. Hanks and D. J. Hamman - Dec. 30, 1966

ORNL-3526
Monte Carlo Calculations of the Penetration of Normally Incident Neutron Beams through Concrete
F. H. Clark, N. A. Betz, J. Brown - January 1967
NBS-Rept. 9071
Dose Albedo and Transmission Coefficients for Cobalt-60 and Cesium-137 Gamma Rays Incident on Concrete Slabs
M. J. Berger and E. E. Morris - July 5, 1966

NBS Report 8681
Photon Attenuation and Energy Absorption Coefficients Tabulations and Discussion (Second Edition)
J. H. Rubbell and M. J. Berger - September 28, 1966

ORNL-4002
A Method of Representing Two-Dimensional Distributions for Use in Monte Carlo Calculations
M. Leimdorfer and J. Barish - January 1967

PSDC-TR-16
An Experimental Evaluation of Roof Reduction Factors
C. McDonnell and J. Velletri - May 1, 1966

ORNL-TM-1744
Fission Spectrum Neutron Dose Rate Attenuation and Gamma Ray Exposure Dose Buildup Factors for Lithium Hydride
F. B. K. Kam and F. H. S. Clark - January 13, 1967

Nucl. Sci. Eng., 11, 324-327 (1961)
Irradiated Ra:Be Neutron Sources
D. J. Dudziak and L. B. Freeman

LA-3606-MS
Gamma-Ray Energy Deposition in the Molten Plutonium Burnup Experiment (MPBE) Reactor Structure
D. J. Dudziak and M. E. Battat - January 12, 1967

ORNL-TR-1508
Determination of the Characteristics of Propagation of Fast Neutrons in Concrete by Measurement of the Scattering Field of a Collimated Neutron Beam
Hilmar Bindewald

ORNL-TR-1509
Circular Plane Radiation Source Before an Absorbing Half-Space
H. Schultz and C. D. Wuneke

LA-3577 (Confidential)
Monte Carlo Calculation of Gamma-Ray Heating Rates and Fluxes in Phoebus 1 from Core Sources
C. W. Watson - Dec. 6, 1966
RPP/R-3

Neutron Studies in Shields and Tunnels at the Rutherford Laboratory
K. B. Shaw

RPI-328-69

Gamma-Ray Spectra from Radiative Capture of Thermal and Resonance Neutrons in Mercury and Tungsten

NP-tr-1415

Anisotropy of the Atomic Scattering Factor for X-Rays in Aluminum and Diamond Crystals
S. T. Konobeevskii, K. P. Mamedov

LA-DC-8148

The Nuclear Explosion as a Single Burst Neutron Source
B. C. Diven

AD-642319 (USNRDL-TR-1076)

Gamma-Ray Spectra of the Products of Fast Neutron Fission of 235 U and 238 U at Selected Times after Fission
L. R. Bunney, and D. Sam - September 13, 1966

AECO-EP-13

Statistical Method of Neutron Transport in Absorbing Media
M. Ahsan - June 1966

UCRL-70172

The Monte Carlo Method
H. Sahlin - Oct. 1966

BNL-tr-103

Theory of X-Ray Scattering by Multicomponent Ordered Solutions
M. A. Krivoglaz, and E. A. Tikhonova

ORNL-TM-1727

Monte Carlo Calculations, Using the Albedo Concept, of the Fast-Neutron Dose Rates Along the Center Lines of One- and Two-Legged Square Concrete Open Ducts and Comparison with Experiment
R. E. Maerker and F. J. Mackenthuler - Sept. 21, 1966

AB-252

Nomogram for Determining Shield Thickness for Point and Line Sources of Gamma Rays
Energy Buildup Factors in Water for Very Deep Penetrations for a 6 MeV Plane Isotropic Gamma Source
L. Lois - August 1966

AD-623557 (N66-11853; ATD-B-65-76)
Nuclear Safety - Annotated Bibliography
A. Baliunas, B. Poplawski

ORNL-TM-1554
Calculation of Doubly Differential Current Albedos for Monodirectional Beams of Epicadmium Neutrons Incident on Concrete and Comparison of the Reflected Subcadmium Component with Experimental Results
W. A. Coleman, R. E. Maerker, F. J. Muckenthaler, and P. N. Stevens
September 27, 1966

NYU-400-65
Evaluation of Gamma Ray Spectrometers
Egilda de Amicis Witherell, and R. F. Cowing - Oct. 10, 1966

Shielding Computer Codes

CEA-N 575 (ORNL-tr-1372) December 1965 STOCK-CAR
Development of STOCK-CAR Computer Program for Flux and Dose Due to a Solid or Toric Cylindrical Source
by Bernadette Daversin
FERRANTI-MERCURY

CEA-N 583 (ORNL-tr-1378) January 1966 NIOBE
NIOBE Computer Program Description and Use
by Gilles Brandicourt and Jacques Culambourg
IBM 7094

GA-6511 April 1966 GADOSE and DOSET
GADOSE and DOSET - Programs to Calculate Environmental Consequences of Radioactivity Release
by E. Lee, R. J. Mack and D. B. Sedgley
FORTRAN for IBM 7044

ORNL-TM-1699 December 1966 RAFFLE
RAFFLE - A Monte Carlo Code for Calculations of First Flight Collision Probabilities
by O. W. Hermann and R. S. Carlsmit
FORTRAN for IBM 7090 and IBM 360
A Machine Code for the Unfolding of Pulse Height Spectra
by Juergen K. Bock and John V. Lanahan
FORAST for BRLESC

Programs Designed for Processing Monte Carlo Events Tapes
by J. Robert Streetman
FORTRAN for IBM 7094

FORTRAN Subroutine RANGE: Calculating the Range-Energy Relation for Charged
Particles in Chemical Elements
by W. Peter Trower

GASKET - A Unified Code for Thermal Neutron Scattering
by J. U. Koppel, J. R. Triplett and Y. D. Naliboff

A Monte Carlo Treatment of the Interaction of an Electron Beam with a
Heavy Target
by M. P. Ruffle
FORTRAN S2 for IBM 7030