

# RSIC Newsletter



RADIATION SHIELDING INFORMATION CENTER

**OAK RIDGE NATIONAL LABORATORY**

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*The worst evil of all is to leave the ranks of the living before one dies.  
...Lucius Annaeus Seneca (First Century)*

## MONTE CARLO REVIEW TO BE REPRINTED BY RSIC

Three volumes, titled "Techniques for Efficient Monte Carlo Simulation," originally issued by Science Applications Incorporated and sponsored by the Office of Naval Research, are being reprinted as ORNL-RSIC-38. Written by E. J. McGrath, D. C. Irving, S. L. Basin, R. W. Burton, S. C. Jaquette, W. R. Ketler, and C. A. Smith, they are titled: Vol. I, *Selecting Probability Distributions*, Vol. II, *Random Number Generation for Selected Probability Distributions*, and Vol. III, *Variance Reduction*. Although written for quite different application, these volumes should be very useful for those using Monte Carlo to calculate radiation transport. Selecting probability distributions efficiently and variance reduction are keys to effective use of Monte Carlo.

Copies can be obtained from RSIC upon request.

## REVIEW ARTICLE ON FUSION REACTORS PUBLISHED

An excellent review article on fusion reactor technology, written for the novice, has been published in *Science*. It is "Fusion Reactors as Future Energy Sources," written by R. F. Post, Deputy Associate Director for Physics and Controlled Fusion at Lawrence Livermore Laboratory and F. L. Ribe, leader of the Controlled Thermonuclear Research Division at Los Alamos Scientific Laboratory. The full citation is *Science*, 186 (4162), 397-407 (1 Nov. 1974).

## AMERICAN SOCIETY FOR TESTING & MATERIALS CALLS FOR PAPERS

The American Society for Testing and Materials (ASTM) has issued a call for papers for the first ASTM-EURATOM "Symposium on Reactor Dosimetry: Developments and Standardization" to be held September 22-25, 1975 in Petten, Netherlands. Papers representing original and previously unpublished research are solicited. Abstracts of 100-200 words with a paper offer should be submitted in English for arrival by February 28, 1975. Additional information is available from ASTM, 1916 Race St., Philadelphia, PA 19103.

## REVIEW OF PARTICLE PROPERTIES ISSUED BY PARTICLE DATA GROUP AT BERKELEY

The Fundamental Particle Data Group at the Lawrence Berkeley Laboratory has issued its yearly review of the Particle Properties, NSRDS-LBL-100, April 1974. This review of the properties of leptons, mesons, and baryons is an updating of the Center's 1973 review. Data are evaluated, listed, averaged, and summarized in tables. Copies of this latest review are available from the Berkeley Particle Data Center, Lawrence Berkeley Laboratory, University of California, Berkeley, Calif. 94720.

## BOOK REVIEW

N. M. Schaeffer, Ed., *Reactor Shielding for Nuclear Engineers*  
(available from NTIS as TID 25951, \$13.60)

Reviewed by Hans Penkuhn, European Shielding Information Service (ESIS)

*...Reprinted from ESIS Newsletter No. 11, Oct. 1974*

IF YOU CHANGE YOUR ADDRESS, please notify us (including Building and Room No. where needed). *Third Class Mail* is returned to us at our expense if the addressee has moved. If your mail is returned, your name will be deleted from our distributions until we hear from you.

### *Historical Background*

During the last years, both American and Europeans have tried to fill the shielding textbook gap – the three “classicals” (Rockwell III, Price-Horton-Spinney, Goldstein) are nearly 2 decades old. The Europeans edited the “Engineering Compendium on Radiation Shielding” which is more an encyclopedia than a textbook (3 volumes not yet finished) or who could read, for example, the Encyclopedia Britannica from A to Z? The Americans were more realistic about a beginner’s need and assembled only 8 authors: Garret, Mooney, Schaeffer and Selph of Radiation Research Associates, Fort Worth, Texas; Claiborne, Stevens and Trubey of Oak Ridge National Laboratory; and Friedman of Los Alamos. Their product also got voluminous (788 pages – roughly the double of each “classical”, but only one half of the “Compendium”).

### *Contents*

After a historical note, the second chapter describes sources of radiation, and the third the interactions of radiation with matter. Chapter 4 and 5 depict the deterministic and Monte Carlo transport theories, and Chapter 6 deals with bulk shield evaluations.

The next two sections describe miscellaneous topics, e.g., albedos, ducts, heating, materials, air transport. The last two chapters deal with experiments (detectors, measurements) and shield design – first in general, then in concrete examples. Finally, there are sixteen detailed appendices and two indexes (authors and subjects).

### *Reviewer's Comment*

The book is extremely useful for a beginner because it contains much up-to-date information, and moreover it is sometimes even funny; for instance, on p. 259 the author comments on a dice experiment: “If both you and your die were honest, the ratio of A’s to B’s...” etc. Another valuable feature for the student is that Chapters 2 to 6 contain exercises on their topics, so the reader can check whether or not he understood them. From the reviewer’s point of view, the chapters on Monte Carlo, on albedos, and on experiments seem the best; on albedos, more information is contained in this book than in the compendium. The authors admit – realistically and honestly – errors by factors up to 7.8 in the early SNAP-10A shield calculations – a consolation for many shielding people who are worried about their own mistakes. Now for some criticism: the paperback edition is not stable enough for a 788-pages book, and it is a pity that the useful exercises were not extended to the last chapters. In some cases obsolete data are used, e.g., the described nuclear ship “Savannah” (designed in the mid fifties) is clearly out of date (Ch. 10); today there are more modern constructions as the German “Otto Hahn” and the Japanese “MUTSU”. And far more useful than the tables of fission-product gamma rays in appendix A2 are those of Albrecht (Kernenergie, Vol. 7, 604 (1964)): they have a better energy structure and cover irradiation times up to two years (not only six weeks) and cooling up to three centuries (not only three years).

The weakest parts of the book are the mathematical appendix D because of its considerable number of misprints\* and the description of gamma shielding in general. It seems that the authors are too specialized in neutronology, so they treat the mathematics and the gammaology in a cavalier manner.

*Annex:* Errors in the Gamma-Ray Transport Description are described as follows.

*P. 81:* Fig.3.7 includes coherent scattering, but eq. 3.2-15 excludes it.

*P. 83 and 421:* Bremsstrahlung gets neglected – but Johnson *et al* demonstrated that at 8 MeV source energy and 7 mfp penetration in lead the dose rate rises by about 50% if bremsstrahlung is included (Reactor Shielding Conference, Paris, October 1972, Proc., Vol. 5, paper E-9).

*P. 632:* Following these data at low source energies the buildup factor of H<sub>2</sub>O should be greater than those of Be and He at the same penetration in mfp, which is clearly incorrect.

*P. 421:* The energy deposition buildup factor is discontinuous if the material changes (especially for low source energies), so its bracketing between its values in the two pure materials might be impossible.

P. 422: For most materials and energies  $B_a(\mu_0x)$  are greater than  $B_E(\mu_0x)$ , thus the use of  $B_E(\mu_0x)$  instead of  $B_a(\mu_0x)$  would in these cases underestimate the heating rate – not overestimate it, as stated in line 7.

P. 456: Denser materials mean smaller buildup? For high source energies and great  $\mu_0x$  the relation is the other way around, e.g.,  $B(\text{Pb}, \mu_0x) > B(\text{H}_2\text{O}, \mu_0x)$ .

Thus the readers are cautioned not to take too literally the mathematical and gamma-ray parts of the book – the marks for the rest range from average to excellent, both from the scientific and didactic viewpoint. D'Alembert compared his own "Encyclopedie Francaise" with a clown's dress – few good pieces and many rags. For this book, we should exchange the weights "few" and "many".

\* *Similar bugs are contained in the dimensions of the ordinate scales of many figures in chapters 8 and 9.*

#### COMMENT ON THE DNA WORKING CROSS SECTION LIBRARY

We recommend that the ENDF/B-IV version of iron (MAT 1192) be used in preference to the iron evaluation (MAT 4180, MOD 3) which is now part of the Defense Nuclear Agency Working Cross Section Library. Both data sets are intended to be identical except that the ENDF/B set uses resonance parameter representation for the 1 to 60 keV energy region while the DNA set uses point cross section in that energy interval. However, the point representation for the capture cross section has been found to be deficient causing gross overestimates of multigroup values (ranging from 8% to 220%) with the largest discrepancy in the 22 to 25 keV range (iron window). This is reflected in a total cross section value for the window region that is 10% higher. The *DLC-31/(DPL-1/FEWG1)* 37-21 group library will be updated to correct this problem.

It is planned that the next update for the DNA iron will exclude the resonance parameter treatment. Anyone who would encounter problems in processing a resonance parameter version of iron should contact RSIC for assistance.

#### CHANGES TO THE CODE COLLECTION

##### CCC-119B/ELBA

An IBM 360 version of the NASA Marshall Space Flight Center electron and bremsstrahlung dose rate code is made available via RSIC conversion. It may be transmitted as cards and documentation. FORTRAN IV; Reference: NASA SP-169 (ANS-SD-5), pp. 529–538 Informal notes.

##### CCC-213/ACRA II

Package has been extended by inclusion of an ERROR Function. The need for it was called to RSIC attention by EPA's Eastern Environmental Radiation Facility, Montgomery, Alabama. ACRA II estimates radiation doses caused by a hypothetical reactor accident. Reference: ORNL-TM-4082; FORTRAN IV; IBM 360.

##### CCC-244/TRANSPORT

A charged particle beam transport systems design code: first- and second-order matrix multiplication – was contributed by National Accelerator Laboratory, Batavia, Illinois, Stanford Linear Accelerator Center, California and CERN, Geneva, Switzerland. FORTRAN IV; IBM 360 (CCC-244A) and CDC 6600 (CCC-244B). Reference: NAL-91/SLAC 91/CERN 73-16. One reel of tape is required for transmittal.

##### CCC-246/TMMS

The transmission matrix method shielding code was contributed by Engineering Research Institute, Iowa State University, Ames, Iowa. Reference: C00-2060. FORTRAN IV; IBM 360.

**PSR-63/AMPX-I**

Modular code system for generating coupled multigroup neutron-gamma-ray libraries from ENDF/B was updated by the originator to include all changes made to the IBM version during FY 74. Also included are several new modules which serve specialized applications. 3 full reels of magnetic tape are required for transmittal written 7 track, 556 bpi; 1 full reel is required for 9 track, 800 bpi. FORTRAN IV; IBM-360/91. Reference; ORNL-TM-3706.

**NUCLEAR SAFETY CODES REVIEWED**

An article with a list of 180 computer codes useful for analyzing nuclear accidents has recently been published in *Nuclear Safety*. The article, by M. L. Winton, "Computer Codes for Analyzing Nuclear Accidents," *Nuclear Safety* 15 (5), 535-553 (Sept.-Oct. 1974), divides the codes into the following: 1) Siting of Nuclear Facilities; 2) Transportation and Handling of Nuclear Materials; 3) Heat Transfer and Thermal Transients; 4) Reactor Transients, Kinetics, and Stability; 5) Fission-Product Release, Transport, and Removal; 6) Sources of Energy Release Under Accident Conditions; 7) Containment of Nuclear Facilities; 8) Environmental Surveys, Monitoring, and Radiation-Dose Measurements; 9) Meteorological Considerations; 10) Effects of Thermal Modifications of Ecological Systems; and 11) Reliability.

The table gives name of code, machine on which it is operable, its language, corporate author, a statement of what the code does, a reference citation, and date of the reference.

**PERSONAL ITEMS**

New appointments at the Electric Power Research Institute (EPRI) include: **Odelli Ozer** and **Frank J. Rahn**, members of the technical staff, Nuclear Safety and Analysis Department, Nuclear Power Division.

**Joseph J. Sapyta** of Babcock and Wilcox Company's Nuclear Power Generation Division, has been named manager of the physics and radiation transport unit. Previously he was a lead engineer in the division's New Products and Services Department.

**Jerry Fishman**, formerly with Teledyne Brown, is currently employed in the Cosmic Radiation Branch, NASA Marshall Space Flight Center, Huntsville, Ala.

**Robert J. Hanson** of the Radiation Control Department, Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, Calif., 91103 has notified RSIC of a need for a Nuclear Engineer/Physicist having experience in developing, modifying, and adapting computer codes for spacecraft radiation analysis.

**VISITORS TO RSIC**

Visitors to RSIC during the month of November were: B. E. Barrachin, G. E. Katz, and P. Petrequin, CEA-CEN, Saclay, France; D. Chenier, AEC, Washington, DC; R. Cloutier, ORAU, Oak Ridge, Tenn.; M. Poyatos, Electricite de France, Clamart, France; J. Rant, Institute Jozef Stefan, Ljubljana, Yugoslavia, presently in the Computer Sciences Division, ORNL; J. Wilson, AEC, Washington, D.C.

**NOVEMBER ACCESSION OF LITERATURE**

The following literature cited has been ordered for review, and that selected as suitable will be placed in the RSIC Information Storage and Retrieval Information System (SARIS). This early announcement is made as a service to the shielding community. **Copies of the literature are not distributed by RSIC.** They may generally be obtained from the author or from a documentation center such as the National Technical Information Service (NTIS), Department of Commerce, Springfield, Virginia 22151.



WE AT RSIC  
EXTEND TO ALL

# Season's Greetings

And best wishes for the coming year

THIS LITERATURE IS ON ORDER. IT IS NOT IN OUR SYSTEM. PLEASE ORDER FROM NTIS OR OTHER AVAILABLE SOURCE AS INDICATED.

## REACTOR AND WEAPONS SHIELDING LITERATURE

AI-AEC-13,136

Environmental Assessment for Fusion Reactor  
Utilizing Brookhaven Minimum Activity Blanket.  
Anderson, R.V.  
September 20, 1974  
Dep., NTIS

ANCR-1169

Decay Heating in the ETR Core with the FEFPL  
Loop, and in the ETR Canal Storage.  
McMurry, H.L.; Jone, R.R.  
August 1974  
Dep., NTIS

BNL-19043; CONF-741017-9

Recoil Energy Distributions in CTR-Related Neutron  
Spectra.  
Parkin, D.M.; Goland, A.N.  
1974  
Dep., NTIS \$4.00

CONF-721111; AEC Symposium Series 31

Technology of Controlled Thermonuclear Fusion  
Experiments and the Engineering Aspects of Fusion  
Reactors.

Proceedings of a Symposium Held at Austin, Texas  
(Nov. 20-22, 1972)

Draper, E.L., Jr. (Ed.)  
April 1974  
NTIS \$16.60

CONF-721111, pp.931-943; AEC Symposium Series  
31, pp.931-943

Neutron and Gamma Heating Rates in Fusion-Reactor  
Blankets.

Perry, R.T., Jr.; Davidson, J.N.; Kohler, W.H.  
April 1974  
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CONF-721111, pp.944-963; AEC Symposium Series  
31, pp.944-963

Calculation of Fusion Spectrum in Graphite.  
Freim, J.B.; Draper, E.L., Jr.  
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 Variational Methods for CTR Blanket Studies.  
 Conn, R.; Stacey, W.M., Jr.  
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 Methods of Calculation Used in the Neutronics Design of FBTR. From Indo-Soviet Seminar on Fast Reactors; Kalpakkam, India (6 December 1972)  
 Shankar Singh, R.; Lee, S.M.  
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 Bhabha Atomic Research Centre, Bombay
- CONF-721237, pp.269-279  
 Measurement of the Neutron Spectra on the BFS Stand.  
 Belov, C.P.; Dulin, V.A.; Efimenko, V.F.; Kazanskii, Yu.A.; Kuzin, E.N.; Lutyayev, V.M.; Shapar, A.V.  
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 Bhabha Atomic Research Centre, Bombay
- CONF-721237, pp.417-423  
 Integral Transform Method for Multidimensional Neutron Problems with Linearly Anisotropic Scattering.  
 Sahni, D.C.  
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- CONF-721237, pp.515-521  
 Resonance Group Cross Sections for Multigroup Codes.  
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 1972  
 Bhabha Atomic Research Centre, Bombay
- CONF-730345-P1, pp.151-170  
 Problems in the Field of Neutron Dosimetry for Health Physics Purposes. From Proceedings of the Regional Conference on Radiation Protection, Jerusalem, Israel (5 March 1973).  
 Nachtigall, D.  
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 Soreq Nuclear Research Centre, Yavne, Israel
- CONF-740903-8  
 ORNL Cross-Section Sensitivity Analysis Applications for Radiation Shielding.  
 Bartine, D.E.; Mynatt, F.R.; Oblow, E.M.; Childs, R.L.; Pace, J.V.; Engle, W.W.; Knight, J.R.; Sims, T.M.  
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 Dosimetry of Internal Emitters for Population Exposure.  
 Snyder, W.S.  
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 Utilization of Interactive Graphics and Continuous Slowing Down Theory.  
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- EUR-5122(Vol.2), pp.677-693; CONF-730952-P2, pp.677-693  
 Fano's Theorem and the Multiple Scattering Correction. From 4th Symposium on Microdosimetry, Verbania, Italy (24 September 1973)  
 Harder, D.  
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- EUR-5122(Vol.2), pp.983-1000; CONF-730952-P2, pp.983-1000  
 Energy Deposition by Fast Neutrons to Small Spheres.  
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 EUR B.Fr. 1.000
- EUR-5122(Vol.2), pp.1001-1013;  
 CONF-730952-P2, pp.1001-1013  
 Influence of Detector Size and Thickness on Neutron Produced Energy Deposition Spectra.  
 Coppola, M.; Pirwitz, D.; Booz, J.  
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- GEAP-14,017  
 An Evaluation of the First-Order Power Distribution and Control Worth Influence Function Approach. Shielding, Critical Experiments and Analysis (Liquid Metal Fast Breeder Reactor Program).  
 Cowan, C.L.; Derby, S.L.  
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 TIC(Applied Technology), USAEC, Oak Ridge, Tenn.
- INIS-mf-911, pp.27-28  
 General Multi-Group Time Moments Method for the Calculation of the Time Dependent Neutron Flux. From Israel Nuclear Society Annual Meeting, Yavne, Israel (26 June 1973)  
 Shvarts, D.; Thieberger, R.; Greenspan, E.  
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- INIS-mf-911, p.29  
 Explicit Solutions of the One Dimensional Time Dependent Transport Equation.  
 Ilamed, Y.; Lemanska, M.  
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- LBL-759 (Appendix A)  
 Foundations of S-Matrix Theory. Appendix A. The Pragmatic Interpretation of Quantum Theory.  
 Stapp, H.P.  
 June 10, 1974  
 Dep., NTIS
- ORNL-4957  
 The Numerical Solution of Ill-Conditioned Systems of Linear Equations.  
 Heath, M.T.  
 July 1974  
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Shielding Benchmark Problems.  
Simmons, G.L.(Ed.)  
July 1974  
Dep., NTIS \$5.45
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Comparison of the Cross-Section Sensitivity of the  
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Alsmiller, R.G., Jr.; Santoro, R.T.; Barish, J.; Gabriel,  
T.A.  
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Rapid Method of Calculating the Flux and Neutron  
Spectra in the Case of a Criticality Accident (CARNAC  
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Bessis, J.  
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CEA-N-1612 (In French)  
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Isopleths of Dose of External Gamma-Radiation  
Following Hypothetical Reactor Hazards with Emission  
of Noble Gases.  
Schultz, H.; Voelz, E.  
1973  
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Spectra and Dose Fractions of Monoenergetic  
Neutrons Passed Through Different Shields and Their  
Application for Dosimeter Evaluation.  
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- SZS-153, pp.137-142 (In German)  
Spectrum of Neutrons Backscattering from a Finite  
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Linemann, H.  
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- SZS-153, pp.166-179  
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