

RSIC Newsletter

RADIATION SHIELDING INFORMATION CENTER

OAK RIDGE NATIONAL LABORATORY

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Many things difficult to design prove easy to performance. . . . Samuel Johnson

GLEANED FROM ANS SOURCES

Best Paper Award

The winners of the Radiation Protection and Shielding Division's Best Paper Award, chosen following presentation at the June 1980 meeting in Las Vegas, Nevada, are **W. Reed Johnson, W. H. Rastin, G. E. Carlson, and M. Pope** of the Nuclear Engineering Department of the University of Virginia at Charlottesville. The winning paper is "A Novel Wide Range Environmental Gamma-Ray Dosimeter." Judges of the "Best Paper," an important part of the division's program, were the chairmen of the seven RP&S sessions at the meeting.

Professional Divisions Name New Officers

The ANS professional divisions below have announced the names of their new officers for 1980-81. In the following list, the names of those officers designated chair-elect last year are given in parentheses.

Radiation Protection and Shielding (Chair, Gerald P. Lahti); vice chair chair-elect, Michael J. Kolar; secretary, E. Thomas Boulette; treasurer, David E. Bartine; executive committee I, Stephen E. Binney; executive committee II, Ronald L. Kathren; executive committee III, Jack W. Lentsch.

Reactor Physics—(Chair, Robert A. Dannels); vice chair chair-elect, Burt A. Zolotar; secretary, H. Sterling Bailey, Jr.; treasurer, Surendra N. Purohit; executive committee, Ratib A. Karam, Leo G. LeSage, and V. O. (Vic) Uotinen.

Mathematics and Computation—(Chair, Warren F. Miller); vice chair chair-elect, John E. Meyer; secretary, Elmer E. Lewis; treasurer, Richard J. Pryor; executive committee, Vincent Esposito, Michael V. Gregory, and William B. Terney.

ANS Fellows Named

Recognized as new Fellows at the Las Vegas Meeting were 21 ANS members, bringing the total to 451. Among those named as Fellows, persons who have been judged to have achieved acknowledged attainment in the nuclear field, are several well known in the shielding community.

Tomonori Hyodo, Professor of Nuclear Engineering, Kyoto, Japan, "for his established record of distinction as author, educator, and research scientist; he has been a leader in many professional societies, especially the Atomic Energy Society of Japan; his textbook, *Introduction to Radiation Shielding*, has been a standard text in Japanese universities; he is a leading authority on neutron and gamma-ray measurements and is especially well known internationally for his measurements and reviews of gamma-ray backscattering."

W. Reed Johnson, Professor of Nuclear Engineering, University of Virginia, "for his contributions as a nuclear engineering educator, his research in radiation shielding, and his services to the American Nuclear Society and the Atomic Safety and Licensing Appeal Board."

Clyde P. Jupiter, Program Manager for Waste Management Research for the U.S. Nuclear Regulatory Commission, "for his outstanding contributions in the field of electron transport, radiation measurements, development of special research applications for electron linear accelerators, and nondestructive assay techniques; he has led commercial activity in aerial radiation survey technology and has played a vital role in ANS, with important appointments and elective offices."

Ratib A. Karam, Professor of Nuclear Engineering, Georgia Institute of Technology, "for his outstanding contributions in generating effective resonance cross sections, measuring adjoint function and normalization integral, and educating nuclear engineers."

Grier Elliott Whitesides, department head at Union Carbide Corporation in Oak Ridge, Tenn., "for his significant contributions to the development and successful application of precise Monte Carlo and discrete ordinates methods for the rigorous mathematical treatment of particle transport and interaction phenomena important to radiation shielding, reactor physics, and nuclear criticality safety."

PERSONAL ITEMS

William Cornelius Hall, former Chief Executive Officer of Chemtree Corporation with a long association with the shielding community and the nuclear industry, is now with Cost Benefit Consultants, P. O. Box 215, Central Valley, NY 10917 (914-928-2203).

The following change of address has been noted: **Suprakas C. Roy** from Department of Physics and Astronomy, University of Pittsburgh, to Department of Physics, Oklahoma State University, Stillwater.

VISITORS TO EPIC

The following persons came for an orientation visit and/or to use EPIC facilities during the month of July.

Giovanni Bruzzi, AGIP Nucleare, Milano, Italy; and **Cesar B. Molins** and **P. J. Otaduy**, University of Florida, Gainesville.

CHANGES IN THE COMPUTER CODE COLLECTION

The following changes were made in July.

CCC-107/ETRAN

The ETRAN code package, a Monte Carlo code system for electron and photon transport through slabs, was updated to make the following corrections called to RSIC attention by Stephen Seltzer, National Bureau of Standards, Washington, D.C. and Dave Rogers, NRC of Canada. Since there are currently many ETRAN users, we list here the information so that each may correct his own version. For both ETRAN-16 and ETRAN-18 in subroutine PHIST, the sixth statement after statement labeled 160 was changed to read: **CA = (ESAVE-EP*COM)/SQRT(EC*(EC+1.021952))**. For ETRAN-18 in subroutine PHIST, two additional corrections were made: 1) The calling arguments were changed to read: **SUBROUTINE PHIST (XP,YP,ZP,LP,CTHP,STHP,CPHP,SPHP,EB,WP,ITYPE)**, i.e., EP in the old version should be replaced by EB; and 2) As the first executable statement, the following was added: **EP = EB**.

CCC-202/PELSHIE

PELSHIE, a general purpose kernel integration shielding code for point and extended gamma-ray sources, has been replaced by a newly frozen version, a contribution of the Atomic Energy Board, Republic of South Africa. The new version has extended capabilities and accuracy. It has direct access to a magnetic disc data library containing emission characteristics as well as attenuation and buildup coefficients for a variety of gamma-ray-emitting isotopes and shielding materials, respectively. Reference: PEL-258-3. FORTRAN IV; IBM 360.

CCC-254/ANISN-ORNL

The multigroup one-dimensional discrete ordinates transport code package with anisotropic scattering was updated to remove subroutines for adjoint weighting (considered useful only for diagnostic purposes) from the package at the suggestion of Ward Engle, the ORNL contributor. FORTRAN IV and assembler language; IBM 360.

CCC-354/ACRO

ACRO, a calculation of organ doses from acute or chronic inhalation and ingestion of radionuclides, has been replaced by a newly frozen version supplied by Power Reactor and Nuclear Fuel Development Corp., Tokai-Mura, Japan. The new version offers a more easily readable output format and addition of output of biological half-life, organ mass translocation class. The code is now more compatible with the IBM DOS/VS operating system. FORTRAN IV; IBM 360.

CCC-374/ACCEPT

The three-dimensional multilayer electron/photon Monte Carlo transport code system with combinatorial geometry has been updated to correct an error called to RSIC attention by the code contributor, John Hableib of Sandia Laboratories, Albuquerque, New Mexico. Current users have been notified of the error. FORTRAN IV and CDC update; CDC.

CCC-377/TRIDENT-CTR

TRIDENT-CTR, a code package contributed by the Los Alamos Scientific Laboratory, Los Alamos, New Mexico, is a two-dimensional, x-y and r-z geometry, multigroup, neutral particle transport code, developed for toroidal calculations. The use of triangular finite elements gives it the geometric flexibility to cope with the non-orthogonal shapes of many toroidal designs. Reference: LA-7835-M. FORTRAN IV; CDC.

CCC-397/SHIELDDOSE

SHIELDDOSE, developed for space-shielding radiation dose calculations, was contributed by the US National Bureau of Standards, Washington, D.C. Absorbed dose as a function of depth in aluminum shielding material of spacecraft, given the electron and proton fluences encountered in orbit, is calculated. This ability to predict absorbed dose within a spacecraft due to specified radiation environment is important for design and planning considerations pertaining to the reliability of electronic components and to the radiological safety of on-board personnel. Reference: NBS Technical Note 1116. FORTRAN IV; IBM 3033.

SCA-02/KENO-IV

The code package was updated to include a modification supplied by the UCC-ND contributors which is fully described in a separate article which follows. Current users are given enough information to update their own versions.

SCA-08/CESAR

CESAR, a critical experiment storage and retrieval code package, has been updated to add new materials to the library. The code and the new materials for the library were contributed by UCCND Computer Sciences Division, Oak Ridge National Laboratory. FORTRAN IV; IBM 360.

KENO-IV MODIFICATION

A query originating in the RSIC Monte Carlo Seminar resulted in a modification to the P_1 scattering model made in the KENO-IV code system (SCA-002). The original model scattered the neutron with a polar angle $\bar{\mu}$ and with a random azimuthal angle. When P_1 cross sections were used for problems in which the first few scatters in a media make an important contribution to k-effective, the results from KENO were sometimes in slight disagreement with results from discrete ordinates codes. The new scattering model uses a

polar angle, μ , sampled from a flat distribution over an interval of width $2(1 - |\bar{\mu}|)$, centered about $\bar{\mu}$. The new model in KENO-IV produces results in agreement with the discrete ordinates solutions.

The only cases that will be affected by this change are those in which the higher order moments of the scattering distribution are important to the answer.

A few representative results are given in the following table.

**Comparison of Discrete and Distributed Angle Scatter
In KENO-IV With XSDRN**

Experiment	Discrete Angle	Distributed Angle	XSDRN
1F125 ¹	0.9450 ± 0.0059	0.9491 ± 0.0060	—
4 Aqueous 4 metal ^{2,3}	0.9979 ± 0.0057	1.0024 ± 0.0058	—
*Pu sphere ⁴	0.9792 ± 0.0065	1.0025 ± 0.0063	1.0008
*LASL sphere ⁵	0.9868 ± 0.0029	0.9963 ± 0.0059	0.9949

*water reflected

References

1. J. T. Thomas, "Critical Three-Dimensional Arrays of Neutron Interacting Units," ORNL-TM-719 (1963).
2. J. T. Thomas, "Critical Three-Dimensional Arrays of U(93.2)-Metal Cylinders," Nuclear Science and Engineering, 52, 350 (Nov. 1973).
3. J. T. Thomas, "Critical Three-Dimensional Arrays of Neutron-Interacting Units," Part II, ORNL-TM-868 (July 1964).
4. W. U. Geer, and David R. Smith "Measurement of the Critical Mass of a Water-Reflected Plutonium Sphere," *Trans. Am. Nucl. Soc.*, 11, 378 (June 1968).
5. Cleo C. Byers, *et al.*, "Criticality Measurements of Water-Reflected Enriched Uranium Sphere," *Trans. Am. Nucl. Soc.*, 27, 412 (Nov. 1977).

The following change must be made to implement the modification:

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SUBROUTINE BEGIN, in the XSEC scattering section.
FROM: 840 FMU=MUBAR(IZ+IGKR)
TO: 840 FMU=MUBAR(IZ+IGKR)+SFLRA(0)*(1.0-ABS(MUBAR(IZ+IGKR)))
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NOTE: SFLRA is a random number generator that returns a random number between -1 and +1.

NUCLEAR STANDARDS NEWS

The ANS Standards Steering Committee Membership for 1980-81 has been announced by Harry Lawroski, new president of the American Nuclear Society. The committee will be chaired by J. F. Mallay (Babcock & Wilcox/NSAC). Mallay has formerly served the SSC as chairman of NUPPSCO, a position he will relinquish on July 30. G. L. Wessman (Torrey Pines Technology), formerly SSC chairman, has accepted the post of vice chairman. Wessman also holds the chairmanship of N18 which will be dissolved soon. Other members are Dixon Callihan (Union Carbide), N16 Chairman; W. L. Whittemore (General Atomic Co.), N17 Chairman; R. F. Foster (Battelle PNL, retired), N19 Chairman. J. A. Prestele (Con Ed/EPRI), J. W. Lentsch (Portland General Electric Co.), and John Kemper (Philadelphia Electric Co.) are members at large.

G. A. Arlotto will continue in his capacity at U.S. Nuclear Regulatory Commission liaison to the SSC. J. E. Olhoeft (Westinghouse Electric Corporation) is ANS Board liaison to the SSC.

The International Commission on Radiation Units and Measurements has issued another in its series of reports, ICRU Report 33, "Radiation Quantities and Units." To receive copies of this or other ICRU reports, write to: ICRU Publications, P. O. Box 30165, Washington, D.C. 20014.

The National Council on Radiation Protection and Measurements has issued two newly published reports: NCRP Report No. 64, "Influence of Dose and its Distribution in Time on Dose-Response Relationships for Low-Let Radiations;" and NCRP Report No. 65, "Management of Persons Accidentally Contaminated with Radionuclides." NCRP has also published the Proceedings of the Fifteenth Annual Meeting, "Perceptions of Risk." For price and availability of the three publications, contact: NCRP Publications, P. O. Box 30175, Washington, D.C. 20014.

ANSI will be calling for comment soon on: ANSI/ANS-5.4, "Method for Calculating the Release of Fission Products from Oxide Fuel." ANSI final action resulted in a new standard: ANSI N42.12-1980, "Calibration and Usage of Sodium Iodide Detector Systems (IEEE)."

UT OFFERS MONTE CARLO THEORY WORKSHOP

A five-day workshop is being offered by the Nuclear Engineering Department of the University of Tennessee, Knoxville, September 8-12, 1980, as part of Tennessee Industries Week (TIW). This year's course will emphasize the theory of Monte Carlo as would be required of the effective use and understanding of Monte Carlo computer codes. Topics will include an in-depth study of transport theory as it applies to Monte Carlo analyses, Monte Carlo estimation techniques, statistical uncertainty and the general problem of variance reduction, albedo calculations, and many topics of current interest. Special attention will be given to the adjoint mode of analysis and related special topics such as contribution theory, adjoint-difference methods, and combined (forward-adjoint) modes of analysis. The computer code MORSE will be described and will be used to illustrate related theories.

For further information call or write the College of Engineering, The University of Tennessee, 124 Perkins Hall, Knoxville, TN 37916 (615) 974-5321.

ESIS COURSE ON RADIATION SHIELDING METHODS

An Ispra (Italy) course on Radiation Shielding Methods, organized by the European Shielding Information Service (ESIS), is planned to be held October 6-10, 1980. The course has been designed to offer to the industries and organizations active in the nuclear field the opportunity to acquire or to increase their knowledge in the field of the design of shields against ionizing radiation.

The course deals with different physical, mathematical and engineering aspects and the norms regarding the design of radiation shields. Topics which will be emphasized during the course will be the calculation methods and the computer codes more widely applied in shielding calculations, the nuclear data libraries which are now available, and the degree of accuracy which can be expected from the calculations. The examples of shield design that will receive particular attention during this course, are the shielding of accelerators, and of spent fuel transport casks.

The lectures will be given (in English) by well known experts coming from various European countries and by specialists of the JRC involved in the European Shielding Information Service activity.

The course is divided into three main sections, dealing with the following items: 1) Basic Shielding Theory—Interactions between ionising radiation and matter; Radiation effects: heating, biological damage, structural damage; Calculation methods; and Neutron activation and decay; 2) Codes and Data for Shielding Calculations—Codes for shielding calculations, ANISN workshop, and Nuclear data libraries; 3) Shield Design—Shielding of accelerators and Shielding and criticality problems of spent fuel transport casks.

Further information may be secured from the Course Coordinator: C. Ponti, ESIS, Joint Research Center, Ispra Establishment, 21020 Ispra (VA) Italy.

RADIATION PHYSICS SEMINAR PLANNED

An announcement has been made of the organization of an *International Seminar on the Role of Finite Element Methods in Radiation Physics* to be held April 23–24, 1981 in London, England under the auspices of the Imperial College of Science and Technology. The background and aims of the meeting are as follows.

The great success of the finite element method for problems in solid mechanics and fluid flow has stimulated interest in finite element methods for problems of radiation physics arising mainly in nuclear engineering. Methods used for solving the energy dependent Boltzmann equation for radiation transport in complex geometry are also of interest to applied mathematicians, numerical analysts and medical physicists.

This Seminar is intended to be a review of the art and will cover the formulations of finite element methods for radiation physics problems, a survey of the finite element solution of benchmark problems, their relationship to Monte Carlo and other methods, and applications to practical problems in reactor physics and shielding. It is sponsored by the Institution of Nuclear Engineers and by the Computational Physics Group of the Institute of Physics.

Solution of radiation diffusion and transport problems by finite difference methods is restricted to simple geometries and, at present, complex geometry problems are treated in detail by Monte Carlo calculations. In principle the finite element method has the potential to provide a deterministic solution of problems with complex geometries for comparison with the statistical Monte Carlo solution. This cross checking of solutions for problems with safety implications is a desirable objective. Alternatively coarse mesh finite element solutions of the adjoint to a given problem can be used as a means of accelerating the Monte Carlo solution.

Methods of solving the Boltzmann equation have to deal with up to three positional coordinates and two directional coordinates for each energy group. The finite element representations proposed either use a finite element structure in 5 dimensional phase space or 3 dimensional elements in conjunction with series expansion in the directional coordinates, which give either continuous or discrete representation of the directional dependence of the solution. The complexity of the finite element representation leads to problems of storing and solving very large numbers of equations, for which some solutions have been found. Comparative trials with finite difference methods show speed and accuracy advantages for the finite element method. The remaining problem is to realise this potential for complex geometries.

Details of the program may be secured from Dr. A. J. H. Goddard, Nuclear Power Section, Mechanical Engineering Dept., Imperial College of Science and Technology, London, SW7 2BX, United Kingdom.

UPCOMING MEETINGS

We call attention to the following meetings.

August 1980

Radioactive Waste Management Course, August 18–22, 1980, LaFonda Hotel, Sante Fe, NM. Contact: Engineering Technology, Inc., P. O. Box 9000, Waco, TX 76710; Phone 817-772-0082.

The Second Chemical Congress of the North American Continent, August 24–29, 1980, San Francisco, CA. Contact: Program Chairman V. E. Viola, Jr., Dept. of Chemistry, University of Maryland, College Park, MD 20742.

International Conference on Nuclear Physics, August 24–30, 1980, University of California, Berkeley, CA. Contact: ICNP, Nuclear Science Div., Lawrence Berkeley Laboratory, Berkeley, CA 94720.

September 1980

International Conference on the Nuclear Fuel Cycle, September 14–17, 1980, Amsterdam Sonesta Hotel, The Netherlands. Contact: Atomic Industrial Forum, Inc., 7101 Wisconsin Ave., Washington, D.C. 20014.

Radiation Protection Course, September 15–19, 1980, Holiday Inn, Gatlinburg, TN. Contact: Engineering Technology, Inc., P. O. Box 9000, Waco, TX 76710; Phone 817-772-0082.

Utility/User Conference on the HTGR, September 30 – October 1, 1980, Hyatt Islandia, San Diego, CA. Contact: Gas-Cooled Reactor Associates, 3344 N. Torrey Pines Court, Suite 300, La Jolla, CA 92037.

October 1980

Third National Conference on Biomedical Physics and Engineering with International Participation, October 25–26, 1980, Sofia, Bulgaria. Contact: Dr. R. Poppitz, Medical Academy – Base No. 2, Laboratory of Clinical Dosimetry and Metrology of Ionizing Radiation (SSDL), 1040 Sofia, Bulgaria.

Applications of Reliability and Risk Analysis Course, October 27–31, 1980, The George Washington University, Washington, D.C. Contact: Continuing Engineering Education Program, George Washington University, Washington, D.C. 20052; Phone 202-676-6106, or toll free 800-424-9773.

March 1981

The 8th Energy Technology Conference and Exposition (ET8), March 9–11, 1981, Sheraton Washington Hotel, Washington, D.C. Contact: Government Institutes, P. O. Box 5918, Washington, D.C. 20014.

August 1981

The 6th International Conference on Structural Mechanics in Reactor Technology (SMIRT), August 17–21, 1981, Paris, France. Contact: Dr. Gilbert Melese-d' Hospital, Senior Technical Advisor, General Atomic Company, P. O. Box 81608, San Diego, CA 92138.

JULY 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.

RSIC maintains a microfiche file of the literature entered into SARIS, and duplicate copies of out-of-print reports may be available on request. Naturally, we cannot fill requests for literature which is copyrighted (such as books or journal articles) or whose distribution is restricted.

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

REACTOR AND WEAPONS RADIATION SHIELDING LITERATURE

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