RSIC Newsletter

Oak Ridge National Laboratory
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No. 307 *June 1990*

One of the secrets of life is to keep our intellectual curiosity acute.—William Lyon Phelps

Clarke's Comments on Draft ICRP Recommendation Reprinted

The ICRP has published a draft of its recommendations for radiological protection. In view of its importance, we are reprinting R. H. Clarke's summary of the draft recommendations, recently published in the U.K.'s NRPB Radiological Protection Bulletin No. 111 (April 1990). Dr. Clarke is director of the National Radiological Protection Board, Chilton, Didcot. The article is appended to this newsletter.

Goldstein to Receive Rockwell Award

The American Nuclear Society Radiation Protection and Shielding Division Executive Committee has awarded the third Rockwell Award to **Herbert Goldstein** for "his lifetime dedication to research and education in the field of radiation protection and shielding. During Dr. Goldstein's distinguished career of nearly four decades, he made many significant and lasting contributions to the field including the origination of the *Computer Index of Neutron Data* (CINDA), his seminal work with the moments method for photon transport, and his authoring of his famous textbooks, *Classical Mechanics* and *Fundamental Aspects of Reactor Shielding.* During his distinguished tenure at Columbia University, he shepherded 27 students through the doctoral degree program, most of whom have gone on to outstanding careers. He is a fellow of several scientific societies including ANS, and was Vice Chairman and Chairman of RP&S during the first two years of the division's existence."

The Rockwell Award is awarded on an *ad hoc* basis to individuals who have achieved a special level of recognition and lifetime achievement in the field of RP&S. Dr. Goldstein will be presented with this prestigious award during the ANS Winter Meeting in Washington.

CHANGES TO THE COMPUTER CODE COLLECTION

During the month six changes were made to the computer code collection. Three new code systems were packaged and added to the collection, two existing code packages were updated or changed to enhance performance, and an existing code package was enhanced with additional documentation. One change resulted from a foreign contribution.

CCC-542/CAP-88

A user at Oak Ridge National Laboratory (ORNL), Tennessee, has alerted RSIC to problems encountered using CAP-88. This code system, contributed by the EPA Office of Radiation Programs, Las Vegas, Nevada, assesses dose and risk due to radionuclide emissions to the air in compliance with National Emission Standards for Hazardous Air Pollutants (NESHAPs) for radionuclides. Health impacts from the inhalation, ingestion, air immersion and ground surface irradiation pathways are estimated, and results for maximally exposed individuals and regional populations out to 80 kilometers are tabulated. A list of modifications has been added to the tapelist. Users who have the package may contact RSIC for the information. Future releases of the package will incorporate the changes. The system runs on IBM mainframe computers and compiles under OS/VS2 using the IBM VS compiler (Level 2.2.0). References: U.S. EPA Draft (Sept. 1989). Fortran 77; IBM.

CCC-545/SCALE-4

This modular code system for performing standardized computer analyses for licensing evaluation was updated with corrections contributed by the developers in the Computing and Telecommunications Division of Martin Marietta Energy Systems, Inc. The SCALE system was developed for the Nuclear Regulatory Commission (NRC) to satisfy a need for a standardized method of analysis for the evaluation of nuclear fuel facility and package designs. While several minor errors were identified and corrected, the primary motivation for this update is the replacement of the extensively revised standard composition library. The changes were mailed to all users who have received SCALE-4, and modifications were made to the distribution tape. The IBM version was compiled under OS/VS2 using the IBM VS compiler (Level 2.2.0) and Assembler level H on an IBM 3033 computer. With minor modifications, the system was installed and tested on a CRAY X-MP running CTSS using the CFT77 compiler, with the exception of the thermal codes which require the CFT compiler. References: NUREG/CR-200, ORNL/NUREG/CSD-2/R4 Volumes 1, 2, and 3 (Draft January 1990). Fortran 77 and Assembler; IBM and CRAY.

CCC-552/RESRAD

Argonne National Laboratory (ANL), Argonne, Illinois, contributed this code system designed to calculate site-specific residual radioactive material guidelines and radiation dose to an on-site resident (maximally exposed individual). A guideline is a radionuclide concentration or level of radioactivity that is acceptable if a site is to be used without radiological restrictions. The guidelines are based on the following principles: (1) the annual radiation dose, averaged over a 50-year period, should not exceed 100 mrem/yr and (2) doses should be kept as low as reasonably achievable (ALARA). Seven environmental pathways are considered: direct exposure, inhalation, and ingestion of plant foods, meat, milk, aquatic foods and water. RESRAD uses a pathway analysis method in which the relation between radionuclide concentrations in soil and the dose to a member of a critical population group is expressed as a pathway sum, which is the sum of products of pathway factors. The code runs on an IBM PC or PS/2 with a hard disk drive and 640K of memory. Use of a math coprocessor or a mouse is optional. The code incorporates internal interactive help files and information on input and output data. RESRAD is distributed on 2 DS/DD (360KB) 5.25-in. diskettes and uses the following software: Lahey Fortran 77 Version 3.01, Microsoft QuickBASIC Version 4.5, and PLINK86 Plus 2.24 overlay linkage editor. Reference: ANL/ES-160, DOE/CH/8901 (June

1989). Fortran 77 and BASIC; IBM PC or compatible.

PSR-171/NJOY89.31

The documentation for NJOY89.31 was enhanced with the addition of the proceedings from the OECD Seminar Workshop on NJOY and THEMIS, held at the NEA Data Bank in Saclay, France, on June 20-21, 1989. Users may contact RSIC for a copy of the proceedings. NJOY89 was developed at Los Alamos National Laboratory (LANL), Los Alamos, New Mexico, to produce pointwise and multigroup neutron and photon cross sections from ENDF/B evaluated nuclear data. NJOY89, first released in July 1989, was extended to include version 31 updates in January 1990. The machine-independent UPDATE emulator developed at Sandia National Laboratories (SNL) and packaged in RSIC as PSR-245/UPEML was used for the IBM implementation and is suggested for general use with NJOY89. Those who request PSR-171/NJOY89 will also receive UPEML. References: LA-UR 89-2057 (June 1990), LANL Memo T-2-L-10991 (June 1987), LA-9303-M (ENDF-324), Vol. I (May 1982), Vol. II (May 1982), Vol. III (October 1987), Vol. IV (December 1985), and Informal Notes (July 1989). Fortran 77; CDC, CRAY, IBM, VAX.

PSR-278/DASQHE

Aktiebolaget Atomenergi, Stockholm, Sweden, contributed this code system through the OECD Nuclear Energy Agency Data Bank, Gif-sur-Yvette, France. DASQHE produces Dancoff corrections for an infinite array of circular rods placed in a square or hexagonal lattice in a moderator. The calculation may be done for a series of moderator cross sections. DASQHE uses the collision probability method. The trapezoidal rule is used for the integration of the Dancoff correction double integral, the linear and angular variables being discretized. Instead of considering a series of pairs of rods, a straightforward "chopper" method is utilized that disregards rods after a certain distance. The effects of the fuel can (and gas coolant channel) are approximated by the homogenization of a gap surrounding each rod. A MAIN program was written by the NEA Data Bank to call Subroutine DASQHE to calculate the set of Dancoff factors published in the report. DASQHE was tested on a VAX 8810 running VMS 5.0 at the NEADB. References: AE-257 (1966). Fortran; VAX.

PSR-281/URR

Oak Ridge National Laboratory contributed this code system which calculates resonance neutron cross-section probability tables, Bondarenko self-shielding factors, and self-indication ratios for fissile and fertile nuclides in the unresolved resonance region. Monte Carlo methods are utilized to select appropriate resonance parameters and to compute the cross sections at the desired reference energy. The neutron cross sections are calculated by the single-level Breit-Wigner formalism with *s*-, *p*-, and *d*-wave contributions. The cross-section probability tables are constructed by sampling the Doppler broadened cross-section. Various self-shielded factors are computed numerically as Lebesgue integrals over the cross-section probability tables. The code is written in Fortran 77 and was tested on the VAX 6000 under the VMS operating system. The package is distributed on one DS/DD (360KB) 5.25-in. diskette. References: ORNL/TM-11297 (1989). Fortran 77; VAX.

Standards Notes

The following newly published or approved standards are noted for your attention.

ANSI N42.17A-1989, *Performance Specifications for Health Physics Instrumentation -Portable Instrumentation for Use in Normal Environmental Conditions*, a new standard available for $45 from ANSI, Sales Department, 1430 Broadway, New York, NY 10018 (phone 212-642-4900).

The following ASTM standards, recently approved by Society Ballot, are available from ASTM, 1916 Race St., Philadelphia, PA 19103-1187, (phone 215-299-5585).

E 393-89, *Test Method for Measuring Reaction Rates by Analysis of Barium-140 from Fission Dosimeters* (revision of C 393-1984); $8.

E 521-89, *Practice for Neutron Radiation Damage Simulation by Charged-Particle Irradiation* (revision of C 521-1983); $8.

E 798-89, *Practice for Conducting Irradiations at Accelerator-Based Neutron Sources* (revision of E 798-1981); $8.

E 821-89, *Practice for Measurement of Mechanical Properties During Charged-Particle Irradiation* (revision of E 821-1981); $8.

E 942-89, *Guide for Simulation of Helium Effects in Irradiated Metals* (revision of E 942-1983); $8.

CONFERENCES, COURSES, SYMPOSIA

RSIC attempts to keep its users/contributors advised of conferences, courses, and symposia in the field of radiation protection, transport, and shielding through this section of the newsletter. Should you be involved in the planning/organization of such events, feel free to send your announcements and calls for papers to RSIC.

8th Symposium on Space Nuclear Power Systems

The Institute for Space Nuclear Power Studies has announced January 6-9, 1991, as the date for the *8th Symposium on Space Nuclear Power Systems* to be held in Albuquerque, New Mexico. The program includes the following topics:

Space Applications/Exploration—*Gregory M. Reck*, Chairman, NASA Headquarters, Code RP, Washington, DC 22043 (phone 202-453-2847)

Space Missions and Power Needs—*David Buden*, Chairman, Idaho National Engineering Laboratory, P.O. Box 1625, Idaho Falls, ID 83415-3511 (phone 208-526-9887)

Nuclear Electric Propulsion—*Joseph C. Mills*, Chairman, Rockwell International Corp./Rocketdyne Div., 6633 Canoga Ave., Canoga Park, CA 91303 (phone 818-718-3357)

Direct Nuclear Propulsion—*David M. Woodall*, Chairman, Idaho National Engineering Laboratory, P.O. Box 1625, Idaho Falls, ID 83415-2516 (phone 208-526-9558)

Key Nuclear Technologies for Human Exploration of the Solar System—*Gary L. Bennett*, Chairman, NASA Hdqrs., Code RP, Washington, DC 20546 (phone 202-453-9114)

Benefits to Mankind—*R. Joe Sovie*, Chairman, NASA Lewis Research Center, 21000 Brookpark Rd., MS: 301-5, Cleveland, OH 44135 (phone 216-433-6129)

Reactor and Power System Control and Instrumentation—*Sam K. Bhattacharyya*, Chairman, Argonne National Laboratory, 9700 S. Cass Ave., Argonne, IL 60439 (phone 708-972-3293)

Space and Environmental Effects—*Charles W. Terrell*, Chairman, Weapons Laboratory, Kirtland AFB, NM 87117-6008, (phone 505-846-4989)

Microgravity Two Phase Flow—*Frederick R. Best*, Chairman, Texas A&M University, R-129 Zachary Engineering Center, College Station, TX 77843-3133 (phone 409-845-4101)

Radiation Effects to Electronics and Simulation Adequacy—*Frank V. Thome*, Chairman, Sandia National Laboratories, Div. 6515, P.O. Box 5800, Albuquerque, NM 87185-5800 (phone 505-844-5437)

Space Power Electronics—*Gene E. Schwarze*, NASA Lewis Research Center, 21000 Brookpark Road, MS: 301-2, Cleveland, OH 44135 (phone 216-433-6117)

Space Nuclear Fuels—*R. Bruce Matthews*, Chairman, Los Alamos National Laboratory, P.O. Box 1663, MS: E505, Los Alamos, NM 87545 (phone 505-667-2358)

Heat Pipe Technology—*Michael A. Merrigan*, Chairman, Los Alamos National Laboratory, P.O. Box 1663, MS: J576, Los Alamos, NM 87545 (phone 505-667-6466)

Thermionic Conversion Technology—*Richard J. Bohl*, Chairman, Los Alamos National Laboratory, P.O. Box 1663, MS: E561, Los Alamos, NM 87545 (phone 505-667-5590)

Thermionic Research—*Geoffrey Main*, Chairman, Georgia Inst. of Technology, School of Mechanical Engineering, Atlanta, GA 30332-0405 (phone 404-894-3242)

Reactors and Shielding—*H. Sterling Bailey*, Chairman, General Electric Company, P.O. Box 530954, San José, CA 95153-5354 (phone 408-365-6313)

Materials—*Robert H. Titran*, Chairman, NASA Lewis Research Center, 21000 Brookpark Rd., MS: 49-1, Cleveland, OH 44135 (phone 216-433-3198)

Key Issues in Space Nuclear Power—*Ehsan U. Khan*, Chairman, BDM International, Inc., 7915 Jones Branch Drive, McLean, VA 22102 (phone 703-848-5619)

Static Energy Conversion—*Jan W. Vandersande*, Chairman, Jet Propulsion Laboratory, 4800 Oak Grove Drive, M/S 277/212, Pasadena, CA 91109 (phone 818-354-0988)

Reliability, Availability, and Maintainability—*Richard B. Harty*, Chairman, Rockwell International Corp./Rocketdyne Div., 6633 Canoga Ave., MS: LB-02, Canoga Park, CA 91303 (phone 818-718-3318)

Power Systems Concepts—*Gerald H. Farbman*, Chairman, Westinghouse Electric Corp., Advanced Energy Systems Div., P.O. Box 158, Madison, PA 15663-0158 (phone 412-722-5359)

Simulation and Modeling—*Raymond A. Meyer*, Chairman, General Electric Company, SP-100 Programs, P.O. Box 530954: MC: S29, San José, CA 95153-5354 (phone 408-365-6471)

Energy Storage—*Marland L. Stanley*, Chairman, Idaho National Engineering Laboratory, P.O. Box 1625, MS: 3413, Idaho Falls, ID 83415 (phone 208-526-2041)

Dynamic Energy Conversion—*James E. Dudenhofer*, Chairman, NASA Lewis Research Center, 21000 Brookpark Rd., MS: 301-2, Cleveland, OH 44135 (phone 216-433-6140)

Space Nuclear Safety—*Neil W. Brown*, Chairman, General Electric Company, SP-100 Programs, 6835 Via del Oro, San José, CA 95119 (phone 408-365-6516)

Thermal Management—*Albert J. Juhasz*, Chairman, NASA Lewis Research Center, 21000 Brookpark Rd., MS: 301-5, Cleveland, OH 44135 (phone 216-433-6134)

Flight Qualification and Testing—*Julio C. Acevedo*, Chairman, NASA Lewis Research Center, 21000 Brookpark Rd., MS: 301-5, Cleveland, OH 44135 (phone 216-433-6120)

Manufacturing and Processing—*Wayne R. Amos*, Chairman, EG&G Mound Applied Technologies, Inc., P.O. Box 3000, Bldg. 88, Miamisburg, OH 45343-0987 (phone 513-865-3058)

Radioisotope Power Systems—*Edward F. Mastal*, Chairman, U.S. Dept. of Energy, MS: NE-53, Washington, DC 20545 (phone 301-353-4362)

Use of Artificial Intelligence in Space—*John A. Bernard*, Chairman, Massachusetts Inst. of Technology, Nuclear Reactor Laboratory, 138 Albany St., Cambridge, MA 02139 (phone 617-253-4211)

Three classified sessions will be held January 10. They are:

Power System Concepts—*John W. Warren*, Chairman, U.S. Dept. of Energy, NE-52, GTN, Washington, DC 20545 (phone 301-353-6491)

Space Nuclear Fuels and High Temperature Materials—*Dewayne L. Husser*, Chairman, Babcock & Wilcox Space & Defense Systems Dept., P.O. Box 10935, Lynchburg, VA 24506-0935 (phone 804-385-2948)

Survivability and Vulnerability—*Charles R. Martin*, Chairman, U.S. Air Force, SAF/AQQS(N), The Pentagon, Washington, DC 20330-5000 (phone 202-697-4185)

Further information about the meeting may be obtained from The University of New Mexico, The Inst. for Space Nuclear Power Studies, Chemical/Nuclear Engineering Dept., University of New Mexico, Albuquerque, NM 87131.

Waste Management '91 Call for Papers

The Sixteenth Annual Waste Management Symposium, *WM '91*, to be held February 24–28, 1991, in Tucson, Arizona, has issued a call for papers. Invited and contributed papers are solicited on research, development, and operational experience in high- and low-level nuclear waste, mixed waste, mill tailings, environmental restoration, and decommissioning management, national and international agreements, regulations governing these topics, and environmental impact of these activities.

The topic titles and coordinators are listed below. Contact the topic coordinator for technical questions.

Status of International Nuclear Waste Management Programs, *Earl McDaniel*, ORNL, 615-574-0439.

Ethics, Values, Socioeconomic Attitudes, and Risk Communication in Nuclear Waste Management—*Linda Ulland*, Bechtel, 402-476-3824.

LLW Management: Compact Status, License Application, Litigation—*Ed Helminski*, Radioactive Exchange, 202-362-5192; *Ed Jennrich*, Rogers & Assoc., 801-263-1600.

Waste Avoidance, Recycling, Treatment and Processing—*Tom Smith*, EG&G-Idaho, 208-526-0009.

Mixed Waste Facility Performance Assessments, Licenses, Permits, and Delisting—*Don Wood*, WEC, 509-376-7832.

Mixed Waste Characterization, Treatment and Management (Including Risk Assessment)—*Leon Borduin*, LANL, 505-667-3150 and *Nancy Rothermich*, HAZWRAP, 615-435-3122.

Below Regulatory Concern and Delisting-Experience and Practice—*Lance Loucks*, Duke Power, 704-373-2377.

Plans and Accomplishments in Environmental Restoration Including Innovative Technologies—*Julie D'Ambrosia*, NJG, 301-762-9364; *Harry Babad*, WEC, 509-376-8510.

Defense HLW and TRU Treatments, Storage, and Disposal (Including WIPP)—*Ned Bibler*, WSRC, 803-725-2313; *Earl McDaniel*, ORNL, 615-574-0439.

Yucca Mountain as a HLW Disposal Site—*Scott Dam*, Weston, 202-646-6660; *Larry Ramspott*, LLNL, 415-422-4176.

Greater Than Class C Waste, Package Designs and Performance—*Bala Nair*, WEC, 412-374-2401.

Transportation of Nuclear Wastes (Including Technical and Non-Technical Issues—*Larry Harmon*, USDOE, 301-353-3506.

Waste Management Aspects of Commercial Reactors and Nuclear Production Facilities' Modernization—*John Randall*, NYSEA, 518-432-1404.

Quality Assurance and Quality Control in Nuclear Waste Management—*Jas Devgun*, ANL, 708-972-3488.

Education Needs (K through Ph. D.) and Initiatives for Careers in Waste Management—*Ed Albenesius*, SRL, 803-725-2482.

Systems Analysis for Nuclear Waste Disposal—*Jas Devgun*, 708-972-3488; *Ed Johnson*, JA, 703-471-7880.

LLW Characterization and Classification—*Bill Gregory*, Automated Science, 615-482-6601.

Business Issues in Waste Management—*Sheila Little*, Fluor Daniel, 714-975-4264; *Neil Norman*, Bechtel, 415-768-4035.

Regulatory Aspects of New Remediation Technologies Including Negotiating Cleanup Standards—*Harry Babad*, WEC, 509-376-8510.

Risk Assessments for Disposal and Cleanup—*Don Wood*, WEC, 509-376-7832; *Jas Devgun*, ANL, 708-972-3488.

EPA Involvement in Nuclear Waste Management—*Ed Helminski*, Radioactive Exchange, 202-362-5192.

General—*Mort Wacks*, Univ. of Arizona, 602-621-6160.

Those interested in contributing a paper are invited to submit an extended summary to the Technical Program Chairman, M. E. Wacks, College of Engineering and Mines, Bldg. 20, Univ. of Arizona, Tucson, AZ 85721 (phone 602-621-6160, Fax 602-621-8096), by **September 4, 1990**. Authors will be notified of acceptance by November 7, 1990, and the completed papers are required by February 1, 1991.

Calendar

Your attention is directed to the following events of interest.

July 1990

3rd International Workshop on Respiratory Tract Dosimetry, July 1-3, 1990, Albuquerque, N. M., sponsored by the U.S. Dept. of Energy, CEC, and the Inhalation Toxicology Research Institute. Contact: Raymond A. Guilmette, Workshop Co-chairman, Inhalation Toxicology Research Inst., P.O. Box 5890, Albuquerque, NM 87185 (phone 505-844-5835).

5iémes Journées d'Etudes sur la Chimie sous Rayonnement, July 1-6, 1990, Sherbrooke, Québec. Contact: Jean-Paul Jay-Gerin, JECR-90, Départment de médecine nucléaire et de radiobiologie, Faculté de médecine, Univ. de Sherbrooke, Sherbrooke, Québec, Canada J1H 5N4 (phone 819-563-5555, ext. 4682, Fax 819-564-5445; Bitnet S015@UDESVM). The conference language is French.

27th Annual International Nuclear and Space Radiation Effects Conference and Short Course, July 16-20, 1990, Reno, Nevada, sponsored by the Institute of Electrical and Electronics Engineers, Inc. Contact: Joseph R. Srour, Northrop Corp., M.S. X400/N5, 2301 West 120th St., P.O. Box 5032, Hawthorne, CA 90251-5032 (phone 213-600-4151).

Radioactive Waste Packaging, Transportation, and Disposal, July 16-20, 1990, a course sponsored by Chem-Nuclear Systems, Inc. Contact Gina C. Pendregrass, Seminar Coordinator, CNSI, 220 Stoneridge Dr., Columbia, SC 29210 (phone 803-256-0450).

12th International CODATA Conference: Data for Discovery, July 17-19, 1990, Columbus, Ohio, sponsored by the National Academy of Sciences. Contact: Columbus Local Organizing Committee, P.O. Box 23, Amlin, OH 43002.

Practical Radiation Shielding, July 17-20, 1990, Atlanta, Georgia, a course offered by the Georgia Inst. of Technology and Shonka Research Assoc., Inc., of Marietta, Georgia. Contact: Education Extension-R, Georgia Inst. of Technology, Atlanta, GA 30332-0385 (phone 404-894-2400).

August 1990

1990 EPRI Radwaste Workshop, Aug. 5-8, Boulder, Colorado, a course designed for utility low-level radwaste personnel. Contact: David Vaught (phone 704373-5495) or Carol Hornibrook, EPRI, 3412 Hillview Ave., Palo Alto, CA 94303 (phone 415-855-2022).

International Topical Meeting on Fast Reactor Safety, Aug. 12-16, 1990, Snowbird, Utah, sponsored by the ANS. Contact: Wayne K. Letho, Argonne National Laboratory, P.O. Box 2528, Idaho Falls, ID 83403-2528 (phone 208-526-7369).

Computational Methods in Reactor Analysis, August 13-17, 1990, Knoxville, Tennessee. Contact: T. W. Kerlin, Head of the Dept. of Nuclear Engg., University of Tennessee, Knoxville, TN 37996 (phone 615-974-2525).

Monte Carlo Analysis, August 13-17, 1990, Knoxville, Tennessee. Contact: T. W. Kerlin, Head of the Dept. of Nuclear Engg., University of Tennessee, Knoxville, TN 37996 (phone 615-974-2525).

Operational Radiation Protection, Aug. 20-22, 1990, Idaho Falls, Idaho, sponsored by the ANS. Contact: Jack Liebenthal, EG&G Idaho, Inc., P.O. Box 1625, Idaho Falls, ID 83415-3515 (phone 208-526-1252).

7th ASTM-EURATOM Symposium on Reactor Dosimetry, Aug. 27-31, 1990, Strasbourg, France. Contact: G. Tsotridis, Joint Research Centre, Petten Establishment, HFR Div., Postbus 2, NL-1755 ZG, Petten, The Netherlands (phone 02246 5122, Telex REACP NL 57211, Fax 02246 1449) or G. P. Lamaze, National Inst. of Standards and Technology, Bldg. 235, Gaithersburg, MD 20899 USA (phone 301-975-6202, Telex 197 674 NBS UT, Fax 301-921-9847).

September 1990

16th Symposium on Fusion Technology, Sept. 3-7, 1990, London. Contact: JET Joint Undertaking, Conference Office, Abingdon, Oxon, OX14 3EA, United Kingdom.

3rd European Community Conference on Radioactive Waste Management and Disposal, Sept. 17-21, 1990, Luxembourg. Contact: M. L. Cecille, Commission of the European Communities, DG XII/D-2 (Arts-Lux 2/16), Rue de la Low 200, B-1049 Brussels, Belgium (phone 32/2 235 75 88).

Joint Annual Congress of the German Society of Medical Physics, the Association of Radiation Protection, the Swiss Association of Radiation Biology and Medical Physics, and the Association of German Physicians in Radiation Protection, Sept. 19-22, 1990, Goettinger, Fed. Rep. of Germany. Contact: D. Harder, Inst. f. Medizinisch Physik und Biophysik, Gosslerstr. 10 f, D-3400 Goettingen, FRG (phone 0551 396 875).

ENC '90, The World Conference and Exhibition, Looking Into Nuclear's Future in the 21st Century, Sept. 23-28, 1990, Geneva, Switzerland, organized by the European Nuclear Society in collaboration with the American Nuclear Society and the European Atomic Forum, Foratom. Contact: ENC '90 Secretariat, c/o ENS, P.O. Box 5032, CH-3001 Berne, Switzerland.

Symposium on Recent Advances in Multidisciplinary Analysis and Optimization, Sept. 24-26, 1990, San Francisco, sponsored by the U.S. Air Force and NASA. Contact: V. B. Venkayya, WRDC/FIBRA, WPAFB, OH 45433-6553 (phone 513-255-7191 or 513-255-6992).

Radiation Transport Calculations Using EGS4: A Four-Day Hands-on Course, Sept. 24-27, 1990, Ottawa, Canada. Contact: Dr. A. F. Bielajew, Div. of Physics, National Research Council of Canada, Ottawa, Canada, K1A 0R6 (phone 613-993-2715, Bitnet BLF@NRCVM01).

International Conference on Monte Carlo Methods for Neutron and Photon Transport Calculations, Sept. 25-28, 1990, Budapest,

Hungary. Contact: Dr. Lázló Koblinger, Central Research Inst. for Physics, P.O. Box 49, H-1525 Budapest, Hungary (Fax 36-1-15552530).

The Safety, Status and Future of Non-Commercial Reactors and Irradiation Facilities, Sept. 30-Oct. 4, 1990, Boise, Idaho, ANS Topical Meeting, sponsored by the Idaho Section and co-sponsored by The Commission of the European Communities (CEC), Atomic Energy Society of Japan, and the Nuclear Reactor Safety Division of the ANS. Contact: Dr. Romney B. Duffey, General Chairman, The Safety, Status and Future of Non-Commercial Reactors and Irradiation Facilities, P.O. Box 51218, Idaho Falls, ID 83405-1218 (phone 208-526-9804).

Spectrum '90: Nuclear and Hazardous Waste Management International Topical Meeting, Sept. 30-Oct. 4, 1990, Knoxville, Tennessee, sponsored by ANS. Contact: Technical Program, Spectrum '90, P.O. Box 1342, Oak Ridge, TN 37831 (phone Earl McDaniel at 615-574-0439 or Karl Notz at 615-574-6632).

October 1990

9th Topical Meeting on Technology of Fusion Energy, Oct. 8-12, 1990, Chicago, sponsored by the American Nuclear Society. Contact: Technical Program Chair, Richard Mattas, Argonne National Laboratory, 9700 S. Cass Ave., Argonne, IL 60439 (phone 708-972-8673, FTS 972-8673).

November 1990

Nuclear Energy Forum, Nov. 11-14, 1990, Washington, D. C., sponsored by the U.S. Council for Energy Awareness. Contact: Conference Office, U.S. Council for Energy Awareness, 1776 I Street NW, Suite 400, Washington, DC 20006-2495 (phone 202-293-0770).

American Nuclear Society Winter Meeting, Nov. 11- 16, 1990, Washington, D.C. Contact: Mary Keenan, Meetings Manager, ANS, 555 N. Kensington Ave., La Grange Park, IL 60525.

International Symposium on High-Dose Dosimetry for Radiation Processing, Nov. 12-16, 1990, Vienna, sponsored by IAEA. Contact: Conference Service Section, IAEA, P.O. Box 100, A-1400 Vienna, Austria.

June 1991

5th International Symposium on Radiation Physics, June 10-14, 1991, Dubrovnik, Yugoslavia. Contact: Dr. Ante Ljubičić, ISRP-5 Chairman, Ruder Bošković Inst., P.O. Box 1016, 41001 Zagreb, Yugoslavia (phone 41 425-563 or 41 434-467, Telex 21383 irbzg yu, Fax 41 425-497).

September 1991

ICNC '91, International Conference on Nuclear Criticality Safety, September 1991, Oxford, United Kingdom. Contact: ICNC '91 Secretariat, Publicity Office, AEA Technology, Winfrith, Dorchester, Dorset DT2 8DH, United Kingdom (phone 0305 251888 ext 2739, Fax 0305 202122, Telex 41231).

October 1991

1991 Joint International Waste Management Conference, Oct. 21-26, 1991, Seoul,

Korea. Contact: Mr. Larry C. Oyen, Sargent & Lundy, 55 East Monroe St., Chicago, IL 60603 (phone 312-269-6750, Fax 312-269-3475, Telex 280603).

MAY 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 22161.

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.

RADIATION SHIELDING LITERATURE

BOOK. . *Nuclear-Physics Constants of Thermonuclear Fusion*. . Abramovich, S.N.; Guzhovskii, B.Ya.; Zherebtsov, V.A.;Zvenigorodskii, A.G. . 1989. . Textbook Publishing, Leningrad, USSR. . In Russian

BOOK. . *Beta- and Antineutrino Radiation of Radioactive Nuclei*. . Aleksankin, V.G.; Rodichev, S.V.; Rubtsov, P.M.; Ruzhanskii, P.A.;Chukreev, F.E. . 1989. . Energoatomizdat, Moscow, USSR. . In Russian

CONF-900156, 213-218. . *Neutron Energy Spectrum at High Energy Proton Accelerators*. . Suzuki, T.; Numajiri, M.; Oki, Y.; Miura, T.; Miura, S.; Tawara, H.;Ban, S.; Hirayama, H.; Kondo, K.; Moritz, L. . Jan. 1990. . JAERI. . In: The 2nd Int. Symp. on Advanced Nucl. Energy Research - Evolution by Accelerators

CONF-900156, 286-291. . *Calculations of Dose Equivalent Due to Stray Radiation from a High Energy Electron Beam in the Forward Direction*. . Hirayama, H.; Ban, S.; Sakano, M. . Jan. 1990. . JAERI. . In: The 2nd Int. Symp. on Advanced Nucl. Energy Research - Evolution by Accelerators

Doc. of the NRPB, 1(2). . *Gut Transfer Factors*. . Harrison, J.D.; Kendall, G.M.; Stather, J.W. . 1990. . HMSO. . NRBP

Nucl. Energy 26, 15-20. . *Attenuation of the Collimated 14 MeV Neutron Flux by Iron and Copper Layers*. . Antonov, S.J.; Vojkov, G.K.; Ilieva, K.D.; Jordanova, J.D. . 1990. . Bulgarian Academy of Sciences

Nucl. Instrum. Methods, A288, 1-292. . *New Developments in Radiation Detectors*. . Longoni, A., Ed.; Lutz, G., Ed.; Schwarz, A., Ed.; Strüder, L., Ed. . March 1990. . Proceedings of the Fifth European Symposium on Semiconductor Detectors, Munich, FRG, Feb. 21-23, 1989.

Nucl. Sci. Eng. 105(1), 1-15. . *A Multiple Balance Approach for Differencing the S_n Equations*. . Morel, J.E.; Larsen, E.W. . May 1990

Nucl. Sci. Eng. 105(1), 16-30. . *Discrete Nodal and S_n Transport Methods for Irregularly Shaped Shields*. . Kim, S.T.; Dorning, J.J. . May 1990

Nucl. Sci. Eng. 105(1), 31-39. . *Stability Analysis of Coarse-Mesh Rebalance*. . Cefus, G.R.; Larsen, E.W. . May 1990

Nucl. Sci. Eng. 105(1), 40-51. . *Vectorization of Diffusion Computations in the Presence of Periodic Boundary Conditions*. . Abu-Shumays, I.K. . May 1990

Nucl. Sci. Eng. 105(1), 52-58. . *Three-Dimensional Multiregion S_n Solutions of the Spencer-Lewis Electron Transport Equation*. . Filippone, W.L.; Monahan, S.P.; Woolf, S.; Garth, J.C. . May 1990

Nucl. Sci. Eng. 105(1), 59-78. . *The Exact Kernel (I*) Method Applied to the Charged-Particle Transport Equation*. . Miazza, P.; Ligou, J. . May 1990

Nucl. Sci. Eng. 105(2), 160-173. . *Development of a Technique for the Practical Implementation of Higher Order Pertubation Methods*. . White, J.R.; Swanbon, G.A. . June 1990

Nucl. Sci. Eng. 105(2), 184-190. . *The Multigroup and Cylindrical Geometry Formulation of the Fully Coupled Sn/Monte Carlo Method*. . Baker, R.S.; Filippone, W.L.; Alcouffe, R.E. . June 1990

Nucl. Sci. Eng. 105(2), 191-197. . *A Diffusion-Accelerated S_n Transport Method for Radiation Transport on a General Quadrilateral Mesh*. . Alcouffe, R.E. . June 1990

Nucl. Technol., 90(2), 215-225. . *Derivation of an Equation for Radionuclide Transport in Porous Media*. . Fu-Long Chen; Shih-Hai Li. . May 1990

Nucl. Sci. Eng., 105(2), 198-203. . *A First-Collision Source Method That Satisfies Discrete S_n Transport Balance* . . Alcouffe, R.E.; O'Dell, R.D.; Brinkley, F.W., Jr. . June 1990

Trans. Theory Stat. Phys. 18(5&6), 383-428. . *Diffusion Theory Via Asymptotics*. . Pomraning, G.C. . 1989

Trans. Theory Stat. Phys. 18(5&6), 447-474. . *Time-Dependent Radiative Transfer in a Spherical Vacuum*. . Wing, G.M.; Zahrt, J.D. . 1989

Trans. Theory Stat. Phys. 18(5&6), 493-512. . *Stability Analysis of the Quasidiffusion and Second Moment Methods for Iteratively Solving Discrete-Ordinates Problems*. . Cefus, G.R.; Larsen, E.W. . 1989

LA-UR-88-672. . *A Benchmark-Problem Specification and Calculation Using SENSIBL, A One- and Two-Dimen-*

sional Sensitivity and Uncertainty Analysis Code of the AARE System. . Muir, D.W.; Davidson, J.W.; Dudziak, D.J.; Davierwalla, D.M.;Higgs, C.E.; Stepanek, J. . 1988. . Intl. Symp. on Fusion Nuclear Tech. Apr. 10-19, 1988, Tokyo, Japan

ORNL/TM-11532. . *Investigation of Radiation Effects in Hiroshima and Nagasaki Using a General Monte Carlo-Discrete Ordinates Coupling Scheme*. . Cramer, S.N.; Slater, C.O. . May 1990

UCRL-50400, Vol. 6, Part A and B, Rev. 4. . *Tables and Graphs of Photon-Interaction Cross Sections from 10 ev to 100 GeV Derived from the LLNL Evaluated Photon Data Library (EPDL)*. . Cullen, D.E.; Chen, M.H.; Hubbell, J.H.; Perkins, S.T.; Plechaty, E.F.;Rathkopf, J.A.; Scofield, J.H. . Oct. 31, 1989. . Part A: Z = 1 to 50, Part B: Z = 51 to 100

UCRL-ID-103424. . *The 1989 Livermore Evaluated Photon Data Library (EPDL)*. . Cullen, D.E.; Perkins, S.T.; Rathkopf, J.A. . March 1990

RADIATION SHIELDING LITERATURE

EPRI NP-4619 . . . . . ORIGEN2
Decay Heat Measurements and Predictions of BWR Spent Fuel. . . Battelle Pacific Northwest Labs, Richland, WA . . June 1986

Journal of Nuclear Materials, 139(1), 1-10 . . . THRES-F
Impurity Activation and Surface Gamma-Dose Levels in First Wall Structural Materials. . . Giancarli, L. . . Euratom/UKAEA Fusion Association, Abingdon, UK . . May 1986

LA-10898-MS . . . . . BENCHMARKING
Los Alamos National Laboratory Computer Benchmarking 1986. . . Simmons, M.L.; Wasserman, H.J. . . Los Alamos National Lab., NM . . January 1987

LA-UR-86-2299 . . . . . COVFILS-2
COVFILS-2: Neutron Data and Covariances for Sensitivity and Uncertainty Analysis. . . Muir, D.W. . . Los Alamos National Lab., NM . . 1986 . . AVAIL: NTIS

NEANDC(J)-117/U, pp.41-51 . . . . . JENDL
Format of JENDL. . . Nakagawa, T. . . Japan Atomic Energy Research Institute, Tokai, Japan . . March 1986

NEANDC(J)-117/U, pp.68-98 . . . . . JENDL
Processing of the Nuclear Data File and the Problems of JENDL. . . Hasegawa, A. . . Japan Atomic Energy Research Institute, Tokai, Japan . . March 1986

ORNL/TM-10191 . . . . . PLOTPACK
Gamma-Ray Production Cross Sections for 0.9 to 20 MeV Neutron Interactions with ^{10}B. . . Bywater, Jr., R.L. . . Oak Ridge National Laboratory, TN . . September 1986

Review of Scientific Instruments, 57(8), 1757-1759 . . . . . TFTR Activation
Analysis Programs and Standardization of the Neutron Activation System at TFTR. . . Nieschmidt, E.B. . . Plasma Physics Laboratory, Princeton University, NJ . . August 1986

Thesis, University Microfilms Order No. 86-03,954 . . . . . ANISN; FINAT; DOT 4.3
Application of Diffusion Theory to the Transport of Neutral Particles in Fusion Plasmas. . . Hasan, M.Z. . . Univ. of California, Los Angeles . . 1985

A summary of the draft recommendations of ICRP, 1990

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This text represents a personal view of the main features of the draft ICRP recommendations.

ICRP has published a draft version of its recommendations for radiological protection and has organised two international seminars to present the concepts, biological bases, and practical application. Within the UK, the Board is consulting widely on the draft proposals. Comments received by ICRP will be discussed at Main Commission meetings in June 1990; at a meeting of the Task Group drafting the recommendations in September 1990; and, if necessary, at a Main Commission further meeting in November 1990. The final text is expected to be published in the first quarter of 1991.

The recommendations consist of a main text, supported by three major appendices covering quantities and units; biological effects of ionising radiation; and criteria for judging the significance of the effects of radiation.

Risk estimates

The biological effects of irradiation are treated at some length, first for deterministic effects (which used to be called non-stochastic effects) and for which the data are similar to those used previously.

For stochastic effects, cancers and hereditary defects, ICRP has not been able simply to use UNSCEAR values because UNSCEAR only defined risks following irradiation to high doses at high dose-rates. ICRP has taken the UNSCEAR recommendation for a constant relative risk to project risks into the future and based its results largely on the Japanese A-bomb survivor data. These risks are then transferred to the baseline cancer rates of other populations, eg, UK and USA, using two different methods and the average result adopted. The risk of fatal cancer, at high doses and dose rates, is then calculated to be 8% Sv^{-1} for a working population aged 18–64, and 10% Sv^{-1} for a population of all ages; this compares with 1977 UNSCEAR equivalent risks of 2.5% Sv^{-1}.

ICRP then has to decide on the risk factors to be used for radiological protection purposes, ie, low dose/low dose-rate exposure. This reduction is effected by

use of a Dose and Dose-Rate Effectiveness Factor, DDREF. A value of 2 for DDREF is adopted on the basis of what can be derived from the leukaemia incidence in the Japanese survivors and on theoretical considerations of a linear-quadratic dose response function ($E = \alpha D + \beta D^2$, where E is effect and D is dose). This leads to fatal cancer risks of 4% Sv^{-1} for a workforce and 5% Sv^{-1} for all ages, compared with 1.25% Sv^{-1} in ICRP Publication 26.

Radiation detriment

ICRP has retained the concept of detriment as a measure of radiation harm for optimisation studies and setting dose limits, but it is now broadened to include, as well as fatal cancers, non-fatal cancers and hereditary defects. Serious mental retardation following irradiation *in utero* is also quantified.

There is a long list of organs and tissues for which fatal and non-fatal cancer risks are available in the ICRP draft. For each tissue the non-fatal cancer risk has been weighted by the lethality fraction for that tissue, on the basis that the higher the lethality fraction, the lower the quality of life for those who survive the cancer. There is also an allowance in the estimate of detriment for hereditary defects in all future generations and ICRP has a lower factor for workers compared with the whole population because of different proportion of total exposure that will be genetically significant. The resulting detriment becomes (in % Sv^{-1})

	Workforce	**Whole population**
Fatal cancer	4	5
Non-fatal cancer (weighted)	1.2	1.5
Hereditary defects	0.6	1.0
Total (rounded)	6.0	7.5

The total figures should be compared with the ICRP 1977 estimate of between 1.65% Sv^{-1} for Effective Dose Equivalent or 2% Sv^{-1} for optimisation studies.

As for mental retardation, which has been noted following irradiation *in utero* for the 8 to 15 week conceptus, ICRP has concluded that the risk in this period is stochastic and now expressed as a **loss** of 30 IQ points Sv^{-1}. This new model, which is consistent with a risk of 0.4 Sv^{-1} for serious mental retardation, implies there is no likelihood of severe damage to individuals at normal levels of exposure.

System of protection

In its new publication, ICRP has generalised its three well-known principles so that they apply not only to dose limitation in PLANNED situations, as in the past, but also to POTENTIAL situations (accidents which have a probability but not certainty of occurring) and PRE-EXISTING situations (where a source is not

under control, such as radon in homes or environmental contamination after an accident). The principles are

Justification
Optimisation
Limitation

The majority of the recommendations apply to PLANNED situations, when a practice needs to be justified, protection optimised and the dose limits met. In POTENTIAL situations, the principles are very similar in that the practice must again be justified, and protection optimised, but the restraint on optimisation would in this case be a risk limit, not the dose limit. In PRE-EXISTING SITUATIONS, it is the introduction of remedial measures or countermeasures which must be justified in that intervention must do more good than harm; optimisation leads to the form, scale and duration of the intervention; limitation may only apply to avoidance of deterministic effects.

Three categories of exposure are defined, to which the system of protection applies; occupational, medical and public exposure. No limits are set for medical therapeutic or diagnostic exposure, although comments are made on justification and optimisation of medical exposures.

Dose and risk limits

It is ICRP's intention that dose limits are set such that continued exposure just above the dose limits would result in added risks that legitimately could be called 'unacceptable'. The dose limits are therefore set at the dividing line between what is just tolerable and what is intolerable. In its 1977 recommendations, ICRP set dose limits by comparing radiation risks with fatal risks in 'safe' industries. This time ICRP considered a number of indices of the consequences of exposure–attributable risk of death, time lost if death occurs, loss of life expectancy, annual risk of death, and the probability of dying in any year. The third annex of the draft recommendations explores these endpoints in detail; however, having defined effectance (effective dose equivalent) to include hereditary defects and non-fatal cancers, the only comparisons presented are fatal cancer risk and fatal risk limits.

For workers, ICRP concludes that the dose limit should be 20 mSv y^{-1} for all plant being designed. However, a year is an arbitrary period biologically and added flexibility is given for present practices by setting the limit at 100 mSv in 5 years with an overriding limit of 50 mSv in any single year. For women occupationally exposed, ICRP recommends that, once the pregnancy is declared, the conceptus should be subject to a dose limit of 5 mSv during the rest of the pregnancy.

In fatal risk terms, continued exposure at 20 mSv y^{-1} from ages 18 to 64 leads to an annual probability of cancer death of 1.3×10^{-3} at age 70 and an average annual risk over a working lifetime of 0.76×10^{-3}.

For members of the public, ICRP sets a dose limit of an average of 1 mSv y^{-1} over any consecutive 5-year period.

Continued exposure at 1 mSv y^{-1} over a lifetime leads to an extra probability of cancer death at age 70 of 1.4×10^{-4} and a mean annually committed risk of cancer death of 6×10^{-5}.

For potential situations, ICRP says the annual risk limit should be the same as the fatality probability corresponding to the dose limits, ie, approximately 8×10^{-4} for workers and 5×10^{-5} for the public.

The concept of a constraint

A dose constraint is a restriction imposed on individual doses resulting from a specified source and is used as an upper bound on optimisation. While a dose limit is an individual-related quantity, a constraint is a source-related quantity but applied to an individual. For many types of exposure, it will be possible to reach conclusions over the likely maximum doses in normal operation. This information will lead to the establishment of dose constraints, which will be fractions of the dose limit — figures of 5 or 10 mSv in a year for workers are suggested in the main text. Optimisation of protection should then be carried out after setting the constraint.

Quantities and units

The term **effectance** has been used to replace effective dose equivalent, but the concept remains the same. There are, however, new w_T values because of the greater number of organs and tissues for which risk factors are now specified — some 13 values are now given compared with 7 previously. A new relationship between Quality Factor and Linear Energy Transfer is proposed and ICRP is using Ambient Dose Equivalent (the dose equivalent at 1 cm depth in the ICRU sphere) to derive radiation weighting factors (w_R) for neutron exposure. The radiation weighting factors which apply for each radiation to all organs and tissues are then as follows.

X-rays, γ-rays, electrons, muons		1
Auger electrons		5
α particles		20
Neutrons	<10 keV	5
	10–100 keV	10
	>100 keV–2 MeV	20
	>2 MeV	10

Practical applications

The final chapters of the recommendations emphasise the regulatory and management requirements that follow from the recommendations. Advice is given on assessment of doses from routine monitoring and on the specification of working conditions, the exemption and exclusion from regulatory control, and on dealing with pre-existing situations, particularly emergencies.