RSIC Newsletter

RADIATION SHIELDING INFORMATION CENTER

OAK RIDGE NATIONAL LABORATORY

OPERATED BY UNION CARBIDE CORPORATION • FOR THE U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

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Nobody can become perfect by merely ceasing to act. ...*Bhagavad Gita*

IAEA REACTOR DOSIMETRY PROGRAM

The International Atomic Energy Agency (IAEA) has initiated a program on "Benchmark Neutron Fields Applications for Reactor Dosimetry." The program has two steps: to compile information on the basis of a survey; and to convene a consultants meeting on "Integral Cross Sections Measurements in Standard Neutron Fields for Reactor Dosimetry". The meeting is to be held in Vienna, Austria, November 15-19, 1976.

Three types of benchmark neutron fields were identified at a workshop held during the Petten Symposium, 1975: standard neutron fields; reference neutron fields; and control neutron environment. The agency program will be directed toward three general objectives: 1) Validation and/or calibration of experimental techniques: 2) Validation and/or improvement of cross sections and other nuclear data needed for proper application of experimental techniques; 3) Validation and/or improvement of analytical methods needed to extrapolate dosimetry data from a monitoring or surveillance position to the location of entrance. The second objective may be the focus of the working effort.

The goals of the November meeting are: to reach as far as possible a consensus regarding the status of reactor dosimetry neutron data; and to work out specific recommendations for future efforts in this field. It will include sessions as follows: an overview; spectral characterization of benchmark neutron fields; integral data in benchmark neutron fields; differential cross section data for reactor dosimetry; comparison of differential and integral cross section in benchmark neutron fields; validation and adjustment of differential cross sections on the basis of integral data; and conclusions and recommendations to the IAEA.

The purpose of the proposed survey is to ascertain the physical and radiation characteristics of both reference and supplementary neutron fields for referencing reactor dosimetry measurements which have been used in the past, are currently available, or which are in an advanced stage of development. It will at the same time collect existing documented results of dosimetry- related measurements performed with the facilities. The primary goal of the survey is to obtain the best information available for all neutron fields which provide reference for neutron dosimetry.

The survey poses the questions which follow. Anyone wishing to participate in the survey may mail their responses to these questions to the Nuclear Data Section, IAEA, Vienna, Austria.

1) *Provide a physical description of the facility including material inventory and geometric arrangements. Include operational characteristics which are relevant for performing experiments.*
2) *Provide spatial description of the neutron flux and the available total flux and fluence for irradiation purposes. Include estimate of the neutron-to-gamma-ratio.*
3) *Specify in numerical form a recommended neutron spectrum for the irradiation position in the facility. Include separately both calculational and experimental results upon which the recommendation is based. Statements of accuracy for the recommended spectrum are desirable and ultimately essential. If the spectrum can be more accurately determined, describe the required measurements and the estimated attainable accuracy.*
4) *Describe flux monitoring methods which are available for routine irradiations and the precision attainable for run-to-run normalizations. Indicate the general availability of the facility for interlaboratory experiments.*
5) *Provide documented experimental reaction rate and other integral experimental results obtained with the facility that are relevant for reactor fuels and materials dosimetry. Inclusion of unpublished or preliminary experimental data is encouraged. No publication or general distribution of such information will be undertaken.*

6) If appropriate, summarize unique features of the facility relevant for referencing dosimetry measurement techniques.

PLEASE PACK TAPES SECURELY!!

Several reels of magnetic tape have arrived at RSIC in damaged condition. Most of the damaged tapes were enclosed in padded envelopes for mailing. Tapes enclosed in regulation tape boxes (Corrugated cardboard) or wrapped in bubble plastic packing have arrived in good condition. To ensure earliest possible delivery, we further suggest your tape be addressed as follows: Radiation Shielding Information Center, Oak Ridge National Laboratory, **Bldg. 6025, Room 15W, P. O. Box X, Oak Ridge, Tennessee 37830.**

ORNL/RSIC-40 AVAILABLE SOON

Proceedings of the RSIC Seminar-Workshop on Unfolding Radiation Energy Spectra, held in Oak Ridge on April 12-13, are in the process of publication and will be distributed soon to those who attended the meeting. A limited number will be available for other requesters. Requests for ORNL/RSIC-40 should be addressed to RSIC Seminar-Workshop, Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, Tennessee 37830. The report will also be available from the National Technical Information Service (NTIS).

NEW GAMMA-RAY SHIELDING MANUAL AVAILABLE

A new and potentially useful shielding handbook titled "The Photon Shielding Manual" by Anthony (Tony) Foderaro is now available. It is primarily a compilation of useful data, but it also has a number of concise explanations and definitions. The author had in mind both the professional shield designer and the student, and the manual should fill the needs of both in hand calculations. In fact, with the increasing power of pocket calculators, "hand" calculations can now be performed which are comparable to machine calculations of a few years ago. This is probably the first shielding manual compiled especially for this application.

The author estimates that the material is sufficient to solve perhaps 90% of the photon shielding problems in the nuclear industry. This, coupled with the fact that the majority of the shielding problems in the nuclear industry do not involve neutrons, makes this a handy book indeed.

In addition to tables of attenuation coefficients, building factors, and conversion factors, equations for the various source geometries are given along with empirical parameters and attenuation functions. The "miscellaneous" data includes compton scattering functions, densities of elements in concretes, and pair production cross sections.

This reviewer could find only two deficiencies. The first is that there are more recent, and undoubtedly better, calculations of photon attenuation than the original moments results of Goldstein and Wilkins (1954). For example, the calculations of Eisenhower and Simmons (Nucl. Sci. Eng. 56, 263-270 (1975)) give a buildup factor for concrete for 0.5 MeV and 15 mfp less than one-half of the old interpolated value which is given again in this handbook. Fortunately, the discrepancy at higher energies is less significant.

The other complaint is one of concept. The manual does a disservice in fostering confusion between RBE and Quality Factor. Since this confusion seems to be so widespread, we will quote extensively from NCRP report No. 39, *Basic Radiation Protection Criteria*, p. 29:

> "Whereas all radiations produce the same types of biological effects, the magnitude of response per unit of absorbed dose is not the same. The inverse ratio of the absorbed dose from one radiation type to that of a reference radiation required to produce the same degree of a stipulated effect is referred to as **Relative Biological Effectiveness (RBE)**. Gamma rays of ^{60}Co and 200-250 kV x rays have been used as the reference radiation. There is no one RBE for a given type of radiation; the value depends upon the tissue, the cell, the biological effect being studied, the total dose, and the dose rate. The concept of RBE continues to be a productive one in the study of basic biological effects. Its use is now restricted by convention to experimental radiobiology.

In radiation protection where it is convenient to add up the dose contributions from different radiation types, a modifier known as quality factor (QF) is used. QF is of the nature of a somewhat arbitrarily chosen conservative round-off of the range of RBE's depending on the LET. The explanatory statement of the ICRU on quality factor is as follows: "In radiation protection it is necessary to provide a factor that denotes the modification of the effectiveness of a given absorbed dose by LET (Linear Energy Transfer). Unlike RBE, which is always experimentally determined, this factor must be assigned on the basis of a number of considerations and it is recommended that it be termed the *quality factor* (QF). Provisions for other factors are also made. Thus a *distribution factor,* (DF), may be used to express the modification of biological effect due to nonuniform distribution of internally deposited radionuclides. The product of absorbed dose and modifying factors is termed the dose equivalent, (DE)'".

In summary–we recommend this little 120-page book. It is a real buy. Order from The Penn State Bookstore, McAllister Building, The Pennsylvania State University, University Park, Pennsylvania 16802. The price is $4.50 plus postage. Make checks payable to the Pennsylvania State University.

ERDA TIC CATALOG AVAILABLE

To help meet the information needs of scientists and engineeers working in energy-related fields, the Energy Research and Development Administration has just published the 1976 edition of *Technical Books and Monographs,* a bibliography of books and monographs sponsored by the Energy Research and Development Administration (ERDA) and by the organizations brought together to form ERDA. This catalog provides access to a large body of knowledge generated by many programs–programs as diverse as the field of nuclear medicine, the exploration of physical mechanisms at work in the environment, and the varied technologies required to realize the potential of the country's energy sources.

Technical Books and Monographs gives for most publications a brief descriptive statement, lists or describes the contents, and indicates the availability. The more than 500 publications are grouped under 13 subject categories: general reference, biology and medicine, chemistry, computers, energy, engineering and instrumentation, environment, health physics, isotope separation, metallurgy, physics, reactors, and vacuum technology. Included are the titles from monograph series prepared in cooperation with the American Chemical Society, American Industrial Hygiene Association, American Institute of Biological Sciences, American Nuclear Society, and American Society for Metals. In addition to the technical books and monographs, separate sections at the end of each subject category list recent symposium proceedings published as ERDA project reports and bibliographies. Title, author, and series indexes are provided.

Technical Books and Monographs is available as TID-4582-R11 without charge from ERDA Technical Information Center, P.O. Box 62, Oak Ridge, Tennessee 37830.

MONTE CARLO ANALYSIS COURSE OFFERED

In recognition of Tennessee Industries Week, the University of Tennessee (UT) offers a 5-day short course (September 13-17, 1976) entitled "An Engineering Approach to Monte Carlo Analysis". The staff includes P. N. Stevens and T. J. Hoffman of the U.T. Department of Nuclear Engineering and R. W. Roussin and D. K. Trubey of RSIC.

This course is designed specifically for the practicing engineer engaged in shield design and does not presume any prior knowledge of Monte Carlo methods. An understanding of the basics of Monte Carlo methods is emphasized along with their specialized application to practical shielding problems. The versatile Monte Carlo computer code, MORSE, will be described. Workshop sessions are planned to enable participants to acquire some practical experience. Acquisition of the correct Monte Carlo code and/or the appropriate cross section data for your job will also be discussed.

Participants need not be familiar with the Monte Carlo method. However, some understanding of radiation-transport physics and computer programming (FORTRAN) is desirable.

The following topics will be covered: Fundamental Concepts of Monte Carlo; Statistical Uncertainty; Evaluation of Integrals — Theory and Workshop; Random Walk Simulation and Routine Biasing; Theory of Monte Carlo Estimation; Random Walk Simulation — Workshop; Monte Carlo Computer Codes; The MORSE Computer Code; Source Particle Generation — Workshop; Analysis of Monte Carlo Histories Description and Checkout of Complex Geometries; Complex Geometry Shield Mockup — Workshop; Computation Time Reduction Techniques; State-of-the-Art Biasing; and Special Topics.

The fee for the course is $375. Registration deadline is August 20th. Other information may be secured from Dr. F. N. Peebles, Dean of Engineering, The University of Tennessee, Knoxville, Tennessee 37916, telephone 615-974-5321.

SYMPOSIUM ON NEUTRON STANDARDS AND APPLICATIONS

Announcement has been made of an International Specialists Symposium on Neutron Standards and Applications to be held on March 28–31, 1977 at the National Bureau of Standards (NBS) Gaithersburg, Maryland. The sponsors include NBS, U.S. Department of Commerce, International Atomic Energy Agency, Electric Power Research Institute and the U. S. Energy Research and Development Administration divisions of Safety, Standards and Compliance, Physical Research, Magnetic Fusion Energy, and Reactor Development and Demonstration.

The purpose of the symposium is to assess progress in neutron standards, to review applications of neutron standards and to establish directions for future work. The last such symposium was held six years ago at Argonne National Laboratory. This meeting stimulated increased international activity in neutron standards and helped emphasize the fundamental importance of the highest obtainable accuracy.

Neutron standards, whether primary or secondary, continue to play a significant role in a number of technologies. Nearly every cross section measurement made in support of nuclear energy programs is measured against a standard which in some instances is known to only modest accuracy.

Neutron personnel dosimetry has greatly increased in importance as the more stringent health and safety standards become more costly to neutron based technologies. For cancer therapy with neutrons, small uncertainties in neutron dose might spell the difference between failure and success. Neutron-induced radiation damage to fusion system materials is providing new challenges for neutron dosimetry in the higher energy ranges. Absolute neutron source strength continues to play a major role in basic science and in technology.

A successful attack on neutron standards problems requires a clear understanding of the range of neutron standards applications, the magnitude of standards uncertainties, their importance to technology and the techniques likely to lead to increased accuracy. The assurance of coordination of international efforts to improve the accuracy of neutron standards also is essential.

Therefore, the symposium will be of interest to: measurers of applied neutron-data requiring neutron standards, the measurements community involved in the improvement in accuracy of neutron primary and secondary standards, the community concerned with neutron dosimetry as it relates to health, safety, and therapy, and the community involved with measurements of techniques ancillary to neutron standards development such as half-lives, mass measurements, foil fabrication, etc.

The program will include such topics as: differential neutron cross section standards, integral cross section standards and tests, detectors, apparatus and techniques, standards for neutron energy scales, impact of γ-ray data and spectroscopy on neutron standards, absolute flux measurement methods, neutron source properties, neutron standards in personnel and medical dosimetry, neutron standards in reactor dosimetry, and accuracy objectives for neutron standards.

NBS will publish the proceedings of this symposium in the NBS Special Publication Series.

The symposium chairman is Dr. Charles D. Bowman, Chief, Neutron Standards Section of NBS. Dr. Horst Liskien, Bureau Central de Mesures Nucleaires, is serving as European secretariat. Dr. Allan D. Carlson will serve as symposium secretary. A program committee has been established consisting of C. D.

Bowman, NBS (Chairman), M. Bhat, BNL, J. B. Czirr, LLL, F. Gabbard, Univ. of Kentucky, W. W. Havens, Columbia Univ., R. W. Peelle, ORNL, A. B. Smith, ANL, P. G. Young, LASL, and B. R. Leonard, Jr., BNW.

The details of the program are now being planned by the Program Committee which will solicit papers by invitation. The Symposium will be open to everyone. For further information, European scientists should contact: Dr. Horst O. Liskien, Central Bureau Voor Nucleaire Metingen, B-2440 Geel Steenweg Naar Retie, Belgium.

Other participants should contact: Dr. Charles D. Bowman or Dr. Allan D. Carlson, RAD P B119, National Bureau of Standards, Washington, D. C. 20234.

OTHER UPCOMING MEETINGS

The following meetings have been noted.

September 21-23, 1976 Second Topical Meeting on the Technology of Controlled Nuclear Fusion, Richland, Washington. Contact: L. Schmid, PNL.

November 14-19, 1976 ANS/AIF International Meeting, Washington, D.C. Contact: ANS, Hinsdale, Illinois.

April 18-22, 1977 5th International Conference on Reactor Shielding, Knoxville, Tennessee. Contact: D. K. Trubey, RSIC-ORNL.

October 17-21, 1977 IEEE 7th Symposium on Engineering Problems in Fusion Research, Knoxville, Tennessee. Contact: M. S. Lubell, ORNL.

PERSONAL ITEMS

Martin M. Dresser joined the staff of Science Applications, Inc. 1200 Prospect Street, La Jolla, California 92037 on April 1, 1976. He will continue to work in high energy laser and radiation transport areas.

The following changes of address have been received in RSIC: **Henry E. Stern**, from Marshall Space Flight Center to Redstone Arsenal, Huntsville, Alabama; **John E. Michales**, from IPD District Manager in San Jose to IPD Director, 1006 Pepper Ave., Sunnyvale, California 94087.

CHANGES TO THE CODE COLLECTION

Aug. '76 (more July)

The following changes were made in July.

CCC-209B/DOT III

This CDC CYBER 73 version of the two-dimensional discrete ordinates radiation transport code was updated to include SORREL, an auxiliary routine which generates a 2-D power distribution for DOT x-y, r-θ, and r-z calculations. SORREL was contributed by Babcock and Wilcox Co., Lynchburg, Virginia. Reference: Informal notes by J. T. West. FORTRAN IV, CDC CYBER-73.

CCC-266/ONETRAN

The IBM 360 and the CDC 7600 versions of this one-dimensional multigroup discrete ordinates finite element transport code were updated to correct errors called to RSIC attention by the Los Alamos Scientific Laboratory contributors. Interested persons may request a list of the corrections from RSIC. The IBM 360 version was further updated to correct one character in Subroutine IFOUT. The 4th card before statement number 116 in IFOUT as corrected reads:

```
CALL REED(O,KAF+((G-1)*MM+M-1)*LNAF,AF,LNAF,1).
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CCC-279/RAFFLE

This general purpose Monte Carlo code with mixed zone geometry option was contributed by Aerojet Nuclear Co., Idaho Falls, Idaho. References: ANCR-1022 and ANCR-1206. FORTRAN IV and Assembler Language, IBM 360.

CCC-281/MUSCAT

This code for calculation of view factors for incident scattered neutron currents in truncated concentric spheres, concentric circular cylinders and cylinders was contributed by General Atomic, San Diego, and NEA Computer Programme Library, Ispra (Varese), Italy. Reference GAMD-6775 . FORTRAN IV; IBM 360/370.

CCC-282/SNOW

This program for solving a two-dimensional multigroup transport equation by SN method, plane and cylindrical geometry, isotropic and anisotropic scattering was contributed by Karlsruhe Nuclear Research Center, Karlsruhe, Germany, and NEA Computer Program Library, Ispra, Italy. Reference: EURFNR-1130 (July 1973). FORTRAN IV and Assembler Language; IBM 360.

PSR-63/AMPX-I

Both versions, IBM 360(A) and CDC compatible (B), of this modular code system for generating coupled multigroup neutron-gamma-ray libraries from ENDF/B were updated to correct statement 90, INGATE subroutine, LAPHANGAS Module. This card as corrected reads:
[redacted] This correction was called to RSIC attention by the code originators, [redacted]

ESIS QUESTIONNAIRE FOR TRIPOLI WORKSHOP

Carlo Ponti of the European Shielding Information Service (ESIS), EURATOM, Ispra, Italy is circulating a questionnaire preceding the Seminar-Workshop on the Monte Carlo code TRIPOLI to be held in Ispra, October 18-19, 1976. He plans to set up a table of comparisons of the main features of the several Monte Carlo codes now in use in the shielding community. If you wish your Monte Carlo code included in the tabulation, answer the following questions and mail them immediately to C. Ponti, Esis, EURATOM CCR Ispra (Varese), Italy. Head your response with name of code, version, origin, references, and name of person responding.

1. Treatment of the nuclear data: (a) If the code reads multigroup xs data, omit this point and go to (b); otherwise (1) Specify structure and characteristics of basic data library processed by the code; (2) Which nuclear reactions are taken into account and in which approximation (isotropic, P_n,....) (elastic scattering, inelastic scattering, (n, 2n), fission, others). (b) Which probability distribution is selected by the code to represent a non-uniform angular distribution?

2. Which geometry may be dealt with by the code? How is it possible to check that the geometry description is correct?

3. Which source distribution (vs. space and energy) may be handled by the code?

4. Are "albedo" options available?

5. Variance reducing techniques–is the code ready to accept the description of an importance function? In which form? Which techniques are provided (Russian Roulette, Splitting, Exponential transform, Source energy biasing, Slowing down biasing, Others)?

6. How is the diffusion of thermal neutrons taken into account?

7. May photon transport be dealt with?

8. Output of the code (specify what is standard and what depends on the version of the code applied or on auxiliary packages).

9. Was the code primarily designed for shielding calculations (Other applications: criticality calculations, adjoint problems, time dependent problems, others)?

10. Machine requirements and operating information: storage needed, number of tapes needed, programming languages, overlay structure, graphical output, execution time control, and restart procedure.

11. Related and auxiliary programs.

12. Other features of the code that you think are important in the framework of a comparison among Monte Carlo codes.

13. Please list references of papers reporting on shielding calculations executed with this code.

THE NEA CRP COORDINATED PROGRAM OF SHIELDING BENCHMARK EXPERIMENTS

The following statement of the results of the first four single material experiments on iron was taken from the July issue of the ESIS Newsletter. The author is John Butler, UK AEE Winfrith.

The NEA coordinated program of shielding benchmark experiments was established at the request of the Nuclear Energy Agency Committee on Reactor Physics (NEA CRP) which reviewed the subject of integral shielding experiments at their 16th Annual Meeting held in June 1973.

The already well-established US program of shield data testing under the auspices of the Cross Section Evaluation Working Group (CSEWG) was discussed at this meeting and papers describing proposals for benchmark experiments were also tabled from Japan and several European establishments. Various new source facilities were being utilized for these experiments, including fission-plates, fast source reactors and accelerators; there was a marked trend away from conventional activation detectors; the shielding community was adopting some of the methods used for neutron spectroscopy in zero energy reactors and developing new techniques to overcome the special problems of measuring spectra at deep penetrations in experimental shields.

The NEA CRP accordingly recommended that the Japanese and European communities should coordinate their programs of work in this field with a view to exchanging results and ultimately making comparisons with experiments conducted in the US program. They further recommended that a format should be established for reporting the results of shielding benchmark experiments which was compatible with that already used for the CSEWG program in the USA.

In response to this initiative, a meeting was held at Ispra in April 1974 to establish the basic requirements for a coordinated program and it was proposed that the first benchmark should be a single-material experiment in iron which has already been studied with the gun source geometry used on the Tower Shielding Facility at Oak Ridge National Laboratory (ORNL). All the laboratories participating in the program agreed to investigate this material using the various source facilities available with the aim of intercomparing techniques and investigating possible systematic errors in the results before embarking on the main program on benchmark experiments in other materials.

The first three experiments to benefit from this close coordination have been conducted at Winfrith, Karlsruhe and Tokyo University; the results are published in a document using the agreed format which is intended to furnish all the information required for theoretical analysis. A further degree of coordination has been achieved in that each laboratory has published separately an analysis of their experiments using the ANISN/DOT codes in conjunction with the EURLIB data set processed from the ENDF/B library. The original ORNL benchmark which was published in September 1974 is included in this compilation for completeness. The theoretical analysis using special data sets based on ENDF/B III has also been published separately.

The publication of these four experiments, conducted in accordance with well-defined international standards, in the first issue of this document represents a significant step forward in the coordination of benchmark results in the shielding field.

Requests for the document (ref. NEA CRP-U-73) should be addressed to OECD, Nuclear Energy Agency, 38, Bd Suchet 75016 Paris, or to ESIS, European Shielding Information Service, JRC Euratom, 21020 Ispra, Italy.

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.

Special bibliographies and selected computer-printed abstracts of the literature in the RSIC system are available upon request. The Selective Dissemination of Information (SDI) Service is available by submitting a list of subject categories defining the recipient's interests.

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

AFCRL-TR-0004; AFCRL-PSRP-620; AD-A-010427
Dose Distributions at and Near the Interface of Different Materials Exposed to Cobalt-60 Gamma Radiation.
Wall, J.A.; Burke, E.A.
December 17, 1974
NTIS $3.75

AFCRL-TR-75-0206; AFCRL-PSRP-629; AD-A-011601
Interface Dose as a Function of Angle of Incidence for Aluminum-Gold and Aluminum-Beryllium Slabs.
Lowe, L.F.; Taylor, W.C.; Cappelli, J.R.
April 11, 1975
NTIS $3.25

ANL-76-10(Vol.2)
Uses of Advanced Pulsed Neutron Sources. Report of a Workshop Held at Argonne National Laboratory, October 21-24, 1975.
Carpenter, J.M.; Werner, S.A. (Eds.)
1975
Dep., NTIS $7.75

ANL CTR-75-4
Proceedings of the International Conference on Radiation Test Facilities for the CTR Surface and Materials Program, July 15-18, 1975, at Argonne National Laboratory.
Persiani, P.J.; Cohen, M.M.; Zwilsky, K.M. (Comps.)
July 1975
NTIS $21.25

ANL/CTR-75-4, pp.3-15
ERDA Neutron Source Program.
Cohen, M.M.; Zwilsky, K.M.
July 1975
NTIS

ANL/CTR-75-4, pp.16-45
Considerations of Test Facility Requirements for CTR Surface Science Experiments.
Kaminsky, M.
July 1975
NTIS

ANL/CTR-75-4, pp.64-88
The Investigation of Neutron Radiation Effects in Structural Materials for CTR Use.
Wiffen, F.W.
July 1975
NTIS

ANL/CTR-75-4, pp.106-128
Design of Irradiation Experiments for Fusion Reactor Materials.
Eyre, B.L.; Lomer, W.M.; Nelson, R.S.
July 1975
NTIS

ANL/CTR-75-4, pp.129-167
A Technical Critique on Radiation Test Facilities for the CTR Surface and Materials Program.
Persiani, P.J.
July 1975
NTIS

ANL/CTR-75-4, pp.171-182
Characteristics of Rotating Target Neutron Source and Its Use in Radiation Effects Studies.
Van Konynenburg, R.A.; Barschall, H.H.; Booth, R.; Wong, C.
July 1975
NTIS

ANL/CTR-75-4, pp.183-200
Livermore Intense Neutron Source: Design Concepts.
Davis, J.C.; Anderson, J.D.; Booth, R.; Logan, C.M.; Osher, J.E.
July 1975
NTIS

ANL/CTR-75-4, pp.201-206
NaK Cooled Rotating Target.
Roche, M.
July 1975
NTIS

ANL/CTR-75-4, pp.208-226
Accelerator for the Production of Very High Neutron Yields of 14 MeV.
Hourst, J.B.; Roche, M.
July 1975
NTIS

ANL/CTR-75-4, pp.227-242
Large Area Solid Target Neutron Source.
Crawford, J.C.; Bauer, W.
July 1975
NTIS

ANL/CTR-75-4, pp.243-249
Neutron Generator with Rotating Selfcharging Target - A Medium Yield (6×10^{13} to 1×10^{14} sec^{-1}) 14 MeV Neutron Source.
Cloth, P.; Darvas, J.; Filges, D.; Haubold, H.G.; Hemmerich, J.; Ihle, H.R.; Kirch, N.; Kupschus, P.; Meixner, C.
July 1975
NTIS

ANL/CTR-75-4, pp.250-258
An Intense 14 MeV Neutron Source Using a Spherical Drive-In Target.
Kim, J.; Morgan, O.B.
July 1975
NTIS

ANL/CTR-75-4, pp.261-314
An Intense Neutron Source Facility for the Fusion Energy Program.
Armstrong, D.D.; Emigh, C.R.; Meier, K.L.; Meyer, E.A.; Schneider, J.D.
July 1975
NTIS

ANL/CTR-75-4, pp.315-334
Gas Target Neutron Generator Studies.
deLeeuw, J.H.; Haasz, A.A.; Stangeby, P.C.; Tong, D.T.
July 1975
NTIS

ANL/CTR-75-4, pp.336-353
Preliminary Design of a 30-MeV Deuteron Linear Accelerator for the Production of Intense Beams of High Energy Neutrons for CTR Research.
Batchelor, K.; Blewett, J.P.; Chasman, R.; Claus, J.; Fewell, N.; Grand, P.; Lankshear, R.; Sheehan, J.; Witkover, R.
July 1975
NTIS

ANL/CTR-75-4, pp.354-379
Production and Use of Li(d,n) Neutrons for Simulation of Radiation Effects in Fusion Reactors.
Goland, A.N.; Gurinsky, D.H.; Hendrie, J.; Kukkonen, J.; Sheehan, T.; Snead, C.L.,Jr.
1975
NTIS

ANL/CTR-75-4, pp. 380-394
A Large-Volume Intense Neutron Source for CTR Materials Studies.
Saltmarsh, M.J.; Horak, J.A.
July 1975
NTIS

ANL/CTR-75-4, pp.397-409
Technical Feasibility of a High Current Accelerator for a (p,n) or (d,n) Neutron Generator.
Chidley, B.G.; Ormrod, J.H.; Ungrin, J.; Brown, J.C.
July 1975
NTIS

ANL/CTR-75-4, pp.410-420
A Heavy Water Jet Target and a Beryllium Target for Production of Fast Neutrons.
Logan, C.M.; Anderson, J.D.; Barschall, H.H.; Davis, J.C.
July 1975
NTIS

ANL/CTR-75-4, pp.422-435
Pulsed Neutron Sources for Fusion Reactor Materials Studies.
Toepfer, A.J.; Martin, T.H.; Clauser, M.J.; Swain, D.W.; Beckner, E.H.
July 1975
NTIS

ANL/CTR-75-4, pp.436-456
Ion Beam Pellet Fusion as a CTR Neutron Test Source.
Arnold, R.; Martin, R.
July 1975
NTIS

ANL/CTR-75-4, pp.457-480
The Laser Heated Solenoid as a Neutron Source Facility.
Steinhauer, L.C.; Rose, P.H.
July 1975
NTIS

ANL/CTR-75-4, pp.483-497
A Repetitively Pulsed Material Testing Facility.
Zucker, O.; Bostick, W.; Gullickson, R.; Long, J.; Luce, J.; Sahlin, H.
July 1975
NTIS

ANL/CTR-75-4, pp.498-526
The Perspectives of a Dense Plasma Focus as a High Intensity Neutron Source.
Cloth, P.; Conrads, H.; Ihle, H.R.; Gourlan, C.; Maisonnier, Ch.; Robouch, B.V.
July 1975
NTIS

ANL/CTR-75-4, pp.527-538
Repetitive Plasma Focus Powered by an *Approximately Equal to 200 MJ Flywheel* Generator.
Nardi, V.
July 1975
NTIS

ANL/CTR-75-4, pp.540-552
The ISX Tokamak as a Radiation Test Facility for Surface Studies.
Colchin, R.J.; Jernigan, T.C.; Schaffer, M.J.
July 1975
NTIS

ANL/CTR-75-4, pp.553-564
The TEXTOR-Project for Plasma-Wall-Interaction.
Wolf, G. (Chairman)
July 1975
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