

A533B AND A502B
WELD DATA FROM FR-EDB/2

- $Cu \leq 0.1 \text{ wt} \%$
- $0.1 < Cu \leq 0.2$
- $0.2 < Cu \leq 0.3$

Cu 0.44 wt%

Reactor Dosimetry:

12th International Symposium

Neutron Fluence, $E > 1.0 \text{ MeV}$ (n/m^2)

STP 1490

Editors:

David W. Vehar

David M. Gilliam

James M. Adams



INTERNATIONAL

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Reactor Dosimetry
12th International Symposium

*David W. Vehar,
David G. Gilliam,
and
James M. Adams, editors*

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Foreword

The Twelfth International Symposium on Reactor Dosimetry was held in Gatlinburg, Tennessee, USA, May 8–13, 2005. This Symposium was jointly sponsored by ASTM International, the European Working Group on Reactor Dosimetry (EWGRD), and the Atomic Energy Society of Japan (AESJ). It was organized by ASTM Committee E10 on Nuclear Technology and Applications and the EWGRD. The Local Organizing Committee was chaired by Douglas L. Selby of Oak Ridge National Laboratory (ORNL). Co-sponsors were Sandia National Laboratories, UT-Battelle (ORNL), Thermo Electron/RMP, Canberra Industries, the National Institute of Standards and Technology, and the U.S. Department of Energy.

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IN MEMORIAM

Masaharu Nakazawa, 1944–2006

We lost our friend and colleague Prof. Masaharu Nakazawa, who died of heart failure on March 10, 2006. From 1967 until his death, Masaharu worked at Faculty of Engineering, the University of Tokyo, where he progressed from research associate to become Director of Research Center for Nuclear Science and Technology. For nearly 40 years, he had contributed to the establishment of nuclear engineering in Japan as one of the leaders in radiation measurement and dosimetry. His special expertise and accomplishments were in the neutron dosimetry, in particular, unfolding neutron energy spectra from foil activation detector and ^3He proportional counter measurements, in the application of lasers and optical fibers to radiation measurement and reactor vessel surveillance, and in the development of superconducting X-ray detectors. Recently, he was also very enthusiastic about the spread of advanced medical and diagnostic applications of radiation in Japan.

Masaharu was well known to participants of the International Reactor Dosimetry Symposia. He was actively involved in the organization of the 10th Symposium held in Osaka in 1999, and also was a member of the program committee of the 11th Symposium in Brussels in 2002. He was always loved and respected by his colleagues and students in Japan and elsewhere for his originality, foresight, good humor and constant dedication to research and education.

Francis Kam, 1929–2005

Francis Kam, known to many of us as Frank, died November 15, 2005 at age 76. He was a researcher at Oak Ridge National Laboratory for 33 years starting in 1961. During that time period, he was deeply involved in and made significant contributions to ASTM E10 and the field of nuclear dosimetry. Frank was involved in the development, documentation, and application of several computer codes used for neutron transport analysis, including the O5R Monte Carlo Code. His publication list in the area of dosimetry included 19 journal articles, 4 book chapters and an assortment of conference publications and reports. Although retired, he was able to attend the 12th International Symposium on Reactor Dosimetry in May of 2005 where he was recognized for his lifetime achievements. Frank is clearly one of those people where it can honestly be said that he made a difference and he will be missed by many.

Harry Farrar IV, 1935–2007

Harry Farrar IV will be long remembered for his contributions to ASTM and to many of the past symposia on reactor dosimetry. Born in England, he emigrated at an early age with his family to Canada. After receiving his PhD from McMaster University, he joined Rockwell International, where he developed a helium mass spectrometer system that formed the basis for a number of dosimetry applications. These include the Helium Accumulation Fluence Monitor, which received an IR-100 award in 1978. Harry participated in early efforts to resolve discrepancies in neutron fluence measurements, starting with the Inter-Laboratory Reaction Rate Program in the early 1970s.

Harry was a contributor to the First ASTM-Euratom Symposium on Reactor Dosimetry in 1975, and continued to serve this symposium series in various capacities, including several terms as

chairman. Harry also initiated and chaired several ASTM international workshops on radiation dosimetry. In 1984, Harry formed a task group "Radiation Dosimetry for Food Processing", which was later expanded to include dosimetry standards for all forms of radiation processing. In 1988 this group became ASTM E10.01, "Dosimetry for Radiation Processing." Under Harry's leadership, it became one of the most successful activities of Committee E10. He was also instrumental in a pioneering effort to have these ASTM standards accepted internationally as ISO standards. Harry has held several ASTM Committee E10 offices, including two terms as chairman. His contributions have been recognized with numerous E10 awards, as well as the ASTM Award-of-Merit in 1992.

Harry was a world traveler, an award-winning amateur photographer, and a man of many other accomplishments. He had an uncanny knack for making friends and creating a warm environment wherever he went. Harry led an amazing life and shared it with all of us.

Overview

The papers in this volume were presented at the Twelfth International Symposium on Reactor Dosimetry, and subsequently published in the Journal of ASTM International (JAI) following peer review. Eighty-seven participants from twenty countries attended the meeting.

Several trends are evident in the papers presented at this symposium. As operating nuclear power reactors have aged and continue to operate on extended operating licenses, new pressure vessel surveillance techniques have been required. In many cases, the original loadings of metallurgical surveillance specimens and their dosimeters have been completely used up. Innovative retrospective dosimetric techniques based on stable isotope transmutation or in-vessel gamma spectrometry are being developed and applied. Eastern European PWR's (especially those of the VVER-440 type) continue to have greater concerns about steel embrittlement, because of higher neutron radiation exposures than most Western European and US reactors. Accordingly, broader dosimetry studies are being made on the VVER reactors through retrospective dosimetry, ex-vessel dosimetry, and careful re-analysis of previously reported data. Vastly improved computer capabilities, international cooperation in nuclear data evaluations, maturation of analytic and adjustment software, and new data from "autopsies" of old decommissioned reactors have all contributed to greater reliability of reactor performance and materials calculations. Throughout the industry and regulatory bodies, there appears to be greater reliance on calculations in place of traditional methods of dosimetry and associated quality assurance.

The opening and keynote session included two papers, one on the very large new Olkiluoto 3 reactor under construction in Finland and one on the new Spallation Neutron Source under construction at Oak Ridge National Laboratory, the host laboratory.

There were seven plenary oral sessions of five or six papers each, and two poster sessions of about twenty-four papers each. In addition, there were two tutorials in parallel, and three workshop sessions with two parallel topics during each session.

The tutorials focused on materials science—one on radiation effects on materials, and one on materials science experiments based on neutron scattering.

Both the oral and poster sessions included the topics Power Reactor Surveillance; Test Reactors, Accelerators, and Advanced Systems; Benchmarks and Intercomparisons; Cross Sections, Nuclear Data, and Damage Correlations; Transport Calculations; Adjustment Methods and Reactor Dosimetry; and Experimental Techniques. In these proceedings, no distinction is made between the poster and oral papers, other than the notation of the awards for best poster papers.

The workshop sessions emphasized a discussion format rather than formal presentations. Workshop topics were LWR Surveillance and Retrospective Dosimetry; Dosimetry for Irradiation Facilities at Test and Research Reactors; Cross-Section Files and Uncertainties; Fusion and High Energy Neutrons; Adjustment Methods and Uncertainties; and Radiation Damage Correlations.

Best poster-paper awards were presented to Desislava Kirilova for "Validation of the Neutron Fluence on the VVER-440 RPV Support Structure," *K. Ilieva, S. Belousov, D. Kirilova, B. Petrov, E. Polk*, and to Mike Luker for "Application of a Silicon Calorimeter in Fast Burst Reactors," *S. M. Luker, K. R. DePriest, P. J. Griffin, D. B. King, G. E. Naranjo, A. J. Suo-Anttila*.

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