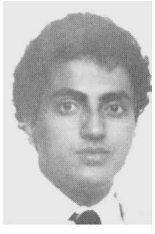
nuclear technology®

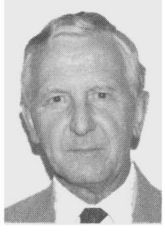
AUTHORS — MARCH 1985

FISSION REACTORS

A SEMIEMPIRICAL RELATIONSHIP FOR THE EXCESS REACTIVITY OF A REACTOR AS A FUNCTION OF CYCLE TIME, AXIAL FLUX FORM FACTOR, AND LEAKAGE PARAMETER

Ashwin P. Muzumdar
Douglas G. Andrews





Ashwin P. Muzumdar (top) (BA, physics, University of Oxford, 1975; MSc, electrical engineering, University of Waterloo, 1977; MEng., chemical engineering, University of Toronto, 1981; MSc, computer science, University of Toronto, 1985; PE) has worked at Ontario Hydro since 1977, where he is currently a nuclear design engineer. He has worked on a variety of projects using computers in the nuclear field. His current interests include the use of data base and artificial intelligence computer techniques for nuclear and medical applications. **Douglas G. Andrews** (BS, 1939, and MS, 1943, engineering science, University of Cambridge) worked with the Royal Naval Scientific Service, specializing in underwater weapons, during World War II. Following the war he joined the precursor of the U.K. Atomic Energy Authority, conducting basic technical design studies on thermal and fast reactors, diffusion plant, chemical separation plant, and radioactive waste storage facilities. He also spent some time on U.K. Defense Headquarters Staff. In 1957 he emigrated to Canada, becoming professor of nuclear engineering at the University of Toronto and holder of Canadian Operating License No. 1, with special interest in reactor physics, heat transfer, and safety analysis. He retired in 1983, becoming Professor Emeritus.

PRIMARY COOLANT FEED AND BLEED OPERATING REGIONS FOR THE MIDLAND PLANT

Hsian Shi Tsai

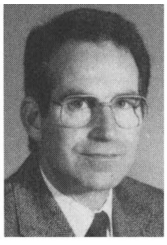
Hsian Shi Tsai (BS, mechanical engineering, Ordnance Engineering College, 1953; MS, nuclear science, National Tsing Hua University, 1959; PhD, nuclear engineering, University of Michigan, 1968) has been a staff engineer for the Midland Project Engineering Department of Consumers Power Company from 1977 to the present, where his responsibilities include the nuclear plant safety review, the system reliability analysis, and the probabilistic risk assessment of the Midland Plant. After joining Consumers Power Company in 1968 as a senior engineer, he was responsible for the off-site and on-site dose assessment, the

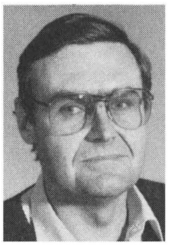
technical review and reliability assessment of several nuclear plant safety systems, and the on-site meteorological data collection and reduction. From 1959 to 1964, he served as an instructor in National Tsing Hua University, where his responsibilities included the reactor physics laboratory and operation of the university's 1-MW research reactor.

NUCLEAR SAFETY

EXPERIMENTAL DETERMINATION OF THE ATMOSPHERIC DISPERSION PARAMETERS AT THE KARLSRUHE NUCLEAR RESEARCH CENTER FOR EMISSION HEIGHTS OF 60 and 100 m

P. Thomas
K. Nester

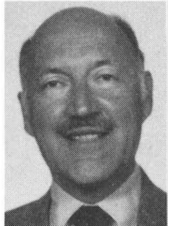




P. Thomas (top) [PhD, 1964, and Dr. rer. nat., 1967, Technical University Munich, Federal Republic of Germany (FRG)] is a physicist at the central safety department of the Karlsruhe Nuclear Research Center (KfK) and a coworker in the Climate Research Program. He works in the environmental meteorology department. His present activities include performing and evaluating atmospheric diffusion experiments and using tracer techniques and constant level balloons tracked by radar. He participates in meteorological measurements by tower instruments and Doppler Sodar Systems and in the evaluation of these measurements. His current interests are the transport and behavior of nuclear and chemical pollutants in the atmosphere and environment. **K. Nester** (Dipl.-Met., Technical University Darmstadt, FRG, 1966) is a meteorologist at the central safety department of the KfK. He works in the environmental meteorology department. His main activities relate to the development of numerical models describing atmospheric diffusion. In this context, he is presently working on the computation of three-dimensional mesoscale wind fields. He is also participating in a project on the environmental effects of interaction of stack and cooling tower plumes.

HIROSHIMA AND NAGASAKI INITIAL RADIATIONS: DELAYED NEUTRON CONTRIBUTIONS AND COMPARISON OF CALCULATED AND MEASURED COBALT ACTIVATIONS

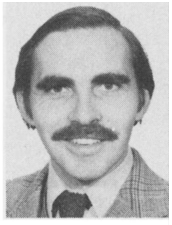
William E. Loewe



William E. Loewe [AB, University of Chicago, 1952; BS, physics, University of Illinois, Urbana, 1953; MS, 1959, and PhD, 1963, physics, Illinois Institute of Technology (IIT), Chicago] has contributed papers on physics problems occurring in nuclear reactors and in nuclear weapons and their effects while employed at the Savannah River Laboratory, IIT Research Institute, Westinghouse Electric Corporation, and Lawrence Livermore National Laboratory. Since 1980, when he and his collaborator publicly challenged and replaced the T65D estimates, he has worked on increasing the confidence in the new dose levels assigned to individual atomic-bomb survivors, which are a necessary ingredient of epidemiological studies on the biological effects of ionizing radiation.

OPTICAL THORIUM-FUELED CANDU NUCLEAR REACTOR FUEL MANAGEMENT

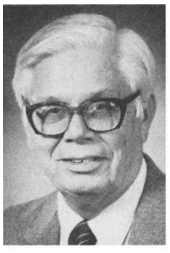
Hugues W. Bonin
Alexander Sesonske

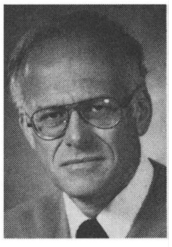


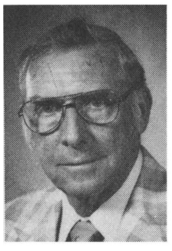
Hugues W. Bonin (top) (BA, Collège de Saint-Laurent; BSc, physics, Université de Montréal; BScA and engineering degree, engineering physics, Ecole Polytechnique, Montréal; MIng, nuclear engineering, Ecole Polytechnique; PhD, nuclear engineering, Purdue University, 1983) is currently an assistant professor of nuclear engineering at Royal Military College. His present research interests are in optimal fuel management of thorium-fueled CANDU nuclear reactors and in the design of neutron moisture gauges for roofing surveys. He is an active member of many learned societies and associate editor of the Canadian Nuclear Society's Bulletin. **Alexander Sesonske** (PhD, University of Delaware, 1950) is professor of nuclear engineering at Purdue University. In addition to nuclear fuel management, his interests include nuclear reactor engineering, reactor safety, and thermal hydraulics.

URANIUM DIFFUSION IN H-451 GRAPHITE

O. K. Tallent
R. P. Wichner
Roy L. Towns



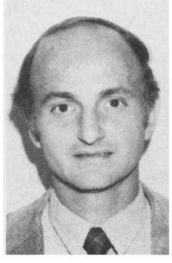




O. K. Tallent (top) (BS, chemistry, University of Tennessee, 1966) is a chemist at Oak Ridge National Laboratory (ORNL). His current interests include actinide separation, high-temperature gas-cooled reactor (HTGR) chemistry, and waste management. **R. P. Wichner** (center) (BS, chemical engineering, City University of New York; MS, chemical engineering, University of Cincinnati; PhD, engineering science, University of Tennessee) has worked in the areas of reactor development, environmental impacts of reactors, and water desalination. Currently he is manager of reactor safety and development activities in the Chemical Technology Division of ORNL. **Roy L. Towns** (bottom) is an engineering technologist in the Chemical Technology Division at ORNL. He has worked on a variety of high-temperature chemistry problems connected with the HTGR and the pressurized reactor programs. His current interests continue in these areas.

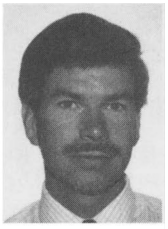
HIGH-TEMPERATURE GAS-COOLED REACTOR FUEL PRESSURE VESSEL PERFORMANCE MODELS

William J. Kovacs
Karl Bongartz
Dan T. Goodin



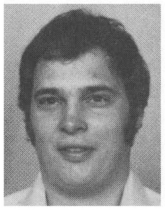
William J. Kovacs (top) (PhD, materials science, Carnegie-Mellon University, 1969) is a staff scientist at GA Technologies, Inc. (GA). He has been involved in material development programs for improving coated particle fuel behavior during irradiation. Current interests include statistical quality control and Monte Carlo simulation studies. **Karl Bongartz** (bottom) (Dr. rer. nat., physics, Technical University of Aachen, 1965) works in the Department for Reactor Materials at the Nuclear Research Center, Jülich. He has been involved in stress modeling of coated

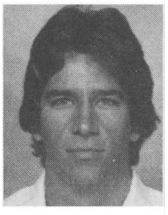
particle fuel behavior during irradiation and also in the measurement of mechanical properties of coating materials. Current interests involve computer modeling of gas/gas equilibria. **Dan T. Goodin** (right) (MS, radiochemistry, University of Kentucky, 1980) is a senior scientist at GA. He is involved with both experimental testing as well as thermal and mechanical performance modeling of coated particle fuels. His interests also include fission product behavior and transport.

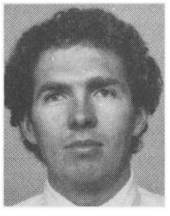


ROD BUNDLE BURNOUT DATA AND CORRELATION COMPARISON

Graydon L. Yoder, Jr.
David G. Morris
Charles B. Mullins



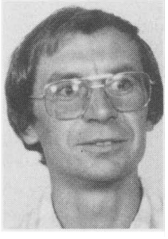




Graydon L. Yoder, Jr. (top) (BS, mechanical engineering, Pennsylvania State University, 1973; MS, mechanical engineering, University of California, Berkeley, 1975; PhD, mechanical engineering, Massachusetts Institute of Technology, 1980) is currently interested in multiphase heat transfer. **David G. Morris** (center) (BS, 1978, and MS, 1979, nuclear engineering, University of Florida) has worked in the area of postcritical heat flux heat transfer for the past two years and is currently interested in this area of research. **Charles B. Mullins** (bottom) (BS, physics, 1975, and MS, mechanical engineering, 1977, University of Texas at Austin; BS, chemical engineering, 1982, University of Tennessee) has been studying boiling heat transfer for the past three years.

ISARD, A METHOD OF TOMOGRAPHIC RECONSTRUCTION OF THE POSITION OF GAMMA EMITTERS IN A NUCLEAR FUEL PIN FROM TRANSVERSAL GAMMA SCANNING

Gérard Ducros

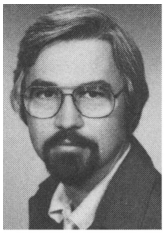


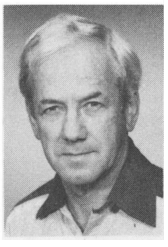
Gérard Ducros (nuclear and electronics engineer, University of Grenoble, France, 1976 and 1977; doctor engineer, nuclear physics, University of Paris, 1980) is an engineer at the Commissariat à l'Energie Atomique, France. His interests and activities are in interpreting and developing nondestructive irradiation examination devices in nuclear research reactors, particularly in-pile gamma scanning and neutron radiography.

MATERIALS

DISSOLUTION OF METAL OXIDES ACCUMULATED IN NUCLEAR STEAM GENERATORS: STUDY OF SOLUTIONS CONTAINING ORGANIC CHELATING AGENTS

Roland Gilbert
Lorenzo Ouellet





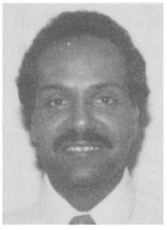
Roland Gilbert (top) (MSc, 1971, and PhD, 1974, physical chemistry, Université de Montréal) joined Hydro-Québec's research institute, IREQ, Varennes, Québec, in 1973. In 1977, he worked at the Chalk River Nuclear Laboratories in Ontario, where he was involved in the development of reactor decontamination and steam generator chemical cleaning processes. He is currently a project manager in the Metallurgy and Nuclear Technology Group of IREQ. His interests include water chemistry and conditioning as well as chemical cleaning and decontamination of components and systems. **Lorenzo Ouellet** (Diplome, technology, Institut de papeterie de la province de Québec, 1954) has been with IREQ since 1972. Before that he was at the research laboratories of Shawinigan Chemicals and Gulf Canada

where he worked in the field of suspension and emulsion polymerization. He is now working as a research collaborator in projects related to chemical cleaning and water chemistry carried out by the Metallurgy and Nuclear Technology Group.

HEAT TRANSFER AND FLUID FLOW

COMPUTATIONAL INVESTIGATION OF FLUID AND THERMAL MIXING OF THE EPRI/CREARE ONE-FIFTH-SCALE FACILITY

Yassin A. Hassan
J. H. Kim



Yassin A. Hassan (top) (BS, nuclear engineering, University of Alexandria, 1968; MS, 1975, and PhD, 1979, nuclear engineering, University of Illinois) is a senior engineer at the Utility Power Generation Division, Babcock & Wilcox Company, Lynchburg, Virginia. His activities are in the area of computational methods for problems in fluid flow and heat transfer. His computation work includes both finite difference and finite element techniques for various thermal-hydraulic aspects and fluid flow analysis. **J. H. Kim** (PhD, mechanical engineering, California Institute of Technology, 1971) is a project manager in the Nuclear Power Division of the Electric Power Research Institute. His interests include computational methods, testing and analysis in fluid flow, and heat transfer.

EVALUATION OF COUNTERCURRENT GAS/LIQUID FLOW IN PARALLEL CHANNELS WITH RESTRICTED ENDS

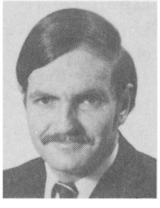
Michio Murase
Hiroaki Suzuki

Michio Murase (top) (BS, mechanical engineering, Nagoya Institute of Technology, 1971; MS, mechanical engineering, Kyoto University, 1973) is a researcher at Energy Research Laboratory, Hitachi Ltd. His current interests are in two-phase flow measurements and thermal-hydraulic experiments on nuclear reactor safety. He worked on two-phase flow measurements by pulsed photon activation at Rensselaer Polytechnic Institute from September 1982 to August 1983. **Hiroaki Suzuki** (BS, applied physics, 1979; MS, energy science, 1981, Tokyo Institute of Technology) is a researcher at Energy Research Laboratory, Hitachi Ltd. His interests are in experiments and analysis of thermal-hydraulic behavior under boiling water reactor loss-of-coolant conditions.

NUCLEAR FUELS

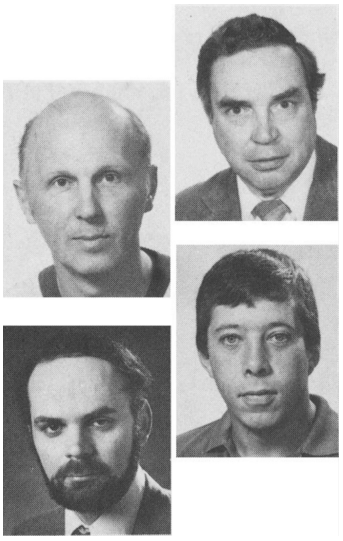
POSTIRRADIATION BEHAVIOR OF NATURALLY AND ARTIFICIALLY DEFECTED UO_2 FUEL ELEMENTS AT 250°C IN AIR

Ian J. Hastings
Elio Mizzan
John R. Kelm
Robert E. Moeller
J. Novak



Ian J. Hastings (right) (PhD, metallurgical science, University of Queensland, 1968) is head of the Fuel Properties and Behaviour Group in the Fuel Materials Branch at the Chalk River Nuclear Laboratories (CRNL) of Atomic Energy of Canada Limited. His current interests are in oxide fuel behavior under irradiation, particularly release of short-lived fission

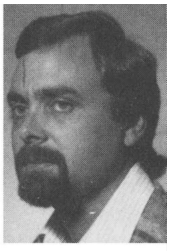
products under normal and accident conditions, and in fusion ceramics. **Elio Mizzan** (top right) (BASc, chemical engineering, University of Toronto, 1949) is a supervisor at the Fuel Materials Branch Hot Cell Facility at CRNL. His interests have been in the areas of post-irradiation examination of reactor fuels and materials, particularly post-defect handling of spent UO_2 fuel. **John R. Kelm** (top left) is a research technician in the Fuel Materials Branch at CRNL. His research responsibility is the operation of a special project hot cell. His current interest is UO_2 oxidation and stress corrosion cracking. **Robert E. Moeller** (bottom right) was a research technician in the Fuel Materials Branch at CRNL when this study was carried out. He is currently a member of the Radiation and Industrial Safety Branch. **J. Novak** (bottom left) (BASc, engineering science, University of Toronto, 1974) is employed in Central Nuclear Services, Nuclear Generation Division of Ontario Hydro. Since 1976 he has been engaged in the areas of nuclear fuel production and development. His current technical interests include behavior of irradiated fuel in air, UO_2 powder characteristics, and fuel performance improvement.



MATERIALS

THERMAL EXPANSION OF U.S. AND AUSTRALIAN SYNROC B

Hans Rolf Käse
John Aloysius Tesk
Eldon Darrel Case



Hans Rolf Käse (top) (PhD, mineralogy, University of Gottingen, Federal Republic of Germany, 1978) is currently employed as a researcher in the Department of Prosthetic Dentistry, University of Gottingen, and is concerned with dental materials. From 1982 to 1984 he was a guest employee at the U.S. National Bureau of Standards (NBS), Dental and Medical Materials Group, Polymers Division in Washington, D.C. Measurements of the properties of dental ceramics, alloys, and composites were his primary interests. Corresponding investigations on nuclear waste disposal materials were conducted. He was also involved in the development of regression equations that described the casting behavior of dental alloys. Current interests include the chemistry of polymer composite resins and cements. **John Aloysius Tesk** (center) (PhD, materials science, Northwestern University, 1963) is a group leader in dental and medical materials at NBS. During 1977-1978 he was director of education services at the Institute of Gas Technology, Chicago, with responsibilities for curricula, supplies, staffing, and seminars for overseas educational programs in liquefied natural gas technology. From 1970 to 1977 he was director of research and development with the Dental Division of Howmedica, Inc., responsible for new product development and quality control departments. He was an assistant metallurgist at Argonne National Laboratory (ANL) from 1968 to 1970, working on the dynamic effects of neutron radiation on the creep of candidate breeder reactor materials. From 1964 to 1968 he was an assistant professor of materials engineering at the University of Illinois, Chicago, and a consultant to ANL on studies of neutron damage in metals at 4 K. **Eldon Darrel Case** (bottom) (BS, physics and mathematics, University of Colorado, 1971; MA, physics, University of Northern Colorado, 1975; PhD, materials science, Iowa State University, 1980) is a research engineer in the Department of Materials Science at the University of California, Berkeley. His research interests are in the mechanical and thermal properties of ceramics, and he is currently working on the impact of water drop damage in brittle materials.