



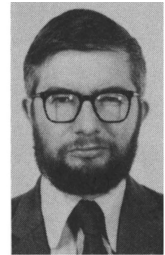
AUTHORS — DECEMBER 1979

NUCLEAR POWER REACTOR SAFETY

COMMON-MODE FAILURES IN REDUNDANCY SYSTEMS

*I. A. Watson
G. T. Edwards*

Ian A. Watson (top) studied electrical engineering at King's College (now University of Newcastle upon Tyne), England, and received a degree in applied science in 1959. After some years in the electronics industry, he joined Elliott Flight Automation (now GEC Marconi Elliott Avionic Systems Ltd.) and became concerned with aircraft automatic landing systems and eventually was responsible for advanced flight control systems. In 1975, he joined the National Centre of Systems Reliability at the Safety and Reliability Directorate, U.K. Atomic Energy Authority (UKAEA), Culcheth, England. His work has been concerned with system reliability analysis and plant availability assessment in connection with both nuclear and non-nuclear installations. Common-mode failures (CMFs) are part of a continuing interest in high integrity control and protection systems. **Gordon T. Edwards** [IEE diploma, electrical engineering, Royal College of Advanced Technology (now University of Salford), Salford, England, 1965] joined UKAEA Risley in 1961 and worked on the design of instrument systems for nuclear reactors until his transfer to their Safety and Reliability Directorate in 1974. His work has mainly been reliability analysis of control and protection systems for reactors and chemical plants. His current interests also include CMFs and plant availability analysis.



THE BEHAVIOR OF CONCRETE IN CONTACT WITH MOLTEN CORIUM IN THE CASE OF A HYPOTHETICAL CORE MELT ACCIDENT

*Martin Peehs
Alfred Skokan
M. Reimann*

Martin Peehs (top) (Dr. rer. nat., University of Saarbrücken, Germany, 1964) is department manager for fuel and special technologies at Kraftwerk Union AG, Erlangen, Federal Republic of Germany. His main interest is in the field of materials science, with special emphasis on fuel development and reactor safety. **Alfred Skokan** (center) (Dr. rer. nat., University of Bonn, Germany, 1972) is a scientific staff member in the Institute for Materials and Solid State Research of the Nuclear Research Center Karlsruhe (KFK) in the Federal Republic of Germany. His interests include phase relations and reactions of nuclear materials, as well as the structure of solids. He is currently involved in materials research concerning hypothetical light water reactor accidents. **Michael Reimann** (bottom) (Dr. Ing., mechanical engineering, Technical University Munich, 1974) has done research in thermodynamics and heat transfer. For the past few years, he worked at KFK on reactor safety problems. At present, his main interest is model development for core meltdown accidents.



TEST PREDICTION FOR THE GERMAN PKL TEST K5A USING RELAP4/MOD6

Yi-Shung Chen (top right) (PhD, mechanical engineering, University of Washington, 1974) is a senior specialist in the Reference Code Development Branch at EG&G Idaho, Inc. His interests include fluid mechanics, heat transfer, two-phase flow, and computer code development for reactor safety. **William S. Haigh** (top left) (MS, Brown University, 1951) is currently a science and engineering supervisor in the Code Assessment and Applications Program of EG&G Idaho, Inc. at the Idaho National Engineering Laboratory. His main technical application is in the assessment of reactor transient analysis codes through comparison of code calculations with a broad scope of reactor safety experimental data. **L. H. Sullivan** (bottom right) (BS, nuclear engineering, North Carolina State University, 1966; MS, chemical engineering, University of Maryland, 1970; PhD, nuclear engineering, 1972) is currently the branch manager of the Reference Code Development Branch at EG&G Idaho, Inc. His main areas of technical expertise include two-phase heat transfer, two-phase flow, computer code development, reactor physics, and emergency core cooling system performance analysis. **S. R. Fischer** (bottom left) (BS, mechanical engineering, Purdue University, 1964; MSE, 1967, PhD, mechanical engineering, 1970) is currently a section supervisor in the Reference Code Development Branch at EG&G Idaho, Inc. His areas of technical expertise include heat transfer two-phase flow, hydraulic, water reactor safety code development, and computer programming.

*Yi-Shung Chen
William S. Haigh
L. Harold Sullivan
Stewart R. Fischer*



PARAMETER STUDY ON THE INFLUENCE OF PREPRESSURIZATION ON PWR FUEL ROD BEHAVIOR DURING NORMAL OPERATION AND HYPOTHETICAL LOCAs

B. Brzoska (top right) (Dipl. Phys., physics, 1971, Dr. rer. nat., 1974, Friedrich-Alexander-University Erlangen-Nürnberg) is senior supervisor in the field of fuel rod design at Kraftwerk Union (KWU) in the Federal Republic of Germany. **F. L. Depisch** (top left) (Dipl. Ing., technical physics, 1965, Dr. Ing., 1968, Technical University of Vienna) is senior supervisor in the field of loss-of-coolant accident analysis at KWU. **H. P. Fuchs** (bottom right) (Dipl. Ing., mechanical engineering, University of Technology Munich, 1968) is currently subdivision manager in the field of fuel assembly and core component design at KWU. **W. Sauermann** (bottom left) (Dipl. Ing., nuclear engineering, University of Technology Hannover, 1977) is currently involved with fuel rod design and licensing problems at KWU.

*B. Brzoska
F. Depisch
H. P. Fuchs
W. Sauermann*



COMPARISONS BETWEEN MEASURED AND FRAP-T4-PREDICTED FUEL ROD FAILURE PROBABILITY UNDER PELLETT-CLADDING INTERACTION CONDITIONS

Dennis R. Coleman (BA, philosophy, Duquesne University, 1971) is presently a special projects consultant at Nuclear Associates International Corporation in Rockville, Maryland. His 11 years of experience at Westinghouse Nuclear Division, Nuclear Fuel Services, Inc., and the Idaho National Engineering Laboratory has involved development, application, and management of fuel rod and core analysis models and data processing systems.

Dennis R. Coleman



THE AXIAL DISTRIBUTION OF DEFORMATION IN THE CLADDING OF PRESSURIZED WATER REACTOR FUEL RODS IN A LOSS-OF-COOLANT ACCIDENT

Kenneth M. Rose (top) (BA, natural sciences, University of Cambridge, 1944; PhD, crystallography, London, 1966) has been a scientist with the United Kingdom Atomic Energy Authority (UKAEA) since 1958, working on fuel for power reactors. His special interests have included the Steam Generating Heavy Water Reactor at Winfrith and water reactor fuel behavior under accident conditions. **C. Alan Mann** (center) (BSc, physics, University of Liverpool, 1948) has been a scientist with the UKAEA since 1956, working on fuel for power reactors. His special interests have included nondestructive testing and latterly the evaluation of water reactor fuel elements. **Edward D. Hindle** (bottom) (BSc, metallurgy, University of Manchester, 1959; MSc, metallurgy, University of Manchester, 1968; chartered engineer, 1978) has been a scientist with the UKAEA since 1954, working on fuel for power reactors. His special interests include the metallurgy of zirconium alloys and the behavior of fuel rods during hypothetical reactor loss-of-coolant accidents.

*K. M. Rose
C. A. Mann
E. D. Hindle*



FAILURE MECHANISMS AND FISSION PRODUCT RELEASE IN HIGH-TEMPERATURE GAS-COOLED REACTOR FUEL UNDER CONDITIONS OF UNRESTRICTED CORE HEATUP EVENTS

Werner Schenk (top) (Dr. Ing., nuclear engineering, Technical University of Aachen, 1978) has been employed at Kernforschungsanlage (KFA), Jülich, in the Hot Cell Laboratories Division since 1964, where he was engaged in the development of hot laboratory facilities and postirradiation examinations of experimental fuel for high-temperature reactors. Presently, he is responsible for postirradiation annealing examinations, particularly at very high temperatures. **Aristides Naoumidis** (Dr. rer. nat., chemistry, Technical University of Aachen, 1967) has worked at KFA as a research chemist since 1962 and is head of the Chemistry and Ceramics Division in the Department for Reactor Materials. His special interest is in high-temperature behavior (fabrication, stability, corrosion, and irradiation) of ceramics and of high-temperature gas-cooled reactor and liquid-metal fast breeder reactor fuel.

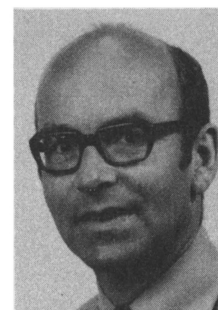
*W. Schenk
A. Naoumidis*



MODES OF FAILURE OF FAST REACTOR FUEL PINS IRRADIATED UNDER LOSS-OF-COOLANT-FLOW CONDITIONS

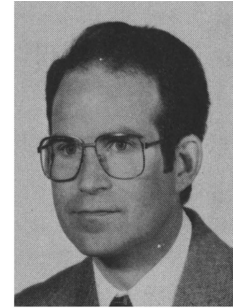
H. Kwast (MSc, metallurgy, Technical University, Delft, The Netherlands, 1966) has been a senior scientist in the Materials Department of The Netherlands Energy Research Foundation ECN, Petten, since 1968. He is involved in in-pile loss-of-cooling experiments on single liquid-metal fast breeder reactor type fuel pins, with special interest in fuel and fuel pin behavior during overload conditions.

H. Kwast



AN ON-LINE METEOROLOGICAL INFORMATION SYSTEM FOR RESPONSE TO ACCIDENTAL RELEASES OF RADIOACTIVITY INTO THE ATMOSPHERE

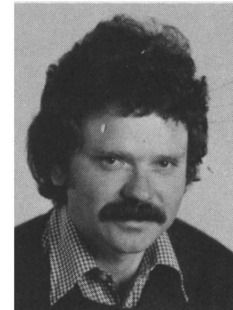
Helmut Peter Thomas



Helmut Peter Thomas (PhD, 1964, Dr. rer. nat., 1967, Technical University of Munich) is a physicist in the Safety Department at Kernforschungszentrum Karlsruhe (KFK) and a co-worker in the Nuclear Safety Project. He works in the Environmental Meteorology Group. His present activities consist of performing and evaluating experiments on atmospheric diffusion, using tracer techniques and constant level balloons. He is interested in health physics, radionuclide behavior in the environment, and meteorological and environmental aspects of nuclear power production. Before joining KFK, he worked on neutron physics at the German-French High Flux Reactor at Grenoble, France.

RADIONUCLIDE TRANSPORT IN SOIL—DESCRIPTION AND APPLICATION OF A CALCULATIONAL MODEL

K. Schwarzer



Klemens Schwarzer (Dipl. Ing., nuclear technology, Technische Universität Berlin, 1974; PhD, Aachen University, 1978) is now a scientist at the Institute for Nuclear Safety Research at Kernforschungsanlage Jülich in Germany. His main area of work is concerned with fission product behavior and, in particular, the release of activity to the atmosphere and the migration in the ground.

CHEMICAL REACTIONS BETWEEN LIGHT WATER REACTOR CORE MELT AND CONCRETE

*Alfred Skokan
Helmut Holleck
Martin Peehs*



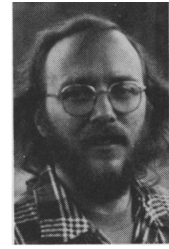
Alfred Skokan (top) (Dr. rer. nat., University of Bonn, Germany, 1972) is a scientific staff member in the Institute for Materials and Solid State Research at Kernforschungszentrum Karlsruhe (KFK) in the Federal Republic of Germany. His interests include phase relations and reactions of nuclear materials as well as the structure of solids. He is currently involved in materials research concerning hypothetical light water reactor accidents. **Helmut Holleck** (center) (Dr. phil., University of Vienna, Austria, 1965) is head of the Constitution and Thermodynamics Group at KFK. His main interests relate to chemical equilibria in different nuclear fuel systems, materials problems under accident conditions, and refractory materials, especially cemented carbides. **Martin Peehs** (bottom) (Dr. rer. nat., University of Saarbrücken, Germany, 1964) is department manager for fuel and special technologies at Kraftwerk Union AG, Erlangen. His main interest is in the field of materials science, with special emphasis on fuel development and reactor safety.



MODELING OF EQUIAXED GRAIN GROWTH IN URANIUM DIOXIDE FUELS

William L. Baldewicz (top) [BS, nuclear engineering, University of Wisconsin, 1970; MS, nuclear engineering, Carnegie-Mellon University, 1973; PhD, nuclear engineering, University of California, Los Angeles (UCLA), 1978] is presently on the faculty of the Department of Chemical Engineering at Clarkson College. His research work at UCLA included several projects in analytical modeling of nuclear fuel rod behavior. His current research is in ceramic microstructures and technology assessment. **Ahmed R. Wazzan** (center) (PhD, engineering science, University of California, Berkeley, 1963) is a professor in the Department of Chemical, Nuclear and Thermal Engineering at UCLA. His current fields of interest include fuel element modeling and laminar boundary layers. **David Okrent** (bottom) (PhD, physics, Harvard University, 1951) is a professor in the Department of Chemical, Nuclear and Thermal Engineering at UCLA. His current fields of interest include nuclear fuel element behavior, reactor safety, and risk-benefit.

*William L. Baldewicz
Ahmed R. Wazzan
David Okrent*



A NEW APPROACH FOR ROD-BUNDLE THERMAL-HYDRAULIC ANALYSIS

W. T. Sha (far right) (PhD, Columbia University, 1963) joined Argonne National Laboratory (ANL) in 1967, and is now a senior scientist and manager of the Analytical Modeling Section in the Components Technology Division. His major research contribution is in the numerical and phenomenological modeling of single- and multiphase flow behavior in reactor components. **H. M. Domanus** (second from left) (PhD, University of Illinois, 1973) joined ANL in 1974 after a year of systems experience at TRW. He specializes in developing computer codes to simulate thermal-hydraulic behaviors in reactor components. **R. C. Schmitt** (second from right) (BS, Western Illinois University, 1968) is a computer scientist at ANL specializing in computer graphics and developing and programming large computer codes. **J. J. Oras** (third from right) (PhD, University of Notre Dame, 1975) has specialized in heat transfer, fluid mechanics, magnetohydrodynamics (MHD), numerical analysis, and experimental techniques. His current interests are numerical modelings and experimental investigations of liquid-metal fast breeder reactor thermal stratification, thermal mixers, heat exchanger for MHD power systems, and intermediate heat exchanger for the Clinch River Breeder Reactor. **Ed I. H. Lin** (far left) (PhD, University of California, Berkeley, 1973) joined ANL in 1974. His current research interests are modelings of thermal-hydraulic phenomena in a reactor core, fast breeder reactor and light water reactor fuel element behavior, and thermocline solar energy storage systems. **V. L. Shah** (third from left) (PhD, Brown University, 1968) was a professor of energetics at the University of Milwaukee until he joined ANL in 1978. His research interests are heat transfer, fluid mechanics, and numerical modeling.

*W. T. Sha
H. M. Domanus
R. C. Schmitt
J. J. Oras
E. I. H. Lin
V. L. Shah*



INVESTIGATION OF LOCAL COOLING DISTURBANCES IN AN IN-PILE SODIUM LOOP IN THE BR2

Wolfgang Kramer (top right) (Dipl. Ing., University of Karlsruhe, 1957), after working five years in the mechanical engineering industry, joined Kernforschungszentrum Karlsruhe (KFK) in 1962. At present, he is deputy head of the Institute for Reactor Development. He is especially engaged in liquid-metal fast breeder reactor (LMFBR) safety-related experiments. **Karl Schleisiek** (top left) (PhD, nuclear engineering, University of Karlsruhe, 1973) is the leader of the Safety Instrumentation Group of the Institute for Reactor Development at KFK. He is currently involved with the problems of propagation and detection of local core faults in LMFBRs. **Lothar Schmidt** (center right) (Ing. Grad., Fachhochschule Siegen, 1961) is working as project engineer for the design and construction of irradiation devices at KFK. For 15 years, he has been occupied in this field. Presently, his main interests are devices for in-pile safety experiments with fast breeder fuel pin bundles. **Gilbert Vanmassenhove** (bottom left) (engineer, University of Ghent, 1956) is a member of the Nuclear Research Center SCK/CEN at Mol, Belgium, where he has been engaged for the last 15 years in the conception, design, construction, and operation of irradiation loops in the BR2 reactor. The irradiation programs are mainly related to gas-cooled and liquid-metal-cooled reactors. **Alfons Verwimp** (bottom right) (engineer, mechanical engineering, University of Ghent, 1969) is a project engineer in the Nuclear Research Center SCK/CEN at Mol, Belgium. He is working in the liquid-metal section, and is involved in sodium loop design for in-pile fuel bundle experimentation (LMFBR development).

W. Kramer
K. Schleisiek
L. Schmidt
G. Vanmassenhove
A. Verwimp



CONSIDERATIONS ON INCOHERENCY OF BOILING AND VOIDING IN LIQUID-METAL FAST BREEDER REACTOR SUBASSEMBLIES DURING A LOSS-OF-FLOW ACCIDENT

Reinier Nijssing (top) (MS, 1955, PhD, 1957, chemical engineering, Technical University of Delft, The Netherlands) has been employed since 1959 by the Joint Research Centre of the Commission of the European Communities in the Heat Transfer Division at the Ispra Establishment (Italy). He worked in heat transfer research in the framework of an organic cooled reactor project. During the period from 1967 to 1972, he was involved in basic research on thermohydraulics in fuel rod bundles. He is presently responsible for core thermohydraulics, particularly for fast reactor safety applications. He worked from March to July 1967 as a visiting professor at the University of Minnesota. **Walter Eifler** (MS, 1960, PhD, 1967, mechanical engineering, Technische Hochschule Darmstadt) has worked at the Joint European Research Centre at Ispra since 1960. His main research interests are fluid flow and heat transfer in nuclear reactor engineering.

R. Nijssing
W. Eifler



THE INFLUENCE OF METEOROLOGICAL PARAMETERS ON THE CONSEQUENCES OF ACCIDENTAL ACTIVITY RELEASES FROM NUCLEAR POWER PLANTS

Siegfried Vogt (right) (Dipl. Meteorologe, Technical University of Karlsruhe, 1968) has been a scientist in the Safety Department of Kernforschungszentrum Karlsruhe (KFK) and a co-worker in the Nuclear Safety Project since 1974. He works in the Environmental Meteorology Group and is engaged in the planning and performance of atmospheric diffusion experiments. He

Siegfried Vogt
Wolfgang G. Hübschmann

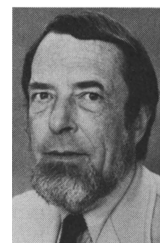


also develops computer codes for the determination of the probability and magnitude of health impacts from hypothetical accidents occurring in nuclear power plants. **Wolfgang G. Hübschmann** (Dr. Ing., nuclear engineering, Technical University of Hanover, 1962) is head of the Environmental Meteorology Group in the Safety Department at KFK. His main areas of interest are atmospheric diffusion and the radiological impact on the population by the radioactivity released into the atmosphere due to normal operation as well as under accident conditions.

THE FISSION PRODUCT RETENTION OF PEBBLE-BED REACTORS IN ULTIMATE ACCIDENTS

Klaus Petersen (top right) (Dipl. Ing., Technical University of Aachen, 1972) joined Kernforschungsanlage (KFA) Jülich in the Federal Republic of Germany in 1972. He is presently engaged in the safety analysis of the process heat prototype reactor, with special emphasis on the thermal-hydraulics of the pebble-bed reactor in hypothetical accidents. **Heinz Barthels** (top left) (Dr. Ing., Technical University of Aachen, 1967) is an engineer at the Institute for Reactor Components at KFA Jülich. His current work is in the experimental investigation and calculation of the pebble-bed heat transfer at high temperatures. **Heinz Erhard Drescher** (second from top right) (PhD, Technical University of Aachen, 1976) has worked since 1976 at the Institute of Reactor Development at KFA Jülich. His current work is in the fission product release out of the fuel elements of pebble-bed high-temperature reactors (HTRs) under hypothetical accident conditions. **Claus-Benedict von der Decken** (center left) (Dr. rer. nat., University Heidelberg, 1956) was with Brown Boveri/Krupp Company from 1956 to 1969, where he was responsible for experimental development of the pebble-bed reactor and the startup of the AVR reactor. Since 1969, he has been director of the Institute for Reactor Components at KFA Jülich. His main activities are in the field of HTR development: behavior of fission products, flow and heat transfer on components, and process heat application of HTRs. **Nicolaos Iniotakis** (second from bottom right) (Lic. ès. sc., orientation physique théorique, Université Neuchâtel, Switzerland, 1970) is a theoretical physicist at the Institute for Reactor Components at KFA Jülich. His current work is in theoretical research and calculation of fission product transport and deposition for HTRs during normal operational and accident conditions. **Werner Schenk** (bottom left) (Dr. Ing., nuclear engineering, Technical University of Aachen, 1978) has been employed at KFA Jülich in the Hot Cell Laboratories Division since 1964, where he was engaged in the development of hot laboratory facilities and postirradiation examinations of experimental fuel for HTRs. Presently, he is responsible for postirradiation annealing examinations, particularly at very high temperatures. **Rudolf Schulten** (bottom right) (Dr. rer. nat., Max Planck Institute Göttingen, 1953) was active in the Reactor Development Group of the Max Planck Society from 1953 to 1956. In 1956, he joined Brown Boveri & Cie Company, later acting as the technical managing director of Brown Boveri/Krupp Reaktorbau GmbH in Mannheim. Since 1964, he has been professor in ordinary for reactor technology at the Rheinisch Westfälische Technische Hochschule at Aachen and director at the Institute for Reactor Development at KFA Jülich. He is engaged in the development of a concept for future energy supply by nuclear energy with the pebble-bed HTR.

*K. Petersen
H. Barthels
H. E. Drescher
C. B. von der Decken
N. Iniotakis
W. Schenk
R. Schulten*



TRITIUM CONTAMINATION OF THE PRODUCT GAS IN A HIGH-TEMPERATURE REACTOR HEATED PROCESS PLANT

Wolfgang Steinwarz (top) (Dipl. Phys., molecular physics, University of Bonn, 1975) is a member of the Radiation Protection Department of Interatom, Internationale Atomreaktorbau GmbH, in the Federal Republic of Germany. His current work is in the calculation of fission product distribution in gas-cooled high-temperature reactors (HTRs). **Hans Josef Cordewiner** (center) (Dipl. Ing., mechanical engineering, Technical University of Aachen, 1975) is presently completing his doctoral thesis on calculations of the tritium balance in high-temperature pebble-bed reactors. He performed his investigations at Kernforschungsanlage Jülich (KFA). **H. Dieter Röhrig** (bottom) (Dr. Ing., nuclear engineering, Technical University of Aachen, 1970) is group leader at the Institut für Reaktorentwicklung of KFA. He has worked on applied nuclear physics with respect to scintillation decay, neutron activation analysis, and diffusion studies in ceramic nuclear materials and fuels. His present activities are in the field of hydrogen and tritium behavior in HTR circuits and materials.

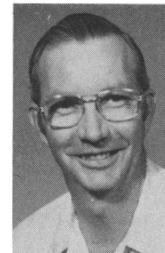
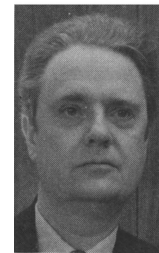
*W. Steinwarz
H. J. Cordewiner
H. D. Röhrig*



CONTROLLING CESIUM IN THE COOLANT OF THE EXPERIMENTAL BREEDER REACTOR II

W. H. Olson (top) (BS, mechanical engineering, Colorado State University, 1959) is plant chemistry supervisor at the Experimental Breeder Reactor II (EBR-II) at Argonne National Laboratory (ANL). He is active in the development of improved sodium purification and purity monitoring equipment for the Liquid-Metal Fast Breeder Reactor Program. **W. E. Ruther** (BS, MS, chemical engineering, Illinois Institute of Technology) is a chemical engineer in the EBR-II Division at ANL, where he is currently involved in material compatibility studies.

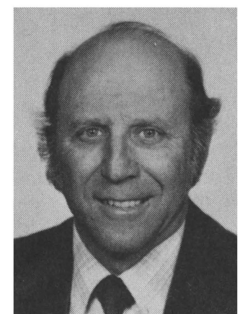
*W. H. Olson
W. E. Ruther*



A REVISED ANS STANDARD FOR DECAY HEAT FROM FISSION PRODUCTS

Virgil E. Schrock (BS, mechanical engineering, 1946, MS, mechanical engineering, 1948, University of Wisconsin, Madison; mechanical engineer, 1952, University of California, Berkeley) is a professor of nuclear engineering at the University of California, Berkeley, where he has served since formation of the Nuclear Engineering Department in 1958. Prior to that, he was a member of the mechanical engineering faculties at Berkeley and at Wisconsin. His research publications have been in the areas of heat transfer and fluid flow and thermal aspects of reactors and power systems. He has served as chairman of the American Nuclear Society (ANS) Standards Working Group 5.1 on Decay Heat since its establishment in 1967.

Virgil E. Schrock



ATTENUATION OF AIRBORNE DEBRIS FROM LIQUID-METAL FAST BREEDER REACTOR ACCIDENTS

Harry A. Morewitz (top photo, seated, right) (BA, physics, College of William and Mary, 1943; MA, Columbia University, 1949; PhD, New York University, 1953) has, for some years, managed the Liquid-Metal Fast Breeder Reactor (LMFBR) Physics and Safety Research Programs at the Energy Systems Group (ESG) of Rockwell International. **Richard P. Johnson** (top photo, standing, center) (BS, chemical engineering, Montana State College, 1957) is project engineer for the Accident Debris Behavior Program at ESG and is responsible for conducting LMFBR safety studies, including behavior of aerosols and core debris. **Carl T. Nelson** (top photo, standing, right) (BA, physics, University of South Dakota, 1947) is a member of the technical staff at ESG. He is a principal investigator in various tasks related to the LMFBR Safety Program. **Edward U. Vaughan** (top photo, seated, left) (BA, physics, University of California, Berkeley, 1943; MA, 1944; PhD, theoretical physics, 1956) of ESG has, during the last ten years, added work on aerosol modeling to previous interests in reactor theory and neutron transport. **Charles A. Guderjahn** (top photo, standing, left) (PhD, applied science, University of Cincinnati, 1956) has specialized in reactor safety for the last seven years at ESG. His current interests include aerosol behavior and post-accident heat removal. **Bob Hilliard** (bottom photo, right) (MS, chemical engineering, University of Idaho, 1960) has been involved in reactor safety research and development for 23 years, the last 7 dealing with LMFBR accident containment. He is currently on the staff of the Containment Systems Test Facility at Hanford Engineering Development Laboratory (HEDL), investigating sodium fires, their containment, and air cleaning. **Jerry McCormack** (bottom photo, center) (BS, chemical engineering, Oregon State University, 1950) has worked at HEDL in experimental studies of fission product and sodium aerosol behavior, air cleaning, and containment systems for both water and sodium-cooled reactors. He is currently on the staff of the Containment Systems Test Facility. **Arlin Postma** (bottom photo, left) (BS, 1958, PhD, 1970, Oregon State University) has, for the past 15 years, devoted his technical efforts to nuclear safety, and he is widely recognized for his work on containment spray systems in light water reactors. For the past four years, he has assisted in LMFBR aerosol behavior studies and in air cleaning development being carried out at HEDL, where he is a consultant. He is currently evaluating alternative air cleaning systems for an LMFBR containment system.

*H. A. Morewitz
R. P. Johnson
C. T. Nelson
E. U. Vaughan
C. A. Guderjahn
R. K. Hilliard
J. D. McCormack
A. K. Postma*



STEAM-WATER MIXING IN NUCLEAR REACTOR SAFETY LOSS-OF-COOLANT EXPERIMENTS

Samuel A. Naff (top) (BS, physics, Old Dominion University, 1964; MS, engineering, Carnegie-Mellon University, 1969) is manager of the Loss-of-Fluid Test (LOFT) Program Planning and Test Evaluation Branch of EG&G Idaho, Inc. at the Idaho National Engineering Laboratory (INEL). He has been involved in various phases of nuclear reactor safety research with both the LOFT and Semiscale programs for seven years. His special interests are in fluid mechanics and multiphase flow. **William F. Schwarz** (BS, electrical engineering, University of Washington, 1964; MB, business administration, University of Idaho, 1976) is involved in several nuclear reactor safety experimental programs at the INEL. His current interest is improved techniques for measuring two-phase fluid behavior in test facilities.

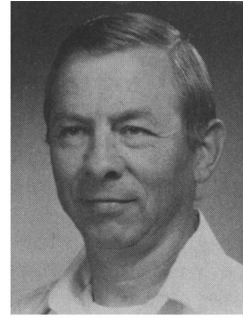
*Samuel A. Naff
William F. Schwarz*



IN-REACTOR EXPERIMENTS ON THE COOLING OF FAST REACTOR DEBRIS

J. B. Rivard

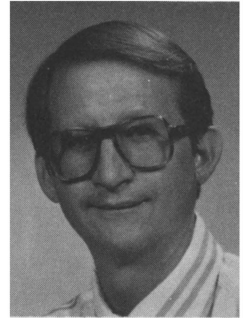
J. B. Rivard (BS, mechanical engineering, University of Florida, 1959) has been with Sandia Laboratories for 19 years, during which time he has been primarily engaged in reactor-related research and development work. For the past five years, he has been in charge of the In-Pile Debris Bed Experiment Program being performed at Sandia on behalf of the U.S. Nuclear Regulatory Commission. His current interest centers on achieving a sound understanding, via experiment and analysis, of the phenomena that characterize the post-accident situation in advanced reactors.



ACOUSTIC MEASUREMENT OF THE PENETRATION OF A MOLTEN METALLIC POOL INTO CONCRETE

Herbert J. Sutherland

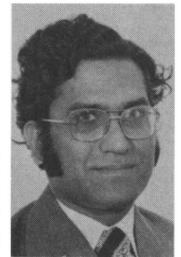
Herbert J. Sutherland (PhD, engineering mechanics, University of Texas at Austin, 1970) is a staff member in the Geotechnology Research Division at Sandia Laboratories. His work has been in the areas of acoustic and finite-amplitude wave propagation in composite and viscoelastic materials. His current interests are the development of instrumentation for reactor safety experiments and the development of centrifuge simulation techniques for geological structures.



DRYOUT HEAT FLUXES IN DEBRIS BEDS COOLED AT THE BOTTOM AND HAVING SUBCOOLED LIQUID AT THE TOP

*Vijay K. Dhir
Ivan Catton*

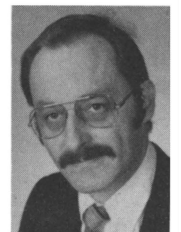
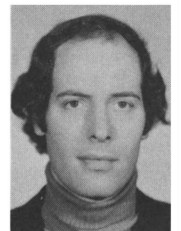
Vijay K. Dhir (top) (PhD, mechanical engineering, University of Kentucky, Lexington, 1972) is associate professor of engineering and applied science at the University of California, Los Angeles (UCLA). His research interests include thermal-hydraulics of nuclear reactors and reactor safety. **Ivan Catton** (BS, engineering, UCLA, 1959; PhD, engineering, UCLA, 1966) is a professor of engineering in the Chemical, Nuclear, and Thermal Engineering Department at UCLA, where he directs the T. E. Hicks Nuclear Energy Laboratory. His special interests include thermal-hydraulics and nuclear safety.



MULTICHANNEL MODEL FOR FUEL-COOLANT INTERACTION IN A LIQUID-METAL FAST BREEDER REACTOR SUBASSEMBLY

*Kent Mehr
Heinz M. Kottowski
Horst Goldammer*

Kent Mehr (top) (MS, nuclear engineering, Technical University of Denmark, 1975) has worked in the field of fuel-coolant interaction (FCI) at the Joint European Research Center at Ispra (Varese), Italy since 1977. **Heinz M. Kottowski** (center) (Technische Hochschule Aachen, 1958-1962; Dipl. Ing., chemical engineering; Dr. Ing., 1968) joined the European Community Laboratories at Ispra (Varese), Italy, in 1964. Since 1964, he has worked in the field of the liquid-metal technology and is head of the liquid-metal technology section. **Horst D. Goldammer** (bottom) (Dipl. Phys., University of Stuttgart, 1971) worked until 1974 on environmental research and nuclear safety. Since then he has worked on FCI at the Joint Research Center at Ispra (Varese), Italy.



**A THEORETICAL STUDY OF REINFORCED CONCRETE
STRUCTURES UNDER MISSILE IMPACT LOADING**

Vladislav Adamík

Vladislav Adamík (Ing., Faculty of Technical and Nuclear Physics, Technical University, Prague, 1967) is a researcher in nuclear engineering at Power Research Institute, Jaslovské Bohunice, Czechoslovakia. His current interest lies in the field of nuclear reactor safety. He is presently involved with the analysis of hypothetical core disruptive accidents of fast reactors and with the analysis of high impact loading of containment structures.

