nuclear technology®

AUTHORS — DECEMBER 1981

FISSION REACTORS

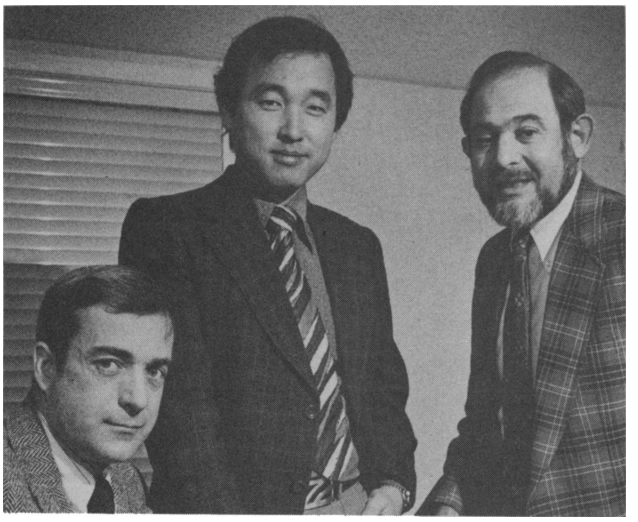
HETEROGENEOUS POISONING OF THE CRITICAL HTGR TEST FACILITY KAHTER: A STUDY FOR THE INITIAL LOADING OF PEBBLE BED POWER REACTORS

Volker Drüke
Detlef Filges
Rahim Nabbi
Ralf D. Neef
Norbert Paul
Hartwig Schaal

Volker Drüke (right) (Dipl.-Phys., physics, 1970, and Dr. rer.-nat., 1978, Technische Hochschule Aachen) is a scientific staff member and is responsible for the neutronic experiments at the Institut für Reaktorentwicklung (IRE) of Kernforschungsanlage (KFA) Jülich GmbH. His current interests include the core physics of the high temperature gas-cooled reactor (HTGR), experiments on fusion reactor blanket research, and plasma diagnostics. **Detlef Filges** (third from left) (Dipl.-Phys., physics, University of Mainz, 1969; Dr. rer.-nat., Technische Hochschule Aachen, 1977) was a research scientist at the HRB Company involved in experimental HTGR physics. Since 1973 he has worked at KFA-Jülich and is presently head of the Neutron Physics Group. His research interests include HTGR physics, fusion reactor technology, and spallation neutron sources. **Rahim Nabbi** (left) (Dipl.-Phys., 1976, and Dr. rer.-nat., 1979, nuclear reactor physics, Technische Hochschule Aachen) is a reactor physicist at KFA-Jülich. His special research interests include analysis of reactivity transient and dynamics of high temperature reactor core under accident conditions. **Ralf D. Neef** (third from right) (Dr. rer.-nat., Technische Hochschule Aachen, 1976) has performed critical experiments since 1970 at KFA-Jülich. During that time, he also spent one year at the Centre d'Etude Nucleaire Cadarache, France. Since 1974, he has worked mainly on the analysis and interpretation of critical experiments. His current research interests include theoretical analysis of near core instrumentation systems for HTGR and Monte Carlo calculations for a spallation intense neutron source. **Norbert Paul** (second from right) (Ing. grad., nuclear engineering, Fachhochschule Aachen, 1971) is chief engineer of the critical facility Kritische Anlage Hochtemperatur-Reaktor (KAHTER) at the IRE of KFA-Jülich. His interests include critical experiments and measurements for spallation sources. **Hartwig Schaal** (second from left) (Dipl.-Phys., physics, Universität Stuttgart, 1974) developed codes for the resonance treatment of HTGR fuel elements at the Institut für Kernenergetik und Energiesysteme of Universität Stuttgart. He joined KFA-Jülich in 1977 and worked on analysis and interpretation of critical experiments. His current interests include transport problems in fusion reactor blankets.

SPECTRAL EFFECTS IN THE EXTRAPOLATION OF PRESSURE VESSEL SURVEILLANCE CAPSULE MEASUREMENTS

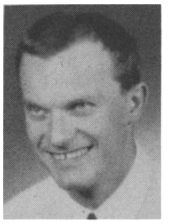
J. F. Carew
D. K. Min
A. L. Aronson

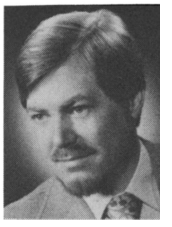


J. F. Carew (left) (PhD, physics, New York University, 1968) is leader of the Core Performance Group at Brookhaven National Laboratory (BNL). He has worked in the areas of reactor physics, thermal reactor design, core monitoring systems, and neutron dosimetry, and is presently involved in light water reactor safety. **D. K. Min** (center) (BE, nuclear engineering, Han-yang University, 1976) is a visiting International Atomic Energy Agency fellow at BNL from the Korean Nuclear Fuel Development Institute, Korea. His current research interests are in neutron transport analysis and dosimetry. **A. L. Aronson** (right) (BS, physics, Ohio University, 1953) has been working in the area of reactor design and analysis since 1957. He is a member of the Core Performance Group at BNL, and his interests include reactor physics, thermal hydraulics, and core transient analysis calculations.

A POSTERIORI EVALUATION OF THE COARSE-MESH CALCULATION RESULTS IN BOILING WATER REACTOR DYNAMICS

Miroslav Havránek
Jochen Elzmann

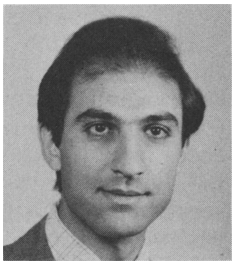




Miroslav Havránek (top) (MS, technical physics, 1961, and PhD, nuclear engineering, 1968, Czech Technical University) has been at the Institut für Kernenergetik und Energiesysteme (IKE), University of Stuttgart, Federal Republic of Germany, since 1968, working in computational physics. His current interests include mathematical modeling in neutron physics, thermohydraulics, heat transfer, thermal energy storage, electron beam welding, and also methodical problems as multidimensional interpolations and elements of FD and FE methods. **Jochen Elzmann** (Dipl.-Ing., University of Stuttgart, 1974) is a staff member at IKE. He is working in the area of thermohydraulics and heat transfer. His current interests are in the fields of computer science, numerical methods related to nuclear physics, and reactor simulation codes.

ANALYSIS OF MANUAL DEPRESSURIZATION OF A BOILING WATER REACTOR UNDER TRANSIENT CONDITION

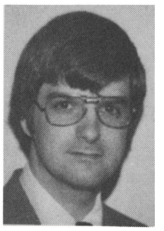
Farid Bamdad

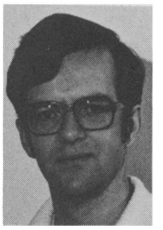


Farid Bamdad (BS and MS, mechanical engineering, Pahlavi University of Iran, 1975; MS, 1977, and candidate for PhD, nuclear reactor engineering, Massachusetts Institute of Technology) currently is working in the Nuclear Engineering Department of Boston Edison Company. He is in charge of computer code development, thermal-hydraulics analysis, and safety of Pilgrim Station Units 1 and 2.

FUEL CYCLE EXTENSION BY PART-LENGTH CONTROL ROD REMOVAL AT RANCHO SECO

T. N. Ake
R. G. McAndrew
D. D. Whitney

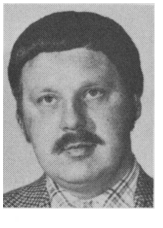


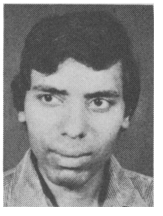


Timothy N. Ake (top) (BS, nuclear engineering, University of Maryland, 1973; MS, University of Cincinnati, 1975) joined the Babcock & Wilcox Company (B&W) Nuclear Power Generation Division facilities in Lynchburg, Virginia, after completing his degrees. In the past six years, he has had experience in the thermal-hydraulic engineering and core performance monitoring areas in the Fuel Engineering Section, and has also worked on developing new reactor concepts in the Development Engineering Section. He is presently involved in determining the maneuvering capabilities of B&W reactors. **Robert G. McAndrew** (center) (BS, mechanical engineering; MS, nuclear engineering) has over ten years of experience with B&W, in fuel assembly design, reactor internals analysis, and, most recently, plant startup testing. **Dan D. Whitney** (bottom) (BS, mechanical engineering, Oregon State University, 1965; MS, Stanford University, 1970) after graduation joined the Sacramento (California) Municipal Utility District (SMUD) as the senior nuclear engineer at the Rancho Seco Nuclear Generating Station. At SMUD, he has been responsible for the initial startup and reactor physics test programs, site reactor fuel management, and operational reactor physics. He is presently the engineering and quality control supervisor, responsible for technical support and quality of operations and maintenance activities. Whitney is registered in California as both a professional nuclear and professional mechanical engineer.

RADIAL CONCENTRATION AND EFFECT ON TEMPERATURE OF PLUTONIUM FORMED IN UO_2 DURING IRRADIATION

H. Carlsen
D. N. Sah

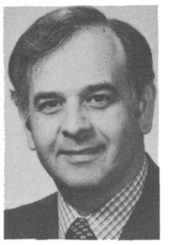


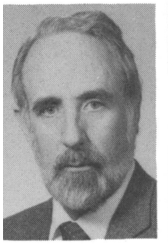


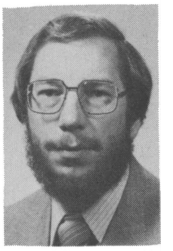
H. Carlsen (top) (MSc, chemical engineer, Technical University of Denmark, 1970) has been working at Risø National Laboratory, Metallurgy Department, since 1971. Since 1975, he has worked with destructive postirradiation examinations on test fuel pins as well as power reactor pins. His current interest is nuclear fuel performance, especially regarding fission gas and ceramography. **D. N. Sah** (BSc, engineering metallurgy, Ranchi University) is scientific officer in the Bhabha Atomic Research Centre Radiometallurgy Division, Bombay, India, where he has been working on the postirradiation examination of reactor fuel elements. He was working at Risø National Laboratory, Denmark, under an International Atomic Energy Agency grant when this work was carried out. His current interests are studies of irradiation performance of nuclear fuel elements from boiling water and pressurized water reactors.

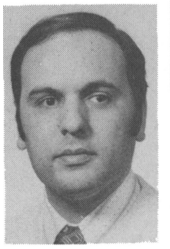
FUEL MOTION IN EXPERIMENTS SIMULATING LIQUID-METAL FAST BREEDER REACTOR LOSS-OF-FLOW ACCIDENTS

Richard Simms
George S. Stanford
Charles L. Fink
James P. Regis







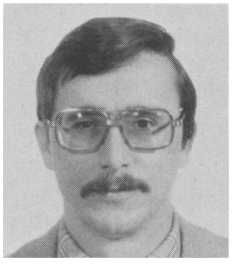


Richard Simms (top right) (BChE, chemical engineering, Cooper Union, 1959; PhD, nuclear engineering, Massachusetts Institute of Technology, 1964) is currently a nuclear engineer in the Reactor Analysis and Safety Division at Argonne National Laboratory (ANL). His current research interests are in the planning, conduct, and analysis of in-pile experiments in the liquid-metal fast breeder reactor safety program. **George S. Stanford** (top left) (BSc, physics, Acadia University, 1949; MA, physics, Wesleyan University, 1951; PhD, nuclear physics, Yale University, 1956) is a physicist in the Reactor Analysis and Safety Division at ANL. He specializes in the analysis of neutron-hodoscope data from Transient Reactor Test Facility experiments. **Charles L. Fink** (bottom right) (BS, physics, University of Pittsburgh, 1966; PhD, nuclear physics, University of Pittsburgh, 1971) is a physicist in the Reactor Analysis and Safety Division at ANL. His current work involves the analysis of hodoscope data and development of improved fuel motion detectors. **James P. Regis** (bottom left) (BS, mathematics, St. Procopius College, 1964) has been at ANL since 1965. He does computer programming and hodoscope data reduction in the Reactor Analysis and Safety Division of ANL.

RADIOACTIVE WASTE MANAGEMENT

VITRIFICATION OF SIMULATED HIGH-LEVEL RADIOACTIVE WASTE BY A SLURRY-FED CERAMIC MELTER

G. G. Wicks

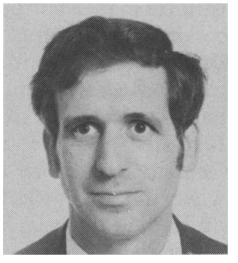


George G. Wicks (MS, applied physics and engineering, Harvard University, 1971; PhD, metallurgy and materials science, Massachusetts Institute of Technology, 1975) is a staff ceramist in the High-Level Waste Technology Section at E. I. du Pont de Nemours and Company's Savannah River Laboratory. His degrees are in the field of glass science, and he has been involved in the research and development of immobilization of nuclear waste in glasses for five years. His special interests are amorphous structures and glass leaching.

ECONOMICS

ECONOMIC IMPACT OF NUCLEAR CORE MATERIALS LIMITATIONS

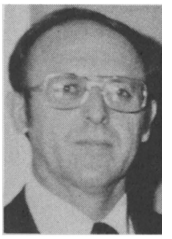
David G. Franklin

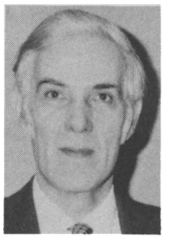


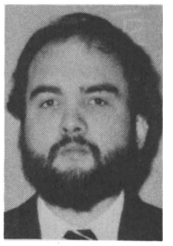
David G. Franklin (PhD, metallurgical engineering, University of Illinois, 1970) is program manager for the Core Materials Program at the Electric Power Research Institute (EPRI). Previous assignments related to nuclear fuel performance have included two years representing EPRI at the Halden Project, three years working on Zircaloy development with Combustion Engineering, and four years working on liquid-metal fast breeder reactor fuels at Argonne National Laboratory. His primary interests are in translating successful design changes to commercial products offered to utilities.

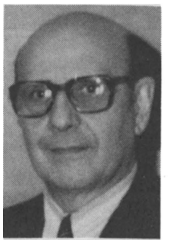
DESIGN, PRODUCTION, AND EVALUATION OF A ZIRCALOY-CLAD URANIUM TARGET FOR AN INTENSE PULSED NEUTRON SOURCE APPLICATION

B. A. Loomis
H. R. Thresh
G. L. Fogle
S. B. Gerber





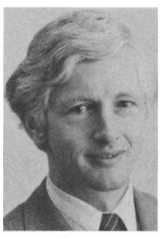




B. A. Loomis (top right) (MS, 1956, and PhD, 1958, metallurgy, Iowa State University) has been a metallurgist in the Materials Science Division at Argonne National Laboratory (ANL) since 1958. He investigated the growth and swelling of uranium and its alloys from 1958 to 1968. His current research interests are the effects of neutron and heavy-ion irradiation on the mechanical properties and dimensional stability of niobium and its alloys. **H. R. Thresh** (top left) (BSc, 1952, and PhD, 1957, metallurgy, University of Birmingham, United Kingdom) joined the Department of Energy, Mines, and Resources in Ottawa as a U.S. Nuclear Regulatory Commission Fellow in 1959. From 1960 to 1967, he was involved in an extensive program on the properties of liquid metals to relate process phenomena such as galvanizing to liquid-metal behavior. In 1967, he joined the Casting Laboratory of Kennecott Copper. Since 1972, he has been with ANL as a group leader for the Materials Processing and Development Group in the Materials Science Division, having responsibility for the design and fabrication of hardware concepts used in the evaluation of energy programs. **G. L. Fogle** (bottom right) (BS, materials science, University of Michigan, 1973) was a metallurgist with the Wolverine Tube Division of Universal Oil Products from 1973 to 1975. He joined the Materials Science Division at ANL as a fabrication engineer in 1975. He is currently involved with the fabrication of experimental fuel elements and subassemblies for testing in the Experimental Breeder Reactor II and the zero-power plutonium reactor. **S. B. Gerber** (bottom left) (OD, Illinois College of Optometry, 1950) is a scientific associate in the Materials Science Division at ANL since 1963. He was associated with the Health Physics Division at ANL from 1957 to 1963. He participated in experiments on the growth and swelling of uranium and its alloys from 1963 to 1968. He is currently involved with investigations on the effects of neutron and heavy ion irradiation on the mechanical properties and dimensional stability of niobium and its alloys.

THE EFFECTS OF TEXTURE AND SURFACE CONDITION ON THE IODINE STRESS CORROSION CRACKING SUSCEPTIBILITY OF UNIRRADIATED ZIRCALOY-2

B. C. Syrett
D. Cubicciotti
R. L. Jones



Barry C. Syrett (top) (PhD, metallurgy, University of Newcastle upon Tyne, England, 1967) is manager of the Aqueous Corrosion Program in the Materials Support Department of the Electric Power Research Institute (EPRI). Before joining EPRI in 1972, he was manager of the Metallurgy Program at SRI International (formerly Stanford Research Institute). He has been engaged in research on the environmental degradation of metals for over 16 years and has a special interest in stress corrosion, erosion-corrosion, pitting, and crevice corrosion. **Daniel Cubicciotti** (bottom) (PhD, chemistry, University of California, 1946) is a project manager in the Materials and Corrosion Program of the Nuclear Power Division of EPRI. He has been engaged in research on chemical aspects of materials

behavior at high temperature since Manhattan Project days. He is currently involved in problems of localized corrosion of structural materials in high temperature aqueous environments. **Robin L. Jones** (right) (PhD, metallurgy, University of Cambridge, 1966) is the manager of the Plant Structural Materials Program in the Nuclear Power Division at EPRI. His current technical interests are in the area of subcritical flaw growth and fracture phenomena in nuclear power plant components and their impact on plant reliability and availability. He was formerly manager of the Metallurgy Group at SRI International where he studied structure property relationships and environment effects for a variety of metallic and ceramic materials.

RADIOISOTOPES AND ISOTOPES

A DESIGN STUDY OF THE NEUTRON IRRADIATION FACILITY FOR BORON NEUTRON CAPTURE THERAPY

Yoshiaki Oka
Ichiroh Yanagisawa
Shigehiro An

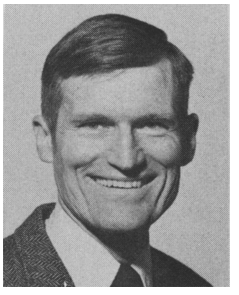
Yoshiaki Oka (top) (Dr. Eng., nuclear engineering, University of Tokyo, 1974) is an associate professor of the University of Tokyo's Nuclear Engineering Research Laboratory (UTNL). He is interested in the design of medical reactors, radiation shielding, and fusion reactor neutronics. **Ichiroh Yanagisawa** (center) (MS, nuclear engineering, University of Tokyo, 1980) is a researcher of Mitsubishi Atomic Power Industry, Inc. He is now engaged in the design of fusion devices. **Shigehiro An** (bottom) (BS, physics, 1948, and Dr. Eng., 1963, University of Tokyo) is a professor at UTNL. His research interests include core design of fast breeder reactors and medical reactors.

HEAT TRANSFER AND FLUID FLOW

THERMAL RESPONSE OF A FLAT PLATE OF FINITE THICKNESS IMMERSED IN A FLUID WITH OSCILLATING TEMPERATURE

A. M. Poindexter

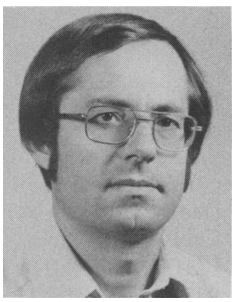
Allan M. Poindexter (MS, mechanical engineering, University of Texas, 1948) is an advisory engineer for Westinghouse Electric Corporation. Having contributed to the development of reactors for submarines, research, electricity, and rocket propulsion, he is now a system engineer on the Clinch River Breeder Reactor.



OPTIMIZATION OF A VARIABLE FLOW ALLOCATION SCHEME IN HETEROGENEOUS LIQUID-METAL FAST BREEDER REACTORS

Constantine P. Tzanos

Constantine P. Tzanos (Diploma, chemical engineering, National Technical University of Athens, Greece, 1968; ScD, nuclear engineering, Massachusetts Institute of Technology, 1971) is manager of Reactor Analysis and Methods Development at Science Applications, Inc., Chicago office. His interests include reactor analysis and design, reactor safety, and methods development for reactor analysis and design.



ANALYSES

AUTOMATED IN-LINE MEASUREMENT OF PLUTONIUM SOLUTIONS IN A PLUTONIUM PURIFICATION PROCESS

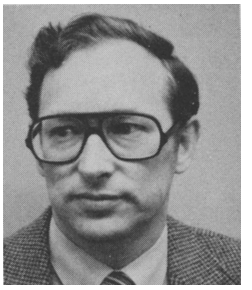
T. K. Li

T. K. Li (PhD, nuclear chemistry, Texas A&M University, 1973) is a staff member in the Safeguards Assay Group at Los Alamos National Laboratory. His previous experience has been in low-energy nuclear physics and atomic collision physics research. He is currently working on research and development of nondestructive assay techniques for special nuclear materials.

TECHNIQUES

WEIGHING OF HEAVY VESSELS USING STRAIN GAUGES

J. P. Ruiter

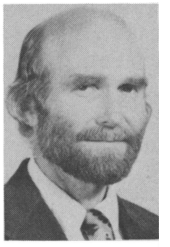


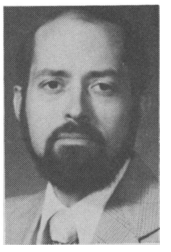
John P. Ruiter (mechanical engineer, Technical University, Delft, Netherlands, 1966) joined the laboratories of the Dutch electricity supply companies [N. V. tot Keuring van Elektrotechnische Materialen, Arnhem (KEMA)] in 1966. Until 1973, he performed technological research for the development of a nuclear reactor, the KEMA suspension test reactor. After investigating possibilities of nonconventional energy sources for some years, he is currently leader of a group for research on heat pumps and other energy conservation technologies.

EDUCATION

THE CRITICAL SAFETY FUNCTIONS AND PLANT OPERATION

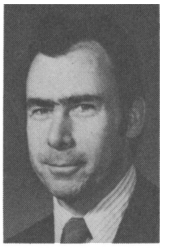
William R. Corcoran
Nancy J. Porter
James F. Church
Michael T. Cross
Walter M. Guinn





William R. Corcoran (top) (PhD, nuclear engineering, Massachusetts Institute of Technology, 1970) is director of plant engineering at Combustion Engineering, Inc. (C-E). Since joining C-E in 1970, he has had assignments in performance engineering, nuclear safety, nuclear licensing, and physics. During his military service, he was chief engineer on a nuclear submarine. Currently, he is responsible for design, analysis, research and development, and procurement of nuclear power plant fluid systems and for related products and services. He is a member of C-E's Nuclear Safety Committee and the C-E plant owner's Regulatory Response Group. **Nancy J. Porter** (center) (MS, electrical engineering, Rensselaer Polytechnic Institute, 1979) is a senior nuclear engineer with C-E. Her assignments have included thermal-hydraulic analysis, reactor modeling for use in C-E's digital monitoring and protection systems, preparation and presentation of thermal-hydraulics lectures for operators, and advanced reactor system designs. Her current assignment is in the development of state-of-the-art products and services. **James F. Church** (bottom) (ME, nuclear engineering, University of Virginia, 1971) is a systems engineer with C-E. For the past ten years he has held analytical and management positions involving numerous aspects of

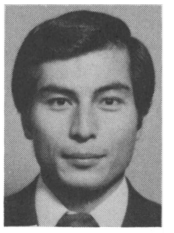
nuclear power plant design and operation, particularly in the areas of reactor thermal hydraulics, operator training, reactor monitoring and protection, and core behavior in normal and accident conditions. As a systems engineer, he is responsible for bringing about effective solutions to state-of-the-art technical problems. **Michael T. Cross** (top) (BE, marine, 1966; MS, mechanical engineering, 1970; MBA, 1972) has been involved in the design of nuclear steam supply systems since 1966. He has also had experience in the operation of fossil-fired marine power plants. He is currently a systems engineer, responsible for formulating the concepts of future plants in the areas of design, construction, operation, and maintenance. **Walter M. Guinn** (bottom) is manager of the Technical Development Department of the Training and Education Division of The Institute of Nuclear Power Operations in Atlanta. He is presently responsible for the development of education and training programs and evaluation of their effectiveness in the nuclear power industry. He has 27 years of experience in commercial power production with 14 years in the nuclear field including both boiling water reactors and pressurized water reactors (PWRs). His responsibilities have included managing the operations department at a PWR plant.

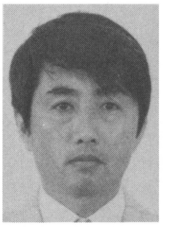


FISSION REACTORS

A FAST REACTOR CORE CONCEPT USING AN INTERNAL BLANKET

Katsuyuki Kawashima
Kotaro Inoue
Setsuo Kobayashi



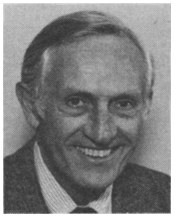


Katsuyuki Kawashima (top) (MS, physical engineering, Tokyo Institute of Technology, Japan, 1977) is a research staff member at the Energy Research Laboratory (ERL), Hitachi Ltd., Japan. His research interests include the areas of reactor physics, nuclear data evaluations, and control and optimization problems in nuclear engineering. **Kotaro Inoue** (center) (PhD, mechanical engineering, University of Tokyo, Japan, 1976) is a senior researcher at the ERL. He is concerned with theory and design study of fast reactor cores and fusion reactor systems. **Setsuo Kobayashi** (bottom) (PhD, reactor physics, University of Kyoto, Japan, 1966) has engaged in nuclear technology research and development work at the Central Research Laboratory, Hitachi Ltd., the Battelle Northwest Laboratory, and the Power Reactor and Nuclear Fuel Development Company. He is presently a manager in the Nuclear Power System Division at the ERL.

MATERIALS

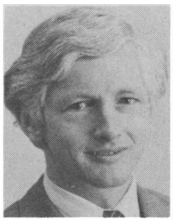
INFLUENCE OF SURFACE CONDITION ON CRACK INITIATION IN IODINE-INDUCED STRESS CORROSION CRACKING OF ZIRCALOYS

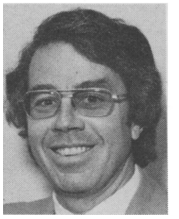
Daniel Cubicciotti
B. C. Syrett
R. L. Jones



Daniel Cubicciotti (right) (PhD, chemistry, University of California, 1946) is a project manager in the Materials and Corrosion Program of the Nuclear Power Division of Electric Power Research Institute (EPRI). He has been engaged in research on chemical aspects of materials behavior at high temperature since Manhattan Project days. He is currently involved in

problems of localized corrosion of structural materials in high temperature aqueous environments. **Barry C. Syrett** (top) (PhD, metallurgy, University of Newcastle upon Tyne, England, 1967) is manager of the Aqueous Corrosion Program in the Materials Support Department of EPRI. Before joining EPRI in 1972, he was manager of the Metallurgy Program at SRI International (formerly Stanford Research Institute). He has been engaged in research on the environmental degradation of metals for over 16 years and has a special interest in stress corrosion, erosion-corrosion, pitting, and crevice corrosion. **Robin L. Jones** (bottom) (PhD, metallurgy, University of Cambridge, 1966) is the manager of the Plant Structural Materials Program in the Nuclear Power Division at EPRI. His current technical interests are in the area of subcritical flaw growth and fracture phenomena in nuclear power plant components and their impact on plant reliability and availability. He was formerly manager of the Metallurgy Group at SRI International where he studied structure property relationships and environment effects for a variety of metallic and ceramic materials.





TECHNIQUES

SOURCE IMAGING USING NEUTRON PINHOLE CAMERAS BASED ON POSITION-SENSITIVE PROPORTIONAL COUNTERS

R. G. Johnson
J. W. Behrens
C. D. Bowman

Ronald G. Johnson (top) (BA, Gustavus Adolphus College, 1963; MS, 1966, and PhD, 1970, nuclear physics, Iowa State University) joined the U.S. National Bureau of Standards (NBS) in 1979. Previously he held positions at the University of Toronto (1970 to 1975), The Pennsylvania State University (1975 to 1979), and Lawrence Livermore National Laboratory (LLNL). His interests are primarily in photonuclear reactions and in the basic and applied aspects of neutron reactions. **James Wm. Behrens** (center) (BS, University of Illinois, 1970; MS, University of California, 1976) joined LLNL in 1970 and then the NBS in 1978. At LLNL, he was responsible for an extensive experimental program to measure fast-neutron-induced fission cross sections at the LLNL 100-MeV electron Linac. His specialties include advanced neutron detector research and development and studies of fission systematics. For the past several years, he has been developing high spatial resolution position-sensitive detectors for use in neutron imaging applications at the NBS Linac. **Charles D. Bowman** (bottom) (BS, Virginia Polytechnic Institute and State University, 1956; MA, 1958, and PhD, 1961, Duke University) joined LLNL in 1961 and went to the NBS in 1972. At LLNL, he led the research program on the 100-MeV electron Linac and at NBS is now principal scientist in the Nuclear Radiation Division. He has worked primarily in the fields of neutron and photonuclear physics and applications of associated measurement methods.