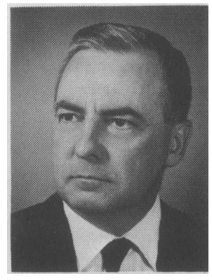
nuclear technology

AUTHORS — OCTOBER 1972

REACTOR MATERIALS PERFORMANCE

PREFACE

W. E. Roake
T. T. Claudson

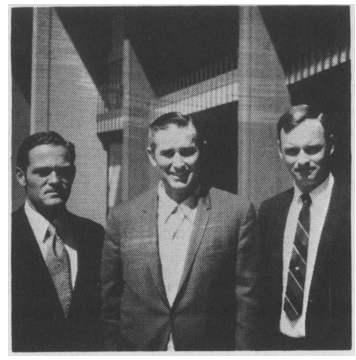


T. T. Claudson (top) (PhD, Oregon State University, 1962) has been interested in the development of Nuclear Fuels and Materials Technology since 1955. He is currently working with the design, operation, construction, and safety analysis for the Fast Flux Test Facility in Hanford. W. E. Roake (PhD, Northwestern University, 1948) is also interested in the development of Nuclear Fuels and Materials Technology. He is currently working in the field of physical chemistry.

MATERIALS

DAMAGE FUNCTION ANALYSIS OF AUSTENITIC-STEEL NEUTRON-INDUCED MECHANICAL PROPERTY CHANGE DATA

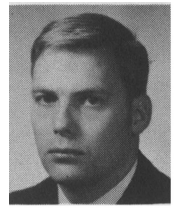
R. L. Simons
W. N. McElroy
L. D. Blackburn

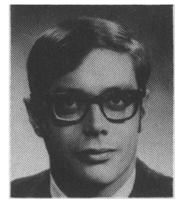


R. L. Simons (right) (BA, Western Washington State College, 1967) and W. N. McElroy (center) (PhD, Illinois Institute of Technology, 1965), both at Westinghouse Hanford since 1970, are engaged in neutron dosimetry and irradiation effects studies for the LMFBR program. L. D. Blackburn (left) (DSc, Massachusetts Institute of Technology, 1963), also at Westinghouse Hanford since 1970, is engaged in the evaluation of irradiation effects on mechanical properties of stainless steel for the LMFBR program.

SCIM—A THEORY BASED COMPUTER CODE FOR THE PREDICTION OF THE IN-PILE BEHAVIOR OF TYPE 304 STAINLESS STEEL

S. D. Harkness
R. Grappel
S. G. McDonald

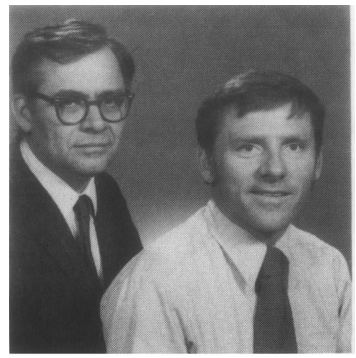




S. D. Harkness (left) (PhD, University of Florida, 1967) is leader of the Radiation Effects Group at Argonne National Laboratory. R. Grappel (not pictured) (BS, University of Michigan, 1971) and S. G. McDonald (right) (PhD, Notre Dame, 1972) served as research associates at Argonne between 1970 and 1972. McDonald is currently employed by Westinghouse Advanced Reactor Division, Pittsburgh, Pennsylvania.

AN ANALYSIS OF THE EFFECTS OF HYDROSTATIC STRESS ON SWELLING

J. L. Straalsund
G. L. Guthrie



J. L. Straalsund (right) (PhD, engineering science, Washington State University) and G. L. Guthrie (PhD, physics, Carnegie Institute of Technology) are senior research scientists in the Reactor Metals Sub-Department of the Westinghouse Hanford Company. Their principal area of research is irradiation-induced swelling of reactor structural materials.

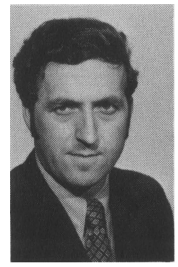
EFFECT OF NEUTRON IRRADIATION ON THE DUCTILITY OF AUSTENITIC STAINLESS STEEL

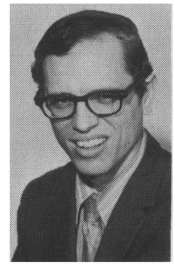
E. E. Bloom
J. R. Weir, Jr.

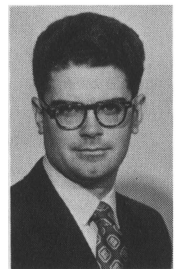
J. R. Weir, Jr. (right) (metallurgical engineering, University of Cincinnati, 1955; MS, University of Tennessee, 1961) is section head in the Metals and Ceramics Division of Oak Ridge National Laboratory. He has worked in the areas of deformation, fracture, irradiation, and environmental effects on metals and alloys. E. E. Bloom (PhD, University of Tennessee, 1970) is head of the Irradiation Mechanical Metallurgy Group in the Metals and Ceramics Division of ORNL and has been involved in investigations of the effects of irradiation on the properties of materials since 1964. Current studies are in the area of irradiation effects in LMFBR cladding and structural materials.

THE INTERRELATIONSHIP BETWEEN SWELLING AND IRRADIATION CREEP

W. G. Wolfer
J. P. Foster
F. A. Garner







The authors are all senior engineers at Westinghouse Advanced Reactor Division. W. G. Wolfer (top) (MS, physics, University of Stuttgart; PhD, nuclear engineering sciences, University of Florida) is currently working in the areas of irradiation damage in metals and fuels. J. P. Foster (center) (PhD, materials science, Drexel University) is interested in the creep and fracture of metals during irradiation and in the thermal performance of fuel pins. F. A. Garner (bottom) (DSc, nuclear engineering, University of Virginia) is presently involved in studies of irradiation damage in metals and the implications to fast reactor design.

AN EVALUATION OF THE EFFECT OF INTERGRANULAR ATTACK ON FUEL PIN BURST PROPERTIES

P. J. Ring
K. D. Challenger
H. J. Busboom

The authors are all members of the Breeder Reactor Department at the General Electric Company. P. J. Ring (left) (BS, metallurgy, Manchester; ACT (MS), Surrey University, U.K.) is a metallurgist engaged in fuel cladding mechanical property development for the past two years. Prior to this, he was involved in materials problems and in the study of electrical effects on liquid metal corrosion at the General Electric Valley Forge facility. Before joining GE, he worked for four years with the UKAEA on thermal reactor cladding and fuel technology. K. D. Challenger (center) (MS, University of Cincinnati) is a metallurgical engineer and has been active in research on austenitic stainless and other heat resisting steels for the last five years. H. J. Busboom (right) is presently task leader for LMFBR cladding development and has been involved in activities related to irradiation effects in LMFBR cladding alloys during the past six years. Prior to this work, he spent four years involved in light water reactor cladding technology.

PERFORMANCE OF MIXED-OXIDE FUEL ELEMENTS TO 11 at.% BURNUP

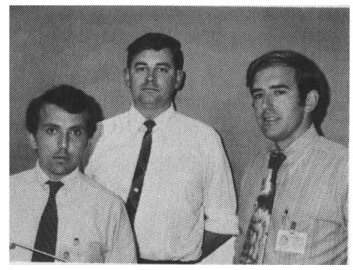
L. A. Neimark
J. D. B. Lambert
W. F. Murphy
C. W. Renfro

The authors are all members of the Fuels Performance Group of the Materials Science Division at Argonne National Laboratory. L. A. Neimark (center, left) (MS, University of Minnesota) is the group leader and has been involved in ceramic fuel irradiation studies at ANL since 1958. He spent $1\frac{1}{2}$ years with the LMFBR Program Office developing the Fuels and Materials Program Plan. J. D. B. Lambert (center, right) (BS, University of Liverpool, U.K.) joined ANL in 1970 after 10 years with the Fuel Element Irradiation Group at Harwell where he worked on the behavior of oxide, carbide, and cermet fuels for thermal and fast reactors. W. F. Murphy (right) (MS, Syracuse University) has worked at ANL for the past 23 years on various aspects of the irradiation of structural materials and metal and oxide fuels. He also taught at the International School of Nuclear Science and Engineering at ANL. C. W. Renfro (left) (BS, University of Illinois) has been at ANL for 1 year and is now involved in the quantitative morphological and chemical analyses of oxide fuel microstructures.

FUEL-CLADDING MECHANICAL INTERACTION IN LMFBR FUEL RODS

B. F. Rubin
T. J. Black
W. K. Appleby
J. D. Stephen
R. F. Hilbert

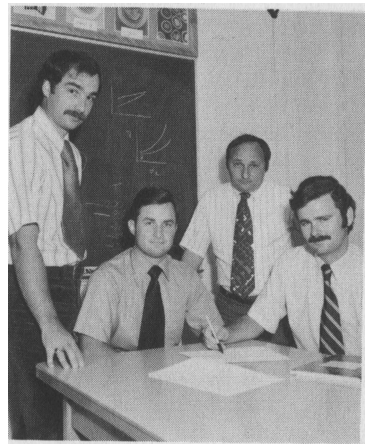
B. F. Rubin, T. J. Black, W. K. Appleby, J. D. Stephen, and R. F. Hilbert are all members of the Fuels and Materials Group in the Breeder Reactor Department of the General Electric Company. B. F. Rubin (left, top) (MS, metallurgy, University of Pittsburgh) is a senior engineer and leader of the current Fuel Properties and Performance Evaluation Task. T. J. Black (right, top) (BS, materials science, San Jose State College) is an engineer engaged in evaluation of the irradiation performance of mixed-oxide fuel rods. W. K. Appleby (left, bottom) (PhD, metallurgy, University of Newcastle-upon-Tyne, U.K.) is manager of the Radiation Metallurgy Unit. His major technical interest is in the area of irradiation effects on fast reactor structural materials. J. D. Stephen (center, bottom) (MS, nuclear engineering, University of Wisconsin; advanced study, Massachusetts Institute of Technology) is a senior engineer and leader of the current Fuel Irradiations Task. In this capacity he has the overall responsibility for planning, irradiation-follow, and analysis of the basic fast flux test program. R. F. Hilbert (right, bottom) (MS, metallurgical engineering, Ohio State University) is a senior engineer with a broad background in nuclear fuels research and development. He is currently leading work on irradiation effects in LMFBR fuel and component materials.



THE MECHANICAL DESIGN OF TRISO-COATED PARTICLE FUELS FOR THE LARGE HTGR

T. D. Gulden
C. L. Smith
D. P. Harmon
W. W. Hudritsch

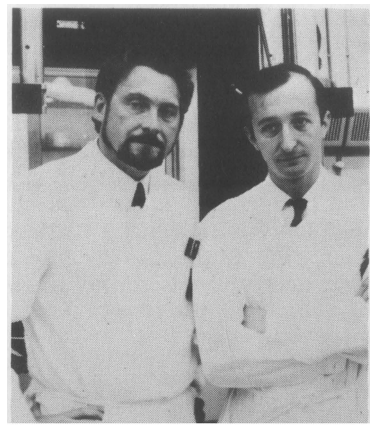
T. D. Gulden (right) (PhD, Stanford University, 1965) is manager of the HTGR Fuel Materials Branch. He has been involved in various aspects of coated particle fuels work at Gulf General Atomic since 1967 and before that was a research associate at the Berkeley Nuclear Laboratories in the U.K. working on irradiation effects in ceramics. Craig L. Smith (center, seated) (PhD, Carnegie-Mellon University, 1971), senior materials engineer, and W. W. Hudritsch (center, standing) (MSc, Vienna University of Technology, 1964), physicist, are involved in analytical studies of the design of coated particle fuels. David P. Harmon (left) (BS, University of California, Berkeley,

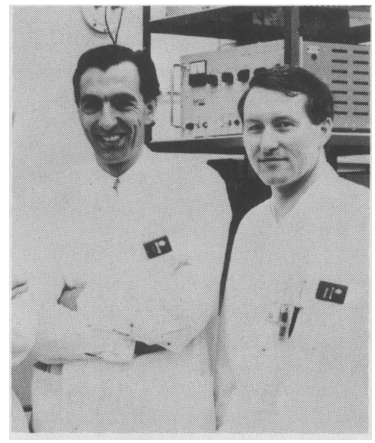


1963), senior materials engineer, has been instrumental in the irradiation testing of coated particle fuels since 1968 and previously was involved in studies of phase equilibrium in transition metal-boron-carbon systems at Aerojet-General Corporation, Sacramento, California.

HIGH BURNUP MIXED-OXIDE FUEL IRRADIATION EXPERIMENTS

M. Coquerelle
J. Gabolde
R. Lesser
P. Werner

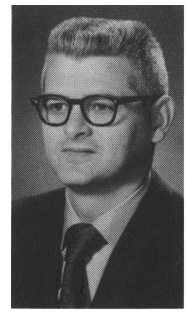


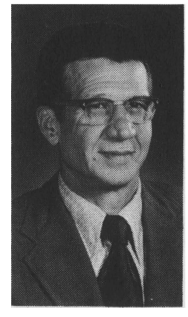


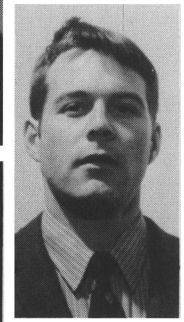
The authors are all staff members of the European Institute for Transuranium Elements at Karlsruhe. M. Coquerelle (left, top) (PhD, solid state chemistry, University of Brussels, Belgium) is a specialist in the field of post-irradiation examinations of fast breeder oxide fuels and advanced fuels. He gained his first experience when working for the French Nuclear Research Center of Saclay. J. Gabolde (right, top) (Ingénieur des Arts et Manufactures, Ecole Centrale de Paris; Ingénieur en Genie Atomique, Saclay) has wide experience in the development of irradiation capsules, and in the preparation and control of irradiation experiments. In 1966, he spent a three-month period at APDA, Detroit, as representative for the European irradiations planned in the Enrico Fermi Reactor. R. Lesser (left, bottom) (PhD, inorganic chemistry, University of Freiburg, Germany) was employed by Heraeus of Hanau, Germany, working on high-temperature metallurgy. He then worked at Cadarache, France, Argonne National Laboratory, and Hanford, where he gained his first experience in the plutonium field. He is primarily interested in plutonium and transplutonium technology. P. Werner (right, bottom) (MS, mechanical engineering, University of Karlsruhe) worked for the local university in the machine-tool and plant management facility. In 1964 he joined the Institute as a staff member and spent a training period at Windscale, Great Britain. He is primarily involved in the development of high-precision hot cell equipment.

POROSITY AND ACTINIDE REDISTRIBUTION DURING IRRADIATION OF $(U, Pu)O_2$

W. J. Lackey
F. J. Homan
A. R. Olsen







Jack Lackey (top) (PhD, ceramic engineering, North Carolina State University) has been at Oak Ridge National Laboratory in the Metals and Ceramics Division since 1969. He is involved in fabrication, characterization, and postirradiation evaluation and modeling of $(U, Pu)O_2$ fast reactor fuels. More recently he has been engaged in developing processes and equipment for coating HTGR fuel particles. F. J. Homan (center) (BS, metallurgical engineering, Cornell University, 1963) is head of the Fuels Evaluation Group, Metals and Ceramics Division, ORNL. His current interests include the economic and performance evaluation of nuclear fuels. A. R. Olsen (bottom) (metallurgical engineering, Colorado School of Mines, 1947), is currently involved in irradiation testing and performance evaluation of reactor fuels in the Fuels Evaluation Group of the Metals and Ceramics Division at ORNL.

POSTIRRADIATION OBSERVATIONS OF MIXED OXIDES WITH INITIAL ADDITION OF FISSION PRODUCT ELEMENTS

M. Conte
M. Mouchnino
F. K. Schmitz

M. Conte (top) (PhD, metallurgy, University of Paris) is in charge of the metallographic examinations and analysis of fast breeder reactor fuel elements and works in the hot laboratory facility in the Plutonium Department at CEA, Fontenay aux Roses, France. M. Mouchnino (center) (civil engineer of Mines and Metallurgy) is in charge of spectrometric studies on fast breeder reactor fuel elements and works in the hot laboratory facility in the Plutonium Department at CEA. F. K. Schmitz (bottom) (PhD, University of Braunschweig, Western Germany) works in the Plutonium Department at CEA as staff member of the EURATOM Fast Breeder Department. He is a member of the German Physical Society.

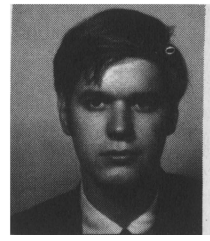
THE DEVELOPMENT OF CYGRO-F FOR FUEL ROD BEHAVIOR ANALYSIS

B. L. Harbourne
M. S. Beck
J. P. Foster
A. Biancheria

Brian L. Harbourne (right, center) (BSc, Manchester, England, 1953) has been involved in fuel rod performance modeling and materials property analysis at Westinghouse Advanced Reactors Division for the last 5 years. Prior to this he worked for the U.K. Atomic Energy Authority on nuclear materials problems. Marvin S. Beck (left) (BS, University of Saskatchewan, 1964; MS, University of Toronto, 1967) has been engaged in the computer simulation of LMFBR fuel rod performance for about 5 years. John P. Foster (left, center) (PhD, Drexel University, 1971) has been largely responsible for the modeling of the early-life behavior of fuel rods, and for the development of models for irradiation-induced creep in cladding materials. Amilcare Biancheria (right) (PhD, Clark University) is manager of Fuels Irradiation at Westinghouse Advanced Reactors Division and has been active in the fuels and fuel rod performance area for the past 15 years.

EXAMINATION OF F3A SERIES UNENCAPSULATED MIXED-OXIDE FUEL PINS IRRADIATED IN EBR-II

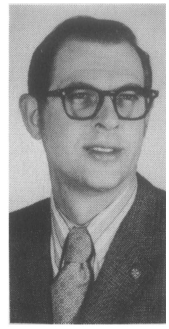
W. H. McCarthy
K. J. Perry
G. R. Hull
J. W. Bennett

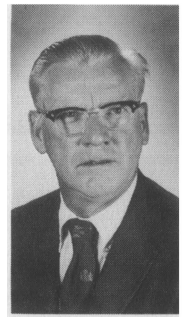


W. H. McCarthy (top right) (PhD, materials science, Stanford University, 1966), K. J. Perry (top, center), and G. R. Hull (top left) (BS, nuclear engineering, North Carolina State University, 1966) are engineers in the Breeder Reactor Department at the General Electric Company. Their principal current work is the design of fast reactor fuels evaluation experiments and the analysis of results from the postirradiation examinations. J. W. Bennett (bottom) (MS, materials science, Stanford University, 1970) is with the Division of Reactor Development and Technology, the U.S. Atomic Energy Commission. He is concerned with fuel and control element design for liquid-metal fast breeder reactors and the irradiation testing of these components. His contributions to the work reported in this issue were made during an assignment at the General Electric Company.

BORON CONCENTRATION GRADIENT FOR IMPROVED THERMAL REACTOR PERFORMANCE OF BORON-STAINLESS-STEEL CONTROL RODS

R. J. Beaver
A. E. Richt

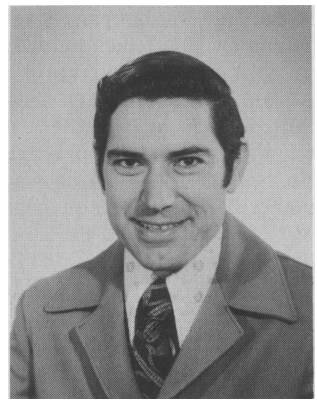




R. J. Beaver (left) (MS, metallurgical engineering, University of Kentucky, 1950) has been at Oak Ridge National Laboratory since October 1950. As group leader he was responsible for the development and production of the first core loading of the stainless-steel base, plate-type fuel elements, and neutron absorbers for the 10-MW U.S. Army's SM-1 reactor. He was active in the development of dispersions of ^{10}B in iron, and subsequently was primarily responsible for the concept and investigations associated with improving the reactor performance capability of the conventional boron-metal dispersion using the boron concentration gradient principle. Beaver is currently technical manager of work at ORNL associated with materials selection and specification improvements for fuel elements and control rods. A. E. Richt (metallurgical engineering, University of Cincinnati, 1952) has been at ORNL since June 1952. He was the investigator responsible for the postirradiation evaluations of fuel elements and neutron absorbers developed for the U.S. Army's SM-1 reactor. During this period he was closely associated with the program of developing dispersions of ^{10}B in iron for the first core loading, and subsequently was in charge of the postirradiation evaluation of the experimental boron concentration gradient neutron absorber. Richt currently is heavily involved in postirradiation examinations of reactor materials at ORNL, including HFIR fuel elements and control rods.

IRRADIATION-INDUCED DIMENSIONAL CHANGE IN BORONATED GRAPHITE

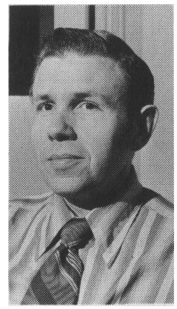
O. M. Stansfield

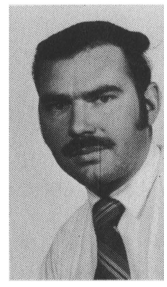


O. M. Stansfield (MS, University of California), a member of the Gulf General Atomic HTGR Fuel Development Department, is involved in the study of effects of irradiation on control materials and thermal stability of reactor fuel.

EMPIRICAL HELIUM RELEASE FUNCTION FROM THERMAL REACTOR IRRADIATED BORON CARBIDE

G. E. Russcher
A. L. Pitner





Glenn E. Russcher (left) (BS, engineering physics, University of Michigan, 1959; PhD, nuclear engineering, Iowa State University, 1964) has been developing analytical techniques for correlating irradiation effects in materials. Nuclear materials roles in various reactor systems and their safety analysis for the FFTF are his current technical interests as a senior research scientist for Westinghouse Hanford Company. A. L. Pitner (BS, physics, Washington State University, 1964) has been engaged in materials irradiation programs at the Hanford Works for the past eight years. Present activities are directed at the characterization of the irradiation performance of boron carbide for fast reactor control rod applications.

PERFORMANCE MODELING OF NEUTRON ABSORBERS

F. J. Homan

F. J. Homan (BS, metallurgical engineering, Cornell University, 1963) is head of the Fuels Evaluation Group, Metals and Ceramics Division, Oak Ridge National Laboratory. His current interests include the economic and performance evaluation of nuclear fuels.

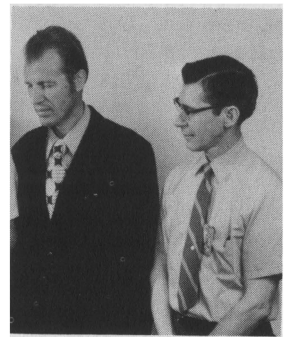
IRRADIATION BEHAVIOR OF BORON CARBIDE

G. L. Copeland
R. G. Donnelly
W. R. Martin

R. G. Donnelly (left) (BS, Case Institute of Technology), W. R. Martin (center) (BS, University of Cincinnati), and G. L. Copeland (right) (MS, Rensselaer Polytechnic Institute) have been active for the past three years in the fast reactor neutron absorber program in the Metals and Ceramics Division of the Oak Ridge National Laboratory. Copeland is lead engineer on boron carbide irradiation behavior in the Ceramic and Powder Development Laboratory which Donnelly heads. Martin now supervises the Mechanical Properties Laboratories.

IRRADIATION EFFECTS IN BORON CARBIDE PELLETS IRRADIATED IN FAST NEUTRON SPECTRA

J. A. Basmajian
A. L. Pitner
D. E. Mahagin
H. C. F. Ripfel
D. E. Baker



J. A. Basmajian, A. L. Pitner, D. E. Mahagin, H. C. F. Ripfel, and D. E. Baker are all employed in the Materials Technology Department at Westinghouse Hanford Company. Basmajian (left, top) (MS, metallurgical engineering, Rensselaer Polytechnic Institute) is a senior development engineer and has had 14 years experience in nuclear materials technology. His last 10 years have been spent in fast reactor materials development and he is currently involved with control materials development. Pitner (center, top) (BS, physics, Washington State University) is a research scientist and was involved in nuclear materials irradiations at Hanford for 8 years. He has worked in boron carbide irradiation performance for the last 3 years and is currently working on LMFBR control materials development. Mahagin (right, top) (MS, metallurgical engineering, University of Idaho) is a senior development engineer who has been involved in nuclear materials development for over 11 years. His current interests are with development of control materials for LMFBR service. Ripfel (left, bottom) (PhD, metallurgical engineering, Karlsruhe University) was formerly a senior staff member of the Karlsruhe Nuclear Research Center. His current interests lie in the design and development of core components for the FFTF. Baker (right, bottom) (MS, chemistry, University of Idaho) has been associated with moderator and control materials research at Hanford since 1951. He is currently engaged in the development of control rod vents for LMFBRs.

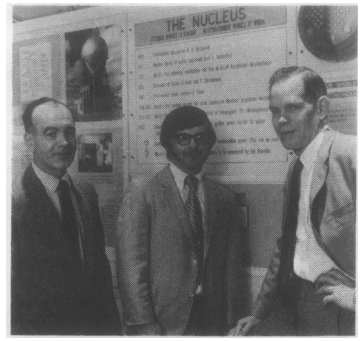
THE STRUCTURE OF SODIUM CORROSION DEPOSITS AND THEIR EFFECT ON HEAT TRANSFER COEFFICIENTS

W. E. Ray
R. L. Miller
S. L. Schrock
G. A. Whitlow

W. E. Ray (left, seated) (MS, physical metallurgy, Pennsylvania State University) is manager of the Materials and Processes Engineering Group, Advanced Reactors Division, Westinghouse Nuclear Energy Systems. He is currently responsible for process development, testing, and performance analysis of all LMFBR nuclear steam supply system materials except for those used in the fuel pin. S. L. Schrock (left, standing) (PhD, chemical engineering, Purdue University), manager of Mass Transfer Studies, is responsible for assessing materials problems arising from the use of sodium in the LMFBR. G. A. Whitlow (right, seated) (PhD, metallurgy, University of Wales) is a fellow engineer principally concerned with LMFBR materials and sodium corrosion, with prior experience in uranium and vanadium alloy development. R. L. Miller (right, standing) (BS, metallurgy, Grove City College) is an engineer engaged in the evaluation of LMFBR materials.

SODIUM CORROSION AND MASS TRANSFER ANALYSIS WITH AN ION PROBE MASS SPECTROMETER

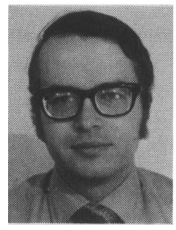
E. Berkey
G. G. Sweeney
W. M. Hickam



Edgar Berkey (center) (PhD, nuclear science, Cornell, 1967) is responsible for the LMFBR sodium technology programs at the Westinghouse Research Laboratories. His research interests have included the application of advanced microanalytical techniques to sodium corrosion problems and the development of on-line instrumentation for impurity monitoring in liquid sodium. George G. Sweeney (left) (MA, mathematics, Duquesne, 1971), a senior engineer at Westinghouse Research, has more than 12 years experience in all phases of mass spectroscopy of solids. William M. Hickam (right) (MS, physics, VPI, 1942) has broad program responsibility for a number of research areas relating to mass spectroscopy, fast breeder reactor sodium technology, analytical instrumentation development, and incandescent lamp chemistry.

MATERIALS CREEP BEHAVIOR AND ELEVATED TEMPERATURE DESIGN

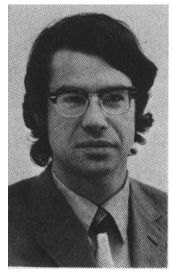
L. D. Blackburn
J. C. Tobin
R. A. Moen

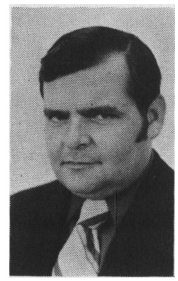


L. D. Blackburn (top) (DSc, metallurgy, Massachusetts Institute of Technology, 1963) has been active in the area of materials development for high temperature nuclear reactors since 1966, and is presently with the Mechanical Metallurgy Section, at the Hanford Engineering Development Laboratory. J. C. Tobin (center) (PhD, metallurgical engineering, University of Michigan, 1956) is presently manager of Process and Manufacturing Engineering Section of the Fast Flux Test Facility Project at HEDL, and has over 15 years experience in the area of materials applications for nuclear systems. R. A. Moen (bottom) (BS, metallurgical engineering, South Dakota School of Mines and Technology, 1962) has been involved in materials support activities for the FFTF project since 1967. He was previously associated with fuels and materials development work at the National Reactor Testing Station.

CREEP DATA ACQUISITION AND APPLICATION TO REACTOR COMPONENT DESIGN

D. J. Ayres
T. M. Cullen

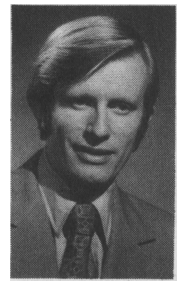




D. J. Ayres (left) (PhD, civil engineering, Carnegie-Mellon University, 1966) is a supervisor in the Engineering Mechanics Development Department of Combustion Engineering, Inc., Windsor, Connecticut. T. M. Cullen (PhD, metallurgical engineering, University of Michigan, 1962) is a section manager of the Metallurgical Research and Development Laboratory of Combustion Engineering, Inc., Chattanooga, Tennessee. Their current interests include analytical and experimental technique development and application in the creep of metal plasticity, creep, and fracture.

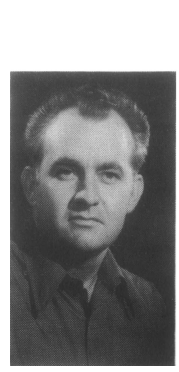
ESTIMATES OF CREEP-FATIGUE INTERACTION IN IRRADIATED AND UNIRRADIATED AUSTENITIC STAINLESS STEELS

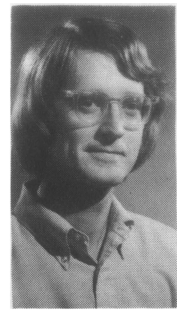
C. R. Brinkman
G. E. Korth
R. R. Hobbins



Charles R. Brinkman (right) (PhD, metallurgy, University of Utah, 1966) is the section chief of the Materials Research Section at Aerojet Nuclear Company. His previous experience and interests include recovery and recrystalli-

zation, hydrogen embrittlement, fracture mechanics, radiation effects, fatigue, and creep-fatigue interactions. Gary E. Korth (left) (PhD, metallurgy, University of Utah, 1968) is an associate scientist in the Materials Research Section of Aerojet Nuclear Company. He has had experience in characterizing microstructure and physical property changes of irradiated stainless steels, aluminum, beryllium, and hafnium. Richard R. Hobbins (right) (PhD, metallurgy, University of Delaware, 1969) is a senior metallurgist in the Materials Research Section. He has been involved, principally, in the performance evaluation of uranium aluminide nuclear fuels, the determination of gases in metals, and the effects of atomic mobility on material properties.

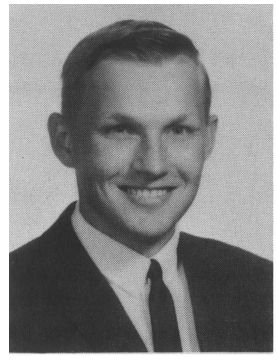




EFFECT OF IRRADIATION ON THE STRAIN RATE DEPENDENCE OF TYPE 304 STAINLESS-STEEL MECHANICAL PROPERTIES

J. M. Steichen

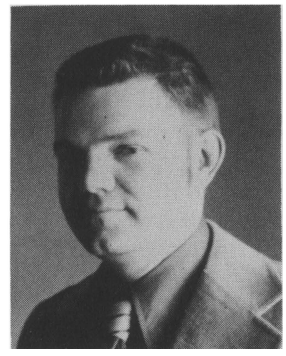
John M. Steichen (BS, metallurgical engineering, South Dakota School of Mines and Technology, 1968) has been active in materials R&D at Westinghouse Hanford Company since 1970. His work is devoted to the determination of mechanical properties of FFTF structural materials at high strain rates.



FATIGUE-CRACK GROWTH IN 20% COLD-WORKED TYPE 316 STAINLESS STEEL AT ELEVATED TEMPERATURES

Lee A. James

Lee A. James (MS, mechanical engineering, University of Washington, 1965) spent eight years as a stress analyst and structural designer with The Boeing Company. In 1967 he moved to the Hanford Works where he is engaged in fracture mechanics and fatigue-crack propagation research, employed first at Battelle-Northwest and later at the Westinghouse Hanford Company.



POSTIRRADIATION CREEP OF ANNEALED TYPE 316 STAINLESS STEEL

A. J. Lovell

Artell J. Lovell (BS, physical metallurgy, Washington State University, 1961; MS, metallurgical engineering, University of Idaho) is a senior research engineer evaluating irradiation effect to materials behavior at the Hanford Engineering Development Laboratory. Since 1961 he has been involved in irradiation effects, both at Hanford, for General Electric, Battelle, and Westinghouse, and at the National Reactor Testing Station (Idaho Falls) for General Electric. He performed the post-incident metallurgical evaluation of the devastated SL-1 reactor.

STRUCTURAL MATERIALS ASPECTS OF LMFBR CORE RESTRAINT SYSTEM DESIGN

W. E. Pennell

W. E. Pennell (MS, Cranfield Institute of Technology, U.K.) is manager of FFTF Structural Analysis at the Westinghouse Advanced Reactors Division. His interests include the application of irradiation effects design data to the mechanical performance evaluation of LMFBR core components.