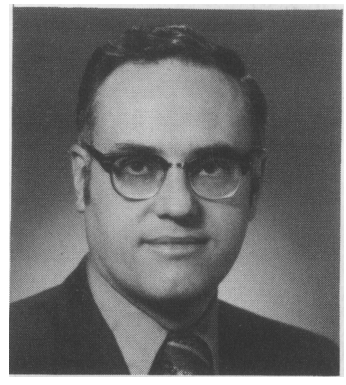
nuclear technology

AUTHORS — AUGUST 1972

PLUTONIUM UTILIZATION IN COMMERCIAL POWER REACTORS

PREFACE

Loren C. Schmid



Schmid

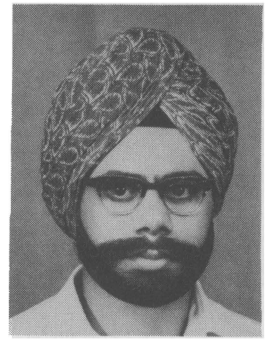
Loren C. Schmid (PhD, physics, University of Michigan, 1958) has been working in the nuclear field for 18 years and has been involved in the Plutonium Utilization Program since its beginning. He is author of numerous publications in the nuclear decay scheme analysis and reactor physics field, including the textbook *Critical Assemblies and Reactor Research*. Dr. Schmid is currently the manager of the Reactor Physics Department at Battelle Northwest, and an acting associate professor in the Nuclear Engineering Department at the University of Washington. His current responsibilities at Battelle include the coordination of the fusion technology efforts of the laboratory.

REACTORS

KINETIC PARAMETERS IN A PLUTONIUM LATTICE CONTAINING WATER REGIONS

V. O. Uotinen
W. P. Stinson
S. P. Singh

Uotinen



Singh

V. O. Uotinen (MS, physics, Worcester Polytechnic Institute, 1963) is working in the area of reactor physics at Battelle-Northwest. His experience includes conducting and directing both experimental and calculational studies of reactors. His current interests involve theory-experiment correlations of a variety of reactor experiments. W. P. Stinson (not pictured) (BS, engineering physics, University of Auburn, 1949) has extensive experience in designing, conducting, and analyzing experiments in research reactors. His interests are in the areas of experimental reactor physics and instrumentation. S. P. Singh (postgraduate, nuclear engineering, Atomic Energy Department Training School, 1971) participated in the theory-experiment correlation of kinetics experiments while he was a visiting engineer at Battelle-Northwest. He served as nuclear and thermal-hydraulic engineer at the Tarapur BWRs in India, and has recently been assigned to a CANDU-type HWR station.

PLUTONIUM AND FISSION PRODUCT REDISTRIBUTION IN MIXED-OXIDE FUELS DURING IRRADIATION

J. K. Bahl
M. D. Freshley

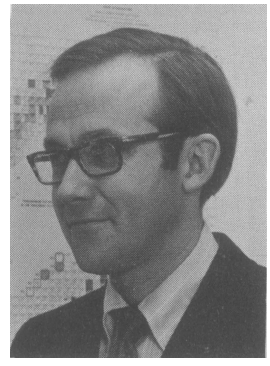
J. K. Bahl (B. Tech, metallurgical engineering, Indian Institute of Technology, Kharagpur), who is presently associated with the Metallurgy Division of the Bhabha Atomic Research Center, Bombay, India, was working as an exchange scientist at Battelle-Northwest when this study was made. M. D. Freshley (BS, University of Portland, 1951) has been involved in studies to investigate the irradiation behavior of mixed-oxide thermal reactor fuels at Battelle-Northwest in which plutonium and fission product redistribution are important considerations.

Bahl

MIXED-OXIDE FUEL IRRADIATIONS IN THE PLUTONIUM RECYCLE TEST REACTOR

Max D. Freshley

M. D. Freshley (BS, University of Portland, 1951) is a member of the Fuels and Materials Department at Battelle-Northwest. As technical program leader for PUP fuel evaluations, he has been involved in plutonium recycle fuel development since the inception of the program at Hanford in 1958.

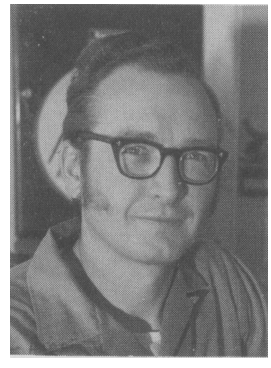


Freshley

THE TRANSIENT BEHAVIOR OF VIPAC AND PELLET THERMAL REACTOR OXIDE FUELS

M. D. Freshley
L. J. Harrison

M. D. Freshley, as technical program leader for PUP fuel evaluations at Battelle-Northwest, coordinated this cooperative experiment to compare the transient behavior of different thermal reactor oxide fuel types. L. J. Harrison (MS, chemical engineering, Purdue, 1957) is an associate chemical engineer at Argonne National Laboratory. He has been at the TREAT facility for nine years working on a variety of assignments in the area of reactor safety.



Harrison

MEASUREMENT OF k_∞ AND RELATIVE REACTION RATES IN AN H_2O-MODERATED UO_2-PuO_2 PARTICULATE FUELED LATTICE

Darrell F. Newman

Darrell F. Newman (BS, nuclear engineering, Kansas State University, 1963; MS, nuclear engineering, University of Washington, 1970) is a research scientist at the USAEC's Pacific Northwest Laboratories, operated by Battelle. His interests are in reactor neutronics and nuclear fuel management.

Newman

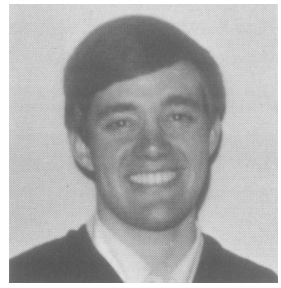
THE DEFECT PERFORMANCE OF UO_2-PuO_2 THERMAL REACTOR FUEL

M. D. Freshley

M. D. Freshley (BS, University of Portland, 1951) has been involved in experiments to investigate the defect performance of mixed-oxide thermal reactor fuels which were conducted as part of the PUP fuel evaluations effort at Battelle-Northwest.

THE DETERMINATION OF RATIOS OF EFFECTIVE CROSS SECTIONS FROM BURNUP DATA FROM THE SAXTON PLUTONIUM PROGRAM

P. E. Coudron
R. P. Matsen
L. C. Schmid



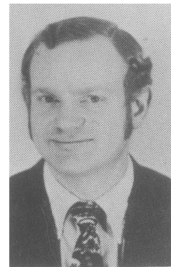
Coudron

Philip E. Coudron (BS, physics, St. John's University, 1970) is currently working on his masters degree in biophysics at the University of Illinois. His research interests are concerned with radiation effects on microorganisms. During his association with the Plutonium Utilization Program he was a summer student doing research. (See p. 106 for biographical data and photos of R. P. Matsen and Loren C. Schmid.)

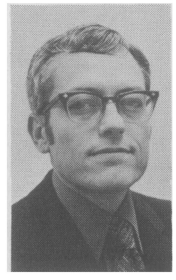
BEHAVIOR OF DISCRETE PLUTONIUM DIOXIDE PARTICLES IN MIXED-OXIDE FUEL DURING RAPID POWER TRANSIENTS

M. D. Freshley
E. A. Aitken
D. C. Wadekamper
R. L. Johnson
W. G. Lussie

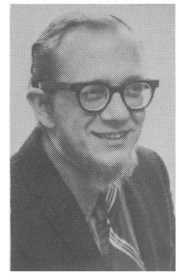
Aitken



Wadekamper



Johnson



Lussie

M. D. Freshley (photo on p. 103) (BS, University of Portland, 1951) as technical program leader for PUP fuel evaluations at Battelle-Northwest, coordinated this cooperative experiment to investigate the effects of PuO_2 particle size on the transient behavior of mixed-oxide fuels. E. A. Aitken (PhD, chemistry, University of California at Los Angeles) is manager of the Plutonium Research Laboratory at General Electric Company's Vallecitos Nuclear Center and has been engaged in studies of nuclear oxide fuels since 1954. Donald C. Wadekamper (MS, ceramic engineering, University of Washington) is a member of the Breeder Reactor Development Operation at General Electric Company's Vallecitos Nuclear Center. His current activities involve plutonium fuel fabrication, processing techniques, and measurement of plutonium homogeneity in mixed-oxide fuels. Roger L. Johnson (MS, physics, University of Idaho) is presently project engineer with Aerojet Nuclear Company involved with experiments and analyses for the Power Burst Facility Program. He has worked in reactor safety programs at the SPERT Project since 1958. William G. Lussie (PhD, nuclear engineering, University of Illinois) joined the SPERT Project in 1968. Currently, with Aerojet Nuclear Company, he is engaged in developing analytical models describing fuel rod behavior under adverse operating conditions for the Power Burst Facility Program.

RADIATION DOSE RATES FROM UO_2-PuO_2 THERMAL REACTOR FUELS

L. G. Faust
L. W. Brackenbush
R. C. Smith
L. L. Nichols
D. W. Brite

Faust

Smith Brite
Brackenbush Nichols

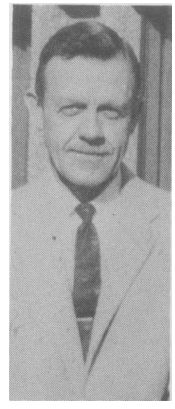
Leo G. Faust (BS, physics, Humboldt State College) is a senior research scientist at Battelle-Northwest. He is currently technical leader of the Fast Fuels Radiation Exposure Program concerned with the characterization of high exposure plutonium. L. W. Brackenbush (MS, nuclear technology, Washington State University) is a research scientist at Battelle-Northwest, where he is involved with plutonium and neutron dosimetry problems. His most recent interests include the use of tissue equivalent proportional counters to make absolute neutron dose measurements and to experimentally determine quality factors from LET distributions. Lowell L. Nichols (MS, physics, Oregon State University) is a senior research scientist at Battelle-Northwest. His current interest is in accelerator physics, neutron dosimetry, and understanding of fundamental interactions of radiation with tissue. R. C. Smith (MS, Oregon State University) is employed at Westinghouse Hanford Company in Fuels Development and Recycle. He is currently interested in the radiation exposure and characterization of plutonium. D. W. Brite (BS, chemistry, University of Kansas) is a senior research engineer who

has been involved in development and fabrication of nuclear fuels and radioisotope heat sources at Hanford for several years, formerly with the General Electric Company and presently with Battelle-Northwest. He is currently interested in PuO_2-UO_2 mixed-oxide fuels fabrication and development.

LATTICES OF PLUTONIUM-ENRICHED RODS IN LIGHT WATER—PART I: EXPERIMENTAL RESULTS

V. O. Uotinen
J. H. Lauby
L. C. Schmid
W. P. Stinson

V. O. Uotinen (MS, physics, Worcester Polytechnic Institute, 1963) is working in the area of reactor physics at Battelle-Northwest. His experience includes conducting and directing both experimental and analytical studies of reactors. His current interests involve theory-experiment correlations of a variety of reactor experiments. J. H. Lauby (BS, Oregon State University, 1950) is experienced in various aspects of experimental reactor physics. His contributions to the program mainly involve conducting experiments in subcritical and critical assemblies. His interests are in the area of experimental reactor physics. Loren C. Schmid (PhD, University of Michigan, 1958) is responsible for the program aspects of personnel working on experimental and analytical reactor developments at Battelle-Northwest. Also, he is an acting associate professor in nuclear engineering at the University of Washington. W. P. Stinson (not pictured) (BS, engineering physics, University of Auburn, 1949) has extensive experience in designing, conducting, and analyzing of experiments in research and test reactors. His interests are in the area of experimental reactor physics and instrumentation.



Lauby

Schmid

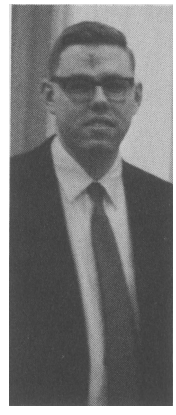
Uotinen

LATTICES OF PLUTONIUM-ENRICHED RODS IN LIGHT WATER—PART II: THEORETICAL ANALYSIS OF PLUTONIUM-FUELED SYSTEMS

R. C. Liikala
V. O. Uotinen
U. P. Jenquin

Ronald C. Liikala (BS, physics, MS, nuclear engineering, Michigan Technological University, 1961) has worked in the nuclear field for ten years. He is presently manager of engineering analysis in the Systems Engineering Department of Battelle-Northwest. His current research interest is solving reactor core design problems. V. O. Uotinen (MS, physics, Worcester Polytechnic Institute, 1963) is working in the area of reactor physics at Battelle-Northwest. His experience includes conducting and directing both experimental and calculational studies of reactors. His current interests involve theory-experiment correlations of a variety of reactor experiments. U. P. Jenquin (BS, physics, University of Wisconsin, 1963) is a research scientist at Battelle-Northwest. He has worked in the area of analytical reactor physics for nine years. His current interests include the physics of power reactor cores.

Liikala



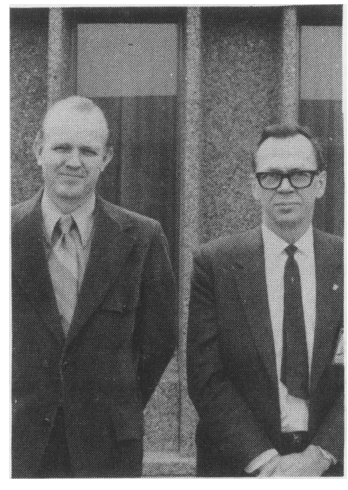
Jenquin

SPECTRUM-AVERAGED CROSS SECTIONS DEDUCED FROM BURNUP DATA AND THEIR APPLICATION TO METHODS VERIFICATION

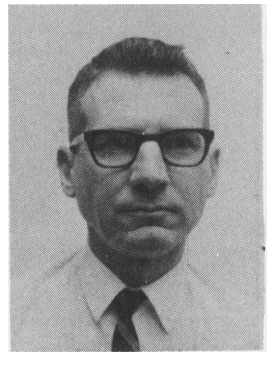
L. C. Schmid
D. E. Christensen
B. H. Duane
R. C. Liikala
R. P. Matsen

Loren C. Schmid (PhD, University of Michigan, 1958) is responsible for the program aspects of personnel working on experimental and analytical reactor developments at Battelle-Northwest. Also, he is an acting associate professor in nuclear engineering at the University of Washington. D. E. Christensen (MA, physics, Brigham Young University, 1962) is working in the reactor physics area at Battelle-Northwest. His experience includes conducting and directing both nondestructive and destructive burnup studies of nuclear fuels and the analyses of the resulting data. His current interests involve the application of burnup relationships to chemical reprocessing plant data from spent fuels for possible safeguards use. Bernhard H. Duane (MS, physics, Massachusetts Institute of Technology, 1955) has 15 years of experience in mathematical physics, with emphasis upon the solutions to a variety of neutron and photon transport problems. He has a broad range of interests, including nuclide transmutation, least-squares fitting on nonlinear theory to correlated measurements, relativistic electromagnetic plasma theory, complex elliptic functions, compressible fluid flow thermodynamics, and gas lasers. Ronald C. Liikala (BS, physics, MS, nuclear engineering, Michigan Technological University, 1961) has worked in the nuclear field for ten years. He is presently manager of engineering analysis in the Systems Engineering Department of Battelle-Northwest. His current research interest is solving reactor core design problems. R. P. Matsen (PhD, physics, University of California, Berkeley, 1961) began work in the area of reactor physics when he joined Battelle-Northwest in 1965. He has done considerable work in the area of destructive analysis of reactor fuels, the development of improved methods of deducing parameters from the data, and applying these methods to available data.

Schmid Liikala



Christensen Duane



Matsen