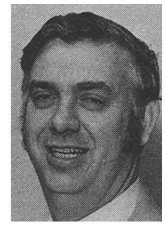
nuclear technology®

AUTHORS — MAY 1983

SECOND INTERNATIONAL RETRAN MEETING

RETRAN OVERVIEW

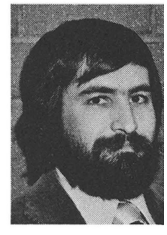
Lance J. Agee

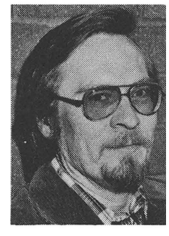


Lance J. Agee (MS, nuclear engineering, University of Nevada, Reno, 1966) has been associated with developing large computer codes since 1967. He has been the Electric Power Research Institute (EPRI) project manager responsible for development of the RETRAN code since its conception in 1975, and is presently responsible for the system and component subprogram at EPRI.

RETRAN NONEQUILIBRIUM TWO-PHASE FLOW MODEL FOR OPERATIONAL TRANSIENT ANALYSES

M. P. Paulsen
E. D. Hughes

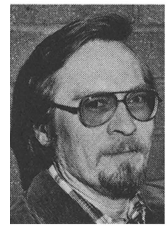


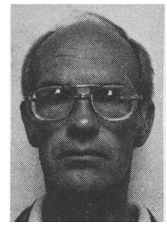


M. P. Paulsen (top) (BS, general engineering, 1972; MS, nuclear science and engineering, Idaho State University, 1974) is a senior nuclear engineer in the Computer Systems and Analysis Division at Energy Incorporated (EI). He joined EI in 1974 and has been involved with the development of the RETRAN code since 1975. His primary responsibilities included development of the code architecture, implementation of a consistent steady-state initialization module, and advanced model development and implementation. His current responsibilities and interests include numerical solution methods and thermal nonequilibrium phenomena in light water reactor transient analyses codes. **E. D. Hughes** (PhD, mechanical engineering, North Carolina State University, 1969) is a staff consultant with EI. His research interests for the past 12 years include mathematical modeling of two-phase flows, computer program development, and numerical thermal hydraulics as related to nuclear steam supply system performance and safety.

NUMERICAL SOLUTION METHOD IMPROVEMENTS FOR RETRAN

E. D. Hughes
K. R. Katsma



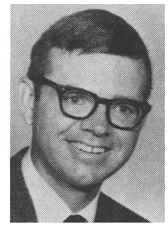


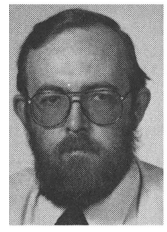
E. D. Hughes (top) (PhD, mechanical engineering, North Carolina State University, 1969) is a staff consultant with Energy Incorporated (EI). His research interests for the past 12 years include mathematical modeling of two-phase flows, computer program development, and numerical thermal hydraulics as related to nuclear steam supply system performance and safety. **K. R. Katsma** (BS, electrical engineering, Michigan State University, 1960; MS, nuclear engineering, University of Arizona, 1962) is a member of the technical staff at EI. He

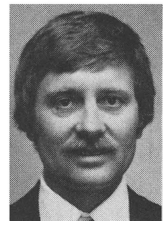
joined EI in 1978 after 15 years at the Idaho National Engineering Laboratory. For the past 10 years he has been active in the development and application of large thermal-hydraulic codes for reactor transient analysis.

RETRAN-02 CALCULATIONS OF OPERATIONAL TRANSIENTS IN THE LOSS-OF-FLUID TEST FACILITY

Clayton S. Miller
James Robert White
Richard D. Hentzen



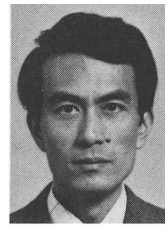


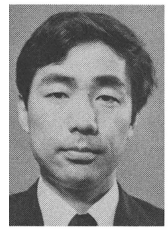


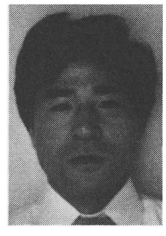
Clayton S. Miller (top) (BS, mechanical engineering, University of Washington, 1960; MS, mechanical engineering, University of Idaho, 1965; PhD, mechanical engineering, Utah State University, 1972) is a senior engineer at Intermountain Technologies, Inc., in Idaho Falls, Idaho, where he is involved in the development, modification, and application of computer codes for thermal-hydraulic analysis. He is also an affiliate professor at the University of Idaho where he teaches courses in fluid flow. His current technical interests include simulation of control systems and analysis of thermal-hydraulic transients. **James Robert (Bob) White** (center) (BS, engineering physics, Texas Tech University, 1970; MS, nuclear engineering, University of New Mexico, 1972) has worked for the Tennessee Valley Authority for three years, at the Idaho National Engineering Laboratory (INEL) for five years, and as an independent consultant. He is currently employed as a senior engineer with Intermountain Technologies, Inc. **Richard D. Hentzen** (bottom) (MS, agricultural engineering, University of Nebraska, 1964) is a member of the technical staff of the Computer Systems and Analysis Division at Energy Incorporated (EI). He joined EI in 1975 after six years at INEL where his work included providing analysis support to Aerojet Nuclear Company's loss-of-fluid test program planning branch. His current responsibilities at EI are in the applications of transient thermal-hydraulic systems analysis computer codes.

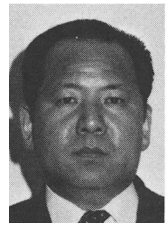
RETRAN SAFETY ANALYSES OF THE NUCLEAR-POWERED SHIP *MUTSU*

Yoshinori Naruko
Toshihisa Ishida
Yoshimi Tanaka
Yoshiaki Futamura





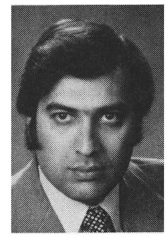
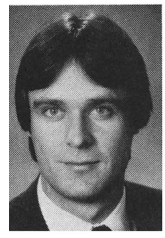
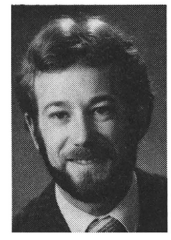
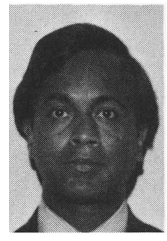
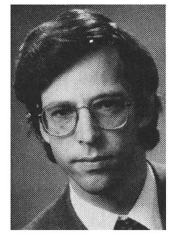




Yoshinori Naruko (top right) (MS, mechanical engineering, Tokyo University, Japan, 1970) has been engaged in safety analyses of the nuclear-powered ship, the N.S. *Mutsu*, at Japan Nuclear Ship Research and Development Agency (JNSRDA) since 1978. He joined JNSRDA in 1978 after eight years at Mitsui Engineering and Shipbuilding Co., Ltd., working on systems engineering problems. His current technical interests include the development and implementation of methodology dealing with maritime reactor safety. **Toshihisa Ishida** (top left) (MS, mechanical engineering, Kobe University, Japan, 1975) has worked for six years in the area of safety analyses of the N.S. *Mutsu* at JNSRDA. He is currently working in the area of thermal-hydraulic analyses of the N.S. *Mutsu* reactor to provide an operational manual for startup testing. **Yoshimi Tanaka** (bottom right) (MS, nuclear engineering, Tohoku University, Japan, 1978) has been engaged in core management and safety analysis of maritime reactors at Ishikawajima-Harima Heavy Industries for two years and at JNSRDA for two years. His current interests are in core design and fuel management of light water reactors. **Yoshiaki Futamura** (bottom left) (Dr.-Eng., nuclear engineering, Nagoya University, Japan, 1979) has worked for 18 years in the area of reactor engineering for boiling water reactors at Japan Atomic Energy Research Institute. He is currently a general manager of the Engineering Division, JNSRDA, with current interests in nuclear engineering for maritime reactors.

PREDICTION OF GE-ATLAS TRANSIENT BOILING TRANSITION DATA USING RETRAN-02/RETRAN-15F

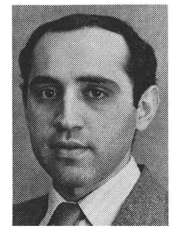
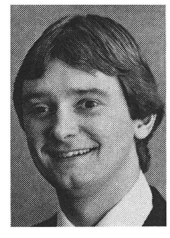
A. A. Farooq Ansari
Kevin J. Burns
Douglas K. Beller
Quazi A. Haque
Stephen P. Schultz

A. A. Farooq Ansari (top right) (MS, mechanical engineering, Worcester Polytechnic Institute, 1976) worked on loss-of-coolant accidents in pressurized water reactors (PWRs), spent fuel pool analysis in boiling water reactors (BWRs) and PWRs, and extensively on the development of thermal-hydraulic methods for licensing BWRs. He is currently working on plant training and plant power upratings for BWRs. **Kevin J. Burns** (top left) (BS and MS, nuclear engineering, Massachusetts Institute of Technology, 1980) is currently involved in BWR core wide transient analysis and thermal margin analysis at Yankee Atomic Electric Company. **Douglas K. Beller** (center right) (BS, mechanical engineering, Worcester Polytechnic Institute, 1980) worked on thermal-hydraulic modeling of reactor transients in BWRs and balance-of-plant modeling with SYNTHA. He is currently involved in developing training packages for reactor operators. **Quazi A. Haque** (bottom left) (MS, nuclear engineering, University of Lowell, 1981) is interested in BWR thermal-hydraulic transient analysis. He worked for a year at Yankee Atomic Electric Company prior to his joining Middle South Services, where he is currently employed as a nuclear engineer in the Nuclear Plant System Analysis Section. **Stephen P. Schultz** (bottom right) (BSE, Harvey Mudd College, 1969; MSNE, Rensselaer Polytechnic Institute, 1970; ScD, nuclear engineering, Massachusetts Institute of Technology, 1977) is manager of the NES Group at Yankee Atomic Electric Company. His experience includes BWR reload licensing and fuel behavior analysis. His current activities are in the application of reactor analysis and risk assessment methods to improve plant performance.

RETRAN'S ROLE IN THE DEVELOPMENT OF NORTHEAST UTILITIES' ANALYTICAL CAPABILITIES

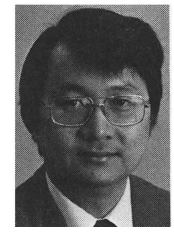
Mario V. Bonaca
Albert Gharakhani
Richard W. Sterner

Mario V. Bonaca (top) (doctor's degree in physics, University of Florence, Italy, 1964) is manager of reactor engineering at Northeast Utilities Service Company (NUSCO). He previously served as manager of the NUSCO Safety Analysis Branch in reactor engineering. Prior to his position at NUSCO, he served in technical and supervisory positions at Babcock & Wilcox Company (B&W) and worked in core physics and in safety analysis at Combustion Engineering. **Albert Gharakhani** (center) (MS, mechanical engineering, University of Virginia, 1983) is employed as an engineer in the transient analysis section of Northeast Utilities. He has also worked as an accident analyst in the Safety Analysis Branch of B&W. His technical interests are in the areas of thermal hydraulics and fluid mechanics applied to two-phase flow systems. **Richard W. Sterner** (bottom) (MS, nuclear engineering, Rensselaer Polytechnic Institute, 1981) is an associate engineer in the transient analysis section of NUSCO. His current interests are in pressurized water reactor accident analysis and open-channel two-phase flow.

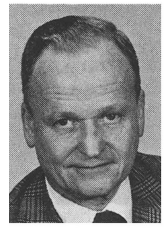
RETRAN-02 AND DYNODE-P ANALYSES OF A STEAM GENERATOR TUBE BREAK TRANSIENT

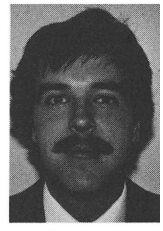
Jason Chao
V. K. (Bindi) Chexal
William H. Layman
David A. Rautmann
Craig E. Peterson
Larry W. Cress

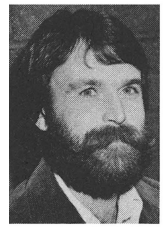


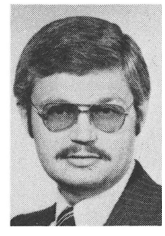
Jason Chao (right) [MA, physics, University of Texas at Austin, 1974; PhD, nuclear engineering, Massachusetts Institute of Technology (MIT), 1979] is currently a project manager at

the Electric Power Research Institute (EPRI). He has participated in thermal-hydraulics analyses related to pressurized thermal shock and steam generator tube integrity issues at the Nuclear Safety Analysis Center (NSAC). His past experience includes thermal-hydraulic design studies of reduced enrichment fuel for research and test reactors for Argonne National Laboratory, a design study of a tokamak fusion reactor blanket at MIT, and experimental investigations of krypton isotope nuclear structure at the University of Texas. **V. K. (Bindi) Chexal** (top right) (MS, mechanical engineering, Georgia Institute of Technology, 1972) has worked on the system design, thermal hydraulics, stress analysis, heat balance, and safety analysis of light and heavy water (Canada deuterium uranium) reactors for the past ten years. Before joining NSAC, which is operated by EPRI, he worked at Quadrex Corporation and at Atomic Energy of Canada, Ltd. He has been a lecturer in the Mechanical Engineering Department at San Jose State University and is currently working on various generic safety issues as well as serving as the matrix manager coordinating EPRI's reactor vessel pressurized thermal shock program. **William H. Layman** (top left), who is currently manager of the Generic Issues Department of NSAC, has been involved in nuclear power since 1952. He was formerly assistant director of the Atomic Energy Commission's Division of Reactor Safety Research, and before that he was chief of the Water Reactors Branch of the Division of Reactor Development and Technology. His work in the nuclear field began with nine years of service in the U.S. Navy's nuclear submarine program. **David A. Rautmann** (center right) (BS, 1978, and MS, 1979, nuclear engineering, University of Wisconsin-Madison) is currently the superintendent of safety analysis at the Northern States Power Company, which he joined in 1979. His experience is in the area of benchmarking of the Prairie Island safety analysis code package including DYNODE-P, COBRA-3C/MIT, CONTEMPT-LT, TOODEE-2, TELLAGRAF, DYNODE-B, and VIPRE. **Craig E. Peterson** (bottom left) (MS, nuclear engineering, Idaho State University, 1974) is a senior nuclear engineer in the Computer Systems and Analysis Division at Energy Incorporated (EI). His work at EI has been in the development and application of computer codes to analyze behavior of thermal-hydraulic systems. He has had a lead position in the development and application of the RETRAN computer code. **Larry W. Cress** (bottom right) (BS, nuclear engineering, University of Virginia, 1973; MS, nuclear engineering, Catholic University of America, 1975; BS, zoology, University of Maryland, 1982) was until recently a senior associate with Nuclear Associates International, where he coauthored the DYNODE computer programs for transient simulation of pressurized and boiling water reactor plants. He has been involved in various aspects of thermo-fluid and control systems modeling since 1974. He is currently a student in the School of Medicine of the University of Maryland and his research interests include experimental pharmacology and computer simulation of biological systems.



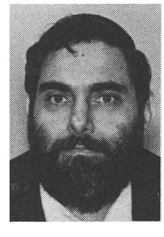






RETRAN-02 ANALYSIS OF ARKANSAS NUCLEAR ONE UNIT 2 TESTS

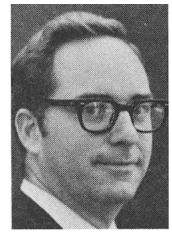
Salvador Ranatza, Jr.

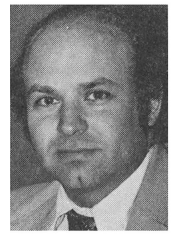


Salvador Ranatza, Jr. (BS, physics, Louisiana State University, New Orleans, 1963) is currently involved in plant systems analysis at Middle South Services. He has been engaged in light water reactor and liquid-metal fast breeder reactor activities for over 15 years, including thermal-hydraulics analysis, computer code development, licensing, and safety analysis.

RETRAN ANALYSES FOR IMPROVING PLANT PROCEDURES AND OPERATOR TRAINING

T. Gary Broughton
N. G. Trikouros

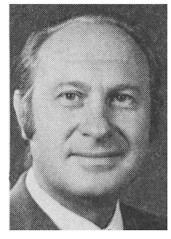




T. Gary Broughton (top) (BA, mathematics, Dartmouth College, 1966) is director of Systems Engineering at General Public Utilities (GPU) Nuclear Corporation. His current interests include operational improvements at nuclear power generating stations through applications of systems analysis. **N. G. Trikouros** (ME, nuclear engineering, New York University, 1972) is manager of Safety Analysis and Plant Control at GPU Nuclear. His experience includes safety analysis, probabilistic risk assessment, and licensing of nuclear power plants. For the past several years, he has been engaged in power plant transient and accident modeling studies.

LOFTRAN/RETRAN COMPARISON CALCULATIONS FOR A POSTULATED LOSS-OF-FEEDWATER ATWS IN THE SIZEWELL 'B' PWR

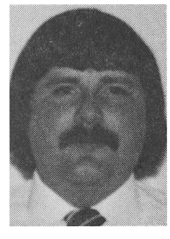
Karel L. Papez
Daniel H. Risher

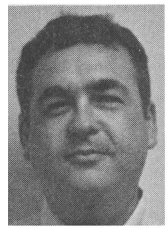


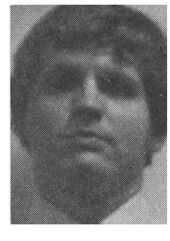
Karel L. Papez (top) (graduate engineer, chemical and nuclear engineering, Technical University of Brno, Czechoslovakia, 1958) is a senior staff member at the National Nuclear Corporation (NNC), Leicester, United Kingdom. He has 24 years of experience in the nuclear industry and since joining NNC in 1974 he has been involved in safety analyses of the high-temperature reactor, second-generation heavy water reactor, advanced gas-cooled reactor, and now pressurized water reactor (PWR) reactor systems. His PWR work has been mainly in the area of intact circuit faults, but he is now engaged in large break loss-of-coolant accident analysis. **Daniel H. Risher** (PhD, nuclear engineering, University of Virginia, 1969) is a principal engineer in the Nuclear Operations Division of Westinghouse Electric Corp. He is currently stationed in Whetstone (Leicester) as a member of the Westinghouse U.K. Technical Assistance team working with NNC on the U.K. PWR. Since joining Westinghouse in 1968, his experience has been in the areas of PWR core control and system transient and safety analysis, with emphasis on core reactivity faults and spatial kinetic analysis.

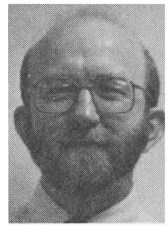
QUALIFICATION OF A RETRAN-02 MODEL FOR BOILING WATER REACTOR TRANSIENT ANALYSIS

Michael E. Garrett
Samuel L. Forkner
T. A. Keys
George W. Perry
M. Wesley Waddell, Jr.



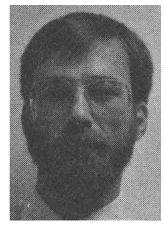






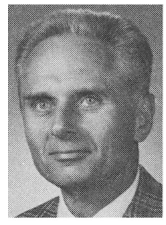
Michael E. Garrett (top right) (BS, 1976, and MS, 1978, nuclear engineering, Purdue University) is a nuclear engineer in the Tennessee Valley Authority's (TVA's) Nuclear Fuel Branch. For the past four years he has been involved in developing computer models for use in thermal-hydraulic and transient safety analysis of boiling water reactors (BWRs). **Samuel L. Forkner** (top left) (BS, 1969, and MS, 1973, nuclear engineering, University of Tennessee) is a staff engineer with the Nuclear Fuel Branch of TVA. He is engaged in the development of methods for reactor physics and thermal-hydraulic analysis of light water reactors. **T. A. Keys** (bottom right) (BS, physics, Eastern Illinois University, 1976; MS, nuclear engineering, University of Illinois) is a staff engineer with the Nuclear Fuel Branch of TVA. His current responsibilities include reload core design, fuel cycle design, and safety analysis of BWRs. **George W. Perry** (bottom left) (BS, nuclear engineering, Mississippi State University, 1965) has been involved in the development of computer-based nuclear engineering methods throughout his career. He is currently developing methods for

probabilistic simulation of nuclear plant operation and fuel supply. Before his present position as a nuclear engineer in TVA's Nuclear Fuel Branch, he supervised TVA's Method Development Section from 1975 to 1980. **M. Wesley Waddell, Jr.** (right) (BS, 1977, and MS, 1980, University of Tennessee) is a nuclear engineer in the TVA's Nuclear Fuel Branch. He is involved in developing methods for core physics and thermal hydraulics. Prior to his current position, he was engaged in nuclear code development at Union Carbide Corporation from 1977 to 1980.



BOILING WATER REACTOR STABILITY ANALYSIS WITH RETRAN

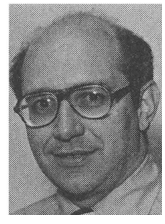
Karl Hornyik



Karl Hornyik (Dipl. Ing., mechanical engineering, University of Technology, Vienna, 1959; PhD, nuclear engineering, University of Illinois, 1965) is a professor of nuclear engineering at Oregon State University. He has been working with the Electric Power Research Institute staff on a number of projects concerning the qualification of the RETRAN code for analyzing light water reactor transients.

EVALUATION OF RETRAN-02 OPTIONS WITH PEACH BOTTOM DATA

Joseph A. Naser

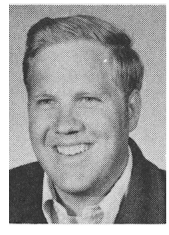


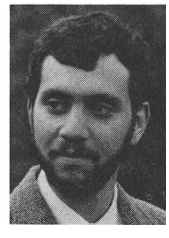
Joseph A. Naser (PhD, nuclear engineering, University of Berkeley, 1976) has been doing nuclear technology research and development work since 1971. He worked at Argonne National Laboratory before joining the Electric Power Research Institute, where he is presently a project manager. His primary technical interests are in system and core thermal hydraulics for light water reactor safety and analysis. He is presently involved in helping develop a complete reload capability for the nuclear utilities.

FISSION REACTORS

SIMPLIFIED TORNADO DEPRESSURIZATION DESIGN METHODS FOR NUCLEAR POWER PLANTS

Neil M. Howard
Mitchell J. Krasnopoler

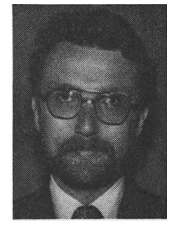


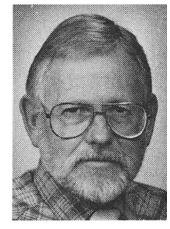


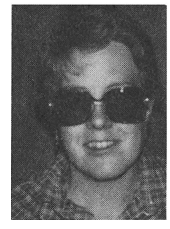
Neil M. Howard (top) (BS, engineering physics, University of California, Berkeley, 1969; MS, 1971, and PhD, 1974, nuclear engineering, University of Illinois) is on the nuclear engineering staff of Bechtel Power Corporation's Gaithersburg Power Division. His general field of interest has been thermohydraulic safety analysis of light water reactors, including containment and subcompartment pressure/temperature analysis, computer modeling of boiling water reactor containment hydrodynamic and condensation phenomena, and computer simulation of nuclear power plant systems. **Mitchell J. Krasnopoler** (BS, chemical engineering, University of Pennsylvania, 1979) began his career working on thermal-hydraulic safety problems of nuclear power plants for Bechtel Power Corporation. He is currently involved in the research and development of flue gas desulfurization systems at Peabody Process Systems, Inc.

DEACTIVATION OF SILVER ZEOLITE ADSORBERS BY AIRBORNE ORGANICS

Lawrence A. Casper
Arvid M. Jensen
Kendall G. Magill
Penny M. Wikoff



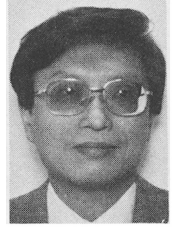


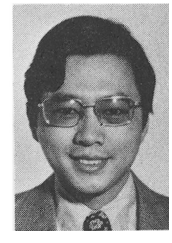


Lawrence A. Casper (top right) (BS, chemistry, Juniata College, 1969; MS, environmental science, University of Alaska, 1975; PhD candidate, chemistry, Lehigh University) is currently responsible for investigations of surface and thin-film chemistry in semiconductor technology at Honeywell's Solid State Development Center. Previously, he was a group leader in materials analysis with EG&G Idaho at the Idaho National Engineering Laboratory [U.S. Department of Energy (DOE)]. **Arvid M. Jensen** (top left) (BS, general engineering, Idaho State University, 1968; MS, nuclear science and engineering, Idaho State University, 1971) is currently manager of the Power Burst Facility Operations Support Branch at the Idaho National Engineering Laboratory. Previously, he served as manager of the Nuclear Steam Supply System Performance Engineering Unit at General Electric Company, San Jose, California. **Kendall G. Magill** (bottom right) (BS, mechanical engineering, California State Polytechnic University, 1959) is currently responsible for the preventive maintenance, corrective maintenance, and inservice inspection programs with EG&G Idaho at the power burst facility nuclear test reactor located at the Idaho National Engineering Laboratory (DOE). **Penny M. Wikoff** (bottom left) (BS, chemistry, 1976; MS, metallurgical engineering, University of Idaho, 1978) is currently employed by the Energy Programs Division of EG&G Idaho, Inc. at the Idaho National Engineering Laboratory. She is working on the Injection, Chemical Heat Pump, and the Waste Heat Rejection Programs.

ANALYSIS OF CREEP FOR NUCLEAR WASTE STORAGE IN A SALT FORMATION

William T. Li
Ching L. Wu

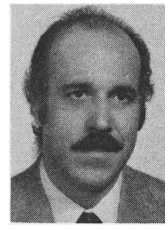


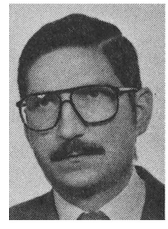


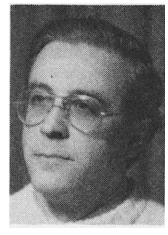
William T. Li (top) (BS, civil engineering, Chung Yuan College, 1966; MS, 1969, and PhD, 1974, structural mechanics, University of Illinois) has been involved in the design and analysis of nuclear-related structures since 1973. He is currently a senior specialist for Nuclear Fuel Operations at Bechtel National, Inc. His current interests include nuclear waste storage facility design, structural dynamics, and nonlinear analysis. **Ching L. Wu** (BS, 1966, civil engineering, Chu Hai College, Hong Kong; MS, 1967, and PhD, 1971, structural engineering, University of California, Berkeley) is the civil/structural/architectural supervisor for the Waste Isolation Pilot Plant project for Bechtel National, Inc. His technical experience includes analysis and design of nuclear fuel cycle facilities such as nuclear waste disposal and nuclear fuel reprocessing plants; and advanced energy facilities such as fusion plants, energy storage, and solar energy plants.

OPTIMAL STEP ASSAYS AND FLOW RATES IN GASEOUS DIFFUSION SQUARED-OFF CASCADES FOR URANIUM ENRICHMENT

Osvaldo Fiorella
Manlio Mangia
Elio Oliveri







Osvaldo Fiorella (top) (Dr. Eng., nuclear engineering, University of Palermo, Italy, 1969) is associate professor of nuclear plants (complements) at the University of Palermo. He has worked in the field of solid-state dosimetry; his current interests involve optimization techniques and nuclear safety computer codes. **Manlio Mangia** (center) (Dr. Eng., nuclear engineering, University of Palermo, Italy, 1971) is associate professor of reactor core engineering at the University of Palermo. He has worked in the field of thermoluminescence dosimetry; his present research interests are related to optimization techniques and computer applications to core engineering. **Elio Oliveri** (bottom) (Dr. Eng., mechanical engineering, University of Palermo, Italy, 1959; "Libero Docente," nuclear engineering, 1965) is full professor of nuclear plants and director of the Istituto di Applicazioni ed Impianti Nucleari of the University of Palermo. His current research interests include heat and mass transfer in nuclear reactor safety, radiation effects, optimization techniques, and computer modeling.