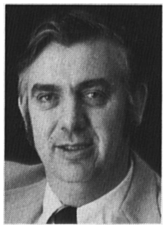
nuclear technology®

AUTHORS — JULY 1985

THIRD INTERNATIONAL RETRAN MEETING

RETRAN OVERVIEW

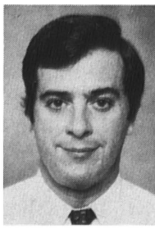
Lance J. Agee

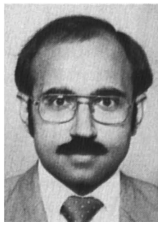


Lance J. Agee (MS, nuclear engineering, University of Nevada, Reno, 1966) has been associated with developing large-computer codes since 1967. He has been the Electric Power Research Institute (EPRI) project manager responsible for RETRAN code development since its inception in 1975 and is currently responsible for the Analytical Methods and Verification Subprogram at EPRI.

RETRAN APPLICATIONS IN PRESSURIZED THERMAL SHOCK ANALYSIS OF TURKEY POINT UNITS 3 AND 4

Jorge Arpa
Alan S. Fatemi
S. K. Mathavan

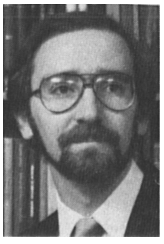




Jorge Arpa (top) (BS, mechanical engineering, University of Barcelona, Spain, 1970; DEA, 3e Cycle, nuclear physics, University of Paris, 1972; MS, nuclear engineering, Purdue University, 1976) is a senior nuclear engineer in the Thermal Hydraulics and Safety Section of Nuclear Fuels at Florida Power and Light Company (FPL). He joined FPL in 1984 after seven years with Energy Incorporated, where he was involved in probability risk analysis, code development and applications, and training. His current interests include core thermal hydraulics, licensing, and power plant transient simulation. **Alan S. Fatemi** (center) (MS, nuclear engineering, University of Illinois, 1976) is a nuclear engineer at FPL. Previously he performed safety analysis in the Plant Engineering Section of Combustion Engineering. His technical interests include reactor thermal hydraulics and transient analysis. **S. K. Mathavan** (bottom) (BS, mechanical engineering, University of Kashmir, India, 1968; MS, 1970, and PhD, 1977, mechanical engineering, University of Miami) is a senior engineer at FPL, where he is involved in thermal hydraulic and structural analysis of Turkey Point and St. Lucie power plants. His previous experience includes teaching and structural design of nuclear plants, telecommunication towers, and aircraft ground support equipment. His current technical interests include studies of pressurized thermal shock, fuel assembly design, and analyses leading to reduction of inadvertent reactor trips.

RETRAN ANALYSIS OF THE HANFORD N REACTOR FOR A LOSS OF FEEDWATER

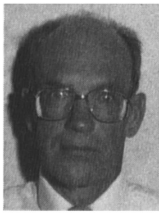
Bruce E. Schmitt

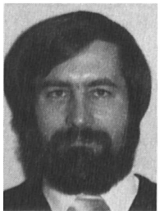


Bruce E. Schmitt (BS, nuclear engineering, University of Illinois, 1980) is currently lead engineer of the Systems Safety Analysis Group at UNC Nuclear Industries, Operations Division, Richland, Washington. He is currently working with computer modeling of operational transients for the Hanford N Reactor, and is also involved with failure analyses of the reactor systems. His interests are in thermal-hydraulic responses of power reactors for operational and accident condition transients.

SEMI-IMPLICIT SOLUTION METHODS FOR THE RETRAN MODEL EQUATIONS

E. D. Hughes
K. R. Katsma
M. P. Paulsen

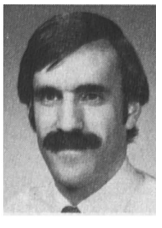


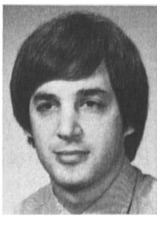


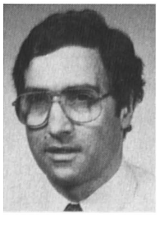
E. D. Hughes (top) (PhD, mechanical engineering, North Carolina State University, 1969) is a staff consultant with Energy Incorporated (EI). His research interests for the past 16 years include mathematical modeling of two-phase flows, computer program development, and numerical thermal hydraulics as related to nuclear steam supply system performance and safety. **K. R. Katsma** (center) (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 11 years he has been active in the development and application of large thermal-hydraulic codes for reactor transient analysis. **M. P. Paulsen** (bottom) (BS, general engineering, 1972, and MS, nuclear science and engineering, 1974, Idaho State University) is a senior nuclear engineer in the Software and Consulting Group at EI. He joined EI in 1974 and has been involved with the development of the RETRAN code since 1975. His current responsibilities and interests include development and implementation of numerical solution methods and thermal nonequilibrium modeling phenomena.

ENGINEERING ANALYSIS ACTIVITIES IN SUPPORT OF SUSQUEHANNA UNIT 1 STARTUP TESTING AND CYCLE 1 OPERATIONS

G. D. Miller
J. G. Refling
A. J. Roscioli
S. A. Somma
C. A. Kukielka
L. M. Olson





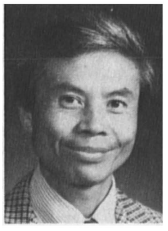


G. D. Miller (top right) (MS, nuclear engineering, University of Delaware, 1974) is supervisor of the Mechanical Engineering Group in the Pennsylvania Power & Light Company (PP&L) nuclear plant engineering organization. He has ten years experience in transient modeling and development. **J. G. Refling** (top left) (PhD, University of Virginia, 1976) is a senior project engineer in PP&L's Engineering Analysis Group. He has ten years of experience of transient analysis, development, and systems analysis. He is currently interested in anticipated transient without scram (ATWS) modeling and emergency procedures for boiling water reactor (BWR) plants. **A. J. Roscioli** (center right) [BS, nuclear engineering, Pennsylvania State University (PSU), 1978] is a project engineer in PP&L's Engineering Analysis Group. He has over six years of experience in transient analysis and modeling and is currently involved with reload licensing and developing PP&L's capability in that area. **S. A. Somma** (bottom left) (MS, nuclear engineering, PSU, 1975) is currently a project engineer in PP&L's Engineering Analysis Group. He has over eight years of experience in transient analysis, fuel management, and operations. His current interests are fuel performance development and analysis. **C. A. Kukielka** (bottom right) (MS, nuclear engineering, Virginia Polytechnical Institute, 1979) is a

project engineer in PP&L's Systems Engineering Group. He has five years of experience in transient and systems analysis and is currently interested in BWR plant performance analysis under ATWS conditions, systems reliability, and probabilistic risk assessment methodology. **L. M. Olson** (right) (BS, nuclear engineering, PSU, 1981) is an engineer in PP&L's Engineering Analysis Group. He has over three years of experience in transient modeling and analysis and is currently interested in formulation and documentation of a transient steam line model.

RETRAN ANALYSIS OF BOILING WATER REACTOR ACCIDENTS

Ernest V. Moore
S. F. Deng
K. K. Chitkara
B. B. Chu



Ernest V. Moore (top right) (BS, nuclear engineering, University of Cincinnati, 1981) worked at the Cincinnati Gas and Electric Company in the area of fuel and thermal-hydraulic analysis. He is currently employed at the Virginia Electric and Power Company as a fuel performance engineer. **S. F. Deng** (top left) (BS, mechanical engineering, Taipei Institute of Technology, 1962; MS, mechanical engineering, University of Iowa, 1964) is currently a project engineer at Exxon Nuclear Company responsible for reload safety analysis and licensing. Prior to joining Exxon, he was director of the Nuclear Systems and Reliability Analysis Division of the Cincinnati Gas and Electric Company. His areas of interest include final-cycle analysis, core thermal hydraulics, plant transient analysis, and reliability engineering. **K. K. Chitkara** (bottom right) (BS, 1963, and MS, 1964, physics, Punjab University, India) is currently employed at Houston Lighting & Power, Department of Nuclear Services, where he is responsible for managing activities in the areas of plant safety analysis, reliability analysis, and core analysis. **B. B. Chu** (bottom left) (BS, mechanical engineering, University of Houston, 1967; MS and PhD, mechanical engineering, University of Wisconsin-Madison, 1972) is a project manager in the Risk Assessment Program of the Electric Power Research Institute.

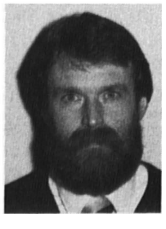
ANALYSIS OF HATCH-2 DUAL RECIRCULATION PUMP TRIP STARTUP TEST

Adel Alapour
Robert A. Hommerson

Adel Alapour (top) (PhD, nuclear engineering, Georgia Institute of Technology, 1980) worked for the Department of Nuclear Energy at Brookhaven National Laboratory for two years prior to joining Southern Company Services, Inc. (SCS). He is currently a senior core analysis engineer in the Department of Nuclear Safety and Fuel at SCS. His primary areas of interest are reactor safety analysis and reactor physics. **Robert A. Hommerson** (BSE and MSE, nuclear engineering, University of Florida, 1983) is employed at SCS and worked in the area of light water reactor transient analysis until August 1984. His current interests are pressurized water reactor reload analysis and reactor safety analysis.

AN INVESTIGATION OF DECREASING REACTOR COOLANT INVENTORY AS A MECHANISM TO REDUCE POWER DURING A BOILING WATER REACTOR ANTICIPATED TRANSIENT WITHOUT SCRAM

Craig E. Peterson
V. K. (Bindi) Chexal
William H. Layman
Richard D. Hentzen
Garry C. Gose



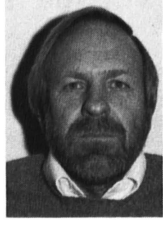
Craig E. Peterson (right) (MS, nuclear engineering, Idaho State University, 1974) is a senior nuclear engineer in the Software & Consulting Group at Energy Incorporated (EI). His work at EI has been in the development and application of computer codes

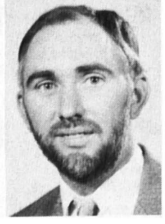
to analyze behavior of thermal-hydraulic systems. He has had a lead position in the development and application of the RETRAN computer code. **V. K. (Bindi) Chexal** (top right) (MS, mechanical engineering, Georgia Institute of Technology, 1972) has worked on the system design, thermal hydraulics, stress analysis, heat balance, and safety analysis of light and heavy water (Canada deuterium uranium) reactors for the past 13 years. He is currently working on thermal-hydraulic analysis of several generic safety issues as well as serving as the matrix manager coordinating the Electric Power Research Institute's (EPRI's) development of realistic emergency core cooling system methodology for future light water reactors (LWRs). Before joining 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. **William H. Layman** (top left), who is currently manager of generic safety analysis at EPRI's Nuclear Safety Analysis Center, has been involved in nuclear power since 1952. He was formerly assistant director of the U.S. Atomic Energy Commission 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. **Richard D. Hentzen** (bottom right) (MS, agricultural engineering, University of Nebraska, 1964) is a member of the technical staff of the Software & Consulting Group at EI. He joined EI in 1975 after six years at Idaho National Engineering Laboratory where his work included providing analysis support to the Aerojet Nuclear Company's loss-of-fluid test program planning branch. His current responsibilities at EI are in the applications of transient thermal-hydraulic computer codes. **Garry C. Gose** (bottom left) (BS and MS, nuclear science, Idaho State University, 1975) is a senior nuclear engineer at EI. He has participated in the development of the RETRAN computer code, where his work has been in the area of the core physics models. His primary interests include both fission and fusion reactor physics, neutronics methods, and the thermal-hydraulic behavior of LWRs.

RETRAN-02 ANALYSIS OF LOSS-OF-FLUID TEST EXPERIMENTS L9-3 AND L9-4

Richard F. Farman
Charles E. Hendrix
Jason Chao

Richard F. Farman (top) (BS, U.S. Merchant Marine Academy, 1958; PhD, nuclear engineering, University of Maryland, 1965) is with Energy Incorporated, Idaho Falls, Idaho. His principal activities are in water reactor transient thermal and hydraulic behavior. **Charles E. Hendrix** (center) (BS, physics, University of Illinois, 1968; MS, State University of New York, 1975) is a member of the technical staff of Intermountain Technologies, Inc. (ITI). He worked at the Idaho National Engineering Laboratory in research and development prior to joining ITI in 1980. His current primary research interest is the analysis and modeling of nuclear reactor transients. **Jason Chao** (bottom) [MA, physics, University of Texas at Austin, 1974; PhD, nuclear engineering, Massachusetts Institute of Technology (MIT), 1979] is presently a project manager at the Electric Power Research Institute. He has participated in plant analyses related to pressurized thermal shock, steam generator tube rupture, anticipated transients without scram, and scram reduction issues at the Nuclear Safety Analysis Center. His past experience includes design studies of reduced enrichment fuel for research reactors at Science Applications, Inc., for Argonne National Laboratory, a design study of tokamak fusion reactor blanket at MIT, and





experimental investigations on nuclear structure of krypton isotopes with a Van de Graaff Accelerator at the University of Texas at Austin. He is a registered professional engineer in mechanical engineering in the state of California.

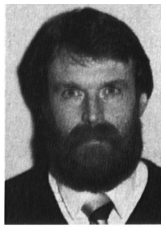
RETRAN ANALYSIS OF THE SAN ONOFRE UNIT 2 TURBINE TRIP FROM 100% POWER

Yine-Ping Ting

Yine-Ping Ting (BS, nuclear engineering, Tsing Hua University, Taiwan, 1972; MSE, nuclear engineering, Texas A&M University, 1976; PhD, nuclear engineering, Oregon State University, 1981; registered professional engineer, mechanical engineering and nuclear engineering, State of California) is an engineer in the Nuclear Analysis Group, Department of Nuclear Engineering, Southern California Edison Company. He gained his initial experience in the field of nuclear reactor safety analysis while working for the safety analysis department of NUS Corporation in Maryland (1977-1979). His recent activities include nuclear plant thermal hydraulics, and plant operational transient and accident analyses.

ANALYSIS OF A HOT-LEG SMALL BREAK LOSS-OF-COOLANT ACCIDENT IN A THREE-LOOP WESTINGHOUSE PRESSURIZED WATER REACTOR PLANT

Craig E. Peterson
V. K. (Bindi) Chexal
Talmage B. Clements



Craig E. Peterson (top) (MS, nuclear engineering, Idaho State University, 1974) is a senior nuclear engineer in the Software and Consulting Group 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. **V. K. (Bindi) Chexal** (center) (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 13 years. He is currently working on thermal-hydraulic analysis of several generic safety issues as well as serving as the matrix manager coordinating the Electric Power Research Institute's (EPRI's) development of realistic emergency core cooling system methodology for future light water reactors. Before joining 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. **Talmage B. Clements** (bottom) (BS, physics, 1969; BS, 1974, and MME, 1977, mechanical engineering, North Carolina State University) currently is in charge of transient analysis in the Nuclear Fuel Section of Carolina Power & Light Company in Raleigh, North Carolina.

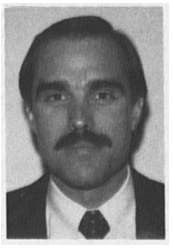
COMPARISON OF RETRAN AND RELAP5 MODELS TO OYSTER CREEK LOSS OF FEEDWATER TRANSIENT

M. A. Alammar

M. A. Alammar (BS, electrical engineering, Birmingham University, 1962; MS, nuclear engineering, Strathclyde University, 1970; PhD, nuclear engineering, Iowa State University, 1981) joined GPU Nuclear Corporation in 1982. Since then, he has been working in the safety analysis department on plant transient analysis, using RETRAN and RELAP5. His current interests are in model development for plant simulation.

RETRAN-02 COMPARISON OF NATURAL CIRCULATION FLOW RATES AT BABCOCK & WILCOX 177-FA PLANTS

Norman T. Simms



Norman T. Simms (BS, nuclear engineering, North Carolina State University, 1974) has been employed at Duke Power Company since 1974 and is a design engineer in the design engineering department. He began using the RETRAN code in 1980 when he joined the Safety Review, Analysis, and Licensing Division. His current responsibility is performing integrated systems analyses of safety-related systems for all of Duke Power's nuclear stations.

NUCLEAR SAFETY

ANALYTICAL INVESTIGATION OF POSTACCIDENT CONTAINMENT ATMOSPHERIC STRATIFICATION

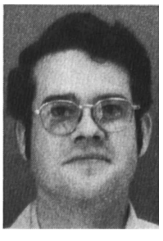
Vincent P. Manno
Michael W. Golay

Vincent P. Manno (top) [BS, nuclear engineering science, Columbia University, 1976; MS, 1979, and ScD, 1983, nuclear engineering, Massachusetts Institute of Technology (MIT)] is an assistant professor of mechanical engineering at Tufts University and is also a visiting assistant professor of nuclear engineering at MIT. His technical interests include mechanical engineering analysis of power production facilities and analysis of enclosed buoyant flows. **Michael W. Golay** (BE, mechanical engineering, University of Florida, 1964; PhD, nuclear engineering, Cornell University, 1969) is an associate professor of nuclear engineering at MIT. His technical interests center on the application of engineering principles to the solution of environmental and safety problems of electric power production.

RADIOACTIVE WASTE MANAGEMENT

LEACHING OF PLUTONIUM FROM A RADIOACTIVE WASTE GLASS BY EIGHT GROUNDWATERS FROM THE WESTERN UNITED STATES

Terry F. Rees
Jess M. Cleveland
Kenneth L. Nash



Terry F. Rees (top) (BS, chemistry, Metropolitan State College, 1974; MS, chemistry, 1981, and PhD, applied chemistry, 1982, Colorado School of Mines) is a research chemist in the Transuranium Research Project (TRP) of the U.S. Geological Survey. His current research interest is in the geochemical behavior of the transuranium elements under conditions expected in and near possible nuclear waste repositories. **Jess M. Cleveland** (center) (BS, chemistry, Georgia Institute of Technology, 1951; MS, chemistry, 1955, and PhD, inorganic chemistry, 1959, University of Colorado) is chief of the TRP of the U.S. Geological Survey. His current interests include actinide element coordination chemistry and the groundwater chemistry of the transuranium elements. **Kenneth L. Nash** (bottom) (BA, chemistry, Lewis University, 1972; MS, chemistry, 1975, and PhD, inorganic chemistry, 1978, Florida State University) is a research chemist in the TRP of the U.S. Geological Survey. His primary research interest is in the solution chemistry of the actinide elements and its application to nuclear waste disposal.