



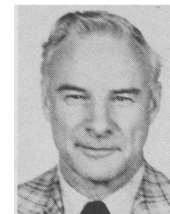
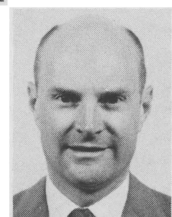
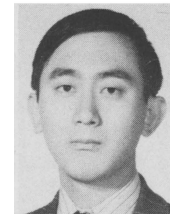
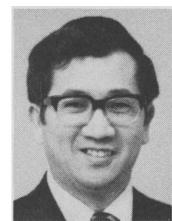
## AUTHORS – SEPTEMBER 1981

### FISSION REACTORS

#### A MATHEMATICAL MODEL OF CORROSION PRODUCT TRANSPORT IN THE BOILING WATER REACTOR PRIMARY SYSTEM

**Chien-chang Lin** (top right) (BS, chemical engineering, Tunghai University, 1959; PhD, chemistry, University of New Mexico, 1968) did his post-doctoral research at Washington University in St. Louis (1967 to 1970) in radiochemical studies of nuclear fission. He joined General Electric Company (GE) at the Vallecitos Nuclear Center in 1971. He is currently a principal engineer, and his interests include reactor coolant chemistry, iodine chemistry, radiochemical techniques, fission product source terms, and corrosion product transport modeling. He was a visiting research professor at the Institute of Nuclear Science, Tsing Hua University (Taiwan) in 1980. **C. Raymond Pao** (top left) (BS, chemistry, National Taiwan University, 1963; MS, 1967, and PhD, 1970, physical chemistry, University of California, Berkeley) has been a senior engineer at GE since 1971. He has participated in various nuclear technology developments including gas technology, radiochemistry, radiation monitor sensor, corrosion, mass transport, and process development and modeling. He was previously involved in physical chemistry research (1965 to 1970) at the Inorganic Material Research Division of Lawrence Radiation Laboratory. **John S. Wiley** (bottom right) (PhD, chemical engineering, Iowa State University, 1954) is manager of chemical and radiological methods in the GE Nuclear Energy Engineering Department. He joined GE in 1965 as a water chemistry and desalination specialist and has been an engineering manager since 1971. His present responsibilities include formulation of radiation reduction recommendations for operating plants, water quality data base management and modeling of corrosion product generation, transport, and activation. **William R. DeHollander** (bottom left) (PhD, physical chemistry, University of Washington, 1951) is a consulting engineer with the GE Nuclear Engineering Division with over 28 years of experience in the nuclear energy field. His previous work was in the field of uranium oxide fuel conversion, fabrication, and testing, followed by considerable experimentation in corrosion and electrochemistry and experimentation in the corrosion of stainless steel in high purity water. His later assignments in the water chemistry field have provided a good means for applying his diverse background in the solution of the radiation reduction problem. In this assignment, he has contributed to the insight and synergistic analysis required to reach our present level of understanding.

*C. C. Lin  
C. R. Pao  
J. S. Wiley  
W. R. DeHollander*



**RADIONUCLIDE CHAIN TRANSPORT THROUGH HETEROGENEOUS MEDIA**

**Jörg Hadermann** (top) (Dipl. Phys., 1964, and PhD, theoretical nuclear physics, 1968, University of Basle, Switzerland) is currently with the Swiss Federal Institute for Reactor Research at Würenlingen, Switzerland. He has been involved for 14 years in low and intermediate energy nuclear physics. Since 1978, he has been working on problems centering on radionuclide transport from waste repositories. Here, his interest lies primarily in safety assessment. **Jean Patry** (PhD, theoretical nuclear physics, University of Geneva, Switzerland, 1940; Math D, applied mathematics, Federal Institute of Technology, Zürich, Switzerland) worked for 14 years in mathematical problems at an electrotechnical factory and for 24 years, until February 1981, in data processing at the Federal Institute for Reactor Research, Würenlingen, Switzerland.

*J. Hadermann  
J. Patry*

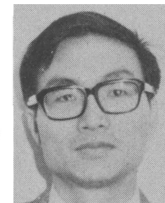


**MATERIALS**

**REGENERATION OF A LARGE COLD TRAP**

**Katsuro Takahashi** (top right) (Dr., nuclear engineering, Osaka University, 1972) has been doing nuclear research and development on liquid-metal fast breeder reactors (LMFBRs). He has studied coolant mixing in LMFBR fuel subassemblies and is currently working with reactor safety experiments as an assistant senior engineer at Power Reactor and Nuclear Fuel Development Corporation (PNC). He is presently at Sandia National Laboratories as a visiting engineer. **Yoshiaki Himeno** (top left) (Master, nuclear engineering, Tohoku University, 1970) has been working with nuclear research and development for fast breeder reactors and is presently an assistant senior engineer at PNC. He stayed at Argonne National Laboratory as a visiting engineer in 1978 and 1979. His current interests include cesium mist behavior in inert cover gas space in reactor components as well as reactor safety-related aerosol behavior. **Nobutomo Takahashi** (center right) (Katsuta Technical High School, 1970) has been working with construction, maintenance, and testing of a large sodium test loop for development of fast reactors. He is presently an assistant engineer at PNC, with interests in the development of LMFBR components, in particular, the cavitation-free fuel subassembly. **June Takahashi** (bottom left) (BSc, geophysics, University of Tokyo, 1957) has been in research management since he joined Oarai Engineering Center, PNC, in 1969. He has also been a member of the group that developed the first large-scale sodium loop in Japan between 1969 and 1973. He is presently a technical director of the Monju development management office of PNC in Tsuruga, Fukui, Japan. **Tatsuro Iguchi** (bottom right) (BSc, mechanical engineering, Nagoya University, 1962) has been a technical group leader of Toshiba Company, and participated in the Fermi Project at Atomic Power Development Associates, Inc., from 1969 to 1971. He is currently a manager of Oarai Engineering Center of PNC with interests in components of LMFBR coolant systems.

*Katsuro Takahashi  
Yoshiaki Himeno  
Nobutomo Takahashi  
June Takahashi  
Tatsuro Iguchi*

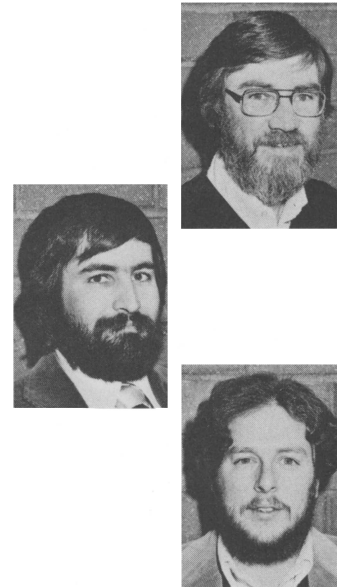


# FIRST INTERNATIONAL RETRAN MEETING

## RETRAN DYNAMIC SLIP MODEL

**J. H. McFadden** (top) (PhD, nuclear engineering, Iowa State University, 1968) is a principal analyst with Energy Incorporated (EI). From 1968 to 1975, he was involved in modeling two-phase flow and the development of two-fluid computer codes. Since joining EI in 1975, he has continued to work in the area of two-phase flow and system modeling for the RETRAN computer code. **M. P. Paulsen** (center) (MS, nuclear science and engineering, Idaho State University, 1974) is a member of the technical staff of the Computer Systems and Analysis Division at EI. He joined EI in 1974 after a year of graduate work on fast reactor inverse kinetics reactivity measurement techniques at the Argonne National Laboratory zero-power plutonium reactor facility. His work at EI has been in the development and application of transient thermal-hydraulic systems analysis computer codes. **Garry C. Gose** (bottom) (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 light water reactors.

*J. H. McFadden  
M. P. Paulsen  
G. C. Gose*



## A ONE-DIMENSIONAL REACTOR KINETICS MODEL FOR RETRAN

**Garry C. Gose** (top right) (BS and MS, nuclear science, Idaho State University, 1975) is a senior nuclear engineer at Energy Incorporated (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 light water reactors. **Craig E. Peterson** (top left) (BS and MS, nuclear engineering, Idaho State University, 1974) is presently a senior nuclear engineer at EI. He has a lead position in the development and application of the RETRAN computer code. His prime responsibilities in the development of RETRAN include the incorporation of a space-time kinetics model, the development of steady-state initialization for the conservation equations, the incorporation of a two-dimensional momentum equation, and the development of a fully dynamic memory management scheme. **Nancy L. Ellis** (bottom right) (BS, biology, University of Washington, 1964; MA, mathematics, University of Colorado, 1969) is currently a senior analyst for EI. **J. A. McClure** (bottom left) (PhD, physics, Virginia Polytechnic Institute and State University, 1962) is a program director at EI. He is responsible for reactor physics and mathematics. He joined EI in 1973 after working at the Idaho Nuclear Engineering Laboratory on reactor physics and safety problems. His main interests at EI have been the development of numerical solution methods for problems in reactor physics and engineering.

*G. C. Gose  
C. E. Peterson  
N. L. Ellis  
J. A. McClure*



## ANALYSIS OF PRESSURIZED WATER REACTOR ANTICIPATED TRANSIENT WITHOUT SCRAM TRANSIENTS WITH RETRAN-02

**Joseph A. Naser** (top) [PhD, nuclear engineering, University of California, Berkeley (UCB), 1976] has been doing nuclear technology research and development work since 1971. He worked at the Argonne National Laboratory (ANL) before joining the Electric Power Research Institute (EPRI), where he is presently a project manager. His present technical interests are in system and core thermal hydraulics for light water reactor safety and analysis. **Bal Raj Sehgal** (center) (PhD, UCB) worked at Brookhaven National Laboratory and ANL before coming to EPRI in 1974. He has been in charge of the program on code development and validation in reactor safety and performance. Currently, he is spending a year at the Massachusetts Institute of Technology as professor of nuclear engineering and teaching a course on numerical methods in reactor engineering analysis. **Lance J. Agee** (bottom) (MS, nuclear engineering, University of Nevada, Reno, 1966) has been associated with developing large computer codes since 1967. He has been the EPRI project manager responsible for the RETRAN code development since its conception in 1975, and is presently responsible for the system and component subprogram at EPRI.

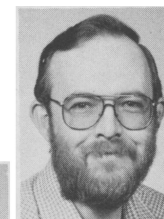
*Joseph A. Naser  
Bal Raj Sehgal  
Lance J. Agee*



## MODELING LOSS-OF-FLUID TEST SMALL-BREAK EXPERIMENTS WITH RETRAN

**James R. (Bob) White** (top) (BS, engineering physics, Texas Tech University, 1970; MS, nuclear engineering, University of New Mexico, 1972) is a principal investigator with Inter-mountain Technologies, Inc. and was formerly a manager in the LOFT Program Planning and Data Evaluation Branch of EG&G Idaho, Inc. His current primary research interest is in modeling small break behavior of nuclear reactor systems. **Charles E. Hendrix** (BS, physics, University of Illinois, 1968; MS, State University of New York, 1975) is an engineer with Inter-mountain Technologies, Inc. He has six years of experience in thermal-hydraulic analysis and model development.

*James R. White  
Charles E. Hendrix*



## A RETRAN ANALYSIS OF THE CRYSTAL RIVER UNIT 3 INCIDENT OF FEBRUARY 26, 1980

**V. K. (Bindi) Chexal** (top) (MS, mechanical engineering, Georgia Institute of Technology, 1972) has worked on the system design, thermal-hydraulic, and safety analyses of light water and Canadian deuterium uranium heavy water reactors. He is presently a project manager at the Nuclear Safety Analysis Center (NSAC), working on in-depth and generic analyses of nuclear power plants. **W. H. (Bill) Layman** (center), presently manager of the Plant Engineering Department of NSAC, has been involved in nuclear power since 1952. He formerly was assistant director of the U.S. Atomic Energy Commission (AEC) Division of Reactor Safety Research and prior to that was chief of the Water Reactors Branch of the AEC Division of Reactor Development and Technology. He started his nuclear work with nine years in the nuclear submarine program. **W. W. (Bill) Brown** (bottom) (MSME, University of Pittsburgh, 1967) is presently on assignment at NSAC. He has several years of experience in design and development of fluid systems for pressurized water reactor (PWR) steam supply systems at

*V. K. Chexal  
W. H. Layman  
W. W. Brown  
G. B. Caldwell*





Westinghouse Electric Corporation. His technical interests are in fluid flow and heat transfer. **G. B. (Gary) Caldwell** (right) is presently on assignment at NSAC. He has 16 years of experience in the operation of the systems used in PWR steam supply systems. He started his nuclear work with eight years in the nuclear submarine program followed by six years at a commercial reactor operated by Duke Power Company. His interests include the development of operating and design review processes.



**RETRAN PRESSURIZED WATER REACTOR APPLICATIONS AT GENERAL PUBLIC UTILITIES**

*T. G. Broughton  
N. G. Trikouros*

**T. Gary Broughton** (top) (BS, mathematics, Dartmouth College, 1966) is the Control and Safety Analysis Manager at General Public Utilities (GPU) Nuclear. He is responsible for dynamic analysis and review of dynamic performance of GPU nuclear power plants. He served ten years in the U.S. Navy as an officer in the nuclear submarine force. He has co-authored several papers on computer simulations of nuclear power plant transients. **N. G. Trikouros** (ME, nuclear engineering, New York University, 1972) is a senior engineer 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. He is presently a student at the Polytechnic Institute of New York.



**RETRAN SIMULATION OF THREE MILE ISLAND UNIT 2 STARTUP OVERFEED INCIDENT**

*L. C. Pwu  
T. G. Broughton*

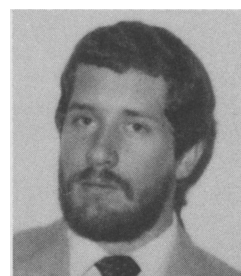
**L. C. (Cliff) Pwu** (top) (PhD, nuclear physics, University of Manchester, 1973) is a senior engineer at General Public Utilities (GPU) Nuclear Group where he has been analyzing the control and safety aspects of nuclear reactors. His earlier experience includes research in fusion neutronics at the University of Michigan and radiation transport at Ebasco Service. **T. Gary Broughton** (BS, mathematics, Dartmouth College, 1966) is the control and safety analysis manager at GPU Nuclear. He is responsible for dynamic analysis and review of dynamic performance of GPU nuclear power plants. He served ten years in the U.S. Navy as an officer in the nuclear submarine force. He has co-authored several papers on computer simulations of nuclear power plant transients.



**OCONEE RETRAN MODEL COMPARISONS WITH PLANT TRANSIENT DATA**

*Gregg B. Swindlehurst*

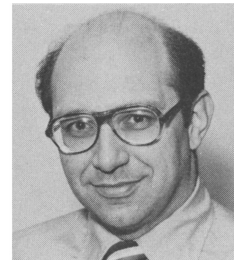
**Gregg B. Swindlehurst** (BSE, nuclear engineering, University of Michigan, 1977) is the lead analysis engineer in the Reactor Safety Unit of the Steam Production Department at Duke Power Company, Charlotte, North Carolina. He is responsible for development of system transient analysis and transient core thermal-hydraulic analysis activities for nuclear stations. He has been involved with the Electric Power Research Institute/Utility System Analysis Working Group since 1978.



## RETRAN ANALYSIS OF THE PEACH BOTTOM TURBINE TRIP TESTS

**Joseph A. Naser** (PhD, nuclear engineering, University of California, Berkeley, 1976) has been doing Nuclear Technology Research and Development work since 1971. He worked at the Argonne National Laboratory before joining the Electric Power Research Institute, where he is presently a project manager. His present technical interests are in system and core thermal hydraulics for light water reactor safety and analysis.

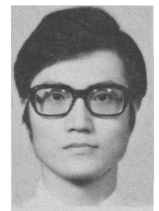
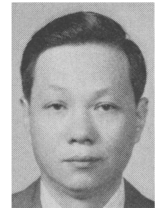
*Joseph A. Naser*



## ANALYSIS OF CHINSHAN UNIT 1 FULL LOAD REJECTION TRANSIENT USING RETRAN

**E. Lin** (top) (MS, nuclear engineering, University of California, Berkeley, 1970) is a deputy director of Taiwan Power's Atomic Power Department responsible for nuclear safety, health physics, and quality assurance. **Y. H. Cheng** (center) (BS, mechanical engineering, Taipei Institute of Technology, 1957) is head of the Nuclear Safety Division of the Atomic Power Department of Taiwan Power, with primary technical interest in plant safety design and review. **J. K. Hsiue** (bottom) (MS, nuclear engineering, University of Tsing Hua, 1972) is the leader of the Transient and Safety Analysis Group at Taiwan Power, with primary technical interest in fluid flow and heat transfer.

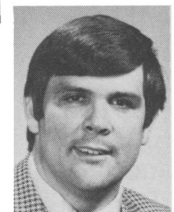
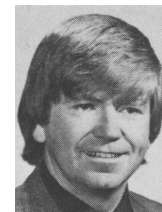
*E. Lin  
Y. H. Cheng  
J. K. Hsiue*



## RETRAN SIMULATION OF PEACH BOTTOM 2 BEGINNING OF CYCLE 5 MAIN STEAM RELIEF VALVE DISCHARGE TEST

**Hugh J. Diamond** (top) (BS, engineering physics, St. Joseph's University, 1968; MS, environmental engineering, Drexel University, 1976; MS candidate, mechanical engineering and applied mechanics, University of Pennsylvania) has been working as an engineer in the Electric Production Generation Division of the Philadelphia Electric Company since 1968. From 1971 through 1975, he participated in the pre-operational test, startup test, and commercial operation phases of Peach Bottom Atomic Power Station Units 2 and 3 while serving as a site test engineer. From 1975 through 1977, he served as an assistant station reactor engineer participating in all reactor startups and planned power transients. He is presently working at the utility headquarters in nuclear core management and is responsible for related projects, which include the installation and operation of a transient analysis methodology package built around RETRAN. **W. G. Lee** (BS, electrical engineering, University of Villanova, 1970; MS, electrical engineering, University of Pennsylvania, 1974) joined Philadelphia Electric Company in 1970. He has one year of experience in nuclear plant safety controls in the Electrical Engineering Department (1975). From 1976 up to the present, he has worked in the Nuclear Branch of the Mechanical Engineering Division. Work includes modeling the Peach Bottom Nuclear Units 2 and 3 using various Electric Power Research Institute and industry computer codes such as CASMO, CPM, SIMULATE (steady-state codes), and RETRAN01, 02 (transient code). His goal is to perform reload licensing using in-house codes.

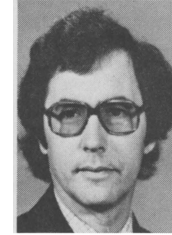
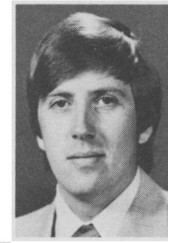
*H. J. Diamond  
W. G. Lee*



## SIMULATION OF A SIMULTANEOUS CLOSURE OF ALL MAIN STEAM ISOLATION VALVES WITHOUT SCRAM FOR A BOILING WATER REACTOR/4 USING RETRAN-01

*James T. Cronin  
Bruce C. Slifer*

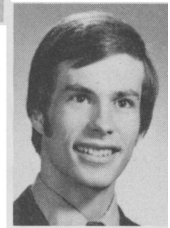
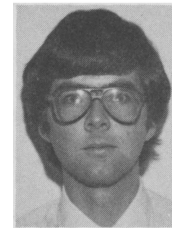
**James T. Cronin** (top) (BS, nuclear engineering, Lowell Technological Institute, 1971; MS, mechanical engineering, Northeastern University, 1975) is a senior engineer at Yankee Atomic Electric Company (YAEC). He has worked in the nuclear industry for nine years and has three years of experience in boiling water reactor (BWR) transient analysis. His current technical interests are in the areas of system dynamics and thermal hydraulics. **Bruce C. Slifer** (BS, fuel technology, Pennsylvania State University, 1963) is manager of nuclear engineering at YAEC. He has 14 years of experience in the nuclear industry, concentrating in the analysis of BWR emergency core cooling, containment, and safety systems. His current technical interests lie in the development and implementation of methodology dealing with reactor safety and operational support.



## RETRAN CALCULATION OF LOSS OF FEEDWATER TRANSIENTS AT CONNECTICUT YANKEE

*D. P. Griggs  
T. J. Honan*

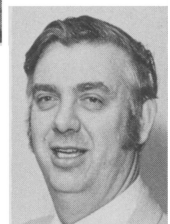
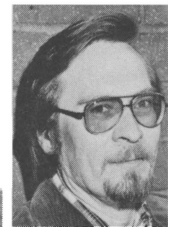
**D. P. Griggs** (top) [BNE, Georgia Institute of Technology, 1976; SM, nuclear engineering, and nuclear engineer degree, Massachusetts Institute of Technology (MIT), 1980] is a doctoral candidate in nuclear engineering at MIT. His work has focused on thermal-hydraulic aspects of light water reactor design and safety analysis. He is currently developing a coupled three-dimensional neutronics/thermal-hydraulics code for reactor safety analysis. **T. J. Honan** (BS, nuclear engineering, 1977, and MEng, nuclear engineering, 1978, Rensselaer Polytechnic Institute) has been employed by Northeast Utilities Service Company (NUSCO) since 1978. His work in the Safety Analysis Section has been in analyzing the effect of postulated operational transients on the reactors operated by NUSCO.



## A DRIFT-FLUX MODEL OF TWO-PHASE FLOW FOR RETRAN

*E. D. Hughes  
M. P. Paulsen  
L. J. Agee*

**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. **M. P. Paulsen** (center) (MS, nuclear science and engineering, Idaho State University, 1974) is a member of the technical staff of the Computer Systems and Analysis Division at EI. He joined EI in 1974 after a year of graduate work on fast reactor inverse kinetics reactivity measurement techniques at the Argonne National Laboratory zero-power plutonium reactor facility. His work at EI has been in the development and application of transient thermal-hydraulic systems analysis computer codes. **Lance J. Agee** (bottom) (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 the RETRAN code development since its conception in 1975, and is presently responsible for the system and component subprogram at EPRI.



**HIGH VOID FRACTION MEASUREMENTS IN FULL-SCALE  
HEAT TRANSFER TESTS**

**Gian Piero Celata** (top) (nuclear engineer, University of Rome, 1980) has performed thesis research on void fraction measurements. He has a fellowship at the Heat Transfer Laboratory, CSN Casaccia, Comitato Nazionale per l'Energia Nucleare, where he is presently involved in critical flow research. **Franco Vittorio Frazzoli** (physicist, University of Rome, 1965) in 1967 joined the engineering faculty of the University of Rome, where, since 1974, he has been a professor in the Nuclear Engineering Section. His research is devoted to subjects in nuclear radiation engineering dealing with the development of radiation gauges for industrial applications (process control, quality assessment, etc.). His current interests include nondestructive techniques for nuclear materials in fuel reprocessing and safeguards.

*Gian Piero Celata*  
*Franco Vittorio Frazzoli*

