

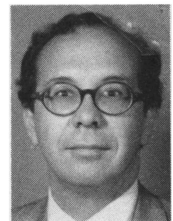
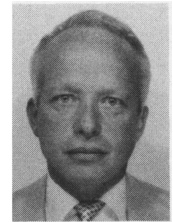
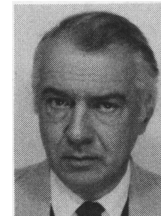
AUTHORS — FEBRUARY 1988

ADVANCED LIGHT WATER REACTORS

PRELIMINARY RESULTS OF THE FEASIBILITY STUDY ON THE CONVERTIBLE SPECTRAL SHIFT REACTOR CONCEPT

D. Hittner (top) (PhD, physics, Ecole Polytechnique, France, 1967) has worked in the fields of elementary particle physics and fast breeder accident analysis. He joined Framatome in 1981 and is in charge of process development for advanced reactors. **J. P. Millot** (center) (Ecole Normale Supérieure, France, 1957) worked for the Commissariat à l'Énergie Atomique in the field of safety studies. In 1971, he joined Framatome where he was first in charge of the core physics department and is now head of the department of advanced reactor concepts. **A. Vallee** (bottom) (Ecole Centrale, France; Institut National des Sciences et Techniques Nucléaires, France) joined Framatome in 1973. He has worked in the fields of accident analysis, thermohydraulics, and new model design. He is now in charge of the development of methods and of the physics of advanced reactors.

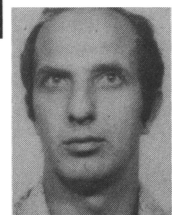
*D. Hittner
J. P. Millot
A. Vallee*



THE HIGH GAIN LIGHT WATER BREEDER REACTOR WITH A URANIUM-PLUTONIUM CYCLE

Alvin Radkowsky (top) (PhD, physics, Catholic University of America) was the chief scientist of the Office of Naval Reactors for many years, and was also responsible for the Shippingport Program of Civilian Power Reactors, including the light water breeder reactor. Since 1972, he has been professor of nuclear engineering at Tel Aviv University and at Ben-Gurion University, where his main interests have been in innovative reactor design concepts. **Z. Shayer** (PhD, nuclear engineering, Tel Aviv University, Israel, 1985) is a group leader in the Licensing Division of the Israeli Atomic Energy Commission. His interests and activities are in reactor physics, the fuel cycle, and shielding calculations.

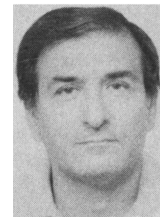
*Alvin Radkowsky
Z. Shayer*



ANALYSIS OF ^{235}U -Pu- ^{238}U -FUELED TIGHT-LATTICE WATER REACTORS

Yigal Ronen (top) (BS, mechanical engineering, and MS, nuclear engineering, Technion-Israel Institute of Technology, 1967; PhD, nuclear engineering, Cornell University, 1970) is professor of nuclear engineering at Ben-Gurion University (BGU). His research interests include advanced concepts of nuclear reactors and problems in uncertainty analysis. **Melvin J. Leibson** (MS, chemical engineering, Syracuse University, 1956) is a research associate at BGU. Since 1983 he has worked on many aspects of tight-lattice advanced pressurized water reactor designs. Prior to his affiliation with BGU, he worked at Alco Products, Inc. on small military reactor power plants, and for over 20 years at the Knolls Atomic Power Laboratory in the field of shielding design and radiation protection.

*Yigal Ronen
Melvin J. Leibson*



ON THE REACTIVITY VOID RESPONSE OF AN ADVANCED PRESSURIZED WATER REACTOR

Yigal Ronen (top) (BS, mechanical engineering, and MS, nuclear engineering, Technion-Israel Institute of Technology, 1967; PhD, nuclear engineering, Cornell University, 1970) is professor of nuclear engineering at Ben-Gurion University (BGU). His research interests include advanced concepts of nuclear reactors and problems in uncertainty analysis. **Melvin J. Leibson** (center) (MS, chemical engineering, Syracuse University, 1956) is a research associate at BGU. Since 1983 he has worked on many aspects of tight-lattice advanced pressurized water reactor designs. Prior to his affiliation with BGU, he worked at Alco Products, Inc. on small military reactor power plants, and for over 20 years at the Knolls Atomic Power Laboratory in the field of shielding design and radiation protection. **Alvin Radkowsky** (bottom) (PhD, physics, Catholic University of America) was the chief scientist of the Office of Naval Reactors for many years, and was also responsible for the Shippingport Program of Civilian Power Reactors, including the light water breeder reactor. Since 1972, he has been professor of nuclear engineering at Tel Aviv University and at BGU, where his main interests have been in innovative reactor design concepts.

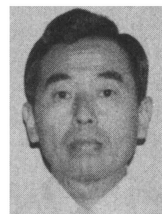
*Yigal Ronen
Melvin J. Leibson
Alvin Radkowsky*



VALIDATION OF THE HELIOS.HX CODE FOR HIGH CONVERSION LIGHT WATER REACTOR LATTICE ANALYSIS

Munenari Yamamoto (top right) (BS, nuclear engineering, Nagoya University, Japan, 1970) is a senior researcher at NAIG Nuclear Research Laboratory (NNRL), NAIG Company, Ltd. He is responsible for the nuclear methods and code development for light water reactors (LWRs). **Koichi Sakurada** (top left) (MS, nuclear engineering, Tokyo Institute of Technology, Japan, 1974) is a researcher at NNRL. His interests and activities are on the nuclear design improvements of various LWRs including high conversion LWRs. **Hiroshi Mizuta** (bottom right) (PhD, nuclear engineering, University of Tokyo, Japan, 1971) is a research fellow at NNRL. Currently, he is leading a research and development (R&D) project on advanced LWRs. **Kakuji Makino** (bottom left) (PhD, nuclear engineering, Kyoto University, Japan, 1968) is a chief specialist at Isogo Nuclear Engineering Center, Toshiba Corporation, responsible for the safety design of boiling water reactors. He is also responsible for an R&D project on advanced LWRs.

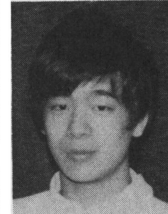
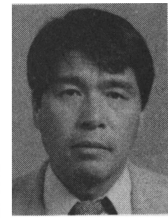
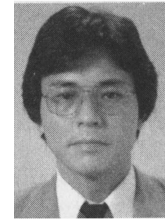
*Munenari Yamamoto
Koichi Sakurada
Hiroshi Mizuta
Kakuji Makino*



THE EFFECT OF FISSION PRODUCTS ON BURNUP CHARACTERISTICS IN HIGH CONVERSION LIGHT WATER REACTORS

Hideki Takano (top right) (BS, mathematics, Ibaraki University, Japan, 1965; Dr. Eng., University of Kyoto, Japan) is a principal engineer at Japan Atomic Energy Research Institute (JAERI) where he is a member of the Advanced Reactor Assessment Team. His current interests are in nuclear designs for advanced reactors (high conversion, inherently safe, and actinide burning reactors). **Kunio Kaneko** (top left) (MS, nuclear engineering, Osaka University, Japan, 1977) is an associate researcher who has previously worked at JAERI. He is now with the Japan Information Service. His interest is in advanced fast reactor design. **Hiroshi Akie** (bottom right) (MS, nuclear engineering, University of Hokkaido, Japan, 1985) is a researcher at JAERI on the reactor system laboratory staff and his current interest is in nuclear design for high conversion light water reactors (LWRs). **Yukio Ishiguro** (bottom left) (BS, physics, Kanazawa University, Japan, 1959; Dr. Eng., University of Kyoto, Japan) is a principal engineer at JAERI. He is head of the reactor system laboratory and responsible for conceptual design for advanced LWRs.

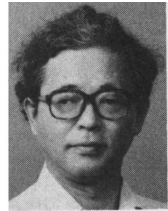
*Hideki Takano
Kunio Kaneko
Hiroshi Akie
Yukio Ishiguro*



FISSION PRODUCT MODEL FOR LATTICE CALCULATION OF HIGH CONVERSION BOILING WATER REACTOR

Shungo Iijima (top) (PhD, fission product cross-section calculation, Tokyo Institute of Technology, Japan, 1982) is a member of the research staff at the Nippon Atomic Industry Group (NAIG) Nuclear Research Laboratory. He has worked on reactor physics theory, reactor analysis, computer code development, crystal dynamics, nuclear physics, and nuclear data evaluation. He is currently interested in nuclear data involving charged particles and their application. **Tadashi Yoshida** (center) (BS, MS, and PhD, nuclear physics, Waseda University, Japan, 1982) is a senior researcher at the NAIG Nuclear Research Laboratory. He has worked mainly in the area of fast reactor physics. His current interests include nuclear data evaluation, theoretical aspects of decay heat, and laser applications in technology. **Tohru Yamamoto** (bottom) (BS, MS, and PhD, nuclear engineering, Tohoku University, Japan, 1977) has been a research associate in the Nuclear Energy Division of the Energy System Group of Toshiba Corporation. He is working on the nuclear design of boiling water reactor fuel and development of reactor core dynamic analysis code.

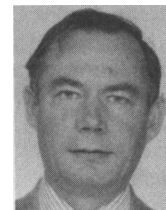
*Shungo Iijima
Tadashi Yoshida
Tohru Yamamoto*



THE FRENCH NEUTRONIC PROGRAM ADDRESSING THE REQUIREMENTS OF FUTURE PRESSURIZED WATER REACTORS

Jean Bergeron (top) (PhD, Paris, France, 1965) is with the Commissariat à l'Énergie Atomique (CEA) Laboratory in Saclay. He is responsible for reactor physics development in pressurized water reactors (PWRs) and small reactors. His interests include fuel management, calculational schemes, and development codes. **Michel Darrouzet** (bottom) (Ecole Centrale des Arts et Manufactures, France, 1965) has been with CEA since 1968, working in the field of reactor physics. He now heads the Nuclear Studies Services where research and experiments are done in the areas of

*Jean Bergeron
Michel Darrouzet
Jean-Michel Gomit
Richard Lenain
Jean-Louis Nigon
Loïck Martin-Deidier*



radioactive corrosion products and development of measurement methods and instrumentation for reprocessing plants and power reactors. **Jean-Michel Gomit** (top right) (PhD, Université de Paris XI-Orsay, France, 1978) is an engineer in the Studies and Research Division of Electricité de France. Since 1986, he has been manager of the Neutronics Codes Group in the Reactor Physics Department at Clamart. His interests lie in various aspects of perturbation theory and his current research activities involve qualification and development of codes and methods for fast breeder and light water reactors. **Richard Lenain** (top left) (PhD, reactor physics, University of Paris, France, 1982) works in the areas of fuel management and reactivity accidents. **Jean-Louis Nigon** (bottom right) (Ecole Polytechnique, France, 1964) began his career in 1967 at CEA in the field of water reactor core physics. From 1980 to 1986, he was in charge of code development for thermohydraulics and safety, contributing to CATHARE, the French advanced safety code for PWRs. Since 1986, he has been with the Core and Systems Service of the Water Reactor Department at the Cadarache Nuclear Center. **Loïck Martin-Deidier** (bottom left) (Docteur des Sciences Physiques, Université de Paris XI-Orsay, France, 1979) has worked at CEA since 1972 in the fields of experimental neutronics and code qualification. He is now head of the Water Reactors Physics Laboratory in the Nuclear Studies Services, in charge of the EOLE and MINERVE reactors (critical experiments) and the COMIR facility (irradiated fuel studies).



CONSTRAINTS ON THE PLUTONIUM RECOVERY ACHIEVABLE IN HOMOGENEOUS PRESSURIZED WATER REACTORS

Klaus Penndorf [master, physics, University of Goettingen, Federal Republic of Germany (FRG), 1962; PhD, physics, University of Kiel, FRG, 1970] joined GKSS Research Center in 1962 and is now head of the Reactor Safety Division of the Institute of Physics. His current interests are in neutron physics, reactor fuels, and general system analysis.

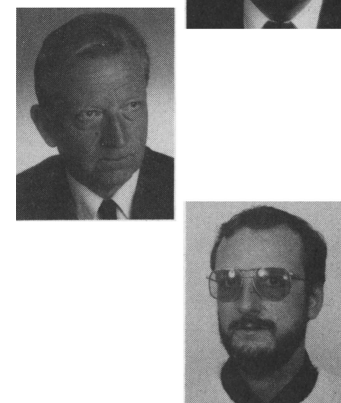
Klaus Penndorf



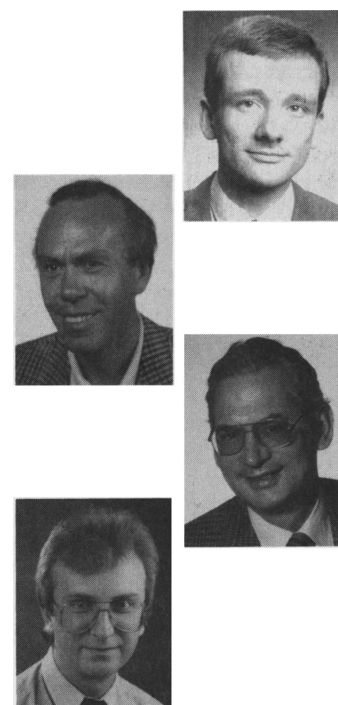
ANALYTICAL METHODS IN THE HIGH CONVERSION REACTOR CORE DESIGN

Wilfried Zeggel (top) [Dipl.-Ing., chemical engineering, and Dr.-Ing., nuclear engineering, Technical University of Braunschweig (TUBS), Federal Republic of Germany (FRG), 1977] is a senior scientist at the Institut für Raumflugtechnik und Reaktortechnik and manages high conversion reactor cooperations. His current research interests are the thermal-hydraulic features of tightly packed rod bundles. **Werner Oldekop** (center) (Dipl.-Phys., Dr. rer. nat., University of Göttingen, FRG, 1951) has been professor at TUBS since 1966 and head of the Institut für Raumflugtechnik und Reaktortechnik and dean of the Faculty of Mechanical and Electrical Engineering from 1985 to 1987. His working and research fields are nuclear technology, space power systems, and energy conversion. **Joachim K. Axmann** (bottom) (Dipl.-Ing., mechanical engineering, TUBS, FRG, 1984) is a scientific co-worker at the Institut für Raumflugtechnik und Reaktortechnik. Since 1984 he has been involved in the neutron physics of a tight-lattice high conversion core for a pressurized water reactor (PWR). Other research activities are in the areas of radiation shielding and low-thrust interplanetary space flight.

*Wilfried Zeggel
Werner Oldekop
Joachim K. Axmann
Sven Bethke
Helmuth Moldaschl
Gerhard Ulrych
Hans-Dieter Berger*



Sven Bethke (top right) (Dipl.-Ing., chemical engineering, TUBS, FRG, 1985) is a scientific co-worker at the Institut für Raumflugtechnik und Reaktortechnik. He has contributed to the development of thermal-hydraulic tight-lattice core models since 1984. His current interest is the application of computer codes to deal with two-phase flow mixing in tight lattices. **Helmut Moldaschl** (top left) (PhD, physics, University of Vienna, Austria, 1986) is project manager for high converter development at Kraftwerk Union (KWU). He joined the company in 1969 and dealt with program development for light and heavy water reactors, as well as with core design and analysis of PWR inherent safety. His responsibilities also included KWU's convoy core and long-term reload strategies. **Gerhard Ulrych** (bottom right) (mechanical engineering, Technical University of Stuttgart, FRG, 1961; Dr.-Ing., TUBS, FRG, 1976) joined Siemens AG, Group KWU in 1961. Since 1961 his professional efforts have covered several areas in the thermal-hydraulic design of PWR cores and primary systems. Currently, he is a senior scientific adviser and department manager for thermal-hydraulic core designs for PWRs. **Hans-Dieter Berger** (bottom left) (Dipl.-Ing., 1978, and Dr.-Ing., 1984, nuclear engineering, TUBS, FRG) carried out his doctoral research on high conversion light water reactor (HCLWR) physics design. On deputation from KWU he has been actively participating in the experimental PROTEUS-HCLWR program at the Swiss Federal Institute for Reactor Research since 1984.



INVESTIGATION OF THE VOID COEFFICIENT AND OTHER INTEGRAL PARAMETERS IN THE PROTEUS-LWHCR PHASE II PROGRAM

Rudolf Seiler (top right) (Dipl. Phys., 1976, and Dr. sc. nat., 1983, Swiss Federal Institute of Technology, Switzerland) joined the Swiss Federal Institute for Reactor Research (EIR) in 1981 after his dissertation in the field of Auger electron spectroscopy. He has been engaged in experimental reactor physics research with specific interests in reaction rate techniques. **Rakesh Chawla** (top left) (PhD, Imperial College, University of London, U.K., 1970) is manager of the light water high converter reactor (LWHCR) project at EIR. His current research interests mainly concern the generation and application of an experimental data base for evaluating LWHCR physics and thermal-hydraulic design. **Kurt Gmür** (center right) (Dipl. Phys., 1968, and Dr. Phil., 1973, nuclear physics, University of Zurich, Switzerland) has been working as an experimental physicist at EIR since 1975. His interests focus on reaction rate measurements. Currently he is responsible for the operation of the PROTEUS zero-energy reactor. **Helmut Hager** (center left) (Dr. Phil., University of Vienna, Austria, 1964) has worked as a staff scientist in the Reactor Studies and Reactor Physics Divisions of EIR. He is currently engaged in the analysis and interpretation of experiments in the PROTEUS-LWHCR program. **Hans-Dieter Berger** (bottom right) [Dipl. Ing., 1978, and Dr. Ing., 1984, nuclear engineering, Technical University Braunschweig, Federal Republic of Germany (FRG)] carried out his doctoral research on LWHCR physics design. On deputation from Kraftwerk Union he has been actively participating in the experimental program on PROTEUS since 1984. **Roland Böhme** (bottom left) (Dipl. Phys., Technical University of Munich, FRG, 1961; Dr. Ing., University of Karlsruhe, FRG, 1977) works at Kernforschungszentrum Karlsruhe and has been involved primarily with the evaluation of experiments carried out at fast critical facilities. Since 1986 he has been attached to the PROTEUS-LWHCR program at EIR.

*Rudolf Seiler
Rakesh Chawla
Kurt Gmür
Helmut Hager
Hans-Dieter Berger
Roland Böhme*



REACTOR PHYSICS CALCULATIONS FOR ALTERNATIVE FUEL RECYCLING STRATEGIES USING TIGHT PRESSURIZED WATER REACTOR LATTICES

Erik Johansson

Erik Johansson (doctor of technology, reactor physics, Chalmers University of Technology, Gothenburg, Sweden, 1967) is a reactor physicist at Studsvik Energiteknik AB, Sweden. He joined the company, then AB Atomenergi, in 1955. His current work is mainly in the area of physics investigations on advanced reactors.

