



## AUTHORS — NOVEMBER 1986

### OVERVIEW

#### THE REVERSED-FIELD PINCH FROM EXPERIMENT TO REACTOR

**H. A. B. Bodin** (top) (BSc and PhD, natural philosophy, University of Glasgow, Scotland) has worked in plasma physics since 1955, originally on fast Z pinches and theta pinches. He joined Culham at its inception (1960) and has headed reversed-field pinch research since 1968. He is the U.K. Atomic Energy Authority program officer for alternative lines and has served on the U.K. Science and Engineering Council Physics Committee and is a member of the Euratom CCFP program committee. He is active in international collaboration and closely associated with the Reversed-Field Experiment, Padua. **R. A. Krakowski** (center) (BS, chemical engineering, Ohio State University; PhD, nuclear engineering, University of California, 1967), after working on nuclear material problems at the Euratom Center of Research in Ispra, Italy, and teaching nuclear engineering at Ohio State University, joined the Los Alamos National Laboratory (LANL) in 1972 to work on material problems associated with space nuclear power. He presently heads a magnetic fusion systems study group at LANL responsible for alternative fusion concepts. **S. Ortolani** (bottom) (PhD, physics, University of Rome, ENEA Laboratory, Frascati, Italy, 1970) joined the Centro Gas Ionizzati, CNR—University of Padova, Italy, in 1971, to study plasma magnetic confinement on the ETA-BETA experiments within the European fusion program. In 1975 he worked at LANL, and has kept in close contact with the U.S. laboratories working on magnetic confinement in the reversed-field pinch (RFP) configuration (LANL and, more recently, GA Technologies, Inc.). He presently heads the Physics Division at the Istituto Gas Ionizzati, Euratom-CNR Association, Padova, Italy, where the European RFP experiment RFX (0.5-m plasma radius, 2-MA plasma current) is under construction.

*H. A. B. Bodin  
R. A. Krakowski  
S. Ortolani*



### IGNITION AND FUELING SCENARIO CALCULATIONS FOR NEUTRAL-BEAM-HEATED TOKAMAK REACTORS BASED ON PELLETT INJECTION

**Lajos L. Lengyel** (Dipl. Eng., Kiev Aviation Institute, Kiev, USSR, 1956; MS, Case Western Reserve University, 1959; PhD, Case Institute of Technology, 1962) has been involved in research on transonic internal flows, magnetohydrodynamic (MHD) channel flows with nonequilibrium ionization, MHD power conversion, laser/matter interaction, inertial confinement fusion, and magnetic confinement of laser-produced plasmas. His current interests are in pellet ablation theory, tokamak fueling by pellet injection, pellet/plasma interaction, and transport phenomena in tokamaks.

*Lajos L. Lengyel*



### DIVERTOR ENGINEERING STUDIES FOR THE INTERNATIONAL TOKAMAK REACTOR

**Richard F. Mattas** (top right) (BS, physics, Yale University, 1969; PhD, metallurgical engineering, University of Illinois, 1974) coordinated impurity control engineering studies for the U.S. International Tokamak Reactor program during phase 2A, Part 2. He is presently manager of Blanket Technology within the Fusion Power Program at Argonne National Laboratory (ANL). **Michael I. Baskes** (top left) (BS, engineering, California Institute of Technology, 1965; PhD, engineering, California Institute of Technology, 1970) is presently Theoretical Division supervisor at Sandia National Laboratories. His recent interests include modeling the effects of hydrogen and helium on mechanical properties and phenomenological calculations of potential tritium permeation and inventory with respect to plasma interactive components in fusion reactors. **Jeffrey N. Brooks** (center right) (PhD, electrical engineering, New York University, 1972) is a staff member in the Fusion Power Program at ANL. His current interests are in fusion plasma engineering and fusion reactor design studies. **James P. Blanchard** (center left) [BS, 1983, and MS, 1984, mechanical engineering, University of California, Los Angeles (UCLA)] is currently attending UCLA under appointment to the Magnetic Fusion Energy Technology Fellowship program administered by Oak Ridge Associated Universities. His primary research interests include fusion blanket thermomechanical analysis, radiation effects on blanket lifetime, and failure of bonded structures. **Ahmed M. Hassanein** (bottom right) (BS, nuclear engineering, Alexandria University, 1974; MS, nuclear engineering, 1978; MS, physics, 1981; and PhD, nuclear engineering, 1982, University of Wisconsin) is interested in research on radiation damage, energy deposition, and thermal response of materials. His recent research interests include tritium behavior in materials and ion transport and related phenomena. **Albert Tobin** (bottom left) (BS, chemical engineering, 1960; MS, metallurgy, Massachusetts Institute of Technology, 1963; PhD, metallurgy, Columbia University, 1968) is staff scientist in the Corporate Research Center of Grumman Corp. Since 1978 he has been involved in joining and bonding issues associated with fabrication of ceramic-metal insulator assemblies in Tokamak Fusion Test Reactors and high heat flux (HHF) components in fusion devices. His current interests are in development of charcoal-based helium cryopumps, oxidation of vanadium-base alloys for blankets, and evaluation of brazing and diffusion bonding techniques for fabrication of HHF components.

*Richard F. Mattas  
Michael I. Baskes  
Jeffrey N. Brooks  
James P. Blanchard  
Ahmed M. Hassanein  
Albert Tobin*



**NEUTRONIC DATA-BASE ASSESSMENT FOR U.S. INTOR**

**Jung-Chung Jung** (top right) (PhD, nuclear engineering, Kyoto University, Japan, 1974) is with the Fusion Power Program at Argonne National Laboratory. His current activities include nuclear analyses for the ongoing Blanket Comparison and Selection Study, fusion materials recycle/waste management study, and lithium blanket neutronics/shielding experiment project. He is also responsible for general neutronics method/code development and nuclear data evaluation. **M. Z. Youssef** (top left) (PhD, nuclear engineering, University of Wisconsin, 1980) is currently a member of the research staff of the Fusion Engineering Program at the University of California, Los Angeles. He spent one year at the Casaccia Nuclear Study Center in Italy. His research interests include pure fusion and hybrid engineering and technology, radioactivity and safety analysis, sensitivity and perturbation theory, and neutronics methods for fusion and fission reactors. **Edward T. Cheng** (bottom right) (PhD, nuclear engineering, University of Wisconsin, 1976) has been a member of the development and technology group in the Fusion Division of GA Technologies, Inc. since 1978. He has been involved with various fusion blanket and reactor design studies, including fusion breeder and chemical production applications. His interests are primarily in neutronics, radioactivity, and blanket engineering. He is currently coordinating the nuclear data needs activities for the magnetically confined fusion energy development. **Joseph D. (J. D.) Lee** (bottom left) (BS, electrical engineering, Duke University, 1961; MS, nuclear engineering, University of New Mexico) is a member of the Mirror (Fusion) Reactor Studies staff at Lawrence Livermore National Laboratory (LLNL). He started investigating the potential of fusion/fission in 1969 and is one of its principal spokesmen. He joined LLNL full-time in 1966 to work on the SNAP 50 project after working two summers on LLNL's "Super Kukla" prompt burst reactors. He has been involved in LLNL's fusion program since 1968.

*Jung-Chung Jung  
M. Z. Youssef  
Edward T. Cheng  
Joseph D. Lee*

**NEUTRON DOSIMETRY QUALIFICATION EXPERIMENTS FOR THE TOKAMAK FUSION TEST REACTOR LITHIUM BLANKET MODULE PROGRAM**

**Francis Y. Tsang** (top) (BS, physics and BS, chemistry, Eastern Oregon State College, 1974; MS, 1976, and PhD, 1978, nuclear engineering, University of Missouri-Columbia) has been involved in the development of fusion reactor blanket dosimetry since 1980. His current research activities include active and passive radiation measurement techniques and neutron and photon interactions with fissile and fertile materials. **Yale D. Harker** (center) (BS, physics, Idaho State University, 1959; MS, physics, Case-Western Reserve University, 1962; PhD, physics, Colorado State University, 1969) is currently a scientific specialist with the Neutron Physics Section. His specialty areas include integral neutron cross-section measurements using active and reactivity techniques, fast neutron spectrum measurements using multiple dosimetry detectors, operation and control of high sensitivity reactivity measurement facility, and neutron radiography. **Robert A. Anderl** (bottom) (PhD, experimental nuclear physics, Iowa State University, 1972) is a scientific specialist in the Physics Division of EG&G Idaho, Inc., Idaho National Engineering

*Francis Y. Tsang  
Yale D. Harker  
Robert A. Anderl  
David W. Nigg  
Dan L. Jassby*



Laboratory (INEL). His current research interests include integral cross-section measurements, neutron dosimetry, on-line mass separator technology, ion implantation, and hydrogen permeation through fusion reactor first-wall structures. **David W. Nigg** (top) (BS, engineering physics, University of Kansas, 1972; MS, nuclear engineering, Texas A&M University, 1973; PhD, nuclear engineering, University of Kansas, 1977) is currently a senior scientist with the Nuclear Engineering Branch of INEL. His recent technical interests have included fission reactor kinetics and fusion reactor blanket neutronics and shielding analysis. **Dan. L. Jassby** (bottom) (BS, physics, McGill University, Canada; PhD, astrophysical sciences, Princeton University) served as assistant professor in the University of California, Los Angeles electrical sciences department from 1970 to 1973. He is now a principal research physicist at Princeton Plasma Physics Laboratory. His research activities include the heating of toroidal plasmas, the design of magnetic confinement fusion devices, and the production and application of fusion neutrons.



## MATERIALS ENGINEERING

### PREDICTIONS OF FRACTURE TOUGHNESS IN IRRADIATED AISI 316 BASED ON A TENSILE-TOUGHNESS CORRELATION

**Margaret L. Hamilton** (top) (materials science and engineering, Brown University, 1978; MS, materials science, Washington State University, 1985) is manager of the Mechanical Properties Group at Hanford Engineering Development Laboratory (HEDL). Her research interests are the development of steels for fast reactor and fusion reactor service, and the changes in mechanical properties and fracture modes that occur during irradiation. **Frank A. Garner** (center) (PhD, nuclear engineering, University of Virginia, 1969) is a fellow scientist at HEDL. His primary research interest is illuminating the microstructural origins of radiation-induced swelling, creep, and changes in mechanical properties. Secondary interests are the development of design correlations for fusion environments that are based on fission reactor or charged-particle irradiations, and the development of alloys for fusion reactor service. **Walter J. S. Yang** (bottom) (PhD, metallurgical engineering, University of Wisconsin-Madison, 1972) is a senior engineer at General Electric Company's Vallecitos Nuclear Center. His research interests are the study of radiation-affected microstructure and property changes in both Zircalloys for water-cooled reactors and austenitic steels for sodium-cooled fast reactors.

*Margaret L. Hamilton  
Frank A. Garner  
Walter J. S. Yang*



## ENERGY STORAGE, SWITCHING, AND CONVERSION

### STUDIES OF COUPLING BETWEEN DISPLACEMENT AND EDDY CURRENTS IN THE FELIX PLATE EXPERIMENT

**Thanh Q. Hua** (right) (BS, 1982, and MS, 1984, nuclear engineering, University of Washington) is a PhD candidate from the University of Washington. He is currently in the Fusion Power Program at Argonne National Laboratory (ANL). His research includes investigation of eddy currents and electromagnetic

*Thanh Q. Hua  
Richard E. Nygren  
Larry R. Turner*



effects in tokamak limiters due to plasma disruptions. He is a U.S. Department of Energy (DOE) Magnetic Fusion Energy Technology fellow. **Richard E. Nygren** (top) (BS, materials science, Massachusetts Institute of Technology, 1966; PhD, materials science, Northwestern University, 1973) has worked on radiation effects on materials at Westinghouse-Hanford, on fusion materials applications at the Fusion Engineering Design Center in Oak Ridge National Laboratory, and, from 1981 to 1985, at ANL as manager of the Blanket Technology Program. Still affiliated with ANL, he is currently serving as special assistant to the director at DOE's Office of Fusion Energy. **Larry R. Turner** (bottom) (PhD, Carnegie Institute of Technology, 1964) is project manager for experiments of the FELIX facility. He has been a physicist at ANL since 1975, working in the areas of electromagnetics and superconducting magnets for fusion and magnetohydrodynamics.



## SHIELDING

### NEUTRON STREAMING THROUGH GAPS IN FUSION REACTOR SHIELDING

**Alan M. Halley** (no photo available) [BS, mechanical engineering, and MS, nuclear engineering, University of Missouri-Columbia (UMC)] works with nuclear shielding code development of the Ralph M. Parsons Company in Pasadena, California. In 1982 he worked as an American Nuclear Society (ANS) nuclear engineer intern for the Electricité de France in Les Renardieres, France, developing a computer simulation of thermal shock in power plant piping using a series of codes to analyze the thermal-mechanical behavior of the system. He was an Institute of Nuclear Power Operations Fellow at UMC in 1981-82, and has worked as an energy engineer for the Missouri Department of Natural Resources. **William H. Miller** (right) (BS and MS, nuclear engineering, Kansas State University; PhD, nuclear engineering, UMC) is an associate professor of nuclear engineering at UMC. He is director of graduate studies for nuclear engineering, co-director of the energy systems and resources program at UMC, a research associate at the University of Missouri Research Reactor, and was interim chairman of nuclear engineering at UMC from 1982 to 1983. He has served as a member for the past 8 years on the ANS 6.2.2, Many Channel Unfolding Problem Benchmark Working Group. His research interests include nuclear fuel cycle analysis and fuel management; fast neutron spectrometry by proton recoil techniques; neutron radiation shielding; minicomputer and microcomputer applications and digital design; and nuclear imaging techniques. He is a consultant to Olin Corporation's Ordnance Division.

*Alan M. Halley  
William H. Miller*



### APPLICABILITY OF NEUTRON-GAMMA-RAY-COUPLED ALBEDO MONTE CARLO METHOD TO STREAMING ANALYSIS IN FUSION REACTORS

**Michinori Yamauchi** (right) (BS, 1970, and MS, 1972, nuclear engineering, Nagoya University, Japan; PhD, Kyoto University, Japan, 1986) is a researcher in the Department of Nuclear Engineering at NAIG Nuclear Research Laboratory, Nippon Atomic Industry Group Company, Ltd. His work has been in the area

*Michinori Yamauchi  
Masayoshi Kawai  
Yasushi Seki*



of radiation transport methods development and radiation shielding calculations and analyses for fusion reactors and integral experiments. He was a visiting scientist at Oak Ridge National Laboratory during 1981. **Masayoshi Kawai** (top) (BS, 1966, and MS, 1968, nuclear engineering, Tohoku University, Japan; PhD, Kyoto University, Japan, 1986) is a senior researcher in the Department of Nuclear Engineering at NAIG Nuclear Research Laboratory. He is engaged in shielding analysis of fusion facilities and fast breeder reactors. He is also involved in nuclear data evaluation for the Japanese Evaluated Nuclear Data Library. His interests include the development and application of the radiation transport analysis method. **Yasushi Seki** (bottom) (BS, nuclear engineering, 1967, and Dr. Eng., nuclear engineering, 1977, University of Tokyo, Japan) is a senior scientist in the Division of Thermonuclear Fusion Research at the Japan Atomic Energy Research Institute. His work has been in the area of fast breeder reactor nuclear design. His interests are in nuclear design and shielding analysis of fusion reactors, and analysis of neutronics integral experiments related to fusion reactors. He is currently involved in the neutronics design and safety design of the Fusion Experimental Reactor.



#### FIRST-WALL TECHNOLOGY

#### FUSION OF LOW ATOMIC NUMBER, WALL COATING MATERIALS IN HIGH-TEMPERATURE PLASMAS

**John G. Gilligan** (top) (BSE, engineering science, Purdue University, 1971; PhD, nuclear engineering, University of Michigan, 1977) is an associate professor of nuclear engineering at North Carolina State University in Raleigh. His past interests have included advanced fuel fusion systems and charged-particle slowing in plasmas. Current research is focused on plasma/wall interactions and high heat load components for fusion devices. He was previously on the faculty at the University of Illinois. **Phillip D. Stroud** (BS, nuclear engineering, University of Wisconsin, 1979; MS, 1980, and PhD, 1984, nuclear engineering, University of Illinois) is currently a visiting scientist at Los Alamos National Laboratory. His research projects have included advanced fusion fuels, fusion product and neutral beam effects on plasmas, heavy ion and neutral beam transport, and fusion systems analysis.

*John G. Gilligan  
Phillip D. Stroud*



#### MAGNET SYSTEMS

#### EXPERIMENTAL OBSERVATIONS OF THE COUPLING BETWEEN INDUCED CURRENTS AND MECHANICAL MOTION IN TORSIONALLY SUPPORTED SQUARE LOOPS AND PLATES

**D. W. Weissenburger** (top) (BS, physics, Colorado College, 1969) is currently a project engineer in the Engineering Analysis Division (EAD) at the Princeton Plasma Physics Laboratory (PPPL). He is the principal developer of the SPARK eddy current analysis computer code. **J. M. Bialek** (bottom) (BS, engineering science, State University of New York, 1968; MS, mathematics, 1972, and MS, physics, 1981, Stevens Institute of

*D. W. Weissenburger  
J. M. Bialek  
G. J. Cargulia  
M. Ulrickson  
M. J. Knott  
L. R. Turner  
R. B. Wehrle*



Technology) is currently a senior engineer in EAD at PPPL. **G. J. Cargulia** (top right) (BAE, 1957, and MAM, 1968, Polytechnic Institute of New York) is currently a project engineer in EAD at PPPL. Prior to PPPL, he had been associated with Grumman Aerospace Corp. for 26 years. **M. Ulrickson** (top) (PhD, nuclear physics, Rutgers University, 1975) is a research physicist at PPPL. He is in the Applied Physics Division and is involved primarily in the physics aspects of the design of limiter and first-wall components for the tokamak fusion test reactor, the fusion engineering device, and the international tokamak reactor. This involves both modeling of the plasma edge and close interaction with the engineers doing the mechanical design. **M. J. Knott** (center right) (BS, electrical engineering, University of Illinois, 1961) has been involved in system control and data gathering with the fusion power, ZGS, IPNSP, GEM, and 6-GeV Synchrotron Light Source programs at Argonne National Laboratory (ANL). **L. R. Turner** (bottom left) (PhD, Carnegie Institute of Technology, 1964) is project manager for experiments of the FELIX facility. He has been a physicist at ANL since 1975, working in the areas of electromagnetics and superconducting magnets for fusion and magnetohydrodynamics. **R. B. Wehrle** (bottom right) (MS, physics, DePaul University, 1967) has been involved with the fusion power, acceleration research, GEM, and IPNSP programs at ANL.



TRITIUM SYSTEMS

**A SIMULATION STUDY FOR HYDROGEN ISOTOPE DISTILLATION COLUMNS IN THE TRITIUM BREEDING BLANKET SYSTEM OF A FUSION REACTOR**

*Masahiro Kinoshita  
Hiroshi Yoshida  
Hidefumi Takeshita*

**Masahiro Kinoshita** (top) (MS, 1979, and PhD, 1983, chemical engineering, Kyoto University, Japan) has worked on development of computer-aided simulation procedures and programs for stage processes both in the fuel cycle system for a fusion reactor and in other chemical engineering systems. He has also started preliminary experimental study for cryogenic distillation. **Hiroshi Yoshida** (center) (PhD, nuclear engineering, Tokyo Institute of Technology, Japan, 1971) is a research engineer at the Tritium Engineering Laboratory of the Japan Atomic Energy Research Institute (JAERI). He has been engaged in nuclear technology research relative to uranium enrichment by gaseous diffusion, spent fuel off-gas treatment, and the fusion fuel cycle since 1971 at JAERI. His present interests include developmental work on tritium processing technologies for fusion fuel cycles and blankets. **Hidefumi Takeshita** (bottom) (PhD, nuclear engineering, Osaka University, Japan, 1979) is on the staff of the Fuel Property Laboratory. He has been engaged in research on lithium oxide in its application to tritium breeding blankets for fusion reactors.

