nuclear technology/Fusion™

AUTHORS — MAY 1984

OVERVIEW

FUTURE TECHNOLOGY REQUIREMENTS FOR MAGNETIC FUSION—AN EVALUATION BASED ON CONCEPTUAL DESIGN STUDIES

W. M. Stacey, Jr.
C. C. Baker
R. W. Conn
R. A. Krakowski
D. Steiner
K. I. Thomassen

W. M. Stacey, Jr. (top right) [BS, physics, 1959, and MS, nuclear science, 1963, Georgia Institute of Technology (GIT); PhD, nuclear engineering, Massachusetts Institute of Technology (MIT), 1966] is Callaway Professor of Nuclear Engineering at GIT and serves as senior U.S. participant to the International Atomic Energy Agency International Tokamak Reactor (INTOR) Workshop. **C. C. Baker** (top left) (PhD, University of Wisconsin, 1972) has overall responsibility for directing the Argonne National Laboratory Fusion Power Program including activities in materials research, fusion reactor system and design studies, superconducting magnets and energy storage development, tritium technology, plasma engineering, atomic physics, and safety studies. He has been director of the program since 1977, and his responsibilities include long-range planning, program implementation, and budget administration. He serves on several advisory committees for the U.S. Department of Energy. He currently serves as manager of the STARFIRE Project, a design study of a commercial tokamak power reactor. **R. W. Conn** (center right) (PhD, California Institute of Technology, 1968) spent one year at the Joint Euratom Nuclear Research Center at Ispra, Italy, and a year at the Brookhaven National Laboratory before joining the University of Wisconsin (UW) in 1970. While at UW, he served as a professor of nuclear engineering and as director of the Fusion Engineering Program. Since 1980, he has been a member of the University of California, Los Angeles faculty as a professor of engineering and applied science. His primary research interests include fusion reactor physics and technology, plasma physics, neutron transport and nuclear reactor physics, reactor plasma analysis, and surface physics. **R. A. Krakowski** (center left) (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. **D. Steiner** (bottom right) (BS, chemical engineering, 1960; MS, nuclear engineering, 1962; PhD, nuclear engineering, 1967, MIT) is professor of nuclear engineering at Rensselaer Polytechnic Institute. Since 1968 he has been involved in fusion power systems analysis and design. From 1978 to 1982 he was manager of the Fusion Engineering Design Center at Oak Ridge National Laboratory. **K. I. Thomassen** (bottom left) (PhD, electrical engineering, Stanford) has been

program leader for the Mirror Fusion Test Facility (MFTF) at Lawrence Livermore National Laboratory since 1977. He has been on the electrical engineering faculties at Stanford and MIT. From 1973 to 1977 he was associate division leader for technology of the Controlled Thermonuclear Reactor Division at LANL. His current interests include upgrades of MFTF-B and fusion technology development.

LOWER ACTIVATION MATERIALS AND MAGNETIC FUSION REACTORS

Robert W. Conn
Everett E. Bloom
J. W. Davis
Robert E. Gold
R. Little
Kenneth R. Schultz
Dale L. Smith
F. W. Wiffen








Robert W. Conn (top right) (PhD, California Institute of Technology, 1968) spent one year at the Joint Euratom Nuclear Research Center at Ispra, Italy, and a year at the Brookhaven National Laboratory before joining the University of Wisconsin (UW) in 1970. While at UW, he served as a professor of nuclear engineering and as director of the Fusion Engineering Program. Since 1980, he has been a member of the University of California, Los Angeles faculty as a professor of engineering and applied science. His primary research interests include fusion reactor physics and technology, plasma physics, neutron transport and nuclear reactor physics, reactor plasma analysis, and surface physics. **Everett E. Bloom** (top left) (BS, metallurgical engineering, South Dakota School of Mines and Technology; MS and PhD, metallurgical engineering, University of Tennessee) is manager, Materials Science Section, Oak Ridge National Laboratory (ORNL). His general areas of interest are the effects of radiation on the properties of reactor structural materials and development of radiation-resistant alloys. He has been active in U.S. Department of Energy-sponsored programs for developing improved alloys for breeder reactor cladding and duct, fusion reactor first-wall and blanket applications, and presently serves as chairman of the Alloy Development for Irradiation Performance Task Group for the Office of Fusion Energy. **J. W. Davis** (second from top right) is a design specialist-materials and manager of all materials activities in fusion energy at McDonnell Douglas. He has worked on the design of UWMAK-II and has participated in most of the tokamak reactor studies in materials and design-related areas. His current activities include coordinating the activities on the Materials Handbook for Fusion Energy Systems and participating in various design studies. **Robert E. Gold** (second from top left) is an advisory engineer in the Steam Generator Technology Division of Westinghouse Electric Corporation. **R. Little** (third from top right) (PhD, physics, Glasgow University, 1964) worked at Harvard University and the Massachusetts Institute of Technology until 1975 on elementary particle physics and storage-ring technology. Since then he has been engaged in fusion research at Princeton Plasma Physics Laboratory, mainly in the construction and operation of the tokamak fusion test reactor. His major interests are presently in tokamak fusion research. **Kenneth R. Schultz** (third from top left) (PhD, nuclear engineering sciences, University of Florida, 1971) is a manager of fusion development and technology at GA Technologies. He is responsible for the fusion nuclear technology aspects of several reactor design study projects for tokamak, mirror, and inertial confinement reactor applications, with emphasis on blanket engineering. He also is involved with several small blanket technology experiments. **Dale L. Smith** (bottom right) (PhD, Iowa State University, 1966) is coordinator for fusion materials programs at Argonne National Laboratory. He has also been responsible for materials selection and has served as task manager for several first-wall/blanket design studies, including the STARFIRE first-wall/blanket design study and the International Tokamak Reactor first-wall design study. **F. W. Wiffen** (bottom left) (PhD, materials science, Northwestern

University, 1967) is on the research staff of the Metals and Ceramics Division, ORNL and of the Fusion Engineering Design Center at Oak Ridge. His areas of interest are radiation effects on materials and the applications of materials data to fusion reactor design. Recent activities include participation in the research programs on fusion reactor materials, assessment of environmental implications of a fusion power economy, and several conceptual reactor design studies.

PLASMA ENGINEERING

TOKAMAK FUSION REACTORS WITH LESS THAN FULL TRITIUM BREEDING

Kenneth Evans, Jr.
John G. Gilligan
Jungchung Jung

Kenneth Evans, Jr. (top) (PhD, physics, University of Illinois, 1970) has been associated with Argonne National Laboratory (ANL) since 1975. He is primarily involved with conceptual designs of tokamak fusion reactors and was the principal investigator for the deuterium-deuterium reactor design, WILDCAT. He has developed several significant computer codes and has spent the past year working on calculations of neutral transport at the Princeton Plasma Physics Laboratory. **John G. Gilligan** (center) (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. **Jungchung Jung** (bottom) (PhD, nuclear engineering, Kyoto University, Japan, 1974) is with the Fusion Power Program at ANL. 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.

SPACE-DEPENDENT ANALYSIS OF FEEDBACK CONTROL TO SUPPRESS THERMAL RUNAWAY BY COMPRESSION-DECOMPRESSION

Masami Ohnishi
Akira Saiki
Masao Okamoto

Masami Ohnishi (top) (Dr. Eng., electrical engineering, Kyoto University, Japan, 1979) is a research associate at the Institute of Atomic Energy, Kyoto University. He was a visiting assistant professor in the Nuclear Engineering Program of the University of Illinois from April 1979 for six months and held a visiting appointment at Lawrence Livermore National Laboratory from October 1979 to April 1980. His current interests include alpha-particle transport in magnetic fusion, dynamics and control of fusion reactors, and reactor design studies of open-ended systems. **Akira Saiki** (center) (MS, electrical engineering, Kyoto University, Japan, 1983) has worked as a research engineer at Central Research Laboratory of Mitsubishi Electric Corporation. He is involved in the research of nuclear power control and instrumentation. **Masao Okamoto** (bottom) (Dr. Eng., nuclear engineering, Kyoto University, Japan, 1971) is an associate professor at the Institute of Plasma Physics, Nagoya University

and holds the portfolio of an associate professor at the Institute of Atomic Energy, Kyoto University. His current interests include magnetohydrodynamics and transports in magnetic fusion.

FIRST-WALL TECHNOLOGY

AN ANALYSIS OF BREMSSTRAHLUNG ENERGY DEPOSITION IN MAGNETIC FUSION FIRST-WALL MATERIALS

Matthew C. Carroll
John G. Gilligan

Matthew C. Carroll (top) (BS, mathematics, Lafayette College, Easton, Pennsylvania, 1974; MS, mechanical engineering, University of Illinois, 1982) operated pressurized water reactors as an officer in the U.S. Navy's nuclear power program from 1974 to 1978. He is currently involved in research connected with the thermal analysis of fusion reactor first walls. **John G. Gilligan** (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.

TRITIUM SYSTEMS

THERMODYNAMICS OF LIQUID HYDROGEN SOLUTIONS

Albert E. Sherwood
P. Clark Souers

Albert E. Sherwood (top) (BS, business and engineering, and MS, chemical engineering, 1957, Massachusetts Institute of Technology; PhD, chemical engineering, University of California, Berkeley, 1963) has been a staff scientist at Lawrence Livermore National Laboratory (LLNL) since 1965, working with tritium since 1976. His interests are in permeation, adsorption, catalysis, and thermodynamics applied to tritium technology, and in the engineering of large-scale low-level tritium capture systems. **P. Clark Souers** (BS, chemistry, Stanford University; PhD, physical chemistry, University of California) has spent most of his career in the tritium area, with work in radiation damage in hydrides, laser targets, cryogenics, and tritium gettering. He is presently the leader of the tritium facility at LLNL.

FUSION REACTORS

SYSTEM STUDIES FOR A QUASI-STEADY-STATE ADVANCED PHYSICS TOKAMAK

R. Lowell Reid
Y-K. M. Peng

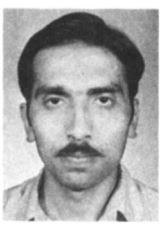
R. Lowell Reid (top) (BS, physics, University of Alabama, 1960; MS, mechanical engineering, University of Florida, 1969) is currently responsible for fusion power system analysis at the Fusion Engineering Design Center (FEDC) at Oak Ridge National Laboratory (ORNL). Since 1975 he has been involved in computer modeling of fusion systems and in performing sensitivity analyses to define the performance, cost, and configuration of proposed fusion reactors. **Y-K. M. Peng** (BS, electrical engineering, National Taiwan University, 1967; MS, 1971, and PhD,

1974, applied physics, Stanford University) has joined the Fusion Energy Division of ORNL as a scientific staff member in the Theory Section. During the last four years he has devoted his effort to plasma engineering studies of tokamak reactor concepts at FEDC.

NONELECTRICAL APPLICATIONS

FAST HYBRID THERMIONIC BLANKETS WITH ACTINIDE WASTE FUEL

Sümer Şahin
Anil Kumar



Sümer Şahin (top) (MS, mechanical engineering, 1967, and PhD, nuclear engineering, 1970, University of Stuttgart, Federal Republic of Germany; Habilitation, physics, University of Ankara, Turkey, 1973) is currently a professor at the King Saud University, Riyadh, Saudi Arabia. His research field covers fusion-fission (hybrid) reactors, thermionic space craft reactors, radiation shielding, and nonproliferation. **Anil Kumar** (BS, 1971, and MS, 1973, physics, Agra University, India; PhD, nuclear engineering, University of Bombay, 1981) is currently senior scientist at Ecole Polytechnique Federale de Lausanne, Switzerland. His main interest is in the field of fusion blanket neutronics with an emphasis on optimum utilization of ^{232}Th in fusion-fission hybrid reactors.

SAFETY/ENVIRONMENTAL ASPECTS

THE MATERIALS IMPACT ON FUSION REACTOR SAFETY

S. J. Piet
M. S. Kazimi
L. M. Lidsky

S. J. Piet (top) (BS and MS, 1979, and ScD, 1982, nuclear engineering, Massachusetts Institute of Technology (MIT)] is currently a member of the Fusion Safety Program of EG&G Idaho at the Idaho National Engineering Laboratory. His major interests and responsibilities include risk assessments, activation product behavior, and lithium compound reactions. He is participating in the Blanket Comparison and Selection Study. **M. S. Kazimi** (center) (PhD, nuclear engineering, MIT) is associate professor of nuclear engineering at MIT. His research interests include thermal phenomena in fission reactor safety, advanced two-phase flow model development for reactor transient analysis, and fusion reactor safety. **L. M. Lidsky** (bottom) (BE, physics, Cornell University, 1958; PhD, nuclear engineering, MIT, 1962) is professor of nuclear engineering at MIT and associate director for technology development of MIT's Plasma Fusion Center. He has prime responsibility for, and has developed major portions of, the nuclear engineering department's academic programs in applied plasma physics and fusion reactor technology. He has made noteworthy contributions in the fields of high intensity neutron source development, fission-fusion symbiosis, plasma diagnostics, fusion reactor blanket designs, and fusion reactor systems studies.