Fusion technology

AUTHORS — NOVEMBER 1987

SAFETY/ENVIRONMENTAL ASPECTS

ENVIRONMENTAL EFFECTS OF FUSION POWER PLANTS. PART I: EFFLUENTS OTHER THAN TRITIUM

Johnnie B. Cannon
Clay E. Easterly
Wallace Davis, Jr.
Jack S. Watson

Johnnie B. Cannon (top right) (BS, Tuskegee Institute, 1970; MS, 1972, and PhD, 1975, California Institute of Technology) is head of the Integrated Analysis and Assessment Section of the Energy Division of the Oak Ridge National Laboratory (ORNL). He has been with ORNL for about 11 years and has specialized in assessing the environmental impacts of energy technologies and related areas. Most recently, he led an ORNL program to prepare an environmental impact statement for the U.S. Department of Energy Magnetic Fusion Energy Program. **Clay E. Easterly** (top left) [BS, physics, University of Mississippi, 1966; PhD, physics, University of Tennessee (UT), 1972] is a research associate in the Health Effects and Epidemiology Group of the Health and Safety Research Division at ORNL. He has worked at ORNL since 1973. Current activities include preparation of a technical basis document for a generic environmental impact statement (GEIS) for magnetic fusion energy and work on that GEIS. He was recently selected to participate in the U.S.-Japan science exchange program on tritium radiobiology and health physics. **Wallace Davis, Jr.** (bottom right) [ScB (honors), Brown University; PhD, chemistry, University of Rochester] spent 27 years with ORNL and 10 years with the Oak Ridge Gaseous Diffusion Plant. In 1965 and 1966 he was a guest scientist at the U.K. Atomic Research Establishment, Harwell. His research has included numerous studies in thermodynamics, solvent extraction, waste management, environmental impact analysis and environmental impact statements, radiation chemistry, nuclear fuel processing, and fluid dynamics of the gaseous diffusion process. He is currently a consultant on international safeguards for uranium enrichment. **Jack S. Watson** (bottom left) (BS, 1958; MS, 1962; and PhD, 1967, chemical engineering, UT) is both a member of the Chemical Technology Division of ORNL and a part-time staff member of the Department of Chemical Engineering at UT. He has been with ORNL for about 30 years and associated with UT for almost 20 years. His research has been associated principally with separation techniques and their uses in fission, fusion, and other energy systems.

ENVIRONMENTAL EFFECTS OF FUSION POWER PLANTS. PART II: TRITIUM EFFLUENTS

Jack S. Watson
Clay E. Easterly
Johnnie B. Cannon
J. B. Talbot

Jack S. Watson (top) [BS, 1958; MS, 1962; and PhD, 1967, chemical engineering, University of Tennessee (UT)] is both a member of the Chemical Technology Division of the Oak Ridge National Laboratory (ORNL) and a part-time staff member of the Department of Chemical Engineering at UT. He has been with ORNL for about 30 years and associated with UT for almost 20 years. His research has been associated principally with separation techniques and their uses in fission, fusion, and other energy systems. **Clay E. Easterly** (center) (BS, physics, University of Mississippi, 1966; PhD, physics, UT, 1972) is a research associate in the Health Effects and Epidemiology Group of the Health and Safety Research Division at ORNL. He has worked at ORNL since 1973. Current activities include preparation of a technical basis document for a generic environmental impact statement (GEIS) for magnetic fusion energy and work on that GEIS. He was recently selected to participate in the U.S.-Japan science exchange program on tritium radiobiology and health physics. **Johnnie B. Cannon** (bottom) (BS, Tuskegee Institute, 1970; MS, 1972, and PhD, 1975, California Institute of Technology) is head of the Integrated Analysis and Assessment Section of the Energy Division of ORNL. He has been with ORNL for about 11 years and has specialized in assessing the environmental impacts of energy technologies and related areas. Most recently, he led an ORNL program to prepare an environmental impact statement for the U.S. Department of Energy Magnetic Fusion Energy Program. A photograph and a biography for **J. B. Talbot** were not available at publication time.

BLANKET ENGINEERING

A HYBRID BLANKET FOR A REVERSED-FIELD PINCH REACTOR

Jean-François Jaeger
Donald J. Dudziak
Giorgio Friedrich
Walter V. Green
Peter Groner
Max Huggenberger
Peter Köhler
P. Marmy
Sandro Pelloni
Jiri Stepanek
Ulrich Stiefel
Peter Stiller
M. Victoria

Jean-François Jaeger (top) (MA, mechanical sciences, Cambridge, U.K., 1957; PhD, electrical engineering, London, U.K., 1961) has worked with the English Electric Company and Sulzer Brothers on safety, dynamic analysis, and control of several reactors and steam generators. He is now with the Fusion Technology Group at the Swiss Federal Institute for Reactor Research (EIR), Würenlingen, Switzerland, and has led the fusion blanket study. His recent interests are in the fields of dynamic stress analysis for the liquid-metal fast breeder reactor (LMFBR) and neutron transport for the shielding of small reactors and the Next European Torus. **Donald J. Dudziak** (center) (BS, marine engineering, 1956; MS, physics, 1957; PhD, applied mathematics, 1962) is presently section leader for high-technology systems studies at Los Alamos National Laboratory (LANL). Previously, he was on sabbatical leave at EIR to pursue fusion reactor systems analysis. His past responsibilities have included Transport and Reactor Theory Group leader, research in shielding analysis, cross-section technology (ENDF), and naval reactor design. He has also served as a visiting professor of nuclear engineering and an adjunct professor of mathematics. **Giorgio Friedrich** (bottom) [MS, electrical engineering, Swiss Federal Institute of Technology (ETH), Zürich, Switzerland, 1979/80] was a member of the Fusion Technology Group at EIR for 3 years. There he worked on setting up an ultrahigh voltage chamber and the discharge

cleaning system for conditioning mechanical components, which are mounted at the tokamak experiment for technology oriented research. Also, he collaborated in calculating neutron flux distributions for a fusion blanket. Currently, he is working as an assistant at ETH in the High Voltage Institute, where he is investigating corona and breakdown phenomena in synthetic humid air and determination of ionization coefficients. **Walter V. Green** (top right) (PhD, metallurgical engineering, University of Wisconsin) is a guest scientist at EIR. He works in the Fusion Technology Division on radiation damage of materials. Prior to this position, he was in the Materials Science Division at LANL, where he worked on radiation effects and earlier on the high-temperature deformation and strength of materials. **Peter Groner** (top left) (diploma, chemistry, ETH, Zürich, Switzerland, 1967; Doctor of Technical Sciences, ETH, 1974) received postdoctoral fellowships at the University of South Carolina and at ETH. From 1978, he was engaged in research on chemical aspects of plasma/wall interactions and tritium breeding with the Fusion Technology Group at EIR. He is currently in the Department of Chemistry at the University of South Carolina in Columbia. **Max Huggenberger** (second from top right) (BS, mechanical engineering, Lucerne State College of Engineering, Switzerland, 1968) is a member of the Thermal-Hydraulics Division at EIR. He worked for 10 years in the experimental and analytical areas of gas-cooled fast breeder reactor core thermal hydraulics. His current interests are concentrated on the thermal-hydraulic problems involved in the cooling of the fusion reactor first wall and blanket. **Peter Köhler** (second from top left) (BS, reactor physics, Prague Institute of Technology, Czechoslovakia, 1965) was a member of the Reactor Physics Division at EIR. He worked for 20 years in different areas of theoretical reactor physics. His main current interests are in the calculation of neutron streaming in gas-cooled reactors. **P. Marmy** (third from top right) (MS, mechanical engineering, ETH, Zürich, Switzerland, 1980) is a member of the Fusion Technology Group at EIR and has worked in the field of robotics for fusion devices and material research on irradiated materials. **Sandro Pelloni** (third from top left) (PhD, mathematics and theoretical physics, ETH, Zürich, Switzerland, 1980) is a visiting associate professor at the Rensselaer Polytechnic Institute and a member of the Physics Division at EIR. He has worked for some years in the nucleonic analysis of fusion and fission reactors, in cooperation with European and U.S. laboratories. His present activities deal with the preparation and testing of nuclear data libraries. **Jiri Stepanek** (no photo available) (MS, nuclear engineering, Technical University of Prague, Czechoslovakia; PhD, ETH, Zürich, Switzerland) is Reactor Theory Group leader and deputy leader of the Reactor Physics Division at EIR. His areas of work include neutral and charged-particle transport, research in shielding analysis, cross-section technology, methods development, and reactor and fusion blanket analysis. He also serves as lecturer at ETH. **Ulrich Stiefel** (bottom right) (MS, mechanical engineering, ETH, Zürich, Switzerland, 1963) is head of the Fusion Technology Group at EIR. After experimental and analytical work on several fission reactor projects, he became responsible for the fusion technology task. He has worked mainly in the field of first-wall materials for about 10 years. **Peter Stiller** (bottom left) [BS, physics, Technical University of Darmstadt, Federal Republic of Germany (FRG), 1971] is a member of the Physics Division at EIR. He worked for 3 years in the theoretical areas of radiation damage at the Institut für Kernenergetik und Energiesysteme of the University of Stuttgart, FRG. At EIR he has been involved in burnup calculations for LMFBR, in neutron damage calculations for the first wall of a fusion reactor, and in reactor core design studies for a small light water heating reactor. His current interests are concentrated



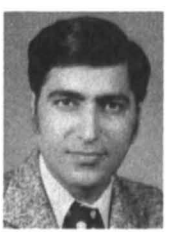





on core design studies of a small pebble-bed reactor and on material activation investigations in a fusion reactor. **M. Victoria** (right) (PhD, physics, Balseiro Institute of Physics, Bariloche, Argentina, 1965) is a member of the Fusion Technology Group at EIR. He has worked for the past 7 years on radiation damage produced by 600-MeV protons in the PIREX facility, where the effects of fusion neutrons are simulated.

REANALYSIS OF NEUTRON MULTIPLICATION MEASUREMENTS IN THICK BERYLLIUM AND GRAPHITE ASSEMBLIES FOR 14-MeV NEUTRONS

Vijay R. Nargundkar
Tejen Kumar Basu
Om Prakash Joneja



Vijay R. Nargundkar (top) (MSc, physics, Karnataka University, India, 1956; PhD, pulsed neutron studies, University of Bombay, India, 1966) has been working at Bhabha Atomic Research Centre (BARC) since 1957. He has worked in the field of fission physics at Atomic Energy of Canada, Ltd., Chalk River, Canada (1961 and 1962), pulsed fast reactors at the Joint Institute for Nuclear Research, Dubna, Soviet Union (1972), and fusion blanket neutronics at the Institute for Reactor Development (IRD), Jülich, Federal Republic of Germany (FRG) (1977 and 1978). He has been the facility supervisor of the Purnima Critical Facility. His current interest is theoretical and experimental studies of fusion blanket neutronics. **Tejen Kumar Basu** (center) (BS, physics, Kurukshetra University, India, 1969; graduate, BARC Training School, India, 1970; PhD, physics, University of Bombay, India, 1980) has been associated with the experimental program of the Purnima fast reactor facility. He worked at the IRD, Jülich, FRG, from 1977 to 1978 in fusion blanket neutronics. His current interests include neutron transport calculations in micropellets and the experimental investigation of neutron multipliers. **Om Prakash Joneja** (bottom) (MSc, Punjabi University, India, 1966; graduate, BARC Training School, India, 1967; PhD, physics, University of Bombay, India, 1976) has been actively working on fast neutron spectrometry and development of Monte Carlo codes. His present interest includes development of new experimental techniques for on-line measurement of tritium breeding in fusion blankets. He has worked at the IRD, Jülich, FRG, from 1972 to 1974 in the field of fast neutron spectrometry and from 1979 to 1980 on the $LiAlO_2$ blanket assembly for measuring tritium production.

FISSION POWER FLATTENING IN HYBRID BLANKETS USING MIXED FUEL

Sümer Şahin
Mohammad Al-Eshaikh

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) has worked at the Radiation Shielding Information Center, Oak Ridge National Laboratory, with a postdoctoral NATO fellowship; at the Institute of Nuclear Energy of the Swiss Federal Institute of Technology in Lausanne, Switzerland, as advanced research scientist; and at the King Saud University in Riyadh, Saudi Arabia, as professor. Currently he is professor and dean of the Faculty of Engineering at the University of Erciyes, Kayseri, Turkey. His research field covers neutron transport theory, fusion-fission (hybrid) reactors, thermionic spacecraft reactors, and radiation shielding. **Mohammad A. Al-Eshaikh** (BSc, King Saud University, Saudi Arabia, 1984) is a

teaching assistant at King Saud University, College of Engineering. He is currently studying for his MS in nuclear engineering. His field of interest is fusion-fission (hybrid) reactors.

TRITIUM SYSTEMS

TRITIUM BREEDING IN AN ASYMMETRICALLY REFLECTED BLANKET USING A NONCENTRAL NEUTRON SOURCE

Arthur W. Dalton

Arthur W. Dalton (BS, physics, 1955, and PhD, nuclear physics, 1960, University of Liverpool, United Kingdom; BA, psychology, University of Sydney, Australia, 1978) has been involved in the structural investigation of intermediate heavy nuclei using deuteron stripping reactions from an 8-MeV cyclotron. From 1958 to 1962 he worked for the U.K. Atomic Energy Authority in research related to gas-cooled reactors. From 1962 to 1965 he was a commissioning physicist for the Atomic Power Company, London. He joined the Australian Atomic Energy Commission in 1965 (renamed the Australian Nuclear Science and Technology Organisation in 1987) as a senior research scientist. His research work includes analytical studies of loss-of-coolant accidents in both water- and metal-cooled fission reactor systems using coupled thermodynamic, two-phase flow, reactor kinetic analyses; absolute detection and measurement of neutron spectra in beryllium/uranium reactor systems using a high-speed neutron chopper and lithium glass detectors. He is currently head of a small group investigating tritium breeding in fusion reactor blanket experiments and the development of lithium glass detectors for real-time on-line measurements of tritium production.

PLASMA ENGINEERING

TWO-DIMENSIONAL TOROIDAL GEOMETRY NEUTRAL ATOM TRANSPORT AND MATERIAL EROSION RATES IN THE TEXTOR AND TFTR TOKAMAKS

Mohammad Zahid Hasan
Robert W. Conn

Mohammad Zahid Hasan (top) [BS, mechanical engineering, Bangladesh University of Engineering and Technology; MS, mechanical engineering, University of Kentucky; PhD, nuclear engineering, University of California, Los Angeles (UCLA), 1985] is currently employed as a research fellow in the Fusion Engineering and Physics Program at UCLA. His primary research interests are neutral atom transport in fusion plasmas, magnetohydrodynamics, and thermal-hydraulic designs and analyses applied to fusion power reactors. **Robert W. Conn** (PhD, California Institute of Technology, 1968) spent 1 year at the Joint Euratom Nuclear Research Center at Ispra, Italy, and 1 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. He has been a member of the UCLA faculty as professor of engineering and applied science, and since 1982 he has been co-director of UCLA's Center for Plasma Physics and Fusion Engineering. His primary research interests include plasma physics, plasma/surface interactions, fusion reactor design, and reactor plasma analysis.

COMPUTER SIMULATION OF REFLECTION OF AND SPUTTERING BY PLASMA PARTICLES

Gy. Vízkelethy
F. Pászti
G. Mezey

Gy. Vízkelethy (top) (MSc, physics, Roland Eötvös University, Budapest, Hungary; PhD, computer simulation of ion-solid interaction, 1986) is a research fellow at the Central Research Institute for Physics, Budapest, Hungary. His main research fields are the computational modeling of the ion/solid interaction and the plasma/wall interaction and surface analysis by nuclear methods. **F. Pászti** (MSc, physics, Lajos Kossuth University, Debrecen, Hungary; PhD, plasma/wall interaction, 1981) is a research fellow at the Central Research Institute for Physics. His main research fields are the physics of ion implantation and model experiments concerning plasma/surface interaction. **G. Mezey** (bottom) (MSc, physics, Roland Eötvös University; PhD, channeling investigation of ion-implanted semiconductors, 1972) is a research fellow at the Central Research Institute for Physics. His main topics of interests are ion implantation and backscattering spectroscopy.

LOCAL RADIATIVE COOLING OF EDGE PLASMAS BY INTENSE NEUTRAL GAS PUFFING

A. K. Prinja
Stewart J. Zweben

A. K. Prinja (top) (PhD, nuclear engineering, University of London, 1980) is currently an assistant research engineer in the Fusion Engineering and Physics Program at the University of California, Los Angeles (UCLA). His primary research interests include modeling of tokamak edge plasmas, physics of pumped limiters (theory and experiment), and application of kinetic theory to neutral atom transport in plasmas and to ion/solid interactions. **Stewart J. Zweben** (PhD, physics, Cornell University, 1977) is a physicist at Princeton Plasma Physics Laboratory, where his current interest is in alpha-particle measurements on the Tokamak Fusion Test Reactor. He studied turbulence and edge plasmas on tokamaks at UCLA and Caltech before coming to Princeton.

ASSESSMENT OF EDDY CURRENT EFFECTS ON COMPRESSION EXPERIMENTS IN THE TOKAMAK FUSION TEST REACTOR

King-Lap Wong
W. Park

King-Lap Wong (top) (PhD, University of Wisconsin, 1975) is an experimental plasma physicist at the Princeton Plasma Physics Laboratory (PPPL) currently working on the Tokamak Fusion Test Reactor. His areas of interest include plasma heating and confinement of magnetized plasmas, adiabatic plasma compression, radio-frequency plasma heating, current drive, linear and nonlinear phenomena associated with plasma wave excitation, and propagation. **W. Park** (PhD, physics, Columbia University, 1978) is a research physicist at PPPL. He is in the Theory Division and has worked on magnetohydrodynamic instabilities and magnetic reconnection.

ON MUON PRODUCTION FOR MUON CATALYZED FUSION

Lali Chatterjee

Lali Chatterjee (PhD, Jadavpur University, India, 1980) is a University Grants Commission Research Associate at the Department of Physics, Jadavpur University. She has worked extensively on various aspects of muon physics, quantum electrodynamics, and particle physics. She has been a visiting scientist at the International Center for Theoretical Physics, Trieste, Italy, in 1983, and at Fermilab in 1984. Her current research interests include muon catalyzed fusion and particle physics.

THE HIGH-POWER (3-MW) LONG-PULSE (3-s) RADIO-FREQUENCY SYSTEM FOR ION CYCLOTRON RESONANCE HEATING EXPERIMENTS ON TEXTOR

G. Van Oost
V. P. Bhatnagar
T. Delvigne
P. Descamps
F. Durodié
R. Koch
A. M. Messiaen
D. I. C. Pearson
P. E. Vandenplas
A. Vanderstraeten
R. Van Nieuwenhove
G. Van Wassenhove
R. R. Weynants
W. Kohlhaas
C. Stickelmann
A. Cosler
B. Giesen
B. Goerg
S. Haltrich
P. Huettemann
M. Korten








G. Van Oost (top right) (engineering degree, 1972; DSc, University of Ghent, Belgium, 1978) is presently acting as a permanent research staff representative for the Laboratoire de Physique des Plasmas (LLP)/Ecole Royale Militaire (ERM)–Koninklijke Militaire School (KMS) at the Institut für Plasmaphysik (IPP), Kernforschungsanlage (KFA) Jülich, Federal Republic of Germany (FRG). His present research activities involve effects of ion cyclotron resonance heating (ICRH) on the plasma edge of the Torus Experiment for Technology-Oriented Research (TEXTOR) and the Axially Symmetric Divertor Experiment (ASDEX) and the radio-frequency (rf) heating and diagnostics development for TEXTOR. He has worked in the area of waves, resonances, and parametric effects in bounded plasmas and rf heating and plasma diagnostics for the ERASMUS tokamak in Brussels, Belgium. **V. P. Bhatnagar** (top left) (MSc, physics, Agra University, India, 1961; M. Tech., electronics, B.I.T.S., Pilani, India, 1965; PhD, electrical engineering, University of Michigan, 1971) presently is an assigned associated staff member at the Joint European Torus (JET) Joint Undertaking, Abingdon, United Kingdom. He has worked on high-power microwave devices, beam-plasma interactions, and resonances in bounded plasmas. For the past 10 years, his main interests have been in controlled nuclear fusion research, especially in the rf heating of tokamak plasmas in the ion cyclotron range of frequencies. **T. Delvigne** (second from top right) (industrial engineering degree, Institut Supérieur Industriel, Brussels, Belgium, 1983) is a nuclear engineer on the technical staff of the LPP/ERM-KMS. He is currently working on the development of electronics devices for the rf heating system and neutron diagnostics for TEXTOR. **P. Descamps** (second from top left) (physics degree, University of Mons, Belgium, 1982) is currently working on a DSc degree. His research work includes the experimental and theoretical study of the ICRH antenna coupling properties and software development for ICRH line and antenna diagnostics. **F. Durodié** (third from top right) (engineering degree, University of Brussels, Belgium, 1983) technically defined the new ICRH system and is currently responsible for its construction and installation on TEXTOR. **R. Koch** (third from top left) (engineering degrees, University of Liège, Belgium, 1969 and 1970; DSc, University of Mons, Belgium, 1977) is presently acting as a permanent research staff representative for the LPP/ERM-KMS at the IPP, KFA Jülich, FRG. His main fields of interest are plasma wave theory and applications to heating experiments. He has also worked on data acquisition and analysis of tokamak heating experiments. **A. M. Messiaen** (bottom right) (engineering degree, ERM, Brussels, Belgium, 1955; DSc, University of Brussels, Belgium, 1963) is a senior research associate of the National Foundation for Scientific Research (NFSR) and the project leader of ICRH on TEXTOR. He has worked on experimental and theoretical physics of waves in plasmas with application to linear machine and tokamak heating. He has also worked on tokamak physics and ICRH antenna theory and design. **D. I. C. Pearson** (bottom left) (BSc, 1973; PhD, Mossbauer physics, University of Sheffield, England, 1977) is a research staff member of the LPP/ERM-KMS. He is currently working on an rf generator control system and TEXTOR diagnostics. He has worked on the ERASMUS tokamak and on ion

sources at the University of Nancy, France. **P. E. Vandenplas** (top right) (engineering degree, ERM, Brussels, Belgium, 1954; DSc, University of Brussels, Belgium, 1961) is a professor at ERM and is director of the "Euratom-Belgian State" association for controlled thermonuclear fusion and plasma physics. He is vice-chairman of the Consultative Committee for Fusion Programmes of the European Community and is a member of the JET council. **A. Vanderstraeten** (top left) (engineering degree, University of Louvain, Belgium, 1981) is presently with the firm Schenk-Treben, Düsseldorf, FRG. He has worked on the construction of the first rf heating system for TEXTOR. **R. Van Nieuwenhove** (second from top right) (physics degree, University of Leuven, Belgium, 1981) is currently working on a DSc degree. His research work involves effects of ICRH on the plasma edge of TEXTOR and ASDEX. He also worked on automatic control and data acquisition for the TEXTOR ICRH system. **G. Van Wassenhove** (second from top left) (physics degree, 1968; DSc, University of Louvain, Belgium, 1977) is a research staff member of the LPP/ERM-KMS. She is presently working on TEXTOR data evaluation and neutron diagnostics. She has worked in the areas of atomic collisions and diagnostics for the ERASMUS tokamak. **R. R. Weynants** (third from top right) (engineering degree, 1966; DSc, University of Leuven, Belgium, 1972) is a staff member at LPP/ERM-KMS as a senior research associate of the NFSR, and is a lecturer at the University of Leuven. He has worked on the theory, modeling, and application of rf heating of fusion plasmas, antenna design, plasma diagnostics, and tokamak physics. **W. Kohlhaas** (third from top left) (Dipl.-Ing., Fachhochschule Aachen, FRG, 1957) is a mechanical engineer on the technical staff at IPP, KFA Jülich. He is currently head of the Advanced Limiter Test-II (ALT-II) project, a toroidally closed pump limiter in TEXTOR. After the design of numerous instruments and plasma physics experiments, he was responsible for the layout and construction of all mechanical components for TEXTOR. **C. Stickelmann** (bottom right) (design engineering degree, Fachhochschule Aachen, FRG, 1962) is a member of the technical staff at IPP, KFA Jülich. His current activity is the design and construction of the new liner for ALT-II. He has built numerous experimental devices. For TEXTOR he designed the toroidal magnet and all mechanical supports (for poloidal field coils, vacuum vessel, etc.). **A. Cosler** (bottom left) (Dipl.-Ing., Fachhochschule Aachen, FRG, 1957) is a mechanical engineer and design office head of the IPP, KFA Jülich. He was responsible for the design of numerous plasma physics experiments and diagnostic systems. These experiences lead to the design of all the components and systems for plasma production and characterization and for the study and control of plasma/wall interaction in TEXTOR. Photographs and biographies for **B. Giesen, B. Goerg, S. Haltrich, P. Huettemann**, and **M. Korten** were not available at publication time.

ICF TARGETS

NUCLEAR SCATTERING AND SUPRATHERMAL FUSION

Anil Kumar
Jacques P. Ligou
Sauro B. Nicli

Anil Kumar (right) [MS, physics, Agra University, India; PhD, physics (nuclear engineering), University of Bombay, India, 1981] is currently senior scientist at Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland. From 1974 to 1981 he worked as a scientific officer in the Bhabha Atomic Research Centre, India. His main research interests include fusion physics, particle

transport, and fusion-fission blanket neutronics. **Jacques P. Ligou** (top) (diploma, electrical engineering, University of Toulouse, France; MS, nuclear physics, University of Lyon, France, 1950) worked for 10 years as a reactor physicist in the French nuclear industry. From 1969 to 1975 he was head of the Reactor Physics Section at the Swiss Federal Institute for Reactor Research. Presently, he is a professor of nuclear engineering at EPFL, and his main research interests lie in inertial confinement fusion and statistical physics. **Sauro B. Nicli** (bottom) (diploma, physics, EPFL, 1985) worked on the present paper as a part of his efforts to earn his diploma. He is employed at the Centre de Recherche en Physique des Plasmas, EPFL, Lausanne. Presently, he is involved in the development of numerical codes for vector machines and parallel processors for simulation of plasmas in tokamak geometries.

INERTIAL CONFINEMENT FUSION

PROCESS DESIGN AND EVALUATION OF A CONTINUOUS CHEMICAL PLANT FOR THE SINGLET OXYGEN-IODINE LASER

Robert J. Demyanovich
Scott Lynn

Robert J. Demyanovich (top) (BS, chemical engineering, Carnegie-Mellon University; PhD, chemical engineering, University of California, Berkeley) has 5 years of experience in process synthesis, evaluation, design, and chemical research. The primary focus of this work has been in the development of novel processes for pollution control. He has performed process design and economic evaluations on new flow sheets for SO_2 removal from sulfuric acid plants, SO_2 scrubbers using ammonia, removal of silicon tetrafluoride from phosphate fertilizer off-gas, and environmentally safe processes for the generation of excited singlet delta oxygen from the halogen-hydrogen peroxide reaction for the fusion power program. His research experience includes identifying suitable organic solvents for SO_2 absorption, NO absorption in iron chelates, studies on the liquid-phase reaction between H_2S and SO_2 to produce sulfur, and new generation techniques for the efficient production of excited oxygen from chlorine and basic hydrogen peroxide. **Scott Lynn** (BS, 1950; MS, 1951; and PhD, 1954, chemical engineering, California Institute of Technology) was a senior research engineer from 1954 to 1966 at Dow Chemical Company. From 1967 to the present, he has been a professor in the chemical engineering department at the University of California, Berkeley, and a consultant in the synthesis and design of chemical processes. He has been the associate dean for undergraduate affairs in the College of Chemistry at the University of California, Berkeley, since 1986. His research areas include process synthesis and design, especially in the fields of industrial electrochemistry, inorganic chemicals, removal of H_2S from gases, pollution abatement, methods of treatment of industrial waste water, separation of aqueous azeotropes, and concentration of aqueous solutions by solvent extraction.