

AUTHORS — SEPTEMBER 1986

FUSION FUEL CYCLES

LUNAR SOURCE OF ^3He FOR COMMERCIAL FUSION POWER

L. J. Wittenberg (top) [PhD, chemistry, University of Wisconsin (UW), 1953] is a senior scientist in the UW Fusion Technology Institute and the Department of Nuclear Engineering. He is currently involved in the design and evaluation of fuel cycles, breeders, and their containment systems required in the conceptual designs of fusion power reactors. Previous industrial experience included initiation of experimental projects and design studies related to tritium handling and containment needed in fusion-related research facilities. **J. F. Santarius** (center) (BS, physics, Caltech, 1973; PhD, physics, University of Texas, 1979) is plasma engineering group leader in the UW Fusion Technology Institute and is an associate scientist in the Department of Nuclear Engineering. His present research centers on plasma physics and engineering for commercial fusion reactor and test facility design. Other research areas include fusion reactors for space applications and plasmas for industrial processing and technological applications. **G. L. Kulcinski** (bottom) (PhD, nuclear engineering, University of Wisconsin, 1965) is the Grainger Professor of Nuclear Engineering and the director of the Fusion Technology Institute at UW. He is a fellow in the American Nuclear Society (ANS) and received the ANS Outstanding Achievement Award in 1980 for fusion. His previous employment includes work at Los Alamos National Laboratory in the Nuclear Rocket Program, Battelle Northwest Laboratory in the Radiation Effects Program, and Karlsruhe Nuclear Laboratory as a visiting scientist in fusion materials research. His present research areas include radiation damage to materials, surface modification of metals, fusion reactor design, and unique applications of nuclear energy.

L. J. Wittenberg
J. F. Santarius
G. L. Kulcinski



THE ADVANCED TOROIDAL FACILITY

J. F. Lyon (top right) (PhD, University of Tennessee, 1970) is stellarator program coordinator in the Fusion Energy Division of Oak Ridge National Laboratory (ORNL). His current activities are in stellarator confinement and reactor studies. He has worked in the mirror and tokamak programs at ORNL and on tokamaks and stellarator programs in the Soviet Union, France, England, Japan, and Germany. **B. A. Carreras** (top left) is a research staff member at ORNL. He has worked in magneto-hydrodynamic (MHD) theory and applications to tokamaks, stellarators, and reverse-field pinches. **K. K. Chipley** (second from top right) (BSME, Memphis State University, 1973) is Engineering Section leader, Fusion Technology Engineering, Martin Marietta Energy Systems, Inc., responsible for the design and analysis of mechanical systems for fusion experiments. **M. J. Cole** (second from top left) (BSME, Memphis State University, 1973) is a mechanical engineer in the Central Engineering Division of Martin Marietta Energy Systems, Inc. On the Advanced Toroidal Facility (ATF), he is responsible for design of the helical field coil system, which includes all tooling fixturing for fabrication and installation. **J. H. Harris** (third from top right) (PhD, University of Wisconsin, 1981) is a staff member in the Fusion Energy Division at ORNL. He has worked on stellarator experiments in the United States, the Soviet Union, and Japan. **T. C. Jernigan** (third from top left) (PhD, University of Wisconsin, 1971) is project manager for the ATF Construction Project in the Fusion Energy Division at ORNL. Previously, he was project manager for the ISX-A Tokamak Construction Project. He has worked on experimental physics in tokamaks and internal ring devices before assuming his present responsibilities. **R. L. Johnson** (fourth from top right) (BS, Georgia Institute of Technology, 1958) is department head, Confinement Systems Engineering in the Central Engineering Division of Martin Marietta Energy Systems, Inc. In this capacity, he provides technical and management support to a wide variety of experimental fusion projects. He is also the design manager for the ATF. **V. E. Lynch** (fourth from top left) (MS, applied math, University of Tennessee, 1979) is a staff member in the Computing and Telecommunications Division of ORNL. She has contributed in the areas of stellarator design and MHD calculations for stellarators and tokamaks. **B. E. Nelson** (fifth from top right) (MS, mechanical engineering, University of Missouri, 1976) is the Confinement and Plasma Technology Section head for the Engineering Division of Martin Marietta Energy Systems, Inc. He has worked on the design and analysis of magnets, magnet structures, and magnetic confinement systems for fusion research. **J. A. Rome** (fifth from top left) (ScD, Massachusetts Institute of Technology, 1971) is a member of the Theory Section of the Fusion Energy Division at ORNL. He has specialized in the design of the magnetic confinement configurations, charged-particle orbits, neutral beam injection, and transport. **J. Sheffield** (bottom right) (PhD, London University, England, 1966) is associate director for confinement in the Fusion Energy Division of ORNL. He works in the tokamak, bumpy torus, and stellarator confinement areas, in the heating and diagnostics of plasmas, and on advanced fusion systems. **P. B. Thompson** (bottom left) is manager of fusion projects engineering for the central engineering organization of Martin Marietta Energy Systems, Inc. He is also the engineering manager for the ATF project and provides technical and management input to a variety of fusion experimental projects.

*J. F. Lyon
B. A. Carreras
K. K. Chipley
M. J. Cole
J. H. Harris
T. C. Jernigan
R. L. Johnson
V. E. Lynch
B. E. Nelson
J. A. Rome
J. Sheffield
P. B. Thompson*



ASSESSMENT OF A COMPACT TORSATRON REACTOR, ATFSR

Wayne A. Houlberg (top) (PhD, nuclear engineering, University of Wisconsin, 1977) is a staff member in the Fusion Energy Division at Oak Ridge National Laboratory (ORNL). His primary research interest is in the development of physics and computational models for toroidal plasmas and the extension of these models to reactor conditions. **James T. Lacatski** (center) (BS, 1982, and MS, 1985, nuclear engineering, University of Tennessee) is currently an engineer assistant in the Nuclear Design Section of Duke Power Company. He is responsible for reactor core design, startup and operating predictions, and plant support. **Nermin A. Uckan** (bottom) (PhD, nuclear engineering, University of Michigan, 1975) is a staff member in the Fusion Energy Division at ORNL and a professor of nuclear engineering at the University of Tennessee, Knoxville. She has contributed to theory and modeling of bumpy tori and tokamaks in the areas of fusion plasma engineering and fusion reactor design studies.

*Wayne A. Houlberg
James T. Lacatski
Nermin A. Uckan*

**ALPHA-PARTICLE DIAGNOSTICS WITH HIGH-ENERGY NEUTRAL BEAMS**

M. Sasao (top) (PhD, nuclear physics, University of Tohoku, Japan, 1976) is a research associate at the Institute of Plasma Physics (IPP), Nagoya University. Her research interest includes nuclear physics related to fusion programs, fusion product diagnostics, negative ion sources, and irradiation effects on plasma diagnostic equipment. She has worked as a member of the "R-Project" (Reacting Plasma Project) of IPP-Nagoya for three years. **K. N. Sato** (PhD, physics, University of Tokyo, Japan, 1974) is an associate professor of IPP, Nagoya University. His research interest includes laser-produced plasmas in the magnetic confinement scheme, fusion product diagnostics, and pellet injection. He has worked as a member of the R-Project of IPP-Nagoya for three years.

*M. Sasao
K. N. Sato*

**TEMPERING OF 2.25 Cr-1 Mo STEEL AND HT-9 STEEL TO REDUCE LIQUID-METAL-INDUCED EMBRITTLEMENT SUSCEPTIBILITY IN 17Li-83Pb LIQUID**

Glen R. Edwards (right) is a professor of metallurgical engineering, Department of Metallurgical Engineering, Colorado School of Mines (CSM), Golden, Colorado. **Kent A. Jones** (left), formerly a graduate research assistant at CSM, is now a quality

*Glen R. Edwards
Kent A. Jones
Steven F. Halvorson*



engineer with Caterpillar Tractor Co., Joliet, Illinois. **Steven F. Halvorson** (right) is a graduate research assistant at the CSM Department of Metallurgical Engineering, Golden, Colorado.



TRITIUM SYSTEMS

PRECISE METHOD OF THE LOCAL TRITIUM BREEDING MEASUREMENTS ORIENTED TO FUTURE ADVANCED BENCHMARK EXPERIMENTS

Jan S. Brzosko (top right) [MSc, 1962; PhD, 1968; and DSc (habilitation), 1971, Warsaw University (WU), Poland] has served as professor of physics at WU and director of the Physics Institute, dean of the Faculty of Science, and head deputy for science and research in the Bialystok Division of WU. He has worked in the areas of neutron physics and gas discharge physics. During the last few years, his research was devoted to fusion physics and technology, mainly nuclear diagnostics of dense plasmas (plasma focus) and nuclear technology of the fusion reactor blanket. Since 1981 he has been working at the European Nuclear Energy Agency (ENEA), Frascati Center, Italy, and is presently at the Stevens Institute of Technology. **Benjamin V. Robouch** (top left) (DSc, nuclear physics, University of Lyon, France) is head of the blanket area of the ENEA Fusion Reactor Project. He has worked in the Accelerator Research Group at CERN, Geneva, and since 1962 he has been with the Commission of the European Community at the EURATOM-ENEA Association, Frascati, where he took part in the dense plasma program (first 120-kJ Mirapi, later the 1-MJ plasma focus) and in the numerical development of codes. He developed the neutronics 3DAMC-VINIA system, which he is presently using in the investigation of the effects of nonhomogeneities on blanket nuclear properties and predicting its nuclear property behavior. **Raffaele De Leo** (center right) [graduate, physics, Bari University (BU), Italy, 1969] has been an associate professor of nuclear physics of BU since 1974. His interests and main experience are in the area of nucleon/nucleus interactions. **Ginevra D'Erasmus** (center left) (graduate, physics, BU, Italy, 1970) was a fellow of the Center for the Study and Applications of Advanced Technologies (CSATA) in 1971. From 1974 to 1984 she worked at the Department of Physics, BU, and in 1985 became an associate professor of physics at BU. Her main fields of interest include nuclear reaction mechanisms with light and heavy ions, response of nuclear particle detectors, and applied nuclear technologies. **Ambrogio Pantaleo** (bottom right) (graduate, physics, BU, Italy, 1971) was a fellow at the CSATA. In 1974 and 1975, he worked as a physics assistant of the Faculty of Sciences, BU. Since 1976, he has been a researcher at the National Institute of Nuclear Physics at the Bari Section. His main interests are nuclear reaction mechanisms with light and heavy ions, response of nuclear particle detectors, and applications of nuclear technologies. **Gigi Skoff** (bottom left) (graduate, physics, University of Milan, Italy, 1957) has been an associated professor of physics at BU since 1966. Before 1966 he worked on the dosimetry of large radiation sources and on archaeological and geological dating by means of nuclear techniques. Since 1966 his interests have been in applied nuclear technologies (neutron activation analysis) and

*Jan S. Brzosko
Benjamin V. Robouch
Raffaele De Leo
Ginevra D'Erasmus
Ambrogio Pantaleo
Gigi Skoff
Marisa Alessio
Lucia Allegri
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radiation measurements, devoted either to space research or to radiological protection. Recently, he undertook studies on energy production problems. **Marisa Alessio** (top) (degree, physics, University of Rome, Italy, 1957) has been an associate professor at the "La Sapienza" University of Rome. She is an expert in ^{14}C dating, tritium, and ^{222}Rn concentration measurements, and is particularly involved in the hydrogeological, geological radioactivities in relation to precursory phenomena of earthquake studies. **Lucia Allegri** (center) (degree, physics, University of Rome, Italy) is a research scientist in the Department of Physics, "La Sapienza" University of Rome. She is an expert in measurements of extremely low radioactivities, and has worked in the dating of archeological (^{14}C) and geological materials, tritium, and ^{222}Rn concentration measurements. **Salvatore Improta** (bottom) (degree, physics, University of Rome, Italy) is an associate professor at "La Sapienza" University of Rome. He is an expert in measurements of extremely low radioactivities, and is concerned with rock dating by electron spin resonance, ^{14}C concentration measurements by HEMS, as well as with tritium and ^{222}Rn concentration measurements.

MATHEMATICAL MODEL APPLIED TO PERMEATION PROBLEMS OF PROCESS DESIGNS FOR TRITIUM RECOVERY FROM LIQUID BLANKETS

Roberto Baratti (top right) (graduate, engineering, University of Cagliari, Italy) is conducting university research on the modeling and optimization of metallurgical processes. **Anna Maria Polcaro** (top left) (graduate, industrial chemistry, University of Rome, Italy) is an associate professor on the engineering faculty of the University of Cagliari. She is the author of several publications on kinetics and equilibrium characteristics of hydrogen/metal systems. **Pier Francesco Ricci** (center right) (graduate, industrial chemistry, University of Rome, Italy) is an associate professor on the engineering faculty of the University of Cagliari. He has authored several publications on the kinetics of heterogeneous phases. **Antonio Viola** (bottom left) (graduate, chemical engineering, University of Rome, Italy) is an associate professor of chemical engineering at the University of Cagliari investigating metallurgical and petrochemical process modeling and optimization techniques. He is the author of many publications in the chemical engineering field, in particular on the absorption of hydrogen on metals and on direct reduction of mixed oxides with H_2 and CO . He was recently involved in the investigation of the recovery of tritium from the breeding materials of fusion reactors. **Giancarlo Pierini** (bottom right) (graduate, chemistry, University of Florence, Italy, 1956) is currently employed at the Joint Research Center of the European Community in Ispra, Italy, and is working with tritium and blanket technology processes.

*Roberto Baratti
Anna Maria Polcaro
Pier Francesco Ricci
Antonio Viola
Giancarlo Pierini*



SAFETY/ENVIRONMENTAL ASPECTS

A METHODOLOGY FOR COST/BENEFIT SAFETY ANALYSIS FOR FUSION REACTORS

Sandra J. Brereton (right) [B.A.Sc., chemical engineering, University of Toronto, Canada, 1983; S.M., nuclear engineering, Massachusetts Institute of Technology (MIT), 1985] is currently working on a PhD at MIT. Her primary interests lie in the areas

*Sandra J. Brereton
Mujid S. Kazimi*



of tritium technology and fusion reactor safety. **Mujid S. Kazimi** (right) (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.



MATERIALS ENGINEERING

RADIOLYTIC CORROSION OF WATER-COOLED FUSION REACTOR HEAT SINK COMPONENTS

Theodore E. Luzzi

Theodore E. Luzzi (ENG ScD, plasma physics, Columbia University) is a senior staff scientist in the Corporate Research Center of the Grumman Corporation. He has been involved in the conceptual design and studies of various reactor components for inertial and magnetic confinement fusion for the past 10 years. His current technical interests include direct converter design for tandem mirror reactors and alternate concepts for fusion power conversion.

