

Fusion Technology™

CONTENTS / MAY 1991 – VOL. 19, NO. 3

PART 2A (pp. 583–1372)

PART 2B (pp. 1373–2020)

**Proceedings of the
NINTH TOPICAL MEETING ON THE TECHNOLOGY
OF FUSION ENERGY
(Oak Brook, Illinois, October 7–11, 1990)**

PART 2A

xvii Comments / *George Miley*

xix Preface: Ninth Topical Meeting on the Technology of Fusion Energy /
Dale L. Smith

OVERVIEWS

- 585 Status of Inertial Confinement Fusion in the United States / *Marshall M. Sluyter*
594 Status of CIT / *John A. Schmidt, D. Bruce Montgomery, The CIT Design Team*
599 The Next ICF Facilities / *William J. Hogan*
608 Overview of the ITER Project / *E. Salpietro*

INERTIAL FUSION

- 617 HYLIFE-II Inertial Confinement Fusion Reactor Design / *Ralph W. Moir*
625 The Heat Transport System and Plant Design for the HYLIFE-II Fusion Reactor / *Myron A. Hoffman*
634 SIRIUS-T, An Advanced Tritium Production Facility Utilizing Symmetrically Illuminated Inertial Confinement Fusion / *I. N. Sviatoslavsky, G. L. Kulcinski, G. A. Moses, M. E. Sawan, R. L. Engelstad, E. Larsen, E. Lovell, J. MacFarlane, E. Mogahed, R. R. Peterson, J. W. Powers, L. J. Wittenberg*
640 The Cascade ICF Reactor with an X-Ray and Debris Shield and a Heavy-Ion Driver / *John H. Pitts, Max Tabak*
646 A Laboratory Microfusion Capability for the U.S. ICF Program / *David N. Bixler, Steven A. Goldstein*
652 Design of a 100-kJ KrF Single-Pulse Inertial Confinement Fusion Driver / *J. A. Sullivan, D. B. Harris, J. McLeod, N. A. Kurnit, J. Pendergrass, E. Rose*

(Continued)

CONTENTS / MAY 1991–VOL. 19, NO. 3

PARTS 2A and 2B

(Continued)

- 664** A Light Ion Beam Driver for the Laboratory Microfusion Facility / *J. J. Ramirez, K. R. Prestwich, R. W. Stinnett, D. L. Johnson, C. L. Olson, G. O. Allshouse, M. J. Clauser, V. Harper-Slaboszewicz, T. W. L. Sanford, J. D. Boyes, T. A. Mehlhorn, L. J. Lorence, D. L. Hanson, M. E. Cuneo, R. R. Peterson, R. L. Engelstad, J. W. Powers, H. Y. Khater, M. E. Sawan, E. G. Lovell, G. A. Moses*
- 669** Plasma Channels for the LIBRA Reactor Design / *Osman Yasar, Gregory A. Moses, Robert R. Peterson*
- 673** Grazing Incidence Metal Mirrors as the Final Elements in a Laser Driver for Inertial Confinement Fusion / *Robert L. Bieri, Michael W. Guinan*
- 679** Adapting an X-Ray/Debris Shield to the Cascade ICF Power Plant: Neutronics Issues / *Michael T. Tobin*
- 686** Pressure Loadings on the Walls of a Light Ion Laboratory Microfusion Facility Target Chamber / *Robert R. Peterson*
- 692** Gigantic Inertial Confinement Fusion-Fission Breeder Systems / *E. F. Marwick*
- 697** Mechanical Design of the LMF Target Chamber / *R. L. Engelstad, J. W. Powers, E. G. Lovell*
- 703** Implications of Non-LTE Buffer Gas Effects for ICF Target Chamber Design / *J. J. MacFarlane, P. Wang, G. A. Moses*
- 709** Radiation Damage and Activation in the HT-9 Structure of ICF Reactors Using Inport Protection / *J. M. Perlado, J. Sanz, D. Guerra, A. S. Perez*
- 716** Experimental Study of Condensation in Expanding Metal Vapors and Implications for ICF Target Chambers / *K. H. Bang, J. J. MacFarlane, J. J. Barry, M. L. Corradini*
- 721** The Pressure Relaxation of Liquid Jets After Isochoric Heating / *X. M. Chen, V. E. Schrock*
- 727** A Note on the Pressure Field Within an Outward Moving Free Annulus / *X. M. Chen, V. E. Schrock*
- 732** An Approximate Method for Analyzing Transient Condensation on Spray in HYLIFE-II / *R. Y. Bai, V. E. Schrock*
- 740** SIRIUS-T Structural System Design and Analysis / *J. W. Powers, E. G. Lovell, I. N. Sviatoslavsky, R. L. Engelstad*
- 746** Neutronics and Thermal Analyses for the Breeding Blanket of the ICF Tritium Production Reactor SIRIUS-T / *M. E. Sawan, E. A. Mogahed*
- 752** Parametric Cost Analysis of a HYLIFE-II Power Plant / *Robert L. Bieri*
- 758** Oscillating Liquid Flow ICF Reactor / *Ronald W. Petzoldt*
- 763** Neutronics Analysis for HYLIFE-II / *Michael T. Tobin*
- 770** A Benchmark Comparison of Predicted X-Ray and Neutron Doses for a Nuclear Effects Test in the Laboratory Microfusion Facility / *Denis E. Beller, Michael T. Tobin, Len J. Lorence*

(Continued)

CONTENTS / MAY 1991–VOL. 19, NO. 3

PARTS 2A and 2B

(Continued)

ADVANCED REACTORS

- 777** Fusion-Fission Hybrid Reactor Research and Development Program in P. R. China / *L. J. Qiu*
- 783** The ARIES-I Tokamak Reactor Study / *F. Najmabadi, R. W. Conn, The ARIES Team*
- 791** Apollo-L3, An Advanced Fuel Fusion Power Reactor Utilizing Direct and Thermal Energy Conversion / *G. L. Kulcinski, G. A. Emmert, J. P. Blanchard, L. A. El-Guebaly, H. Y. Khater, C. W. Maynard, E. A. Mogahed, J. F. Santarius, M. E. Sawan, I. N. Sviatoslavsky, L. J. Wittenberg*
- 802** Options and Optimizations for Tokamak Reactors: ARIES / *R. L. Miller, R. A. Krakowski, The ARIES Team*
- 807** Updated Comparison of Economics of Fusion Reactors with Advanced Fission Reactors / *J. G. Delene*
- 813** Comparison of Euratom and U.S. Estimates of Fusion Reactor Costs / *R. L. Miller, W. R. Spears, R. Hancox, R. A. Krakowski*
- 820** Tritium Permeation Losses in HYLIFE-II Heat Exchanger Tubes / *Glen R. Longhurst, Thomas J. Dolan*
- 826** Neutronics Study for a Tokamak Commercial Breeder / *Ch. You, Q. Wang, L. Wu, Y. Jiao, J. Huang*
- 830** Superconducting Magnet Development Requirements for Commercial High Field Tokamaks / *J. Schwartz, L. Bromberg, D. R. Cohn, J. H. Schultz, J. E. C. Williams*
- 836** Enhancement of Predicted X-Ray Effects with Advanced-Fuel Pellets for Nuclear Effects Tests in the Laboratory Microfusion Facility / *Denis E. Beller, Mark S. Herte, Michael T. Tobin*
- 840** Inertial-Electrostatic Confinement: An Approach to Burning Advanced Fuels / *G. H. Miley, J. Nadler, T. Hochberg, Y. Gu, O. Barnouin, J. Lovberg*
- 846** Plasma Focus Device for Use in Space Propulsion / *B. Temple, O. Barnouin, G. H. Miley*
- 852** Neutron Activation in First-Wall Materials for Advanced-Fuel Fusion Reactors / *Massimo Zucchetti*
- 857** A Gaseous Divertor for High Field Reactors / *T. F. Yang, G. S. Luan, L. Bromberg, D. R. Cohn, B. J. Braams*
- 864** The Impact of Proton-Induced Activation on the Level of Radioactivity in D-³He Fusion Reactors / *H. Y. Khater, W. F. Vogelsang*
- 870** Direct-Energy Conversion from High-Energy Ions Through Interaction with Electromagnetic Fields / *K. Yoshikawa, T. Noma, Y. Yamamoto*
- 876** Design Study of Blanket Neutronics of a Commercial Tokamak Fusion-Fission Hybrid Reactor / *Liu Cheng-An, Wang Tian-Long, Lu Xun*

(Continued)

CONTENTS / MAY 1991–VOL. 19, NO. 3

PARTS 2A and 2B

(Continued)

- 882** Current Drive Using Fast Waves and Folded-Waveguide Launchers for the ARIES-I Tokamak Reactor / *T. K. Mau, D. A. Ehst, D. J. Hoffman, The ARIES Team*
- 889** Design Integration and Maintenance of the ARIES-I Tokamak Reactor / *S. P. Grotz, F. Najmabadi, L. Bromberg, R. L. Miller, D.-K. Sze, L. Creedon, C. P. C. Wong*
- 895** Divertor Engineering for the ARIES-I Reactor / *S. Sharafat, S. P. Grotz, M. Z. Hasan, T. K. Kungi, C. P. C. Wong, E. E. Reis, The ARIES Team*
- 901** SiC-Composite First-Wall Design for the ARIES-I Reactor / *S. Sharafat, C. P. C. Wong, E. E. Reis, The ARIES Team*
- 908** Thermal Response of ARIES-I Divertor Plate to Plasma Disruption / *M. Z. Hasan, T. Kunugi, M. Seki, M. Yokokawa, H. Ise, H. Kaburaki, The ARIES Team*
- 913** Li Overlayer Formation, Oxidation and Sputtering Characteristics of Al-Li Alloys and W/Al-Li Composites for Fusion Applications / *Alan R. Krauss, A. B. DeWald, P. Scott, H. Savage*
- 921** Innovative Design Option for Internal Coils / *L. Bromberg, M. S. Tillack*

BLANKET TECHNOLOGY

- 931** In-Situ Tritium Recovery from Li₂O Irradiated in Fast Neutron Flux – BEATRIX-II Initial Results / *T. Kurasawa, O. D. Slagle, G. W. Hollenberg, R. A. Verrall*
- 938** ARIES-I SiC Composite Low Activation Blanket Design / *C. P. C. Wong, E. T. Cheng, B. McQuillan, E. E. Reis, Jr., K. R. Schultz, S. P. Grotz, M. Z. Hasan, R. Martin, F. Najmabadi, S. Sharafat, T. Kunugi, J. S. Herring, D. K. Sze, The ARIES Team*
- 944** Status of the Design and Feasibility Assessment of the European Helium Cooled Ceramic Breeder Inside Tubes Test Blanket / *E. Proust, L. Giancarli, X. Raepsaet, J. Szczepanski, L. Baraer, B. Bielak, F. Gervaise, J. Mercier, F. Vallette, L. Anzidei, P. Cecchi, S. Cevolani, M. Gallina, L. Petrizzi, V. Rado, V. Violante, V. Vettraino, V. Zampaglione*
- 951** MHD Considerations for Poloidal-Toroidal Coolant Ducts of Self-Cooled Blankets / *T. Q. Hua, J. S. Walker*
- 961** Reduction of MHD Pressure Drop of Liquid Metal Flow by Insulation, Part I: Insulated Circular Ducts / *Keiji Miyazaki, Kensuke Konishi, Hiroshi Aoyama, Shoji Inoue, Nobuo Yamaoka*
- 969** Reduction of MHD Pressure Drop of Liquid Metal Flow by Insulation, Part II: Three-Face Insulated Rectangular Duct / *Keiji Miyazaki, Kensuke Konishi, Yoshihisa Gonno, Shoji Inoue, Masaki Saito*
- 976** Tritium Retention and Release Analysis for the U.S.-ITER Driver Blanket / *M. C. Billone, C. C. Lin, H. Attaya, Y. Gohar*

(Continued)

CONTENTS / MAY 1991–VOL. 19, NO. 3

PARTS 2A and 2B

(Continued)

- 984** Neutronics Design Aspects of Reference ARIES-I Fusion Blanket / *E. T. Cheng, The ARIES Design Team*
- 990** MHD Heat Transfer in Elongated Rectangular Ducts for Liquid Metal Blankets / *Alice Y. Ying, Mark S. Tillack*
- 996** Tritium Recovery from Lithium Zirconate Spheres / *J. M. Miller, S. R. Bokwa, D. S. MacDonald, R. A. Verrall*
- 1000** Analysis of Liquid Metal MHD Fluid Flow and Heat Transfer Using the KAT Code / *T. Kunugi, M. S. Tillack, M. A. Abdou*
- 1006** European Water-Cooled Lithium-Lead Blanket Designs for a DEMO Reactor / *Ph. Labbe, L. Giancarli, L. Baraer, P. Leroy, J. Mercier, Y. Severi, J. Quintric-Bossy*
- 1012** Processes for Desorption from LiAlO₂ Treated with H₂ as Studied by Temperature Programmed Desorption / *Albert K. Fischer*
- 1018** Modeling of Surface Reactions in Tritium Release from Solid Breeding Materials / *S. Tanaka, D. Yamaki, M. Yamawaki*
- 1024** Entry-Length Effect on the Thermal-Hydraulic Design of Plasma Facing Components of Fusion Reactors, Part I: Non-MHD Flow / *T. Kunugi, M. Z. Hasan*
- 1030** Entry-Length Effect on the Thermal-Hydraulic Design of Plasma Facing Components of Fusion Reactors, Part II: MHD Flow / *M. Z. Hasan, T. Kunugi*
- 1036** Linear Stability Results for High-Velocity Boundary Layers in Self-Cooled Liquid-Metal Tokamak Blankets / *A. Ting, J. S. Walker, T. J. Moon, C. B. Reed, B. F. Picologlou*
- 1040** Comparison of Tritium Production Reactors / *Layton J. Wittenberg*
- 1046** Kinetics of Tritium Recovery from Liquid Lithium by Molten Salt Extraction / *H. Moriyama, Y. Asaoka, Y. Ito*
- 1051** Recent Progress on the Predesign and Feasibility Studies of the NET Shielding Blanket Segments / *B. Bielak, D. Besson, F. Carre, J. Mercier, G. Stalport, P. Thomas, W. Daenner, M. Gouton, P. Hubert, G. Vieider*

IGNITION DEVICES

- 1059** Compact Ignition Tokamak (CIT) Central Solenoid Design and R&D for a "Bucked" and for a "Wedged" Machine / *R. J. Thome, B. A. Smith, R. D. Pillsbury, Jr., M. M. Olmstead, J. Bates, R. Vieira, J. Feng, P. Titus, R. L. Myatt*
- 1065** Impact of the Design Point on the Poloidal Field Coil System for the CIT (Compact Ignition Tokamak) / *R. D. Pillsbury, Jr., R. J. Thome, B. A. Smith*
- 1070** Description of the Scientific and Technological Aspects of the Fusion Ignition Experiment IGNITEX / *IGNITEX Group*

(Continued)

CONTENTS / MAY 1991–VOL. 19, NO. 3

PARTS 2A and 2B

(Continued)

- 1076** ZTI: Preliminary Characterization of an Ignition Class Reversed-Field Pinch / *C. G. Bathke, R. A. Krakowski, R. L. Miller, K. A. Werley, J. N. DiMarco*
- 1083** Modification of Electromechanical Stresses in the Poloidal Field Magnet of a Single-Turn Tokamak Due to Eddy Current Effects / *J. Q. Dong, E. Montalvo, R. Carrera, M. Driga, K. T. Hsieh, W. A. Walls, W. F. Weldon*
- 1089** Electromechanical and Thermomechanical Stress Analysis of the Toroidal Field Magnet System in Single Turn Ignition Tokamaks / *K. T. Hsieh, W. F. Weldon, M. D. Werst, E. Montalvo, R. Carrera*
- 1095** Surface Erosion and Tritium Inventory Analysis for CIT / *J. N. Brooks, H. F. Dylla, A. E. Pontau, K. L. Wilson*
- 1102** CIT Elongation Tradeoffs Studies / *L. Bromberg, J. Wei*
- 1109** Overview of the CIT Physics Design / *G. H. Neilson, D. B. Batchelor, G. Bateman, M. G. Bell, J. Bialek, B. J. Braams, J. N. Brooks, R. J. Goldston, J. R. Haines, D. N. Hill, W. A. Houlberg, S. C. Jardin, C. E. Kessel, S. S. Medley, F. W. Perkins, R. D. Pillsbury, N. Pomphrey, M. Porkolab, W. T. Reiersen, R. O. Sayer, J. E. Scharer, J. A. Schmidt, D. J. Sigmar, J. C. Sinnis, R. D. Stambaugh, D. Stotler, D. J. Strickler, M. Ulrickson, R. E. Waltz, K. M. Young, J. J. Yugo*
- 1115** Compact Ignition Tokamak Vacuum Vessel Material Selection / *W. A. Fragetta, R. E. Rocco*
- 1121** Structural Performance of the Bucked Design Compact Ignition Tokamak (CIT) Vacuum Vessel / *S. Dinkevich, T. Feng, M. Z. Khan, P. K. Hsueh, S. J. Chen*
- 1127** Compact Ignition Tokamak, Vacuum Vessel Heating/Cooling Preliminary System Design / *S. Stoenescu, T. Feng, J. Swanson*
- 1133** First Wall Inboard Limiter Design Development for the Compact Ignition Tokamak / *H. C. Mantz, D. A. Bowers, F. R. Williams, J. W. Sapp, M. A. Witten*
- 1138** Divertor Design Development for the Compact Ignition Tokamak / *D. A. Bowers, J. R. Haines, M. D. McSmith, V. D. Lee*
- 1143** Operational Procedures and Out-Vessel Maintenance Considerations for the IGNITER Experiment / *W. D. Booth, G. W. Brunson, R. Carrera, G. Hallcock, S. S. Medley, M. E. Oakes, C. A. Ordonez, T. A. Parish, R. L. Sledge, W. A. Walls, W. F. Weldon, M. D. Werst*
- 1149** Development of Preloading and Precooling Systems for a Single-Turn Ignition Tokamak / *G. W. Brunson, W. D. Booth, R. Carrera, W. F. Weldon*
- 1154** Description of Pulsed-Power Homopolar Technologies for a Fusion Ignition Experiment / *W. A. Walls, J. H. Gully, W. F. Weldon, H. H. Woodson*
- 1160** IGNITOR Scale-Up Studies (DIGNITOR) / *L. Bromberg, P. Titus, C. Bolton*
- 1168** Design Optimization of Ignited Tokamaks / *E. A. Chaniotakis, J. P. Freidberg, D. R. Cohn*

(Continued)

CONTENTS / MAY 1991–VOL. 19, NO. 3

PARTS 2A and 2B

(Continued)

- 1177** Evaluation of Conductors and Design Criteria Development for the Central Solenoid of the Compact Ignition Tokamak (CIT) / *Jun Feng, Frank A. McClintock, Rui Vieira, Regis M. Pelloux, Richard J. Thome*
- 1183** Internal Ring Coil Design for the Compact Ignition Tokamak (CIT) / *B. A. Smith, R. J. Thome, Z. Piek, M. M. Olmstead*
- 1189** Evaluation of Low Friction Materials for the Central Solenoid of the Compact Ignition Tokamak (CIT) / *B. A. Smith, Z. Piek, P. Thomas, R. Vieira*
- 1194** Description of the Construction of the IGNITEX Facility / *M. R. Manavazhi, P. Cooper, W. D. Booth, J. Borcherding, G. Brunson, R. Carrera, J. H. Gully, J. Quiñones, W. A. Walls, W. F. Weldon, M. D. Werst*
- 1199** Diagnostic System for a 20 Tesla, Toroidal, Single Turn Magnet Prototype for Fusion Ignition / *M. J. Johnson, W. F. Weldon, D. J. Wehrle, M. D. Werst*
- 1205** High-Current Busbars for a Prototype Homopolar-Toroidal Magnet System for Fusion Ignition / *R. L. Sledge, G. W. Brunson, R. Carrera, K. T. Hsieh, W. F. Weldon, M. D. Werst*
- 1211** Analysis of the Breakdown of a Poloidal Field Coil of RFX During Acceptance Tests / *F. Bellina, G. Chitarin, A. Stella*
- 1217** Magnet Technology Demonstration for an Ignition Single-Turn Tokamak / *M. D. Werst, G. W. Brunson, K. T. Hsieh, R. L. Sledge, D. J. Wehrle, W. F. Weldon, H. H. Woodson*
- 1223** Preliminary Cost Estimate of the Construction Phase of the Fusion Ignition Experiment IGNITEX / *W. D. Booth, T. Bauer, G. W. Brunson, R. Carrera, H. P. Cooper, J. Q. Ling, M. R. Manavazhi, J. Quiñones, W. A. Walls, W. F. Weldon, M. D. Werst*
- 1229** Evaluation of Electromechanical Loads in the Vacuum Vessel of a Single-Turn Ignition Tokamak / *J. Q. Dong, E. Montalvo, R. Arslanoğlu, E. B. Becker, G. Brunson, R. Carrera, R. Khayrutdinov, W. A. Walls, W. F. Weldon*

RESULTS OF LARGE EXPERIMENTS AND PLASMA ENGINEERING

- 1237** Technical Aspects of Impurity Control at JET: Status and Future Plans / *M. Huguet, The JET Team*
- 1247** Latest Results from DIII-D and Their Implications for Future Devices / *A. P. Colleraine, J. L. Luxon, The DIII-D Group*
- 1257** Overview of ZTH / *Philip Thullen*
- 1266** Plasma Confinement Requirements for Compact RFP Reactor (TITAN) Plasmas Operated in a High-Radiation Mode / *K. A. Werley, C. G. Bathke, R. A. Krakowski, R. L. Miller, J. N. DiMarco*
- 1272** ARIES-I Tokamak Reactor Start-Up Simulations, Tradeoffs, and Engineering Considerations / *R. A. Krakowski, C. G. Bathke, K. A. Werley, G. L. Varsamis, T. K. Mau, C. Wong, K. R. Schultz*

(Continued)

CONTENTS / MAY 1991–VOL. 19, NO. 3

PARTS 2A and 2B

(Continued)

- 1278** Coolant Ingress Induced Disruption Calculations for ITER / *B. J. Merrill, S. C. Jardin*
- 1284** Plasma Dynamics, Particle Transport, and Internal Activity in the IGNITEX Experiment / *E. Montalvo, B. R. Shi, R. Carrera, G. Y. Fu, Z. Guo, R. Hazeltine, L. M. Hively, G. H. Miley, M. N. Rosenbluth, K. Tani, J. W. Van Dam, X. Xiao*
- 1290** Study of Plasma Disruption During the Ignited Phase in a Single-Turn Tokamak Fusion Experiment / *J. Q. Dong, E. Montalvo, R. Carrera, R. Khayrutdinov, F. J. Helton, M. N. Rosenbluth*
- 1296** Discharge Control in an Ignition Single-Turn-Coil Tokamak / *R. Khayrutdinov, J. Q. Dong, E. Montalvo, E. A. Azizov, R. Carrera, W. D. Booth, M. N. Rosenbluth*
- 1302** Electromechanical Description of Tokamak Plasma Operation by Fiber Theory / *N. A. Salingaros, R. Carrera*
- 1307** 1-1/2D Transport Studies of ITER Burn Control Scenarios / *J. Mandrekas, W. M. Stacey, H. He*
- 1313** An Improved Calculation on the Enhancement of Fusion Reaction Rate in a Driven Reactor / *X. Z. Li, C. Ren, P. Jiang*
- 1317** Plasma Stability Study for FRC Compact Torus / *P. G. Papanikolaou, C. K. Choi*
- 1322** Assessment of Emergency Plasma Shutdown Schemes for ITER / *S. K. Ho, R. B. Campbell, L. J. Perkins, S. W. Haney*
- 1327** An RF Heated Tokamak—Phaedrus-T / *R. Breun, D. Brouchous, D. Diebold, R. Fonck, N. Hershkowitz, T. Intrator, Y. J. Kim, M. Kishinevsky, W. Li, R. Majeski, J. Pew, P. Probert, E. Y. Wang, Y. Wen, H. Che, M. Doczy, G. McKee, J. Sorensen, T. Tanaka, M. Vukovic, P. Bellan, M. R. Brown*
- 1331** LOCA Analysis for Manganese-Stabilized Steel / *H. Attaya*
- 1337** A Comparative Analysis of the Radiological Consequences of Routine Operation of a Fission Research Reactor and the Fusion Ignition Experiment IGNITEX / *R. Durrer, T. A. Parish, G. Schlapper, R. Carrera*
- 1342** Evaluation of Graphite/Steam Interactions for ITER Accident Scenarios / *G. R. Smolik, B. J. Merrill, S. J. Piet, D. F. Holland*
- 1349** External Events Analysis for Experimental Fusion Facilities / *L. C. Cadwallader*
- 1355** Mass Transfer Modelling of Liquid Metal/Water Interactions / *P. O. Biney, S. Lomperski, M. L. Corradini*
- 1362** Radiological Analysis for NOVA Upgrade / *Wayne R. Meier, Michael T. Tobin, Michael S. Singh*
- 1368** Empirical Formula to Evaluate Activation Radioactivity for Various First Wall Designs of a Fusion Reactor / *S. K. Ho*

(Continued)

CONTENTS / MAY 1991–VOL. 19, NO. 3

PARTS 2A and 2B

(Continued)

PART 2B

SAFETY

- 1375** Innovative Safety Ideas for Fusion Experimental Machines / *S. J. Brereton, S. J. Piet, B. J. Merrill, D. F. Holland, M. Gouge, D. K. Sze*
- 1386** Activation Product Safety in the ARIES-I Reactor Design / *J. Stephen Herring, Clement Wong, E. T. Cheng, D. K. Sze, S. P. Grotz, The ARIES Team*
- 1392** Safety and Environmental Aspects of HYLIFE-II / *T. J. Dolan, G. R. Longhurst*
- 1398** Predictions of Radioactive Tungsten Release for Hypothetical ITER Accidents / *G. R. Smolik, S. J. Piet, R. M. Neilson, Jr.*
- 1403** Consequences of Water Injection into High-Temperature Li17Pb83 Alloy Breeder Material / *D. W. Jeppson, C. Savatteri*

ITER

- 1411** ITER Physics Basis / *N. A. Uckan, D. E. Post*
- 1418** ITER System Study—Safety Aspects / *S. J. Piet, J. Raeder, H. Iida, Y. Seki, L. N. Topilski*
- 1424** Tritium Breeding Blanket / *D. Smith, M. Billone, Y. Gohar, C. Baker, S. Mori, T. Kuroda, K. Maki, H. Takatsu, H. Yoshida, A. Raffray, I. Sviatoslavsky, G. Simbolotti, W. Daenner, D. Lorenzetto, A. Anitipenkov, A. Siderov, G. Shatalov*
- 1432** ITER Maintenance / *T. Honda, J. Doggett*
- 1439** ITER Test Program: Key Technical Aspects / *Mohamed A. Abdou*
- 1452** Dependence of CIT PF Coil Currents on Profile and Shape Parameters Using the Control Matrix / *D. J. Strickler, Y-K. M. Peng, S. C. Jardin, N. Pomphrey*
- 1457** Neutronics and Thermal Design Analyses of U.S. Solid Breeder Blanket for ITER / *Y. Gohar, M. Billone, H. Attaya, M. Sawan*
- 1463** Comparison of ITER Single-Null and Double-Null Operation / *J. D. Galambos, Y-K. M. Peng, L. J. Perkins*
- 1469** Three-Dimensional Neutronics Analysis for the U.S. Magnet Shield of ITER / *M. E. Sawan, L. A. El-Guebaly*
- 1475** Overview of the US-ITER Magnet Shield: Concept and Problems / *Laila A. El-Guebaly*
- 1481** LOFA Analysis for US ITER Solid Breeder Blanket / *A. Y. Ying, A. R. Raffray, M. A. Abdou*

(Continued)

CONTENTS / MAY 1991–VOL. 19, NO. 3

PARTS 2A and 2B

(Continued)

- 1487** First Wall and Divertor Performance and Lifetime Analysis for the U.S. ITER Design / *Richard F. Mattas*
- 1493** ITER Physics Design Guidelines / *N. A. Uckan, The ITER Physics Group*
- 1499** ITER Confinement Capability / *N. A. Uckan, J. T. Hogan*
- 1504** ITER Global Stability Limits / *J. T. Hogan, N. A. Uckan*
- 1509** ITER Helium Ash Accumulation / *J. T. Hogan, D. L. Hillis, J. D. Galambos, N. A. Uckan, K. H. Dippel, K. H. Finken, R. A. Hulse, R. V. Budny*
- 1513** Three-Dimensional Neutronics Analysis of the U.S. Blanket Design for ITER / *M. E. Sawan, Y. Gohar, H. Attaya*
- 1519** Study of Effective Solid-to-Solid Contact Thermal Resistance and Its Application to Solid Breeder Blanket Design for ITER / *Z. R. Gorbis, A. R. Raffray, M. A. Abdou*
- 1525** Rate-Controlling Tritium Transport Mechanisms in Solid Breeders / *A. R. Raffray, Z. R. Gorbis, M. A. Abdou*
- 1532** Tritium Analysis for the US-ITER Solid Breeder Blanket / *A. Badawi, A. R. Raffray, A. Ying, M. A. Abdou*
- 1538** U.S. Solid Breeder Blanket Design for ITER / *Y. Gohar, H. Attaya, M. Billone, C. Lin, C. Johnson, S. Majumdar, D. Smith, P. Goranson, B. Nelson, D. Williamson, C. Baker, A. Raffray, A. Badawi, Z. Gorbis, A. Ying, M. Abdou, I. Sviatoslavsky, J. Blanchard, E. Mogahed, M. Sawan, G. Kulcinski*
- 1546** Thermal Analysis of the Blanket and Shield for the U.S. ITER Design / *E. A. Mogahed, I. N. Sviatoslavsky*
- 1552** Mechanical Design and Fabrication of the U.S. Solid Breeder Blanket for ITER / *I. N. Sviatoslavsky, J. P. Blanchard, Y. Gohar, S. Majumdar*
- 1558** ITER Torus Vacuum Pumping Equipment Remote Handling Issues / *J. Stringer*
- 1563** Investigation of an ITER Advanced Technology Phase / *S. J. Brereton, L. J. Perkins*

MATERIALS AND TRITIUM

- 1571** Some Implications of Radiation-Induced Property Changes in Austenitic Stainless Steels on ITER First-Wall Design and Performance / *P. J. Maziasz, A. F. Rowcliffe, M. L. Grossbeck, G. E. C. Bell, E. E. Bloom, D. C. Lousteau, A. Hishinuma, T. Kondo, R. F. Mattas, D. L. Smith*
- 1580** Swelling Dependence of Neutron-Irradiated Vanadium Alloys on Temperature, Neutron Fluence, and Thermomechanical Treatment / *B. A. Loomis, D. L. Smith*
- 1585** The Effects of Neutron Irradiation on the Trapping of Tritium in Graphite / *R. A. Causey, K. L. Wilson, W. R. Wampler, B. L. Doyle*

(Continued)

CONTENTS / MAY 1991–VOL. 19, NO. 3

PARTS 2A and 2B

(Continued)

- 1589** Conceptual Design Description for the Tritium Recovery System for the U.S. ITER Li₂O/Be Water Cooled Blanket / *P. A. Finn, D. K. Sze, R. G. Clemmer*
- 1595** Development of the JAERI Fuel Cleanup System for Tests at the Tritium Systems Test Assembly / *S. Konishi, M. Inoue, T. Hayashi, K. Okuno, Y. Naruse, J. W. Barnes, J. L. Anderson*
- 1601** Possible Design Modifications of ITER Fuel Cycle / *D. K. Sze, P. A. Finn, J. Anderson, J. Bartlit, R. Sherman*
- 1607** Permeation Behavior of Deuterium Implanted into 304 SS / *K. Okuno, S. Ohira, Y. Naruse, K. Yamanaka, M. Misumi*
- 1612** FLIBE Chemistry Studies / *R. G. Clemmer, D. K. Sze, P. E. Blackburn, E. VanDeventer, V. A. Maroni*
- 1619** Stress Corrosion Cracking of Candidate Structural Materials in Simulated First-Wall/Aqueous Coolant Environments / *M. R. Fox, A. B. Hull, T. F. Kassner*
- 1629** Tritium System Design Considerations for a Basic Fusion Ignition Experiment / *R. Carrera, W. D. Booth, J. L. Anderson, T. Bauer, D. Coffin, T. A. Parish*
- 1634** Tritium Fill Station to Charge Microballoons for Fusion Experiments / *R. S. Matsugu, L. Borowski, J. C. Lehman, P. Ladd*
- 1640** BEATRIX-II: In-Situ Tritium Test Operation / *D. E. Baker, T. Kurasawa, J. M. Miller, O. D. Slagle*
- 1646** Separation of Hydrogen Isotopes by an Advanced Thermal Diffusion Column Using Cryogenic-Wall / *J. Mitsui, Y. Okada, F. Sakai, T. Ide, I. Yamamoto, A. Kanagawa, K. Hirata, T. Yamanishi, K. Okuno, Y. Naruse*
- 1651** Application Study of Laser Raman Spectroscopy to In Situ Gas Analysis for Fusion Fuel Processing Systems / *T. Uda, K. Okuno, S. O'Hira, Y. Naruse*
- 1657** ITER Fuel Storage System Conceptual Design Description / *J. E. Nasise, M. E. Muller, J. L. Anderson, J. R. Bartlit*
- 1663** Development of Large Oil-Free Roughing Pump for Tritium Service / *T. Hayashi, S. Konishi, M. Yamada, Y. Matsuda, M. Inoue, T. Nakamura, T. Takanaga, Y. Naruse, K. Okuyama*
- 1668** Tritium Experiments on Components for Fusion Fuel Processing at the Tritium Systems Test Assembly / *S. Konishi, H. Yoshida, Y. Naruse, R. V. Carlson, K. E. Binning, J. R. Bartlit, J. L. Anderson*
- 1674** ARIES-I Tritium System / *D. K. Sze, S. W. Tam, M. C. Billone, A. M. Hasanein, R. Martin*
- 1680** Tritium Inventory Modeling of Potential Tokamak Reactor System Operational Scenarios / *Thomas W. Eichenberg, Andrew C. Klein*
- 1686** Zirconium Cobalt for Tritium Storage: Some Bed Design and Operation Considerations / *A. G. Heics, W. T. Shmayda, N. P. Kherani*

(Continued)

CONTENTS / MAY 1991 –VOL. 19, NO. 3

PARTS 2A and 2B

(Continued)

- 1692** The Corrosion Behavior of Fe-Ni-Cr Alloys in Liquid Lithium / *Jiming Chen, Jiaju Qian*
- 1696** Lithium Mass Transport in Ceramic Breeder Materials / *P. E. Blackburn, C. E. Johnson*
- 1701** SiC/SiC Composites for Fusion Applications: Opportunities and Issues—1990 / *G. W. Hollenberg, R. H. Jones, G. E. Lucas*
- 1707** Tritium and Helium Behavior in Irradiated Beryllium / *M. C. Billone, C. C. Lin, D. L. Baldwin*

IMPURITY CONTROL AND PLASMA-FACING COMPONENTS

- 1717** Studies of Runaway Electron Damage on Plasma Facing Components / *K. A. Niemer, J. G. Gilligan, C. D. Croessmann, A. C. England, D. L. Hillis*
- 1724** Thermal Sweeping Analysis for Divertor Plate Materials / *A. Hassanein*
- 1729** Thermal-Hydraulic Design Issues and Analysis for the ITER Divertor / *J. A. Koski, R. D. Watson, A. M. Hassanein, P. L. Goranson, J. C. Salmonson*
- 1736** The Effect of Sputtering on Stress Distributions in Plasma-Facing Components / *James P. Blanchard, Richard F. Mattas*
- 1740** Tritium Retention and Release at the First Wall of a Fusion Ignition Experiment / *C. A. Ordonez, W. D. Booth, R. Carrera, M. E. Oakes*
- 1745** Thermomechanical Stress Analysis of the Vessel Coating of an Ignition Experiment / *G. Rodin, Y. L. Hwang, R. Carrera, R. Mohanti, C. A. Ordonez*
- 1750** Effects of the Surface Floating Potential on Sputtering, Backscattering, and Implantation by Fusion Plasma Ions / *C. A. Ordonez, W. D. Booth, R. Carrera, M. E. Oakes*
- 1755** Operation, Description, and Simulation of an In-Vessel Remote Maintenance System for a Fusion Ignition Device / *J. Q. Ling, R. Carrera*
- 1761** The TFTR Bumper Limiter Performance Enhancements / *G. W. Barnes, A. Janos, D. Loesser, D. K. Owens, M. Ulrickson*
- 1765** Analysis of Thin Film Liquid Metal Protection of Fusion Reactor Limiter/Divertor Surfaces / *Neil B. Morley, Mark S. Tillack, Mohamed A. Abdou*
- 1772** Copper Infiltrated Graphite for Improved Brazed Joints / *Joseph K. Weeks, Nathalie Chevreau*
- 1778** Comparison Between Pump Limiter Performance and Modelling Predictions on Tore Supra / *R. Maingi, J. Gilligan, O. Hankins, L. Owen, P. Mioduszewski, T. Uckan*
- 1783** Erosion of a Smooth First-Wall System for a Compact Fusion Ignition Experiment / *C. A. Ordonez, R. Mohanti, W. D. Booth, R. Carrera, M. E. Oakes*

(Continued)

CONTENTS / MAY 1991–VOL. 19, NO. 3

PARTS 2A and 2B

(Continued)

- 1789** Erosion and Redeposition of Divertor and Wall Materials During Abnormal Events / *A. Hassanein*
- 1794** Development and Testing of the ITER Divertor Monoblock Braze Design / *R. D. Watson, F. M. Hosking, M. F. Smith, C. D. Croessmann*
- 1799** Evidences of Hydrogen Trapping in Tungsten and Implications for Plasma-Facing Components / *G. R. Longhurst, R. A. Anderl, D. F. Holland*
- 1806** 2-D Heat Load Distribution on the TFTR Bumper Limiter During High-Power Neutral Beam Injection / *A. C. Janos, M. Corneliusen, D. K. Owens, M. Ulrickson*
- 1811** Continued Studies of Co-Pumping of Deuterium and Helium on a Single, 4K Activated Charcoal Panel / *C. R. Walther, E. M. Jenkins, T. H. Batzer, D. W. Sedgley, S. Konishi, S. O'Hira, Y. Naruse*
- 1814** Physical Sputtering, Blistering and Flaking Effect on Plasma-Facing Materials / *J. P. Qian, Z. Y. Xu, X. Liu, Z. X. Xiao, J. B. Cheng, C. J. Pan, L. H. Sun*
- 1819** Surface Segregation in Trinary Alloy Al-Li-Mg / *J. P. Qian, X. Liu*
- 1823** Conceptual Design of an In-Vessel Remote Maintenance System for Basic Fusion Experimental Device / *J. Q. Ling, W. D. Booth, R. Carrera, D. Tesar*

NEUTRONICS

- 1831** Activation Products Effluents Evaluation for ITER / *Y. Seki, H. Noguchi, K. Maki, H. Iida, S. J. Piet*
- 1837** US-ITER Activation Analysis / *H. Attaya, Y. Gohar, D. Smith*
- 1843** Analysis for the Simulation of a Line Source by a 14 MeV Moving Point Source and Impact on Blanket Characteristics: The USDOE/JAERI Collaborative Program on Fusion Neutronics / *M. Z. Youssef, Y. Watanabe, A. Kumar, Y. Oyama, K. Kosako*
- 1853** Three-Dimensional Monte Carlo Calculations of Nuclear Heating in CIT and Comparisons with Results from Simpler Models / *S. L. Liew, L. P. Ku*
- 1859** Experiments and Analysis for Measurements of Decay Heat Related Induced Activities in Simulated Line Source Driven D-T Neutron Fields of Phase IIIA: USDOE/JAERI Collaborative Program on Fusion Neutronics / *A. Kumar, M. Z. Youssef, Y. Ikeda, C. Konno, Y. Oyama*
- 1867** Gamma Heating Measurements in a Mixed Radiation Field / *H. K. Chiu, E. F. Bennett, B. J. Micklich*
- 1873** A Line D-T Neutron Source Facility for Annular Blanket Experiment: Phase III of the JAERI/USDOE Collaborative Program on Fusion Neutronics / *T. Nakamura, Y. Oyama, Y. Ikeda, C. Konno, H. Maekawa, K. Kosako, M. Z. Youssef, M. A. Abdou*
- 1879** Annular Blanket Experiment Using a Line DT Neutron Source: Phase IIIA of the JAERI/USDOE Collaborative Program on Fusion Neutronics / *Y. Oyama, C. Konno, Y. Ikeda, H. Maekawa, K. Kosako, T. Nakamura, A. Kumar, M. Youssef, M. Abdou, E. Bennett*

(Continued)

CONTENTS / MAY 1991–VOL. 19, NO. 3

PARTS 2A and 2B

(Continued)

- 1885** Measurements of the Source Term for Annular Blanket Experiment with a Line Source: Phase IIIA of JAERI/USDOE Collaborative Program on Fusion Neutronics / *C. Konno, Y. Oyama, Y. Ikeda, K. Kosako, H. Maekawa, T. Nakamura, A. Kumar, M. Z. Youssef, M. A. Abdou, E. F. Bennett*
- 1891** Analysis for Heterogeneous Blankets and Comparison to Measurements: Phase IIC Experiments of the USDOE/JAERI Collaborative Program on Fusion Neutronics / *M. Z. Youssef, A. Kumar, M. Abdou, M. Nakagawa, K. Kosako, Y. Oyama, T. Nakamura*
- 1903** Breeding Rate Measurements in Solid Fusion Blankets with Metallic Lithium Samples / *K. G. Porges, M. M. Bretscher*
- 1909** Analysis of Induced Activities Measurements Related to Decay Heat in Phase IIC Experimental Assembly: USDOE/JAERI Collaborative Program on Fusion Neutronics Experiments / *A. Kumar, M. A. Abdou, Y. Ikeda, T. Nakamura*
- 1919** Experiments of Neutron Multiplication in Beryllium / *Yuan Chen, Gang Chen, Rong Liu, Haiping Guo, Wenjiang Chen, Wenmian Jiang, Jian Shen*
- 1925** Neutron Multiplication in Bulk Beryllium / *J. Richard Smith, John J. King*
- 1931** Activation and Decommissioning Considerations for the Fusion Ignition Experiment IGNITEX / *D. E. Palmrose, T. A. Parish, R. Carrera, Y. Watanabe*
- 1938** Evaluation of Radiation Streaming Effects in a Single-Turn Ignition Tokamak / *Y. Watanabe, T. A. Parish, B. Shofolu, W. D. Booth, R. Carrera, N. E. Hertel*
- 1944** Diagnostic System for the Deuterium-Tritium Phase of the IGNITEX Experiment / *W. D. Booth, R. Carrera, T. Elevant, T. A. Parish, B. Wehring*
- 1949** Benchmark Experiment and Analysis of a Beryllium Cylindrical Assembly / *H. Maekawa, S. Yamaguchi, C. Konno, Y. Oyama, Y. Ikeda, K. Sekiyama, K. Kosako*
- 1955** Measured Characteristics of Be Multi-Layered and Coolant Channel Blankets: Phase IIC Experiments of the JAERI/USDOE Collaborative Program on Fusion Neutronics / *Y. Oyama, S. Yamaguchi, K. Tsuda, C. Konno, Y. Ikeda, H. Maekawa, T. Nakamura, K. Porges, E. Bennett*
- 1961** Experiment on Induced Activities and Decay-Heat in Simulated D-T Neutron Fields: JAERI/USDOE Collaborative Program on Fusion Neutronics / *Y. Ikeda, C. Konno, T. Nakamura, A. Kumar, M. A. Abdou*
- 1967** Study on the Accuracy of Several Beryllium Evaluations and Comparison of Measured and Calculated Data on Reaction Rates and Tritium Production Distributions / *M. Z. Youssef, Y. Watanabe*
- 1974** Analysis of Neutron Streaming Through a Tungsten-Based, ITER-Like Fusion Reactor Shield / *G. L. Varsamis, D. Steiner, M. J. Embrechts*
- 1979** Experimental Measurements and Analysis of Nuclear Heat Deposition Rates in Simulated D-T Neutron Environment: JAERI/USDOE Collaborative Program on Fusion Neutronics Experiments / *A. Kumar, Y. Ikeda, C. Konno*

(Continued)

CONTENTS / MAY 1991–VOL. 19, NO. 3

PARTS 2A and 2B

(Continued)

- 1989** Measurements of TFTR Radiation Shielding During High Power D-D Operations / *H. W. Kugel, C. W. Barnes, J. Gilbert, J. Greco, K. W. Hill, D. L. Jassby, L. C. Johnson, L. P. Ku, J. Levine, R. W. Motley, J. D. Strachan*
- 1996** First and Second Collision Source for Mitigating Ray Effects in Discrete Ordinates Calculations / *L. M. Gomes, P. N. Stevens*
- 2001** Generalized Albedo Option in the Morse Monte Carlo Code / *I. C. Gomes, P. N. Stevens*
- 2007** Calculation of the INEL Beryllium Multiplication Experiment / *J. W. Davidson, M. E. Battat*

DEPARTMENT

- 2016** Author Index