

# Fusion Science and Technology

CONTENTS / AUGUST 2011—VOL. 60, NO. 2

Proceedings of the  
**NINETEENTH TOPICAL MEETING  
ON THE TECHNOLOGY OF FUSION ENERGY (TOFE)  
(Part 2)**

**Las Vegas, Nevada, November 7–11, 2010**

**Guest Editors: Farrokh Najmabadi, Mark Tillack, Lane Carlson**

- vii Preface: Nineteenth Topical Meeting on the Technology of Fusion Energy /  
*Farrokh Najmabadi*

**POWER PLANT, DEMO, and FNSF**

- 433** Strategic Plans for the Fusion DEMO Program of Korea / *Hyuck Jong Kim, Hyung Chan Kim, Chul-Sik Lee, Myeun Kwon, Gyoung-Su Lee*
- 441** Fusion Nuclear Science Facility (FNSF) Before Upgrade to Component Test Facility (CTF) / *Y. K. M. Peng et al.*
- 449** Fusion Nuclear Science Facility—Advanced Tokamak Option / *C. P. C. Wong, V. S. Chan, A. M. Garofalo, J. A. Leuer, M. E. Sawan, J. P. Smith, R. D. Stambaugh*
- 454** Development of an Extreme Environment Materials Research Facility at Princeton / *A. B. Cohen et al.*
- 459** Development of a Visualization Tool for the ARIES Systems Code / *Lane Carlson, Mark Tillack, Farrokh Najmabadi, Charles Kessel*
- 464** FRC Based Fusion Neutron Source for Materials Evaluation / *John Slough*

**PLASMA ENGINEERING—FUELING and DIAGNOSTICS**

- 473** A Technique for Producing Large Dual-Layer Pellets in Support of Disruption Mitigation Experiments / *S. K. Combs, J. W. Leachman, S. J. Meitner, L. R. Baylor, C. R. Foust, N. Commaux, T. C. Jernigan*
- 480** Modeling of an Ablation-Free Electrothermal Plasma Pellet Accelerator / *A. Leigh Winfrey, Mohamed Abd Al-Halim, John G. Gilligan, Alexei V. Saveliev, Mohamed A. Bourham*
- 486** Visco-Plastic Flow Predictions of Solidified Deuterium-Tritium Mixtures / *J. W. Leachman*

(Continued)

# CONTENTS / AUGUST 2011—VOL. 60, NO. 2

(Continued)

- 491** Development of PC-Based Control System in JT-60SA / *Y. Kawamata et al.*
- 496** Architecture Plan of the Real-Time Diagnostic Signals Acquisition System Toward JT-60SA Project / *Shinya Sakata et al.*
- 501** Development of a Compact Diagnostic System for Monitoring Hard X-Rays / *Y. S. Lee, U. W. Nam, A. C. England, Z. Y. Chen, J. W. Yoo, W. C. Kim, Y. K. Oh*
- 506** Velocity Profile Measurement of Lead-Lithium Flows by High-Temperature Ultrasonic Doppler Velocimetry / *Y. Ueki, M. Hirabayashi, T. Kunugi, K. Nagai, J. Saito, K. Ara, N. B. Morley*

## BLANKET DESIGN AND EXPERIMENTS

- 513** 3D Numerical Study of MHD Flow in a Rectangular Duct with a Flow Channel Insert / *Damien Sutevski, Sergey Smolentsev, Neil Morley, Mohamed Abdou*
- 518** Stability Analysis for Buoyancy-Opposed Flows in Poloidal Ducts of the DCLL Blanket / *N. Vetcha, S. Smolentsev, M. Abdou*
- 523** Feasibility Study of Flibe Blanket with Cs / *Hidetoshi Hashizume, Noritaka Yusa, Kentaro Matsui*
- 528** Heat Transfer Experiments Using a High Prandtl Number Fluid Flowing in Sphere-Packed Channels for Flibe Blanket Design / *Katsuya Shimizu, Shinji Ebara, Hidetoshi Hashizume*
- 533** Impact of Neutronics on the Determination of a Radial Build of Tokamak Reactor Systems / *B. G. Hong, J. H. Seo*
- 538** Evaluation of the Electroforming Technique for IFMIF-EVEDA Beam Dump Manufacturing / *F. Arranz et al.*
- 544** Experimental Study of First Wall Cooling with Gas Loop in the Development of a Korean Test Blanket Module / *Jun Soo Lee, Dong Won Lee, Goon Cherl Park*
- 549** Design Study of Remote Handling System for Lower Divertor Cassettes in JT-60SA / *Takao Hayashi, Shinji Sakurai, Kiyoshi Shibanuma, Akira Sakasai*
- 554** Mock-up Divertor of KTM Tokamak on the Basis of Lithium CPS / *I. Tazhibayeva, I. Lyublinski, A. Vertkov, V. Lazarev, E. Azizov, G. Mazzitelli, P. Agostini*
- 558** Design of Tritium Collecting System from LiPb and LiPb Dropping Experiment / *Yasushi Yamamoto, Mai Ichinose, Fumito Okino, Kazuyuki Noborio, Satoshi Konishi*

## IFE DESIGN & TECHNOLOGY

- 565** Materials Research for HiPER Laser Fusion Facilities: Chamber Wall, Structural Material and Final Optics / *J. Alvarez, A. Rivera, R. Gonzalez-Arrabal, D. Garoz, E. del Rio, J. M. Perlado*
- 570** Three-Dimensional ‘Textured’ Coatings as First-Wall Materials: Exposure to Energetic Ions on RHEPP-1 / *T. J. Renk, B. Williams, L. El-Guebaly, A. Jaber*

(Continued)

# CONTENTS / AUGUST 2011—VOL. 60, NO. 2

(Continued)

- 579** Waste Management Assessment of Candidate Materials for HiPER Reaction Chamber / *J. Sanz, R. Juárez, F. Ognissanto, J. M. Perlado*
- 585** Investigation of Condensed Liquid Film Flow on Chamber Ceiling of Laser-Fusion Reactor / *Kunihiro Yamamoto, Zensaku Kawara, Tomoaki Kunugi, Takayoshi Norimatsu*
- 590** Nanoscale View of Shock Wave Propagation in Single Crystal Fe, W, and Ta for Nuclear Fusion Technology / *Santiago Cuesta-Lopez, J. M. Perlado*
- 595** Planning Tools for Estimating Radiation Exposure at the National Ignition Facility / *J. Verbeke et al.*
- 600** Benchmarks for Verification of HEDP/IFE Codes / *Ryan G. McClaren, Daniel Holladay*

## ALTERNATE CONCEPTS & MAGNETS

- 607** New Insight into Gridded Inertial Electrostatic Confinement (IEC) Fusion Devices / *G. L. Kulcinski et al.*
- 615** D-Cluster Converter Foil for Laser-Accelerated Deuteron Beams: Towards Deuteron-Beam-Driven Fast Ignition / *Xiaoling Yang et al.*
- 620** Driven Subcritical Assembly Using a Cylindrical Inertial Electrostatic Confinement (IEC) Neutron Source / *G. H. Miley, B. Ulmen, L. Wu, H. Momota, H. Hora, P. J. Shrestha*
- 625** Numerical Study of Ion Recirculation in an Improved Spherical Inertial Electrostatic Confinement Fusion Scheme by Use of a Multistage High Voltage Feedthrough / *Kai Masuda, Yu Yamagaki, Taiju Kajiwara, John Kipritidis*
- 630** A Verification Scenario of Ion-Heating Enhancement due to Nuclear Plus Interference Scattering / *Hideaki Matsuura, Osamu Mitarai, Makoto Nakamura, Yasuyuki Nakao*
- 635** Status of High Temperature Superconducting Fusion Magnet Development / *L. Bromberg, H. Hashizume, S. Ito, J. V. Minervini, N. Yanagi*
- 643** Stellarator Configuration Improvement Using High Temperature Superconducting Monoliths / *L. Bromberg, M. Zarnstorff, O. Meneghini, T. Brown, P. Heitzenroeder, G. H. Neilson, J. V. Minervini, A. Boozer*
- 648** Design Progress on the High-Temperature Superconducting Coil Option for the Heliotron-Type Fusion Energy Reactor FFHR / *Nagato Yanagi, Toshiyuki Mito, Romain Champailleur, Gourab Bansal, Hitoshi Tamura, Akio Sagara*
- 653** Integration of the ITER in Vessel Coil System / *A. Martin, E. Daly*
- 658** Analysis of NSTX Upgrade OH Magnet and Center Stack / *A. Zolfaghari, P. Titus, J. Chrzanowski, A. Salehzadeh, F. Dahlgren*
- 664** Thermal, Electromagnetic and Structural Analysis of NSTX TF Coil / *H. Zhang, M. Smith, P. Titus, P. Rogoff, A. Zolfaghari, D. Mangra*

(Continued)

# CONTENTS / AUGUST 2011—VOL. 60, NO. 2

(Continued)

## NUCLEAR ANALYSIS & EXPERIMENTS

- 671** Neutronics Analysis in Support of the Fusion Development Facility Design Evolution / *M. E. Sawan, A. M. Ibrahim, P. P. H. Wilson, E. P. Marriott, R. D. Stambaugh, C. P. C. Wong*
- 676** Global Evaluation of Prompt Dose Rates in ITER Using Hybrid Monte Carlo/Deterministic Techniques / *A. M. Ibrahim, M. E. Sawan, S. W. Mosher, T. M. Evans, D. E. Peplow, P. P. Wilson, J. C. Wagner*
- 681** Measurement of Reaction Rates in Li/V-Alloy Assembly with 14 MeV Neutron Irradiation / *T. Tanaka et al.*
- 687** Measurements of Activation and Decay Heat Produced in Materials Irradiated with D-T Neutron and Comparison with EASY-2007 Code Predictions / *Mario Pillon, Maurizio Angelone, Sandro Sandri*
- 692** Adjoint-Based Uncertainty Analysis for Essential Reactions in a Laser Inertial Fusion Engine / *Jeffrey E. Seifried, Massimiliano Fratoni, Kevin J. Kramer, Jeffrey F. Latkowski, Per F. Peterson, Jeffrey J. Powers, Janine M. Taylor*
- 698** Investigation of Observed Peaking in Nuclear Parameters at Steel/Water Interfaces / *T. D. Bohm, M. E. Sawan, B. Smith, P. P. H. Wilson*
- 703** Assessment of the Surface Source Approach in 3-D Fusion Neutronics Analysis / *T. D. Bohm, B. Smith, M. E. Sawan, P. P. H. Wilson*
- 708** Neutronic Analyses for the Upper Ports in the Neutral Beam Cell of ITER / *A. Serikov, U. Fischer, D. Grosse, M. J. Loughlin, M. Majerle, S. Schreck, P. Spaeh, D. Strauss*
- 715** Activation and Radiation Damage Characteristics of W-Based Divertor of ARIES Power Plants / *A. Robinson, L. El-Guebaly, D. Henderson*
- 720** Rigorous Evaluation of Biological Dose for Fusion Systems and Comparison with Approximate Contact Dose Approach / *A. Robinson, L. El-Guebaly, D. Henderson*
- 725** Neutronics Studies for a Compact, High-Field Tokamak Neutron Source / *Zachary S. Hartwig, Massimo Zucchetti*
- 730** Neutronics Analysis of the Divertor Interferometer Diagnostics Inside the Lower Port #8 Plug of ITER with ATTILA 3-D CAD-Based FEM Code / *Mahmoud Z. Youssef, Russell Feder, Mohamed Dagher, Aaron Aoyama, Michael Duco*
- 738** Activation Analysis for a He/LiPb Dual Coolant Blanket for DEMO Reactor / *J. P. Catalán, F. Ogando, J. Sanz*
- 743** Exploration of Clearance Strategy for an Advanced-Fuel Fusion Experimental Device / *Massimo Zucchetti*

## SAFETY & ENVIRONMENT

- 751** Challenges of Fusion Power Plant Licensing: Differences and Commonalities with Existing Systems / *L. El-Guebaly, L. Cadwallader, W. Sowder, ARIES Team*
- 760** Post-Shot Radiation Environment Following Low-Yield Shots Inside the National Ignition Facility / *S. Sitaraman et al.*

(Continued)

# CONTENTS / AUGUST 2011—VOL. 60, NO. 2

(Continued)

- 765** Radioactive Safety Estimates for ITER TBM Systems / *M. Zucchetti, L. Guerrini, Y. Poitevin, I. Ricapito, M. Zmitko*
- 771** Successive Volume Reduction of Hydrogen-Isotopic Gaseous Waste by Pressure Swing Adsorption Using SZ-13X Column / *K. Kotoh, M. Tanaka, T. Tsuge, S. Moriyama, S. Takashima, Y. Asakura, T. Uda, T. Sugiyama*
- 776** Personnel Dose Assessment at the PRIMA Neutral Beam Test Facility / *S. Sandri, A. Coniglio, A. Daniele, M. D'Arienzo, L. Di Pace, M. Pillon*
- 781** Classification of ITER Tokamak Cooling Water System in Accordance with French Regulations Concerning Pressure and Nuclear Pressure Equipment / *Fan Li, Vladimir Barabash, Warren Curd, Giovanni Dell'Orco, Babulal Gopalapillai, Keun-Pack Chang, Steve Ployhar, Fabio Somboli*
- 786** Safety Analyses for CANDOR, an Advanced-Fuel Fusion Device / *Massimo Zucchetti*

## COMPUTATIONAL TOOLS, MODELING & VALIDATION

- 793** Improved Inertial Fusion Energy Direct-Drive Target Survival in Chamber Gas Through Validated Simulation / *Robert Martin, Farrokh Najmabadi*
- 798** Development of a Numerical Tool to Simulate Magnetohydrodynamic Interactions of Liquid Metals with Strong Applied Magnetic Fields / *Chiara Mistrangelo, Leo Bühler*
- 804** Aerosol Formation and Hydrogen Co-Deposition by Colliding Ablation Plasma Plumes of Carbon / *Y. Hirooka, T. Oishi, H. Sato, K. A. Tanaka*
- 809** Tritium Transport in Poloidal Flows of a DCLL Blanket / *M. J. Pattison, S. Smolentsev, R. Munipalli, M. A. Abdou*
- 814** Modeling Tritium Transport in PbLi Breeder Blankets Under Steady State / *H. Zhang, A. Ying, M. Abdou, B. Merrill*
- 819** A New Simulation Framework Based on the Kepler and Scicos Open-Source Software for the Design and Qualification of Tokamak Control Algorithms: First Test Case Results / *Oliviero Barana, Cédric Boulbe, Sylvain Brémond, Simone Mannori, Philippe Moreau, Nathalie Ravenel, EFDA ITM Task Force contributors*
- 825** Upgrading of Plasma Wall Interaction Model for Tokamak Transient Modeling Code AINA 2.0, Used in Safety Studies of ITER Plasma Instability Events / *Jose-Carlos Rivas, Javier Dies*
- 830** Development of A-LITE Model for Use in ATTILA Radiation Transport Finite Element Analysis of the ITER Lower Divertor Region / *Aaron T. Aoyama, Mohamad Dagher, Russell Feder, Michael Duco, Mahmoud Youssef*
- 835** Application of PACTITER v3.3 Code to the ACPs Assessment of ITER Neutral Beam Injectors Primary Heat Transfer System / *Luigi Di Pace, Dario Carloni, Lorenzo Perna, Sandro Paci*
- 840** Experimental Investigation on Anisotropic Effective Thermal Conductivity of Pebble Bed / *Takehiko Yokomine*

**845 INDEXES**