

American Nuclear Society

# International Congress on Advances in Nuclear Power Plants

ICAPP 2008

June 8-12, 2008  
Anaheim, California, USA

Volume 1 of 4

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571  
[www.proceedings.com](http://www.proceedings.com)

ISBN: 978-1-60560-787-0

Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2008) by the American Nuclear Society.  
All rights reserved.

For permission requests, please contact the American Nuclear Society  
at the address below.

American Nuclear Society  
555 North Kensington Avenue  
LaGrange Park, Illinois 60526

# TABLE OF CONTENTS

## VOLUME 1

### **Track 1.00: Water-Cooled Reactor Programs and Issues**

|  |     |
|--|-----|
| <b>IRIS: A Comprehensive Approach to Nuclear Power in Smaller Size and Developing Countries.....</b>   | 1   |
| <i>M.D. Carelli, B. Petrovic, L. Sandell, G.D. Storrick</i>  |     |
| <b>Justification and Manufacturing Quality Assurance for the Use of Hot Isostatically Pressed, Reactor Coolant System Components in PWR PLANT .....</b>                        | 8   |
| <i>J.L. Sulley, I.D. Hookham</i>   |     |
| <b>EPR : High Load Variation Performances with the "Tmode" Core Control.....</b>   | 21  |
| <i>Alain Grossetete</i>  |     |
| <b>An Integrated PWR for Marine Propulsion .....</b>   | 26  |
| <i>A. Letouze, A. Marecaux, J. Rollason, S. Heap, A. Foster, S. Jewer, A.C. Thompson, A.M. Williams, P.A. Beeley</i>   |     |
| <b>European Passive Plant (AP1000 - Europe) Design Status.....</b>   | 30  |
| <i>Kathyn J. Demetri, Gianfranco Saini</i>   |     |
| <b>The Safety Concept of the SWR 1000 with Active and Passive Safety Systems .....</b>   | 39  |
| <i>Doris Pasler</i>  |     |
| <b>SWR 1000: Efficient Design for Operational Excellence .....</b>   | 46  |
| <i>Werner Brettschuh</i>   |     |
| <b>ESBWR Power Maneuvering Via Feedwater Temperature Control .....</b>   | 53  |
| <i>Pradip Saha, Wayne Marquino, Larry J. Tucker</i>  |     |
| <b>Role of Human Factors in System Safety .....</b>  | 62  |
| <i>Denise Brooks, Curt Robert, Thomas Graham</i>   |     |
| <b>Coupled Regional Stability Analysis of Natural Circulation BWRs.....</b>  | 76  |
| <i>Rui Hu, Mujid S. Kazimi</i>   |     |
| <b>SWR 1000 Integral and Full Scale Tests of the Passive Safety Systems .....</b>  | 87  |
| <i>Stephan Leyer, Michael Wich, Heinrich Schäfer</i>   |     |
| <b>Optimization Planning for the Construction of the U.S. EPR.....</b>   | 93  |
| <i>Michael K. Phillips</i>   |     |
| <b>Experimental Investigation of Non-Condensable Gases Effect on Operation of VVER Steam Generator in Condensation Mode .....</b>  | 102 |
| <i>Alexander D. Efanov, Sergey G. Kalyakin, Andrey V. Morozov, Oleg V. Remizov, Alexander A. Tsyganok, Vladimir N. Generalov, Viktor M. Berkovich, Gennady S. Taranov</i>      |     |
| <b>European Research on Issues Concerning Hydrogen Behaviour in Containment within the SARNET Network of Excellence.....</b>   | 110 |
| <i>Heinz Wilkening, Ivo Kljenak, Walter Ambrosini, Ahmed Bentaib, Laure Blumenfeld, Frederic Dabbene, Jeanne Malet, Ernst-Arndt Reinecke, Eveliina Takasuo, John R. Travis</i> |     |
| <b>Economic Advantage of the Korean Nuclear Plants By Shortening the Construction Schedule .....</b>   | 120 |
| <i>Kee Cheol Park, Dong Soo Ryu</i>  |     |
| <b>Study on High Conversion Type Core of Innovative Water Reactor for Flexible Fuel Cycle (FLWR) for Minor Actinide (MA) Recycling .....</b>                                   | 127 |
| <i>Y. Fukaya, Y. Nakano, T. Okubo</i>  |     |

|   |     |
|---|-----|
| <b>A Review of Dopants Used to Increase UO<sub>2</sub> Burnup Capabilities by Grain Size Modification.....</b>  | 136 |
| <i>Brett Dooies, Samim Anghaie</i>  |     |
| <b>A Comparative Evaluation of Pressurizer Surge Line Thermal Loads .....</b>   | 145 |
| <i>T. Pournaras, T. Wiley, J. Smouse, R. Brice-Nash, S.A. Swamy</i>   |     |
| <br><b>Track 2.00: High Temperature Gas Cooled Reactors</b>   |     |
| <b>Why HTR/VHTR? A European Point of View.....</b>  | 152 |
| <i>V. Basini, E. Bogusch, E. Breuil, D. Buckthorpe, V. Chauvet, M. Fütterer, A. van Heek, D. Hittner, W. von Lensa, J. Pirson, D. Verrier</i>   |     |
| <b>Design, Analysis and Development of the Modular PB-AHTR.....</b>   | 161 |
| <i>Philippe Bardet, Edward Blandford, Massimiliano Fratoni, Aurelie Niquille, Ehud Greenspan, Per F. Peterson</i>   |     |
| <b>Using Helicoids to Eliminate "Hot Streaking" and Stratification in the Very High Temperature Reactor Lower Plenum.....</b>   | 179 |
| <i>Sal B. Rodriguez, Mohamed El-Genk</i>  |     |
| <b>Risk Minimization for Near-Term Deployment of the Next Generation Nuclear Plant .....</b>  | 188 |
| <i>Lew Lommers, Finis Southworth, Bernard Riou, Michel Lecomte</i>  |     |
| <b>Neutronic Performance of High Molecular Weight Coolants for a Prismatic VHTR .....</b>   | 198 |
| <i>Timothy M. Schriener, Mohamed El-Genk</i>  |     |
| <b>Gas Cooled Fast Reactor 2400 MWth, End of the Preliminary Viability Phase .....</b>  | 208 |
| <i>J.Y. Malo, N. Alpy, F. Bertrand, T. Cadiou, N. Chauvin, P. Dumaz, D. Haubensack, G. Geffraye, N. Jonquères, D. Lorenzo, F. Morin, L. Nicolas, Y. Penelieu, A. Ravenet, P. Richard, E. Studer</i> |     |
| <b>Studies of Unprotected Transients and Alternative Decay Heat Removal System for the Gas Cooled Fast Reactor (GFR) .....</b>  | 219 |
| <i>P. Dumaz, A. Epiney, N. Alpy, P. Broxtermann, J.Y. Malo, A. Tosello</i>  |     |
| <b>Preliminary Safety Analysis of the 2400 MWth Gas-Cooled Fast Reactor .....</b>   | 228 |
| <i>F. Bertrand, C. Bassi, F. Bentivoglio, A. Messié, A. Tosello, J.Y. Malo</i>  |     |
| <b>Power Conversion System (PCS) Evaluation for the Next Generation Nuclear Plant (NGNP).....</b>   | 238 |
| <i>Gregory A. Johnson</i>   |     |
| <b>Means, Methods and Performances of the AREVA's HTR Compact Controls .....</b>  | 254 |
| <i>J. Banchet, P. Guillermier, D. Tisseur, M.P. Vitali</i>  |     |
| <b>Developments and Economical Aspects in the Fabrication of HTR Fuel Elements .....</b>  | 260 |
| <i>Karl Froschauer, Georg Brähler, Werner Heit</i>  |     |
| <b>Development of a Fission Product Release Analysis Code COPA-FPREL .....</b>  | 265 |
| <i>Y.M. Kim, M.S. Cho, Y.W. Lee, W.J. Lee</i>   |     |
| <b>Review of the Material Properties of Pyrolytic Carbon Coating Layers in Relation to QC Measurements for HTR Coated Particle Fuels.....</b>   | 273 |
| <i>Young-Woo Lee, Young Min Kim, Woong Ki Kim, Won Ju Kim, Ji Yeon Park, Moon Sung Cho</i>  |     |
| <b>Alloy 617 for the High Temperature Diffusion-Bonded Compact Heat Exchangers .....</b>  | 282 |
| <i>Xiuling Li, David Kininmont, Renaud Le Pierres, Stephen John Dewson</i>  |     |
| <b>An Optimal Loading Principle of Burnable Poisons for an OTTO Refueling Scheme in Pebble Bed HTGR Cores.....</b>  | 289 |
| <i>Hoai Nam Tran, Yasuyoshi Kato</i>  |     |

|   |     |
|---|-----|
| <b>Out-of-Core Fuel Cycle Characteristics of VHTRs with No On-Site Refueling.....</b>                                       | 298 |
| <i>Pavel V. Tsvetkov, Ayodeji B. Alajo, Tom G. Lewis III, David E. Ames II</i>  |     |
| <b>Deployment of FBR/VHTR Systems for Japan's Future Energy Demands.....</b>  | 303 |
| <i>Matt Richards, Kazuhiko Kunitomi</i>   |     |
| <b>Implications of Air Ingress Induced by Density-difference Driven Stratified Flow.....</b>                                | 313 |
| <i>Chang Oh, Eung Soo Kim, Richard Schultz, David Petti, C.P. Liou</i>  |     |
| <b>A Three-Dimensional Heat Transfer Analysis on the Prismatic Fuel Elements in the Very High Temperature Reactor .....</b> | 323 |
| <i>Nam-il Tak, Min-Hwan Kim, Won-Jae Lee</i>  |     |
| <b>3D Thermal Simulation of Decay Heat Removal in a HTR Half Geometry .....</b>   | 330 |
| <i>C. Peniguel, I. Rupp, F. Archambeau</i>  |     |
| <b>TINTE Transient Results for the OECD 400 MW PBMR Benchmark .....</b>   | 340 |
| <i>Gerhard Strydom</i>  |     |
| <b>Alternative Working Fluids to Reduce Size of Turbomachinery for VHTR Plants.....</b>                                     | 351 |
| <i>Jean-Michel Tournier, Mohamed El-Genk</i>  |     |
| <b>Thermo-Economic Performance of HTGR Brayton Power Cycles .....</b>   | 361 |
| <i>José I. Linares, Luis E. Herranz, Beatriz Y. Moratilla, A. Fernandez-Perez</i>   |     |
| <b>Thermo-Chemical Behavior of a Laboratory Scale SO<sub>3</sub> Decomposer.....</b>  | 368 |
| <i>Chan Soo Kim, Sung-Deok Hong, Jong-Ho Kim, Yong-Wan Kim, Won Jae Lee</i>   |     |

### **Track 3.00: LMFR and Longer Term Reactor Programs**

|  |     |
|--|-----|
| <b>Sodium Fast Reactors (SFRs) and Recyclers .....</b>   | 377 |
| <i>Salomon Levy</i>  |     |
| <b>Near-term Deployment of the Prism Sodium-fast Reactor.....</b>  | 390 |
| <i>Eric P. Loewen</i>  |     |
| <b>Approach for FBR Commercialization in Japan.....</b>  | 396 |
| <i>Keizo Ogata</i>   |     |
| <b>An Innovative Design Approach to a Cost Effective Commercial Liquid Metal Reactor .....</b>                                     | 405 |
| <i>M.D. Carelli, H.D. Garkisch, R. Hundal, K. Arie, H. Handa, H. Ota, S. Matsuyama, N. Todreas, P. Hejzlar, P. Wells</i>           |     |
| <b>Design Approaches from Breakeven Core to TRU Burner Core based on KALIMER-600 Reactor .....</b>                                 | 407 |
| <i>Jae-Yong Lim, Sang-Ji Kim, Yeong-Il Kim</i>   |     |
| <b>Conceptual Core Designs for a 1200MWe Sodium Cooled Fast Reactor.....</b>   | 414 |
| <i>Hyung-Kook Joo, Ki-Bog Lee, Jae-Woon Yoo, Yeong-Il Kim</i>  |     |
| <b>Improving SFR Economics Through Innovations from Thermal Design and Analysis Aspects.....</b>                                   | 421 |
| <i>Haihua Zhao, Hongbin Zhang, Vincent A. Mousseau, Per F. Peterson</i>  |     |
| <b>RELAP5 Analysis of the Hybrid Loop-Pool Design for Sodium Cooled Fast Reactors.....</b>   | 437 |
| <i>Hongbin Zhang, Haihua Zhao, Cliff Davis, Matthew Memmott</i>  |     |
| <b>Design Studies on a Large-Scale Sodium-Cooled TRU Burner .....</b>  | 450 |
| <i>Hoon Song, Sang-Ji Kim, Hae-Yong Jeong, Yeong-Il Kim</i>  |     |
| <b>Inherent Safety Evaluation of Pool-type Liquid Metal Fast Reactors by a Multidimensional Thermal-hydraulic Calculation.....</b> | 458 |
| <i>Y.M. Kwon, K.S. Ha, H.Y. Jeong, W.P. Chang, Y.B. Lee, D. Hahn</i>   |     |

|  |     |
|--|-----|
| <b>Global Cooperation and Conceptual Design.....</b>   | 466 |
| <i>Kazumi Ikeda, Kim Stein, Wataru Nakazato, Makoto Mito</i>   |     |
| <b>An Assessment of Annular Fuel for Sodium-Cooled Fast Reactors .....</b>   | 476 |
| <i>Matthew Memmott, Jacopo Buongiorno, Pavel Hejzlar</i>   |     |
| <b>Development of Advanced Loop-Type Fast Reactor in Japan (1): Current Status of JSFR Development .....</b>   | 486 |
| <i>Shoji Kotake, Takatsugu Mihara, Shigenobu Kubo, Kazumi Aoto, Mikio Toda</i>   |     |
| <b>Development of Advanced Loop-Type Fast Reactor in Japan (2): Technological Feasibility of Two-Loop Cooling System in JSFR .....</b>   | 496 |
| <i>Hidemasa Yamano, Shigenobu Kubo, Ken-ichi Kurisaka, Yoshio Shimakawa, Hiromi Sago</i>   |     |
| <b>Development of Advanced Loop-Type Fast Reactor in Japan (3): Easy Inspection and High Reliable Reactor Structure in JSFR.....</b>   | 505 |
| <i>Yoshihiko Sakamoto, Shigenobu Kubo, Shoji Kotake, Yoshio Kamishima</i>  |     |
| <b>Development of Advanced Loop-Type Fast Reactor in Japan (4): An Advanced Design of the Fuel Handling System for the Enhanced Economic Competitiveness.....</b>  | 512 |
| <i>Shinichi Usui, Takatsugu Mihara, Hiroyuki Obata, Shoji Kotake</i>   |     |
| <b>Development of Advanced Loop-Type Fast Reactor in Japan (5): Adoption of Self-Actuated Shutdown System to JSFR .....</b>  | 519 |
| <i>Shigeyuki Nakanishi, Shigenobu Kubo, Misao Takamatsu, Iwao Ikramoto, Jungo Kato, Yoshio Shimakawa, Kiyoshi Harada</i>   |     |
| <b>Development of Advanced Loop-Type Fast Reactor in Japan (6): Minor Actinide Containing Oxide Fuel Core Design Study for the JSFR .....</b>  | 526 |
| <i>Masayuki Naganuma, Takashi Ogawa, Shigeo Ohki, Tomoyasu Mizuno, Shigenobu Kubo</i>  |     |
| <b>Studies on French SFR Advanced Core Designs.....</b>  | 536 |
| <i>G. Mignot, J.C. Klein, M.S. Chenaud, C. Thevenot, A. Ravenet, M. Pelletier, B. Valentin, P. Masoni, P. Dubuisson, S. Delafontaine, L. Nicolas, D. Verrier, A.C. Scholer, D. Ruah, V. Garat, D. Lecarpentier, P. Tétart, B. Maliverney, S. Massara</i> |     |
| <b>Innovative Steam Generator Concepts for Sodium Fast Reactors .....</b>  | 546 |
| <i>B. Giraud, C. Mauget, A. Capitaine, G. Laffont</i>  |     |
| <b>Sodium Fast Reactor Concepts .....</b>  | 553 |
| <i>G. François, J.P. Serpantié, J.F. Sauvage, P. Lo Pinto</i>  |     |
| <b>The Use of Gas Based Energy Conversion Cycles for Sodium Fast Reactors.....</b>   | 565 |
| <i>M. Saez, D. Haubensack, N. Aply, A. Gerber, F. David</i>  |     |
| <b>Scoping Investigation into Viability of a Lead-Cooled Fast Reactor Demonstration Test Reactor (Demo).....</b>   | 574 |
| <i>James J. Sienicki, Anton Moisseytsev, Constantine P. Tzanos</i>   |     |
| <b>A Design and Safety Features of Small CANDLE Fast Reactor .....</b>   | 584 |
| <i>Hiroshi Sekimoto, Mingyu Yan</i>  |     |
| <b>Nuclear Safety Evaluation of a LBE Cooled Transmutation Reactor - PEACER-300 .....</b>  | 593 |
| <i>Jae-Yong Lim, Myung-Hyun Kim, Il-Soon Hwang</i>   |     |
| <b>Development of Transportable Capsule Version of PEACER Design.....</b>  | 601 |
| <i>Il Soon Hwang, Myung Hyun Kim, Han Gyu Joo, Bong Yoo, Moo Hwan Kim, Seung Rok Oh, Kyung Woo Yi, Dong Yoon Han, Jun Lim, Hyo On Nam, Jae Hyun Cho, Keun Young Lee, Moo Hoon Bae, Sung Yeol Choi, Chang Hyo Kim</i>                                     |     |
| <b>Design and Analysis of 900 MWt Lead-Cooled Fast Reactor.....</b>  | 611 |
| <i>Sang Ji KIM, Yonghee Kim, Sergi Hong, Choong Ho Cho, Jae-hyuk Eoh, Jong Bum Kim, Myung Hwan Wi, Kwi Seok Ha, Eui Kwang Kim</i>  |     |

|   |     |
|---|-----|
| <b>A 2400 MWth Liquid Lead-Cooled Flexible Conversion Ratio (FCR) Reactor</b>   | 620 |
| <i>A. Nikiforova, P. Hejzlar, N. Todreas, C. J. Fong</i>  |     |
| <b>Corrosion Test of Cr- and Al-containing Alloys in Static LBE at 550 °C</b>   | 632 |
| <i>Jun Lim, Hyo On Nam, Il Soon Hwang</i>   |     |
| <b>Comparison of the Hydraulics in Concentric and Three Feeder XT-ADS Windowless Spallation Target Designs</b>  | 638 |
| <i>F. Roelofs, N.B. Siccam, B. de Jager, K. van Tichelen, M. Dierckx, J. Heyse, K. Rosseel, P. Schuurmans</i>   |     |
| <b>Application of a Controlled Swirl in the XT-ADS Spallation Target</b>  | 643 |
| <i>F. Roelofs, N.B. Siccam, H. Jeanmart, K. van Tichelen, M. Dierckx, P. Schuurmans</i>   |     |
| <b>Progress within the European Project: "High Performance Light Water Reactor Phase 2" (HPLWR Phase 2)</b>   | 649 |
| <i>J. Starflinger, T. Schulenberg, P. Marsault, D. Bittermann, C. Maraczy, E. Laurien, J.-A. Lycklama, H. Anglart, N. Aksan, M. Ruzickova, L. Heikinheimo</i> |     |
| <b>Coolant Mixing in the Plenum of the HPLWR Three Pass Core</b>  | 660 |
| <i>Alexander Wank, Thomas Schulenberg, A. Class</i>   |     |
| <b>Determination of Mixing Coefficients in a Wire-Wrapped HPLWR Fuel Assembly using CFD</b>   | 670 |
| <i>Steffen Himmel, A. Class, E. Laurien, T. Schulenberg</i>   |     |

## VOLUME 2

|   |     |
|---|-----|
| <b>Numerical Simulation of a HPLWR Fuel Assembly Flow With Wrapped Wire Spacers</b>   | 680 |
| <i>A. Kiss, E. Laurien, A. Aszodi</i>   |     |
| <b>Thermo-Mechanical Stress and Deformation Analysis of a HPLWR Pressure Vessel and Steam Plenum</b>                                  | 690 |
| <i>K. Fischer, T. Redon, G. Millet, C. Koehly, T. Schulenberg</i>   |     |
| <b>Coupling Analysis on a New SCWR Core Design</b>  | 700 |
| <i>X.J. Liu, X. Cheng</i>   |     |
| <b>Prediction of Overheated Zones along the Wall of Strongly Heated Quasi-Fully Developed Pipe Flow at Supercritical Pressure</b>     | 708 |
| <i>E. Laurien, M. Rashid</i>  |     |
| <b>Summary for Three Different Validation Cases of Coolant Flow in Supercritical Water Test Sections with the Code ANSYS CFX 11.0</b> | 716 |
| <i>Attila Kiss, Attila Aszodi</i>   |     |
| <b>Reactor Physical Program in the frame of the MSR-SPHINX Transmuter Concept Development</b>   | 726 |
| <i>Miloslav Hron, Miroslav Mikisek</i>  |     |
| <b>Design Options for the Advanced High-Temperature Reactor</b>   | 733 |
| <i>C.W. Forsberg, P.F. Peterson, R.A. Kochendarfer</i>  |     |
| <b>Use of a Liquid Salt Nuclear Reactor to Transmute Minor Actinides</b>  | 750 |
| <i>K.O. Stein, R.A. Kochendarfer, J.W. Maddox</i>   |     |
| <b>Designing the Advanced High-Temperature Reactor for Low Radionuclide Releases in Beyond-Design-Basis Accidents</b>                 | 755 |
| <i>Charles W. Forsberg</i>  |     |
| <b>Initial Status and Test Results from a Supercritical CO<sub>2</sub> Brayton Cycle Test Loop</b>                                    | 768 |
| <i>Steven A. Wright, Robert Fuller, Paul S. Pickard, Milton E. Vernon</i>   |     |

|  |     |
|--|-----|
| <b>Design of Small Centrifugal Compressor Test Model for a Supercritical CO<sub>2</sub> Compressor in the Fast Reactor Power Plant .....</b> | 776 |
| <i>Yasushi Muto, Takao Ishizuka, Masanori Aritomi</i>  |     |
| <b>Dynamic Modeling of the S-CO<sub>2</sub> Recompression Cycle.....</b>   | 784 |
| <i>N.A. Carstens, R.B. Vilim, P. Hejzlar, M.J. Driscoll</i>  |     |
| <b>Controllability of the Supercritical Carbon Dioxide Brayton Cycle Near the Critical Point.....</b>  | 799 |
| <i>Anton Moisseytsev, James J. Sienicki</i>  |     |
| <b>Supercritical CO<sub>2</sub> Brayton Cycle Compression and Control Near the Critical Point .....</b>                                      | 810 |
| <i>Steven A. Wright, Robert Fuller, Jeff Noall, Ross Radel, Milton E. Vernon, Paul S. Pickard</i>  |     |
| <b>Comparative Analysis of Supercritical CO<sub>2</sub> Power Conversion System Control Schemes .....</b>                                    | 820 |
| <i>Richard B. Vilim, Anton Moisseytsev</i>   |     |
| <b>Preliminary Design of Turbomachinery for the Supercritical Carbon Dioxide Brayton Cycle Coupled to the KALIMER-600 .....</b>              | 831 |
| <i>J.E. Cha, S.O. Kim, T.W. Kim, K.Y. Seo</i>  |     |
| <b>Dynamic System Analysis of a Supercritical CO<sub>2</sub> Compression Loop .....</b>  | 837 |
| <i>Richard B. Vilim, Steven A. Wright, Milton Vernon, Ross Radel, Paul S. Pickard</i>  |     |

## **Track 4.00: Operation, Performance and Reliability Management**

|   |     |
|---|-----|
| <b>Instrumentation and Control and Human Machine Interface Science and Technology Roadmap in Support of Advanced Reactors and Fuel Programs in the U.S. ....</b>              | 844 |
| <i>Don W. Miller, Steven A. Arndt, Donald Dudenhoeffer, Bruce Hallbert, Leonard J. Bond, David E. Holcomb, Richard T. Wood, Joseph A. Naser, John O'Hara, Edward L. Quinn</i> |     |
| <b>A Novel Approach to Modeling Single Event Upsets in Digital Microelectronic Devices.....</b>   | 853 |
| <i>S. M. Cetiner, C. Celik, K. Ünlü, V. Narayanan, M. J. Irwin, Y. Xie</i>  |     |
| <b>Licensing of Simple Digital Devices .....</b>  | 861 |
| <i>Terry W. Jackson</i>   |     |
| <b>Switching Scheme of Data Communication Network for Safety System in Nuclear Power Plant .....</b>  | 865 |
| <i>Je-Yun Park, Jong-Yong Keum, In-Soo Koo</i>  |     |
| <b>An Advanced Protection System for the SHIN-KORI 3&amp;4 Nuclear Power Plant .....</b>  | 871 |
| <i>Yong Hak Kim, Jong Soo Kwon, Woong Seock Choi, C. Frank Ridolfo, Stephen Wilkosz</i>   |     |
| <b>Top-Mounted Incore Instrumentation Insertion Test for Westinghouse AP1000.....</b>   | 878 |
| <i>Thomas A. Kindred, Daniel P. Kistler, Michael C. Prible, Joe Hahn, John Iacovino, Michael D. Heibel</i>  |     |
| <b>Design of a Software Training System for Severe Accident Mitigation of Korean Standard Nuclear Power Plants.....</b>   | 888 |
| <i>Ko-Ryu Kim, Soo-Yong Park, Yong-Man Song</i>   |     |
| <b>APR1400 I&amp;C Architecture with the Advanced Design Feature Including High Reliability and Maintainability.....</b>  | 892 |
| <i>Sung Kon Kang, Byoung Hwan Bae, Song Hae Ye</i>  |     |
| <b>Strategy for Establishing Integrated I&amp;C Reliability of Operating Nuclear Power Plants in Korea .....</b>  | 899 |
| <i>H.T. Kang, H.Y. Chung, Y.H. Lee</i>  |     |
| <b>Westinghouse AP1000 Protection and Safety Monitoring System.....</b>   | 904 |
| <i>W.R. Odess-Gillett, C.A. Vitalbo</i>   |     |

|   |     |
|---|-----|
| <b>Steam Generator Asset Management Model Application .....</b>   | 911 |
| <i>Mike G. Pop, Paul Shoemaker, Kent Colgan, John Griffith</i>  |     |
| <b>An Experience in Low Temperature Stress Corrosion Cracking at Steam Generator Coldleg Drain Nozzle for YGN 3 Unit .....</b>  | 918 |
| <i>Sim Kyo Lee, Seon Hak Lee</i>  |     |
| <b>Fatigue Crack Growth Impact on Leak-Before-Break Due to Mechanical Stress Improvement Process.....</b>   | 928 |
| <i>S.F. Hankinson, T.J. Pournaras, T.F. Wiley, J.A. Smouse, C.K. Ng, D. Bhowmick, S.A. Swamy</i>  |     |
| <b>Effect of Structural Weld Overlay on Recommended Leak - Before - Break Margins .....</b>   | 934 |
| <i>Dulal Bhowmick, Seth Swamy, Anees Udyawar</i>  |     |
| <b>Technology Success: Integration of Power Plant Reliability and Effective Maintenance .....</b>   | 938 |
| <i>Kenneth Ferguson</i>   |     |
| <b>Reliability Database Development and Plant Performance Improvement Effort at Korea Hydro &amp; Nuclear Power Co. ....</b>  | 945 |
| <i>Seung-Jong Oh, Seok-Won Hwang, Jang-Hwan Na, Hyuk-Soon Lim</i>   |     |
| <b>Risk-Informed Assessment of the Scope and Frequency of Technical Service and Repair at the Kozloduy Nuclear Power Plant.....</b>   | 950 |
| <i>Vladimir Popov, Vesselina Vladimirova, Georgi Georgiev, Iliyan Ivanov, Gerald Andre, John Kitzmiller</i>   |     |
| <b>Risk-Informed Assessment of the Scope and Frequency of Testing at the Kozloduy Nuclear Power Plant.....</b>  | 959 |
| <i>Emil Kichev, Tzvetan Topalov, Kaliopa Mancheva, Lyubomir Ivanov, Krasimir Kamenov, Gerald Andre, Daniel McLaughlin</i>   |     |
| <b>Application of Systems Engineering to Nuclear Power Plant Design .....</b>   | 968 |
| <i>Hyeong Heon Kim, Joo Hyun Baik, Taek Sang Choi, Kwang Suk Oh, Dong Hee Kim</i>   |     |
| <b>Passing of Reactors WWER-1000 of NPP Kozloduy - Bulgaria to Extended Fuel Cycle Operation (Implementation of <math>^{235}\text{U}</math> Higher Enriched Fuel) .....</b> | 975 |
| <i>Ivan D. Dobrevski, Neli N. Zaharieva, Katia Minkova, Tsvetan Peychinov, Radka A. Ivanova, Georgi D. Michaylov, Penyo G. Penev, N. Gerchev</i>                            |     |

## **Track 5.00: Plant Safety Assessment and Regulatory Issues**

|  |      |
|--|------|
| <b>Assessment of Core Cooling Capability of Emergency Core Cooling System in LBLOCA Condition for TAPS#3&amp;4 .....</b> | 984  |
| <i>Nrependra Kumar, S.K. Yadav, T.A. Khan, Mukesh Singhal, H.P. Rammohan, P.K. Malhotra, S.G. Ghadge</i>                 |      |
| <b>Large Break LOCA Analysis for TAPS-3&amp;4 using RELAP-5/MOD 3.2 .....</b>  | 994  |
| <i>S.L. Sharma, H.P. Rammohan, P.K. Malhotra, S.G. Ghadge</i>  |      |
| <b>Large Break Loss of Coolant Accident Analysis of VVER-1000 Reactor Using CATHARE Code.....</b>                        | 1001 |
| <i>Luben Sabotinov, Abhishek Srivastava</i>  |      |
| <b>Assessment on the Integrity of Component Cooling Water System During DBA with LOOP for Kori 3&amp;4.....</b>          | 1010 |
| <i>Yyeong Taek Kim, Sung Bok Lee, Sang Won Lee, Young Chan Park</i>  |      |
| <b>Improvement of the Interfacial Drag Model in TRAC-PF1/IBER to Simulate Downcomer Boiling Phenomena.....</b>           | 1017 |
| <i>J.A. Bermejo, A. Concejal, R. Orive, P. Garcia</i>  |      |

|   |      |
|---|------|
| <b>Sensitivity Studies on Uncertainty Parameters and Code Modeling During LBLOCA .....</b>  | 1024 |
| <i>Deog-Yeon Oh, Young Seok Bang, Byung Gil Huh, Sweng Woong Woo, Yong Jin Cho</i>  |      |
| <b>Evaluation of Radiological Effects Due to Injection of Argon Gases into Reactor Coolant System .....</b>   | 1031 |
| <i>Kimun Nam, Chaichul Im, Wook Sohn, Duk-won Kang</i>  |      |
| <b>Dynamic Structural Analysis Concerning Integrity Assessment of a Reinforced Concrete Ceiling Due to Impact Loads.....</b>  | 1039 |
| <i>J. Sievers, P. Eisert, P. Bachmann</i>   |      |
| <b>Effect of Break Size on Severe Core Damage Behaviour for VVER 1000 Reactor with the ASTEC V1 Code.....</b>   | 1057 |
| <i>B. Chatterjee, D. Mukhopadhyay, H.G. Lele, A.K. Ghosh</i>  |      |
| <b>MAAP4.0.7 Analysis and Justification for PRA Level 1 Mission Success Criteria.....</b>   | 1064 |
| <i>Jennifer S. Butler, Darvin Kapitz, Robert P. Martin, Farrokh Seifaei, Ramu K. Sundaram</i>   |      |
| <b>MAAP4.0.7 Severe Accident Source Term Analysis .....</b>   | 1076 |
| <i>Amy C. Slaga, Stanley H. Levinson, Robert Prior, David Gerlits</i>   |      |
| <b>Analysis of Station Blackout in the Gösgen Nuclear Plant .....</b>   | 1086 |
| <i>T. Haste, J. Birchley, J.-U. Klügel</i>  |      |
| <b>SCDAP/RELAP5 Investigation on Coolability of Severely Degraded CANDU 6 Core - Preliminary Results.....</b>   | 1095 |
| <i>Daniel Dupleac, Ilie Prisecaru, Mirea Mladin, Gheorghe Negut</i>   |      |
| <b>Relevant Scenarios and Uncertainty Analysis of Severe Accidents in the U.S. EPR.....</b>   | 1102 |
| <i>Robert P. Martin, Michael W. Bingham, Eric Williams, Arnaud Caillaux</i>   |      |
| <b>Recent Revisions to MAAP4 for U.S. EPR Severe Accident Applications .....</b>  | 1110 |
| <i>Eric Williams, Robert Martin, Pascal Gandrille, Rui Meireles, Robert Prior, Chris Henry, Quan Zhou</i>   |      |
| <b>AREVA NP's Severe Accident Safety Issue Resolution Methodology for the U.S. EPR .....</b>  | 1122 |
| <i>Robert P. Martin, Michael W. Bingham, Carlos A. Bonilla, Jennifer S. Butler, Paul D. Duncan-Whiteman, Patrick Gruenewald, Amy C. Slaga, Eric Williams, Garo Azarian, Markus Nie</i>  |      |
| <b>Influence of Jet Breakup Modeling on Ex-Vessel Steam Explosion Simulation Results.....</b>   | 1132 |
| <i>Matjaž Leskovar</i>  |      |
| <b>Modeling of Two-Phase Natural Convection Flows in a Water Pool with a Decay-Heated Debris Bed.....</b>   | 1141 |
| <i>Sergey Yakush, Pavel Kudinov, Truc-Nam Dinh</i>  |      |
| <b>Thermodynamic Analysis for the Melt Pool Configuration During the Severe Accidents in the APR1400 .....</b>  | 1151 |
| <i>Kyoung-Ho Kang, Rae-Joon Park, Seong-Wan Hong</i>  |      |
| <b>Transient Conduction Heat Transfer Modelling in Concrete for the Simulation of Long Term Phase of Molten Core Concrete Interaction .....</b>   | 1156 |
| <i>B. Tourniaire, B. Spindler, M. Guillaumé</i>   |      |
| <b>Interaction Between Molten Corium <math>\text{UO}_{2+x}</math>- <math>\text{ZrO}_2</math>- <math>\text{FeO}_y</math> and VVER Vessel Steel .....</b>   | 1163 |
| <i>S.V. Bechta, V.S. Granovsky, V.B. Khabensky, E.V. Krushinov, S.A. Vitol, A.A. Sulatsky, V.V. Gusarov, V.I. Almiashev, D.B. Lopukh, D. Bottomley, M. Fischer, P. Piluso, A. Miassoedov, E. Altstadt, F. Fichot, O. Kymäläinen</i> |      |
| <b>European Research on the Corium Issues within the SARNET Network of Excellence .....</b>   | 1172 |
| <i>C. Journeau, J.M. Bonnet, L. Godin-Jacqmin, P. Piluso, D. Tarabelli</i>  |      |

|  |      |
|--|------|
| <b>Pre-Test Calculational Support for the QUENCH-13 Experiment .....</b>   | 1182 |
| <i>T. Haste, J. Birchley, J.-S. Lamy, B. Maliverney, H. Austregesilo, C. Bals, K. Trambauer, M. Steinbrück, J. Stuckert</i>                    |      |
| <b>An Experimental Study on Debris Formation with Corium Simulant Materials .....</b>  | 1191 |
| <i>Pavel Kudinov, Aram Karbojian, Weimin Ma, Truc-Nam Dinh</i>   |      |
| <b>An Investigation on the Material Effect on the Result of Fuel Coolant Interactions in the TROI Experiments.....</b>                         | 1200 |
| <i>I.K. Park, J.H. Kim, B.T. Min, S.W. Hong</i>  |      |
| <b>Comparison of the High Temperature Steam Oxidation Kinetics of Advanced Cladding Materials .....</b>  | 1209 |
| <i>M. Grosse</i>   |      |
| <b>Towards a Comprehensive Interpretation of MCCI 2D tests .....</b>   | 1215 |
| <i>J.M. Seiler, B. Tournaire</i>   |      |
| <b>Measurements of the Mechanical Strength of Corium Crusts .....</b>  | 1223 |
| <i>S. Lomperski, M.T. Farmer</i>   |      |
| <b>Differences Between Silica and Limestone Concretes That May Affect Their Interaction with Corium.....</b>                                   | 1233 |
| <i>Christophe Journeau, Jean-François Haquet, Pascal Piluso, Jean-Michel Bonnet</i>  |      |
| <b>Current European Experiments on 2D Molten Core Concrete Interaction: HECLA and VULCANO .....</b>  | 1241 |
| <i>Christophe Journeau, Jean Michel Bonnet, Eric Boccaccio, Pascal Piluso, Tuomo Sevón, Pekka H. Pankakoski, Stefan Holmström, Jouko Virta</i> |      |
| <b>Interpretation of Real Material 2D MCCI Experiments in Homogeneous Oxidic Pool with the ASTEC/MEDICIS Code.....</b>                         | 1251 |
| <i>M. Cranga, C. Mun, B. Michel, F. Duval, M. Barrachin</i>  |      |
| <b>Application of the ASTEC V1 Code to the LIVE-L1 Experiment .....</b>  | 1261 |
| <i>Alexei Miassoedov, L. Godin-Jacqmin, Andrea Bachrata, Thomas Cron, Xiaoyang Gaus-Liu, Thomas Wenz</i>                                       |      |
| <b>Experimental and Post-Test Calculation Results of the Integral Reflood Test QUENCH-12 with a VVER-type Bundle .....</b>                     | 1270 |
| <i>J. Stuckert, J. Birchley, M. Große, T. Haste, L. Sepold, M. Steinbrück</i>  |      |
| <b>Direct Containment Heating Experiments for Konvoi Power Plants.....</b>   | 1280 |
| <i>Leonhard Meyer, Giancarlo Albrecht</i>  |      |
| <b>Triggered Steam Explosions with Corium Melts of Various Compositions in a Narrow Interaction Vessel in the TROI Facility.....</b>           | 1291 |
| <i>J.H. Kim, B.T. Min, I.K. Park, H.D. Kim, S.W. Hong</i>  |      |
| <b>A Study on the Operator's Communication Pattern Characteristics Under Abnormal Operating Situation of Nuclear Power Plants.....</b>         | 1300 |
| <i>Seung Hwan Kim, Jinkyun Park</i>  |      |
| <b>Mechanism-based Ageing Management of Primary Water Stress Corrosion Cracking of Ni-base Components in PWR Environments.....</b>             | 1307 |
| <i>Tae Hyun Lee, Il Soon Hwang</i>   |      |
| <b>A Study on the Verification and Validation of Programmable Logic Component in a Nuclear Power Plant .....</b>                               | 1315 |
| <i>G.Y. Park, D.I. Kim, C.H. Jung</i>  |      |
| <b>U.S. NRC's Generic Issues Program .....</b>   | 1320 |
| <i>John V. Kauffman, Jack W. Foster</i>  |      |

|   |      |
|---|------|
| <b>Korean Experience in Periodic Safety Reviews and Safety Improvements of Operating Nuclear Power Plants.....</b>  | 1324 |
| <i>In-Goo Kim, Jong-Tae Ha, Kyun-Tae Kim</i>  |      |
| <b>Introduction of Regulatory Guide on Cyber Security of I&amp;C Systems in Nuclear Facilities.....</b>   | 1332 |
| <i>Youngdoo Kang, Choong-Heui Jeong, Dai I. Kim</i>   |      |
| <b>Resolution of Digital Instrumentation and Control and Human Factors Technical and Regulatory Issues for New Plants and for Modernization of Operating Plants .....</b> | 1338 |
| <i>Joseph A. Naser, Raymond C. Torok, Kenneth T. Canavan</i>  |      |
| <b>Treatment of Complementary Events in Event Trees in Constructing Linked Fault Trees for Level 1 and Level 2 PRA .....</b>  | 1347 |
| <i>Young G. Jo</i>  |      |

## VOLUME 3

|   |      |
|---|------|
| <b>Spatial Interactions Database Development for Effective Probabilistic Risk Assessment .....</b>  | 1357 |
| <i>James K. Liming, Roland F. Dunn</i>  |      |
| <b>SIMPROC: Procedures Simulator for Operator Actions in NPPs .....</b>   | 1364 |
| <i>J. Gil, J. Esperón, L. Gamo, I. Fernández, P. González, J. Moreno, C. Queral, A. Expósito, G. Jiménez, J. Hortal</i>   |      |
| <b>A Study on Uncertainties Evaluation in Containment Event Tree.....</b>   | 1373 |
| <i>Hirotaka Sugiyama, Ryoichi Hamazaki, Tomoyuki Matsumoto, Naoki Hirokawa</i>  |      |
| <b>The Comparison of Frequency-Consequence (F-C) Criteria In Evaluating the Risk of New or Existing Reactor .....</b>   | 1382 |
| <i>Oh Kju Myeng, Sang-Kyu Ahn, Won-Hyo Yoon, Hoon-Joo Lee</i>   |      |
| <b>Overview of the Activities of the OECD/NEA/NSC Working Party on Nuclear Criticality Safety .....</b>   | 1391 |
| <i>Y. Rugama, R. Blomquist, M. Brady Raap, B. Briggs, J. Gulliford, Y. Miyoshi, K. Suyama</i>   |      |
| <b>Drafting and Implementation of a "Practical Elimination" Approach for GEN IV Nuclear Reactors.....</b>   | 1394 |
| <i>C. Clement, B. Maliverney, D. Mulet-Marquis, J.F. Sauvage, M.T. Blanchard, B. Guesdon, B. Carluc, S. Ehster, D. Grenèche, P. Anzieu, G.L. Fiorini, M. Rozenholc, F. Vitton</i> |      |
| <b>EFIT Reactor Simulation Coupling Neutronics/Thermal-hydraulics with the RELAP5/PARCS Code .....</b>  | 1399 |
| <i>Paride Meloni, Giacomo Bandini, Massimiliano Polidori</i>  |      |
| <b>Comparative Review of Design and Improved Safety Features of New LWR Plants .....</b>  | 1407 |
| <i>Alejandro Chomat, Samim Anghaie</i>  |      |

### **Track 6.00: Thermal Hydraulic Analysis and Testing**

|   |      |
|---|------|
| <b>Verification and Validation of Almaraz NPP TRACE Model.....</b>  | 1421 |
| <i>César Queral, A. Expósito, Gonzalo Jiménez, Laura Valle, Juan Carlos Martínez-Murillo</i>                            |      |
| <b>Parametric Sensitivity Study on the Reflooding Models of the MARS Code Based on 6x6 Rod Bundle Test Results.....</b> | 1429 |
| <i>Ki-Yong Choi, Seok Cho, Hyoung-Kyu Cho, Chul-Hwa Song</i>  |      |
| <b>Implementation of a New Controlling Function in MELCOR Computer Code for Uncertainty Evaluations .....</b>           | 1436 |
| <i>Plamen V. Petkov</i>   |      |

|   |      |
|---|------|
| <b>TRACG Statistical Method for BWR Loss-of-coolant Accident Analyses.....</b>  | 1443 |
| <i>Baris Sarikaya, Jens G. M. Andersen, Francis T. Bolger, James R. Fitch, Charles L. Heck, Lev A. Klebanov, A. Kurshad Muftuoglu, Bharat S. Shiralkar, Feibiu D. Shum, Dan T. Rock</i> |      |
| <b>BFBT Benchmark Sub-Channel Analysis with RELAP5-3D Code .....</b>  | 1447 |
| <i>A. Kovtonyuk, A. Petrucci, F. D'Auria</i>  |      |
| <b>Assessment of Compensating Error in the WCOBRA/TRAC-TF2 Thermal- Hydraulic Code.....</b>   | 1457 |
| <i>Michael A. Shockling, Cesare Frepoli</i>   |      |
| <b>Development and Qualification of the Coupled Code System COBRATF/ THREEDANT for the Pin-by-Pin Power Calculation .....</b>   | 1466 |
| <i>V. Sanchez, A. Al-Hamry, C.H.M. Broeders</i>   |      |
| <b>An Improved Horizontal Flow Regime Map For The 1-D Module of WCOBRA/TRAC-TF2 .....</b>   | 1474 |
| <i>Cesare Frepoli, Jun Liao, Katsuhiro Ohkawa</i>   |      |
| <b>Full-size and Scaled 3-loop Reactor Vessel Simulation for Boron Dilution Studies Using CFD .....</b>   | 1486 |
| <i>T.V. Dury, M.T. Dhotre</i>   |      |
| <b>MELCOR Validation Against a PUMA Facility Main Steam Line Break Integral Test.....</b>   | 1498 |
| <i>Y. Liao, K. Vierow, J.T. Han</i>   |      |
| <b>An Integral Effect Test on the Reflood Period of a Large-Break LOCA for the APR1400 Using the ATLAS .....</b>  | 1506 |
| <i>H.S. Park, K.Y. Choi, S. Cho, K.H. Kang, N.H. Choi, D.J. Euh, Y.S. Kim, W.P. Baek</i>  |      |
| <b>Experimental Validation of a Core Heat Transfer Model in the TASS/SMR Code Using Film Boiling Data .....</b>   | 1516 |
| <i>Seong Wook Lee, Soo Hyung Kim, Young Jong Chung</i>  |      |
| <b>PC-based Simulator PCTRAN for Advanced Nuclear Power Plants.....</b>   | 1520 |
| <i>Li-chi Cliff</i>   |      |
| <b>Analysis of Dynamic Behavior of MEGAPIE Cooling System.....</b>  | 1528 |
| <i>X. Cheng, A. Class</i>   |      |
| <b>Development of Evaluation System of Safety Margin effects for Degradation of CANDU Reactors Using RELAP-CANDU.....</b>   | 1537 |
| <i>Yong Won Choi, Jun Soo Yoo, Un Chul Lee, Manwoong Kim, Sang-Kyu Lee</i>  |      |
| <b>Testing Programs Related to Potential Adverse Flow Effects In Nuclear Power Plants .....</b>   | 1547 |
| <i>Jai Rajan, Andre Turlin, Thomas Scarbrough</i>   |      |
| <b>The TRABSMABRE for 3D Plant Transient and Accident Analyses .....</b>  | 1556 |
| <i>Jaakko Miettinen, Hanna Raty, Antti Daavittila</i>   |      |
| <b>Analysis of Beyond Design Basis Accidents in Spent Fuel Pools of the Ignalina NPP .....</b>  | 1566 |
| <i>A. Kaliatka, V. Ognerubov, M. Vaisnoras, E. Uspuras, K. Trambauer</i>  |      |
| <b>Subchannel Analysis of CANDU-SCWR Fuel.....</b>  | 1576 |
| <i>Changying Li, Jianqiang Shan, Laurence K.H. Leung</i>  |      |
| <b>GNF2 Counter-Current Flow Limitation Testing.....</b>  | 1585 |
| <i>P.R. Diller, D. Abdollahian, J.G.M. Andersen</i>   |      |
| <b>Interfacial Momentum Exchange Models Used in Nuclear Reactor System Analysis Codes.....</b>  | 1593 |
| <i>J.-W. Park, B.-D. Chung</i>  |      |

|  |      |
|--|------|
| <b>Thermohydrodynamic Analysis of Reactor Vessel Auxiliary Cooling System for Lead-Cooled Battery Omnibus Reactor Integral System.....</b>           | 1597 |
| <i>Hyung M. Son, Kune Y. Suh</i>   |      |
| <b>Development of a High Fidelity System Analysis Code for Generation IV Reactors.....</b>   | 1606 |
| <i>Hongbin Zhang, Vincent A. Mousseau, Haihua Zhao</i>   |      |
| <b>Multidimensional Analysis of Developing Two-phase Flows in an ESBWR Chimney with and without Riser Channels .....</b>                             | 1616 |
| <i>Hideki Murakawa, Steven P. Antal, Richard T. Lahey Jr.</i>  |      |
| <b>On the Modeling of Channel-to Channel Oscillations in Boiling Water Reactors .....</b>  | 1635 |
| <i>Sebastien Roubaud, Michael Z. Podowski</i>  |      |
| <b>Heat Transfer in Intermediate Heat Exchanger Under Low Flow Rate Conditions.....</b>  | 1650 |
| <i>Hiroyasu Mochizuki</i>  |      |
| <b>Identification of the Relation between Turbulence Coefficient and Local Wall Thinning inside Carbon Steel Piping .....</b>                        | 1659 |
| <i>Kyeong Mo Hwang, Lee Woo, Tae Eun Jin, Kyung Hoon Kim</i>   |      |
| <b>Theoretical and Experimental Study of Steam Condensation Induced Water Hammer Phenomena.....</b>  | 1666 |
| <i>Imre Ferenc Barna, Gábor Baranyai , György Ézsöl</i>  |      |
| <b>Transient Accident Analysis of the Glovebox System in a Large Process Room.....</b>   | 1673 |
| <i>Si Y. Lee</i>   |      |
| <b>Pressure Drop Characteristics of Cross-Shaped Spiral (CSS) Rod Bundles for LWRs .....</b>   | 1682 |
| <i>T. Conboy, T. McKrell, P. Hejzlar, M.S. Kazimi</i>  |      |
| <b>Application of the Subchannel Analysis Code MATRA for Low Flow and Low Pressure Conditions .....</b>  | 1692 |
| <i>Kyong-Won Seo, Dae-Hyun Hwang, Chung-Chan Lee</i>   |      |
| <b>Optimizing Critical Heat Flux Enhancement Through Nanoparticle-Based Surface Modifications .....</b>  | 1699 |
| <i>Bao Truong, Lin-Wen Hu, Jacopo Buongiorno</i>   |      |
| <b>Applications of Nanofluids to Enhance LWR Accidents Management in Invessel Retention and Emergency Core Cooling Systems.....</b>                  | 1707 |
| <i>Antoine Chupin, Lin-Wen Hu, Jacopo Buongiorno</i>   |      |
| <b>Thermal-fluid characterizations of ZnO and SiC Nanofluids for Advanced Nuclear Power Plants.....</b>  | 1715 |
| <i>In Cheol Bang</i>   |      |
| <b>Evaluation of Crack Opening Area, Leak Rate and Probabilistic Models in CANTIA .....</b>  | 1725 |
| <i>Shripad T. Revankar, Brian Wolf, Jovica R. Riznic</i>   |      |
| <b>Condensation Correlation for a Vertical Passive Condenser System.....</b>   | 1735 |
| <i>Shripad T. Revankar, Suengmin Oh, Wenzhong Zhou, Gavin Henderson</i>  |      |
| <b>Pressure Loss Coefficient Evaluation Based on CFD Analysis for Simple Geometries and PWR Reactor Vessel Without Geometry Simplification .....</b> | 1744 |
| <i>Byeong Il Ko, Jong Pil Park, Ji Hwan Jeong</i>  |      |
| <b>CFD Estimation of the Heat Transfer Due to the Natural Convection in a CEA Extension Shaft Guide Tube .....</b>                                   | 1754 |
| <i>Seong Hoon Kim, Young In Kim, Chun Tae Park, Jae Kwang Seo</i>  |      |
| <b>System / CFD Coupling For Reactor Transient Analysis. An Application to the Gas Fast Reactor with CATHARE And TRIO_U .....</b>                    | 1762 |
| <i>Fabien Perdu, Simone Vandroux</i>   |      |

|  |      |
|--|------|
| <b>A CFD Solver with Variable Gas Properties for Applications to High Temperature Gas-Cooled Reactors.....</b>   | 1770 |
| <i>Anne Charmeau, Samim Anghaie</i>  |      |
| <b>Free Surface Modeling and Simulation of the Water Experiment for the XT ADS Spallation Target.....</b>  | 1779 |
| <i>Abdalla Batta, A. Class</i>   |      |
| <b>CFD Calculations of the Fuel Assembly of VVER-440 Type PWR Reactors .....</b>   | 1787 |
| <i>István Farkas</i>   |      |
| <b>RANS-based CFD Simulations of Wire-Wrapped Fast Reactor Fuel Assemblies .....</b>   | 1792 |
| <i>W. David Pointer, Paul Fischer, Andrew Siegel, Jeffrey Smith</i>  |      |
| <b>CFD Predictions of Heat Transfer in the Super Critical Flow Regime.....</b>   | 1802 |
| <i>D.C. Visser, J.A. Lycklama a Nijeholt, F. Roelofs</i>   |      |
| <b>CFD Study on Coolant Mixing in VVER-440 Fuel Assembly Head .....</b>  | 1813 |
| <i>S. Tóth, A. Aszódi</i>  |      |
| <b>Evaluation of Two-phase Flow Characteristics in Steam Separator by Using a CFD Code .....</b>   | 1824 |
| <i>Masao Chaki, Kenichi Katono, Hironobu Kataoka, Akio Tomiyama</i>  |      |
| <b>k-E modeling using Modified Nodal Integral Method .....</b>   | 1832 |
| <i>Suneet Singh, R. Rizwan-uddin</i>   |      |
| <b>Supercritical Water Heat Transfer in a Vertical Bare Tube: Normal, Improved and Deteriorated Regimes.....</b>   | 1843 |
| <i>I.L. Pioro, P.L. Kirillov, S.J. Mokry, Y.K. Gospodinov</i>  |      |
| <b>LWR Containment Safety Research in PANDA .....</b>  | 1853 |
| <i>D. Paladino, M. Huggenberger, M. Andreani, S. Gupta, S. Guentay, J. Dreier, H. Prasser</i>  |      |
| <b>Interfacial Area Transport in Horizontal Bubbly Flow with Elbow Restrictions .....</b>  | 1862 |
| <i>Justin Talley, Seungjin Kim, Gunol Kojasoy</i>  |      |
| <b>High Temperature Irradiation Resistant Thermocouples - A Low Cost Sensor for In-Pile Testing at High Temperatures .....</b>                                     | 1873 |
| <i>Darrell L. Knudson, Joy L. Rempe, Keith G. Condie, S. Curtis Wilkins, Joshua E. Daw, J.C. Crepeau</i>   |      |
| <b>Analysis of Two-Phase Flow and Boiling Heat Transfer in Inclined Channel of Core-catcher .....</b>  | 1883 |
| <i>M. Tahara, Y. Suzuki, N. Abe, T. Kurita, R. Hamazaki, Y. Kojima</i>   |      |
| <b>Performance and Scaling Analysis for the Two-Phase Natural Circulation.....</b>   | 1891 |
| <i>JinHo Song</i>  |      |
| <b>Development of the Cooling Technology on TRU Fuel Pin Bundle During Fuel Fabrication Process (1) Whole Study Plan and Fabrication of Test Apparatuses .....</b> | 1899 |
| <i>Kunihiro Itoh, Kazuo Ikeda, Koichi Hishida, Taichiro Kuroda, Akira Yamaguchi, Takashi Takata</i>  |      |
| <b>Development of the Cooling Technology on TRU Fuel Pin Bundle During Fuel Fabrication Process (2) High-Speed PIV Measurements in Gap among Fuel Pins.....</b>    | 1906 |
| <i>Koichi Hishida, Taichiro Kuroda, Kunihiro Itoh, Kazuo Ikeda, Akira Yamaguchi, Takashi Takata</i>  |      |
| <b>Development of the Cooling Technology on TRU Fuel Pin Bundle During Fuel Fabrication Process (3) Development of Analytical Tool .....</b>                       | 1916 |
| <i>Takashi Takata, Akira Yamaguchi, Akira Hishida, Taichiro Kuroda, Kunihiro Itoh, Kazuo Ikeda</i>   |      |
| <b>An Assessment of Large-eddy Simulation for Thermal Fatigue Prediction .....</b>   | 1923 |
| <i>Arkadiusz K. Kuczaj, B. de Jager, Ed Komen</i>  |      |

|   |      |
|---|------|
| <b>Experimental Investigation of Hematite Particulate Deposition Under Sub-cooled Boiling Conditions</b>                      | 1934 |
| <i>H. Bindra, Q.Rao, B.G. Jones</i>   |      |
| <b>Investigation of Heat Transfer for Gas Cooled Systems</b>  | 1942 |
| <i>Wolfgang Hering, Frederik Arbeiter, Andrei Bologa, Angela Jianu, Jurong Zhuang</i>   |      |
| <b>Mixing Process by Natural Convection and Molecular Diffusion of Two Component Gases in a Stable Stratified Fluid Layer</b> | 1948 |
| <i>Tetsuaki Takeda</i>  |      |
| <b>Design Considerations for Compact Heat Exchangers</b>  | 1953 |
| <i>David Southall, Renaud Le Pierres, Stephen John Dewson</i>   |      |

## **Track 7.00: Fuel Cycle and Waste Management**

|  |      |
|--|------|
| <b>A Contingency Safe, Responsible, Economic, Increased Capacity Spent Nuclear Fuel (SNF) Advance Fuel Cycle</b>   | 1969 |
| <i>Salomon Levy</i>  |      |
| <b>Market Share Scenarios for Gen-III and Gen-IV Reactors in Europe</b>  | 1980 |
| <i>Ferry Roelofs, Aliki van Heek, Luc Van Den Durnel</i>   |      |
| <b>Progress in Development of Erbia-Bearing Super High Burnup Fuel</b>   | 1988 |
| <i>Masatoshi Yamasaki, Takeshi Kuroishi, Toshikazu Takeda, Akio Yamamoto, Hironobu Unesaki, Masaaki Mori</i>   |      |
| <b>Radioactive Waste Management in Romania</b>   | 1996 |
| <i>Gheorghe Negut, Gheorghe Ionita, Ortenzia Niculae, Ion Durdun, Stela Diaconu</i>  |      |
| <b>Prospects of Thorium-fuel Reprocessing for Molten-Salt Reactor Systems</b>  | 2005 |
| <i>Jan Uhlíř</i>   |      |
| <b>A Study on Methodology of Optimal Characterization and Disposal Priority for Low and Intermediate Level Radioactive Wastes (LILWs) in Korea</b>               | 2009 |
| <i>Min Ho Ahn, Sang Chul Lee, Kun Jai Lee</i>  |      |
| <b>Development of an Integrated Systems Engineering Modeling Package for Chemical Separation Processes under Advanced Fuel Cycle Initiative</b>                  | 2014 |
| <i>Ming Chang, Hsuan-Tsung Hsieh, Yitung Chen, Matthew Hodges, George Vandegrif, Jackie Copple, James Laidler</i>  |      |
| <b>Development of FR Fuel Cycle in Japan (1) Development Scope of Fuel Cycle Technology</b>  | 2019 |
| <i>Hirofumi Nakamura, Hideyuki Funasaka, Takushi Namekawa</i>  |      |
| <b>Development of FR Fuel Cycle in Japan (2) Basic Design and Verification of U-Pu-Np Co-recovery Flowsheets for Engineering Scale Hot Examinations in Japan</b> | 2029 |
| <i>Hiroki Nakabayashi, Toshihisa Nagai</i>   |      |

## **VOLUME 4**

|  |      |
|--|------|
| <b>Development of FR Fuel Cycle in Japan (3) Current State on Unified Technology of De-nitrification Conversion and Granulation for the Simplified Pellet Fuel Production Based on Microwave Heating</b> | 2036 |
| <i>Masahiro Suzuki, Katsunori Ishii, Takuma Yamamoto, Yoshiyuki Kato, Tsutomu Kurita, Katsunobu Yoshimoto, Yoshiyuki Kihara, Takashi Namekawa, Kan-ichi Fujii</i>  |      |
| <b>Development of FR Fuel Cycle in Japan (4) Consideration of transition from LWR-cycle to FR-cycle</b>  | 2046 |
| <i>Fuminori Sato, Hirofumi Nakamura</i>  |      |

|  |      |
|--|------|
| <b>Evaluation of the Possibility of Plutonium and Minor Actinides Transmutation in HWR .....</b>                       | 2051 |
| <i>Petre Ghitescu, Nineta Balas Ghizdeanu</i>  |      |
| <b>Preliminary Analysis by means of the TRANSURANUS Code of Mixed Oxide Fuel Rod for Gen IV Lead Fast Reactor.....</b> | 2060 |
| <i>F. Vetraino, R. Calabrese, C. Artioli, L. Luzzi, V. Sobolev</i>   |      |
| <b>Mixed Plutonium Conversion and Actinides Burning in Fast Molten Salt Reactors.....</b>                              | 2068 |
| <i>Youhei Kamiyama, Yoichiro Shimazu, Tadashi Narabayashi, Masashi Tsuji</i>   |      |

## **Track 8.00: Materials and Structural Issues**

|  |      |
|--|------|
| <b>New Nuclear Power Plants in Europe - Design Aspects for Constructional Engineering .....</b>  | 2075 |
| <i>Rüdiger Meiswinkel, Franz-Hermann Schlüter</i>  |      |
| <b>Multiscale Modeling Approach to Stress Corrosion Cracking .....</b>   | 2081 |
| <i>Ismail Tirtom, Nishith Kumar Das, Ken Suzuki, Kazuhiro Ogawa, Tetsuo Shoji</i>  |      |
| <b>Influence of Non Linear Geometrical Parameter on Curved Thin Shell Buckling Behaviour.....</b>  | 2090 |
| <i>R. Lo Frano, G. Forassassi</i>  |      |
| <b>Correlation Between Intrinsic Hardness and Defect Structures of Ion Irradiated Fe Alloys .....</b>  | 2100 |
| <i>Chansun Shin, Hyung Ha Jin, Junhyun Kwon</i>  |      |
| <b>Dynamics of Frictional Interaction of a Fuel Rod Cladding and Spacer Grid Cell in a Fuel Assembly .....</b>   | 2108 |
| <i>Yu. Drozdov, V. Makarov, A. Afanasiev, I. Matvienko, T. Savinova</i>  |      |
| <b>Ultrasonic TOFD Method Application for Steel Components and Welds of 10mm Wall Thickness Using Ultrasonic Flaw Detector and ULTRA7 TOFD Software.....</b> | 2116 |
| <i>K. Kasarov, B. Tabakova</i>   |      |
| <b>Study of the Tunneling Effect Within Lattices with Cubic Structure on Varying Temperature .....</b>   | 2121 |
| <i>Fulvio Frisone</i>  |      |
| <b>High Temperature Thermal and Structural Material Properties for Metals used in LWR Vessels .....</b>  | 2127 |
| <i>J.L. Rempe, D.L. Knudson, J.E. Daw, J.C. Crepeau</i>  |      |
| <b>Flaw Tolerance Evaluation to Support Alternative Examination Volume and/or Inspection Interval for Nickel-Based Alloy Components .....</b>                | 2135 |
| <i>C.K. Ng, A. Udyawar, S. Swamy</i>   |      |
| <b>Oxide Fouling Mitigation Technology in BWR .....</b>  | 2142 |
| <i>Young-Jin Kim, Catherine Dulka</i>  |      |
| <b>Flexural Behavior of Concrete Beam with Mechanical Splices of Reinforcement Subjected to Cyclic Loading.....</b>  | 2151 |
| <i>H.S. Nah, K.S. Kim</i>  |      |
| <b>Creep Behaviors of Alloy 617 at Temperatures Between 800 and 1000°C .....</b>   | 2158 |
| <i>Daejong Kim, Changheui Jang, Woo Seog Ryu</i>   |      |
| <b>Corrosion Studies of Candidate Materials for European HPLWR .....</b>   | 2163 |
| <i>Sami Penttilä, Aki Toivonen, L. Heikinheimo, Radek Novotny</i>  |      |
| <b>Theoretical Design of SCC Resistant Ni-base Alloy by a Computational Chemistry Approach.....</b>  | 2175 |
| <i>Nishith Kumar Das, Ken Suzuki, Yoichi Takeda, Kazuhiro Ogawa, Tetsuo Shoji</i>  |      |

|  |      |
|--|------|
| <b>Study on an Innovative Fast Reactor Utilizing Hydride Neutron Absorber.....</b>   | 2183 |
| <i>Kenji Konashi, Tomohiko Iwasaki, Kunihiro Itoh, Mutsumi Hirai, Ikken Sato, Ken Kuroasaki, Akihiro Suzuki, Yoshihito Matsumura, Yoshihisa Tahara</i> |      |
| <b>Comparison of Inelastic Behaviors Between Cold Worked 316L and Solution Annealed 316L Stainless Steels .....</b>                                    | 2191 |
| <i>J.B. Kim, H.Y. Lee, C.G. Park, J.H. Lee</i>   |      |
| <b>Effects of Alloying Elements on the Microstructure and Mechanical Properties in SA508 Gr.4N Low Alloy Steel .....</b>                               | 2198 |
| <i>Min-Chul Kim, Sang-Gyu Park, Yoon-Sun Lee, Bong-Sang Lee</i>  |      |
| <b>Effects of Welding on Toughness of Mod. 9Cr-1Mo Steel.....</b>  | 2206 |
| <i>Woo-Seog Ryu, Sung-Ho Kim, Ji-Hyun Yoon</i>   |      |
| <b>Development of Digital Materials Database for Design and Construction of New Power Plants .....</b>   | 2210 |
| <i>Weiju Ren</i>   |      |

### **Track 9.00: Nuclear Energy and Sustainability**

|   |      |
|---|------|
| <b>IAEA'S Study on Advanced Applications of Water Cooled Nuclear Power Plants .....</b>   | 2220 |
| <i>John Cleveland, Alan McDonald, Atam Rao</i>  |      |
| <b>Analytical Hierarchy Process for the Selection of Nuclear Reactors for Mexico .....</b>  | 2228 |
| <i>Cecilia Martin-del-Campo, Pamela F. Nelson, Juan Luis François</i>   |      |
| <b>New Power Expansion Strategy and a Low GHG Emitting Economy in Korea .....</b>   | 2237 |
| <i>Whan-Sam Chung, Sung-Won Yun, Dae Sung Lee, Jae-Woo Jeong</i>  |      |
| <b>The Role of Nuclear Power in a CO<sub>2</sub> Emission Reduction in Korea .....</b>  | 2241 |
| <i>Seung-Su Kim, Man-Ki Lee</i>   |      |
| <b>Evaluation of the Scenario for Innovative Russian Nuclear Power Development.....</b>   | 2248 |
| <i>Alexander Chebeskov, Victor Dekusar</i>  |      |
| <b>Risks and Benefits of Nuclear Energy in a Sustainable Development Perspective.....</b>   | 2257 |
| <i>Evelyne Bertel</i>   |      |
| <b>The Norwegian Thorium Initiative.....</b>  | 2266 |
| <i>Øystein Asphjell, Bård Sæthre, Julian Kelly</i>  |      |
| <b>High-Temperature Reactors for Underground Liquid-Fuels Production With Direct Carbon Sequestration .....</b>   | 2269 |
| <i>C.W. Forsberg</i>  |      |
| <b>Novel Reactor Designs to Burn Non-Fissile Fuels .....</b>  | 2278 |
| <i>J. Gilleland, Charles Ahlfeld, Dimitri Dadiomov, Rod Hyde, Yuki Ishikawa, David McAlees, Jon McWhirter, Nathan Myhrvold, John Nuckolls, Ashok Odedra, Kevan Weaver, Charles Whitmer, Lowell Wood, George Zimmerman</i> |      |
| <b>Initial Operation of the High Temperature Electrolysis Integrated Laboratory Scale Experiment at INL .....</b>   | 2285 |
| <i>C.M. Stoots, J.E. O'Brien, K. Condie, J.S. Herring, J.J. Hartvigsen</i>  |      |
| <b>Commercial Scale Performance Predictions for Hightemperature Electrolysis Plants Coupled to Three Advanced Reactor Types .....</b>   | 2295 |
| <i>J.E. O'Brien, M.G. McKellar, J.S. Herring</i>  |      |
| <b>Hydrogen Production for Transportation Fuels Using Nuclear Energy .....</b>  | 2307 |
| <i>J.S. Herring, K. Condie, James E. O'Brien, Carl M. Stoots, J.J. Hartvigsen</i>   |      |

|   |      |
|---|------|
| <b>Initial Assessment of the Operability of the VHTR-HTE Nuclear Hydrogen Plant .....</b>                               | 2315 |
| <i>Richard B. Vilim</i>   |      |
| <b>Once-through Hybrid Sulfur Process for Nuclear Hydrogen Production .....</b>   | 2326 |
| <i>Yong Hoon Jeong</i>  |      |
| <b>Integrating Large-scale Co-generation of Hydrogen and Electricity from Wind and Nuclear Sources (NUWINDZ™) .....</b> | 2335 |
| <i>A.I. Miller, R.B. Duffey</i>   |      |

## **Track 10.00: Near Term Issues**

|  |      |
|--|------|
| <b>Integration of New Nuclear power Plants into Transmission Grids Part I: Transmission System Issues .....</b>      | 2345 |
| <i>Nick Abi-Samra</i>  |      |
| <b>Integration of New Nuclear Power Plants into Transmission Grids Part II: Zones of Vulnerabilities (ZoV) .....</b> | 2350 |
| <i>Nick Abi-Samra</i>  |      |
| <b>Advanced Cooling Technologies .....</b>   | 2358 |
| <i>John S. Maulbetsch</i>  |      |
| <b>Application of Hybrid Cooling Technology for North Anna Unit 3 .....</b>  | 2369 |
| <i>John D. Waddill, Douglas A. Kemp</i>  |      |
| <b>Human Resource Development for the New Nuclear Power Plant Unit in Armenia .....</b>                              | 2375 |
| <i>Aram Gevorgyan, Areg Galstyan, Michael Donovan</i>  |      |
| <b>Near-Term Deployment of Advanced Light Water Reactors.....</b>  | 2377 |
| <i>Jeffrey F. Hamel</i>  |      |
| <b>How an EAM Solution Could Support a New Build Project? .....</b>  | 2382 |
| <i>Eric Luanco</i>   |      |
| <b>Design of Integrated Managing System for NPP Safety Based on CIMS and Fractal Modeling Method .....</b>           | 2389 |
| <i>Feng-yu Li, Xin-ye Wang, Ying Liu</i>   |      |

## **Track 11.00: Reactor Physics and Analysis**

|   |      |
|---|------|
| <b>A Heterogeneous Model for Burnup Calculation in High Temperature Gas-Cooled Reactors.....</b>  | 2394 |
| <i>Christopher M. Perfetti, Samim Anghaie, Alan Baxter, Chris Ellis</i>   |      |
| <b>The Enhancements and Testing for the MCNPX Depletion Capability.....</b>   | 2402 |
| <i>Michael L. Fensin, John S. Hendricks, Samim Anghaie</i>  |      |
| <b>A New Method to Compute the Dominance Ratio in Monte Carlo Simulations - Application to a Simple Pin Cell with the 3-D Monte Carlo Code TRIPOLI4 .....</b> | 2413 |
| <i>Eric Dumonteil, Tanguy Courau</i>  |      |
| <b>Pin-by-Pin Power Reconstruction in the Future EDF Calculation Scheme .....</b>   | 2421 |
| <i>E. Girardi, M. Cometto, T. Courau, D. Couyras, N. Schwartz</i>   |      |
| <b>Elements of Validation of Microscopic Depletion for the Future EDF Calculation Scheme Based on APOLLO2 and COCAGNE Codes .....</b>                         | 2431 |
| <i>F. Hoareau, F. Laugier, D. Couyras</i>   |      |

|   |      |
|---|------|
| <b>Elements of Validation of Pin-by-Pin Calculations with the Future EDF Calculation Scheme Based on APOLLO2 and COCAGNE Codes</b>  | 2439 |
| <i>Tanguy Courau, M. Cometto, Enrico Girardi, David Couyras, Nadine Schwartz</i>  |      |
| <b>ZPPR-21 Critical Benchmark Analyses with ENDF/B-V and -VII Data</b>  | 2449 |
| <i>Changho Lee, Sang Ji Kim, Won Sik Yang</i>   |      |
| <b>An Application Method of Benchmark Experiment Results to Small Innovative Fast Reactor Designs</b>   | 2457 |
| <i>Yasushi Tsuboi, Yasuyuki Moriki, Masatoshi Kawashima</i>   |      |
| <b>Development of an Automated Testing System for Verification and Validation of Nuclear Data</b>   | 2461 |
| <i>Brian S. Triplett, Samim Anghaie, Morgan C. White</i>  |      |
| <b>Identification of the Doppler Coefficient from a Low Power Transient Observed in a Zero-Power Reactor Physics Test of PWRs</b>   | 2469 |
| <i>Masashi Tsuji, Yoichiro Shimazu, Tadashi Narabayashi, Yasushi Hanayama, Yasunori Ohoka, Masatoshi Yamasaki</i>   |      |
| <b>Improvement of Prediction Accuracy for Fuel Fabrication System with Erbia Bearing Fuel</b>   | 2479 |
| <i>Toshikazu Takeda, Tadafumi Sano, Takeshi Kuroishi, Masatoshi Yamasaki, Hironobu Unesaki</i>  |      |
| <b>Checkmate<sup>SM</sup> - a New Concept in Core Design</b>  | 2487 |
| <i>Magnus Krunders, Emilio Fuentes</i>  |      |
| <b>A Minimum Shuffle Core Design Strategy for ESBWR</b>   | 2494 |
| <i>Atul A. Karve, Russ M. Fawcett</i>   |      |
| <b>Neutronic Study for Introduction of Erbium As a Burnable Poison Into the Fuel Cladding Tube to Enable PWR Core Control</b>   | 2499 |
| <i>C. Chabert, J.C. Brachet, S. Olier</i>   |      |
| <b>Modification of the Japanese First Nuclear Ship Reactor for a Regional Energy Supply System</b>  | 2505 |
| <i>Kotaro Sato, Yoichiro Shimazu, Tadashi Narabayashi, Masashi Tsuji</i>  |      |
| <b>Validation of Shielding Design for Spent Fuel Cask Storage Facility Using Various Codes</b>  | 2512 |
| <i>Hideo Nakano, Shigeki Nemezawa, Toshihisa Tsukiyama, Yuji Nemoto</i>   |      |
| <b>Reactor Physics Aspects of the Incident Occurred at Paks NPP in 2003</b>   | 2518 |
| <i>Sándor Fehér, András Wirth, József Kópházi, Szabolcs Czifrus</i>   |      |
| <b>Core Monitoring Combining Measurements from Different Nuclear Instrumentations</b>   | 2527 |
| <i>Gérard Rio, Benjamin Battel</i>  |      |
| <b>Decay Heat Analysis of a VHTR Core Using the HELIOS and ORIGEN-2 Codes</b>   | 2533 |
| <i>Jae Man Noh, Kang-Mok Bae</i>  |      |
| <b>Criticality Calculations on Realistic Modelling of Pebble-bed HTR-proteus as a Validation for the Woodcock Tracking Method Implemented in the MORET 5 Monte Carlo Code</b> | 2540 |
| <i>Benoit Forestier, Joachim Miss, Olivier Jacquet, Franck Bernard, Bernard Verboomen</i>   |      |
| <b>Optimal Control Search of Xenon Oscillation Control in Large PWRs Using a Characteristic Ellipse Trajectory Drawn by Three Axial Offsets</b>                               | 2549 |
| <i>Youichiro Shimazu</i>  |      |
| <br><b>Track 12.00: Innovative and Space Reactor Systems</b>  |      |
| <b>Compact, Readily Deployable Reactor Systems for Secure Power for Civilian and Defense Applications</b>   | 2559 |
| <i>James R. Powell, J. Paul Farrell</i>   |      |

|  |      |
|--|------|
| <b>A Basic LEGO Reactor Design for the Provision of Lunar Surface Power .....</b>  | 2571 |
| <i>John Darrell Bess</i>   |      |
| <b>Modeling and Analysis of a Lunar Space Reactor with the Computer Code RELAP5-3D/ATHENA.....</b>   | 2581 |
| <i>Juan J. Carbojo, Louis Qualls</i>   |      |
| <b>Modifications to the Fission Surface Power Primary Test Circuit (FSP-PTC) .....</b>   | 2589 |
| <i>Anne E. Garber</i>  |      |
| <b>Experimental and Research Study of Novel Nuclear Concepts (Survey of Current Results of ISTC Programs).....</b>                                   | 2598 |
| <i>L.V.Tocheny</i>   |      |
| <b>Computational Thermohydrodynamic Analysis of Thermal Engine Rocket Adventurer for Space Nuclear Application .....</b>                             | 2605 |
| <i>Seung H. Nam, Seong G. Kang, Il K. Jung, Kune Y. Suh</i>  |      |
| <b>Recent Developments of the MOA Thruster, a High Performance Plasma Accelerator for Nuclear Power and Propulsion Applications .....</b>            | 2618 |
| <i>Norbert Frischauf, Manfred Hettmer, Andreas Grassauer, Tobias Bartusch, Otto Koudelka</i>   |      |
| <b>Thermal-hydraulic Analysis of the MIT Research Reactor Low Enrichment Uranium (LEU) Core .....</b>  | 2631 |
| <i>Yu-Chih Ko, Lin-Wen Hu, Mujid S. Kazimi</i>   |      |
| <b>Advanced Test Reactor - National Scientific User Facility: Research Proposal Process and Lessons Learned .....</b>                                | 2640 |
| <i>Clifford J. Stanley, Frances M. Marshall, Mary Catherin Thelen</i>  |      |
| <b>Proposed Fuel Pin Irradiation Facilities for the High Flux Isotope Reactor .....</b>  | 2645 |
| <i>J.L. McDuffee, J.C. Gehin, R.J. Ellis, R.W. Hobbs, R.T. Primm III</i>   |      |
| <b>Innovations in Design for the Enhancement of Experimental Neutron Flux at the Massachusetts Institute of Technology Research Reactor.....</b>     | 2652 |
| <i>Tyler Ellis, Thomas Newton Jr.</i>  |      |
| <b>The ATR National Scientific User Facility: A New Role for a National Asset.....</b>   | 2657 |
| <i>Mitchell K. Meyer, Frances Marshall</i>   |      |
| <b>General Purpose Heat Source Simulator .....</b>   | 2663 |
| <i>William J. Emrich Jr.</i>   |      |
| <b>NaK Plugging Meter Design for the Feasibility Test Loops .....</b>  | 2667 |
| <i>J. Boise Pearson, Thomas J. Godfroy, Robert S. Reid, Kurt A. Polzin</i>   |      |
| <b>Concept of Direct Energy Conversion Nuclear Cogeneration Plant .....</b>  | 2674 |
| <i>V.I. Yarygin, G.E. Lazarenko, V.S. Mironov, A.P. Pyshko, M.K. Ovcharenko, A.D. Krotov, V.A. Linnik, A.S. Mikheyev, A.V. Sonko, D.G. Lazarenko</i> |      |

### **Track 13.00: Plant Licensing Issues**

|  |      |
|--|------|
| <b>Competitive Paths to New Plant Licensing .....</b>  | 2681 |
| <i>Alexander Restrepo, Samim Anghaie</i>   |      |
| <b>Special Treatment for Important to Safety Structures, Systems and Components (SSCs) in the Licensing of Light Water Reactors.....</b> | 2689 |
| <i>Richard W. McNally</i>  |      |

### **Author Index**