

Canadian Nuclear Society

29th Annual Conference of the
Canadian Nuclear Society
and
32nd CNS/CNA Student
Conference
2008

June 1-4, 2008
Toronto, Ontario, Canada

Volume 1 of 3

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571
www.proceedings.com

ISBN: 978-1-60560-710-8

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

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

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

Canadian Nuclear Society
480 University Avenue
Suite 200
Toronto, Ontario, Canada M5G 1V2

Phone: 416-977-7620
Fax: 416-977-8131

cns-snc@on.aibn.com

TABLE OF CONTENTS

Volume 1

Modelling of Aircrew Radiation Exposure from Solar Particle Events	1
<i>H. Anid, B.J. Lewis, L. Bennett</i>	
An Analysis to Determine Industry's Preferred Option for an Initial Generic Reliability Database for CANDU	11
<i>D. Komljenovic, E. Chan, S. Ganguli, J. Wu, R. Parmar</i>	
Environmental Monitoring of Chinook Salmon	26
<i>D. Morris, D. Boreham</i>	
Overview of Experimental Programs on Core Melt Progression and Fission Product Release Behaviour	35
<i>B.J. Lewis, R. Dickson, F.C. Iglesias</i>	
Effects of Fluid Stream Impurities on Performance of a Supercritical CO₂ Power Conversion System	59
<i>D. Côté, A. Gagnon, D. Pucsek</i>	
Fission Product Release Mechanisms: Research in Canada	67
<i>F.C. Iglesias, B.J. Lewis, A. Olivia, P. Purdy</i>	
Fuel Performance and Thermochemistry Modeling of CANDU Nuclear Fuel	89
<i>M.H.A. Piro</i>	
Study on the Dissolution of Uranium Dibutyl Phosphate Deposits	101
<i>A.L. Rufus, V.S. Sathyaseelan, S. Velmurugan, S.V. Narasimhan</i>	
Diagnostic Imaging Procedures During Pregnancy: What are the Fetal Risks?	112
<i>K. Taylor</i>	
Evaluation of Network Structures and Protocols for Nuclear-Specific Applications	123
<i>P. Zahedi</i>	
Computed Phase Equilibria for Burnable Neutron Absorbing Materials for the Advanced CANDU Reactor Design	129
<i>E.C. Corcoran, B.J. Lewis, W.T. Thompson</i>	
IEC 61508: Compatibility, Application and Requirements in Canadian Nuclear Industry	141
<i>E. Zahedi</i>	
The Kinetics of Cathodic Oxygen Reduction on Thin Films on NI-CR-MO (W) Alloys	145
<i>X. Zhang, P. Jakupi, D. Zagidulin, J.J. Noël, D.W. Shoesmith</i>	
Application of Multi-State Systems in Fault Tree Analysis of a Conceptual Thermochemical Hydrogen Plant	154
<i>Y. Zhang, L. Lu, G.F. Naterer</i>	
Modification of Fuel Bundles and Associated Optimization of Fuel Handling Equipment	162
<i>P. Ponomaryov</i>	
Application of the Simple Analytical Approach to Calculate Pressure Drop in Liquid Nitrogen Two Phase Flow Over Large Distances Using Hoses	166
<i>M.A. Aamir, D. Creates, P. Bekeris</i>	
Numerical Investigation of Turbulent Flow in a Twin Rectangular Sub-Channel Geometry	177
<i>D. Home, M.F. Lightstone, M.S. Hamed</i>	
Mock-Up to Simulate Pipe Freezing in Shutdown Cooling Rooms	194
<i>M.A. Aamr, D. Creates, P. Bekeris</i>	
Radiolysis of Water Containing Dissolved Nitrogen Species	206
<i>P. Yakabuskie, J. Joseph, J. Wren</i>	

Best Estimate Methods for Safety Analysis and Trip Assessment	214
<i>A.C. Morreale</i>	
Aqueous Solubility of Zirconia	224
<i>S. Sunder, S. Wren</i>	
Distributed Control System Implementation in Nuclear Power Plants Worldwide: A Literature Survey	236
<i>N. Khan</i>	
Fluid-Phase Transitions in Light Water and Heavy Water	248
<i>R.L. Varty</i>	
Unsteady Reynolds Averaged Navier-Stokes (URANS) Modelling of Turbulent Flow in a Twin Rectangular Sub-Channel Geometry	258
<i>G. Arvanitis, D. Home, M.F. Lightstone, M.S. Hamed</i>	
Evaluation of Crud Behavior in Primary Circuit of Integral Reactor by Multi-Region Model	269
<i>B. Choi, W. Maeng, J. Yeon, J. Hong, H. Yang, J.C. Wren</i>	
Effect of Gamma Radiation on Steel Corrosion	280
<i>K. Daub, X. Zhang, J. Noel, D. Shoemith, J.C. Wren</i>	
Thermochemical Process Heat Requirements of the Copper-Chlorine Cycle for Nuclear-Based Hydrogen Production	290
<i>Z. Wang, K. Gabriel, G.F. Naterer</i>	
Film Breakdown Processes on Carbon Steels in the Presence of Large Anions	301
<i>K. Yazdanfar</i>	
Metal-Oxide Film Conversions Involving Large Anions	307
<i>S. Pretty, X. Zhang, D.W. Shoemith, J.C. Wren</i>	
Pressure Tube-Calandria Tube Thermal Contact Conductance	319
<i>A. Cziraky</i>	
Fundamental BOP I&C Systems Structure in Nuclear Power Plants	324
<i>K. Ishii, H. Harada, T. Yamamori, K. Igarashi, T. Arakida</i>	
The Latest Application of Hitachi's State-of-the-art Construction Technology and Further Evolution Towards New Build NPP Projects	335
<i>K. Akagi, K. Morita, R. Miyahara, K. Murayama, C. Deir, S. Akahori</i>	
Intergranular Corrosion Mechanism of Alloy 400	345
<i>W. Zhang</i>	
Brad Statham Novel Design of a Critical Heat Flux Experimental Facility	358
<i>B. Statham</i>	
Investigation Into the Potential Release of Chloride from the Moderator Cover Gas Recombiner Catalyst	369
<i>L. Stolberg, S. Suppiah, K. Kutchcoskie</i>	
New Laws of Practice for Learning and Error Correction	381
<i>R. Duffey</i>	
Validation of Fluent Software for Prediction of Flow Distribution and Pressure Gradients in a Multi-Branch Flow Header	390
<i>A. Muhana, D. Novog</i>	
First Steps Toward a Mechanistic Model for Core Disassembly in a CANDU Reactor	404
<i>R. Perez</i>	
Reactivity Management in Control Room Operations	410
<i>T. Primeau, A. Dykeman</i>	

Determination of Realistic Margins to Fuel Heatup for Slow Loss of Regulation Accidents in a CANDU Reactor	419
<i>D.R. Novog, P. Sermer, D. Quach, J. Luxat</i>	
An Approach to Modelling the Effects of a Small LOCA with a Loss of ECI Under Natural Circulation Conditions in a CANDU Reactor	431
<i>D. Pohl</i>	
Improvement and Qualification of WIMS Utilities	441
<i>T. Liang, W. Shen, E. Varin, K. Ho</i>	
The Development of a Trip Map for the McMaster Nuclear Reactor	447
<i>K. Stoll</i>	
Safety Issues in Nuclear Hydrogen Production with the Very High Temperature Reactor (VHTR)	448
<i>S. Baidur</i>	
Development of the Maple Simulator by Integration of Maple Reactor Model and Plant Display HMI	460
<i>P. Zahedi, M. Borairi</i>	
Electrochemical Impedance Spectroscopy Study of H₂O₂ Interaction with γ-FeOOH Single-Phase Films on the Gold Electrodes	468
<i>D. Fu</i>	
Modelling of Liquid Injection Shutdown System (LISS) in ACR-1000	476
<i>M. Boubcher, A. Colton, J.V. Donnelly</i>	
Effet d'une Vidange Stratifiée du Caloporteur sur la Réactivité et la Distribution du Flux Neutronique d'une Cellule CANDU-6	485
<i>M. Massicotte</i>	
RFSP-IST Simulation of Fuel Transient During Refuelling the ACR-1000 Reactor	496
<i>J. Hu, I. Martchouk, R. Robinson</i>	
A Simplified Oxidation Model For Defective Nuclear Fuel	508
<i>K. Shaheen, B.J. Lewis</i>	
The Determination of Local Corrosion Kinetics Using Scanning Electrochemical Microscopy	520
<i>H. He, Z. Qin, P. Keech, J.J. Noel, Z.F. Ding, D.W. Shoesmith</i>	
Void Reactivity Studies for the ATUCHA-II PHWR Reactor. Preliminary Design of a Lower Void Reactivity Fuel	530
<i>F. Khatchikian, J. Fink</i>	
Effects of Low-Dose Gamma and Neutron Radiation on Genotoxicity and Cytotoxicity of Reticulocytes in a Mouse Model	543
<i>N. Phan, N. McFarlane, J. Lemon, D. Boreham</i>	
Crevice Corrosion Damage Analysis on Ni-Cr-Mo Alloys Proposed for the Fabrication of Nuclear Waste Containers	552
<i>P. Jakupi, D. Zagidulin, J.J. Noel, D.W. Shoesmith</i>	
A Probabilistic Approach to the Estimation of Lifetime Distribution of Alloy 800 SG Tubing	557
<i>M.D. Pandey, S. Datla, R.L. Tapping, Y.C. Lu</i>	
Crevice Corrosion Damage Analysis on No-Cr-Mo Alloys Proposed for the Fabrication of Nuclear Waste Containers	569
<i>P. Jakupi, D. Zagidulin, J.J. Noel, D.W. Shoesmith</i>	
Hardware-in-the-Loop (HIL) Nuclear Power Plant Training Simulation Platform Design and Validation	574
<i>D. Rankin</i>	

Human Factors in the Canadian nuclear Industry: Future Needs	585
<i>F. Harrison</i>	
Time-Average CANDU Model with Fuel Reshuffling	591
<i>K. Auyeung, S. Kelley, R. Godovarthi</i>	

Volume 2

Over-Packing of Spent Ion Exchange Resin Carbon Steel Liners at Ontario Power Generation's Western Waste Management Facility	598
<i>S. Husain, D. Pearson, B. Sklar</i>	
Literature Investigation of Air/Steam Ingress through Small Cracks in Concrete Wall under Pressure Differences	610
<i>J. Jiang</i>	
Surface Electrochemistry of UO₂ in Dilute Acidic Hydrogen Peroxide Solution	622
<i>D. Hall, P. Keech, J. Noel, D. Shoesmith</i>	
Thermal Gradients Caused by the CANDU® Moderator Circulation	629
<i>V. Mohindra, M. Vartolomei, R. Scharfenberg</i>	
Providing Operator Support During Monitoring for Unanticipated Events Through Ecological Interface Design	641
<i>N. Lau, G. Jamieson, G. Skraaning, C. Burns</i>	
Design of a Guaranteed Shutdown State Using Solid Rods for the ACR-1000 Reactor	653
<i>L. Hill, J.V. Donnelly, I. Martchouk, A. Buijs</i>	
Simulation of High Temperature, Non-Congruent Phase Transitions in UO_{2+x}	663
<i>M.J. Welland, B.J. Lewis, W.T. Thompson</i>	
Steam Generator Deposit Mapping	677
<i>V. Newman</i>	
Life Cycle Assessment of Nuclear-Based Hydrogen Production Using Thermochemical Water Decomposition: Extension of Previous Work and Future Needs	686
<i>L. Lubis, I. Dincer, M. Rosen</i>	
Obtaining Third-Party CRNs for N285.0 Class 6 Components	698
<i>G. Waterhouse</i>	
Environmental Assessment Planning for Nuclear New Build in Canada	703
<i>D. Moffett, M. Mayhew, J. Scongack</i>	
The Pebble Bed Modular Reactor (PBMR) as a Source of High Quality Process Heat for Sustainable Oil Sands Expansion	716
<i>A. Morris, R. Kuhr</i>	
Modifications for Better control of the First Radial Mode During Load-Cycling of the ACR-1000	728
<i>G. Teneva, R. Robinson</i>	
The Effect of Hydrazine on the Electrochemical Corrosion Potential of Steam Generator Tubing in the Presence of Oxygen	737
<i>J.M. Smith, A.C. Lloyd</i>	
Heat Transfer Limitation During Rapid Depressurization	751
<i>J.C. Luxat, D.R. Novog</i>	
Improved Linear Congruential Random Number Generators	766
<i>H. Shen, P. Zhang, K. Wang</i>	
Simulation of Long-Term Fuelling Operations for the ACR-1000	771
<i>R. Farkas, R. Robinson, A. Rehman, A. Buijs</i>	

Energy and Exergy Analyses of a Copper-Chlorine thermochemical Water Decomposition Pilot plant for Hydrogen Production	781
<i>M. Orhan, I. Dincer, M. Rosen</i>	
Utilization of Simulated Annealing Algorithm in the ROP Detector Layout Optimisation	801
<i>D. Kastanya, V. Caxaj</i>	
Laser Peening Applications for Next Generation of Nuclear Power Facilities	813
<i>J. Rankin, C. Troung, M. Walter, H. Chen, L. Hackel</i>	
Hydraulic Nuts (Hydranuts) for Critical Bolted Joints	825
<i>S Greenwell</i>	
Use of Soft-Metal Engineered Surfaces to Minimize Galling of Carbon Steel Bolting Materials in Gasketed Joints at Elevated Temperatures	831
<i>D. Hopkins, C. Harrington, S. Greewell</i>	
Modeling the Quenching of a Calandria Tube Following a Critical Break Loca in a CANDU Reactor	842
<i>J.T. Jiang, J.C. Luxat</i>	
A Technical Basis for the Flux Corrected Local Conditions Critical Heat Flux Correlation	861
<i>J.C. Luxat</i>	
A k_{eff} Calculation Method by Monte Carlo	870
<i>H. Shen, K. Wang</i>	
Reactor Building Indoor Wireless Network Channel Quality Estimation Using RSSI Measurement of Wireless Sensor Network	876
<i>S. Merat</i>	
Best Practices in Design and Delivery of a New Tritium Facility	881
<i>I. Bonnett, A. Busigin, A. Griffiths</i>	
Plans to Adapt Point Lepreau Ageing Management to New Industry Guidelines	893
<i>G. Greenlaw, T. Gendron, J. Slade, B. Rankin</i>	
Research on Visual Modeling and Simulation Method for Operational Flowsheets-Oriented CANDU Control Systems	906
<i>Z. Cui, R. Prime, K. Scott, M. McInTyre</i>	
Comparison of Simulated Radioiodine Ratios with Measured Values for Three CANDU Stations	914
<i>S. Mostofian</i>	
Cable Condition Monitoring using Non-Destructive and Non-Intrusive Fourier Transform Near Infrared (FT-NIR) Spectroscopy	922
<i>H. Azizian, S. Benson</i>	
Ultrasonic Inspection of Tubes Without Rotation	934
<i>A. Karpelson</i>	
Molten Salt Reactors: A New Vision for a Generation IV Concept	946
<i>D. LeBlanc</i>	
Modifications to Improve Reliability in Deaerator Level Control by Using Digital Technology	961
<i>S. Harrington, K. Yu</i>	
Online Control Loop Tuning in Pickering Nuclear Generating Stations	970
<i>K. Yu, S. Harrington</i>	
Canadian Regulatory Oversight of Ageing Management for Nuclear Power Plants	976
<i>K. Kirkhope, A. Blahoianu, G. Frappier</i>	
Current & Future Ultrasonic Inspection for CANDU SG Tubes	988
<i>Z. Chen, K. Chan, J. Huggins, T. Malkiewicz</i>	

Using Statistical Inference for Decision Making in Best Estimate Analyses	1000
<i>P. Sermer, K. Weaver, F. Hoppe, C. Olive, D. Quach</i>	
Measurements of Turbulent Pressures of Flow in a Water-Conveying Pipe Containing A Simulation Fuel Bundle	1012
<i>F. Abbasian, J. Cao, S.D. Yu</i>	
Modeling of Pickering NGS B Heat Transport System Seismic Boundary Leak Tightness Test	1023
<i>R. MacLeod, C. Lorencez</i>	
Monitoring and Managing Component Fatigue in CANDU Stations	1032
<i>M. Yetisir, G.L. Stevens, S. Robertson, Y. Ding, G. Burton</i>	
Cracking of 304L Stainless Steel Observed within CANDU Nuclear Power Plants Under Cyclic Moist Environments	1045
<i>R.G. Allen, G.I. Ogundele, A.C. Lloyd, D.K. Jain, A.K. Järvine</i>	
Commercial Implementation of an Innovative Multi-Stage Treatment System for Removal of Radiological and Chemical Contaminants to Near-Zero Levels	1058
<i>A. Davloor, B. Harper, C. Bastien, D. Rapley</i>	
Steam Generator Replacement at Bruce A: Approach, Results, & Lessons Learned	1071
<i>W. Tomkiewicz, B. Savage, J. Smith</i>	
Hydrodynamics of Cupric Chloride Hydrolysis in a Fluidized Bed for Nuclear Hydrogen Production	1083
<i>Y. Haseli, I. Dincer, G.F. Naterer</i>	
STANPIPES Moves to the Windows Environment	1095
<i>T. Stevens, B. Manning</i>	
Generic and Profile Specific Feeder Stress Analysis	1107
<i>M. Li, M.L. Affarwal</i>	
Comparison of Bare-Lattice Calculations Using MCNP Against Measurements with CANFLEX-LEU in ZED-2	1116
<i>Y. Dweiri, B. Arsenault, M. Zeller</i>	
Comparison of MCNP Calculations Against Measurements in Moderator Temperature Experiments with CANFLEX-LEU in ZED-2	1130
<i>D. Watts, F. Adams, M. Zeller, B. Bromley</i>	
Utilization of Handheld Computing to Trend Improvements in Compliance	1142
<i>G. Galvin, J. Rasmussen, A. Haines</i>	
An Introduction to a New LAEA Safety Guide: "Ageing Management for Nuclear Power Plants	1153
<i>J. Pachner, T. Inagake, K.S. Kang</i>	
Investigation of the Combined Effect of Appendages and Axial Power Profile on Post-Dryout Heat Transfer in Tubes	1165
<i>H. Zahlan, D.C. Groeneveld, L.K.H. Leung, A. Tanase, S.C. Cheng</i>	
Methods for Characterizing Uncertainty Effects in Key Input Parameters Used in the 2-Dimensional Monte-Carlo Simulation of Dryout Power	1176
<i>D. Quach, P. Sermer, O. Nainer, B. Phan</i>	
The ACR-1000 Fuel Design Verification Process	1189
<i>P. Reid, M. Tayal, M. Gacesa</i>	

Volume 3

BNA Pellet Material Properties Test Program in Support of ACR-1000 Fuel Design	1198
<i>J. Chang, Z. He, M. Gacesa, P. Reid</i>	

Zirconia-Rare Earth Oxide Material properties Test Program in Support of ACR-1000 Fuel Design	1209
<i>J. Chang, Z. He, P. Reid</i>	
New Shielding Materials with Advances Gamma Absorption	1220
<i>S.G. Ermichev, A.A. Maslov, V.Z. Matveev, A.I. Morenko, V.K. Orlov, A.G. Semenov, V.M. Sergeev, V.I. Shapovalov, O.I. Yuferov, A.M. Visik</i>	
Experimental Investigation of Flow Obstacles Effect on Single Phase Heat Transfer	1232
<i>A. Tanase, D.C. Groeneveld, H. Zahlan, S.C. Cheng</i>	
Evolution of Operations Culture	1241
<i>D. Gould</i>	
Process Simulation of Nuclear-Based thermochemical Hydrogen Production with a Copper-Chlorine Cycle	1250
<i>C.C. Chukwu, G.F. Naterer, M.A. Rosen</i>	
Multi-Objective Optimization of Thermodynamic Power Cycles Using an Evolutionary Algorithm	1259
<i>W. Hounkonnou, J. Dipama, F. Aubé, A. Teyssedou</i>	
Fuel Performance and Thermochemistry Modeling of CANDU Nuclear Fuel	1271
<i>M.H.A. Piro</i>	
Degradation and Bacterial Survival on Nuclear-Grade Ion Exchange Resins and Implications for Waste Management	1283
<i>T. Chiappetta, F. Caron, A. Omri</i>	
Subduction for Permanent Disposal of Long-Lived Highly Radioactive Nuclear Waste	1295
<i>F.P. Ottensmeyer</i>	
Implementation of a Comprehensive Program to Deal with Canada's Nuclear Legacy Liabilities: A Progress Report	1307
<i>J. Miller, S. Halpenny, S. Brooks, G. Dolinar, P.J. Ingham, S. Kenny, G. Koroll, A. Melnyk, D. Metcalfe, M. Blanchette</i>	
The Practical Aspects of Incorporating Human Factors Considerations into Design Changes at nuclear Facilities - A Contractor's Perspective	1321
<i>M. Hourihan, M. Remisz, P. Spagnolo</i>	
Validation of Impinging Jet Models to be Used in CANDU Calandria Vessel CFD Simulations	1332
<i>M. Bouquillon, A. Teyssedou, E. Cuesta, H. Huynh</i>	
A Transient Neutronic-Thermalhydraulic Coupled Modelling Approach	1344
<i>M. Fehri, R. Chambon, A. Teyssedou</i>	
How Safe is Safe Enough? The Canadian Answer	1355
<i>F. Boyd</i>	
Development of Public Acceptance and Market Success with Very Small Nuclear Power Reactors (VSR)	1364
<i>P. Lang</i>	
Implementing Adaptive Phased Management (APM) for Canada's Used Nuclear Fuel	1376
<i>F. King</i>	
What's the Rest of the World Doing With Its Spent Nuclear Fuel?	1390
<i>T. Isaacs</i>	
What Canadians Say About Management of Used Nuclear Fuel	1405
<i>T. Isaacs</i>	
Moving Forward	1414
<i>M. Binder</i>	
Women and the Nuclear Talent Pool: Myths and Perspectives on the Present and Future	1444
<i>C. Cottrill</i>	

Pressure Tube Reactors and a Sustainable Energy Future: The Ultra Development Path	1468
<i>R. Duffey</i>	
Sustainable Development	1473
<i>P. Lamarre</i>	
Nuclear Regulation and Gen III Reactors	1477
<i>J.D. Waddington</i>	
Nuclear Recycle	1488
<i>W. Hannum</i>	
Pressure Tube Reactors and a Sustainable Energy Future: The Ultra Development Path (presentation)	1512
<i>R. Duffey</i>	
Nuclear Regulation and Generation III Reactors: Challenges and Opportunities	1540
<i>J.D. Waddington</i>	
Hydrogen Energy and Sustainability: Overview & the Role for Nuclear Energy	1566
<i>M. Rosen</i>	
COG's Contribution to the Industry	1596
<i>J. Froats</i>	
Tacit Knowledge Emergence	1611
<i>B. Garland</i>	
Human Resources-Meeting the Challenge: An Organization of CANDU Industries Perspective	1659
<i>M. Wash</i>	
Women & the Nuclear Talent Pool: Myths and Perspectives on the Present and Future	1676
<i>S. Brissette, B. Keenan</i>	
ACR-1000--Update	1696
<i>A. Alizadeh</i>	
Global Deployment of the AP1000	1722
<i>B. Pearce</i>	
The Path to Greatest Certainty	1744
<i>J. Harding</i>	
Canada's Oil Sands: Nuclear Power in an Integrated Energy Economy	1761
<i>E. Isaacs</i>	

Author Index