

# TABLE OF CONTENTS

Foreword .....	ix		
<b>PERSPECTIVES ON REPOSITORY PROGRAMS-PANEL</b>			
<b>Monday, June 5, 2000</b>			
<b>Afternoon</b>			
Chairs: <b>John Clouet (TRW)</b> <b>Glen Vawter (TRW)</b>			
✓ Operational and Scientific Questions Related to the Long Term Evolution of Spent Nuclear Fuel in Dry Conditions. Current Status of the French Research, <b>Christophe Poinsot, Pierre Toulhoat, Jean-Paul Piron, Chantal Cappelare, Lionel Desgranges (CEA-France), Jean-Marie Gras (EdF-France)</b> .....	3		
✓ International Nuclear Waste Repository Programs, <b>R. Glenn Vawter (TRW)* J. Strahl — OCRWM</b>			
✓ Overview of the U.S. Waste Repository Programs. <b>J. Williams (DOE-RW)</b> *			
<b>PLUTONIUM DISPOSITION—CAN ROBOTS HELP?</b>			
<b>Tuesday, June 6, 2000</b>			
<b>Morning</b>			
Chair: <b>Joe Cohen (Westinghouse SRC)</b>			
Plutonium Disposition by Immobilization, <b>Tom Gould (WSRC/LLNL), Al DiSabatino, Mark Mitchell (LLNL)</b> ...	13		
Remote Material Handling in the Plutonium Immobilization Project, <b>Jeffery R. Brault (Westinghouse SRC)</b> .....	16		
Material Transfer System in Support of the Plutonium Immobilization Program, <b>D. Pak (Westinghouse SRC/LLNL), W. Brummond (LLNL)</b> .....	20		
Plutonium Immobilization-Can Loading, <b>Eric Kriikku, Gregg Hovis (Westinghouse SRC)</b> .....	22		
A Robotic System for Automated Handling of Ceramic Pucks, <b>Kurt D. Peterson (Westinghouse SRC)</b> .....	26		
Plutonium Immobilization Project-Robotic Canister Loading, <b>E. Lee Hamilton, Gregory L. Hovis, Mitchell W. Stokes (Westinghouse SRC)</b> .....	30		
Plutonium Immobilization Project-Cold Pour Phase 1 Test Results, <b>Gregory L. Hovis, E. Lee Hamilton, Michael E. Smith (Westinghouse SRC)</b> .....	35		
<b>SPENT NUCLEAR FUEL STABILIZATION AND CONDITIONING-I</b>			
<b>Tuesday, June 6, 2000</b>			
<b>Morning</b>			
Chairs: <b>John Ackerman (ANL)</b> <b>Joe Krupa (Westinghouse SRC)</b>			
Melt-Dilute Treatment Technology for Aluminum-Based Research Reactor Fuel, <b>Thad M. Adams, Harold B. Peacock, Jr, Robert L. Sindelar, Natraj C. Iyer, William F. Swift, Fred C. Rhode, Helen M. Brooks (Westinghouse SRC)</b> ...	41		
The Melt-Dilute Disposition Option for $^{233}\text{U}$ , <b>Thad M. Adams, Harold B. Peacock, Jr, Robert L. Sindelar (Westinghouse SRC)</b> .....	46		
Off-Gas System Development for the Melt-Dilute Treatment of Aluminum-Based Spent Nuclear Fuel, <b>Andrew J. Duncan, Thad M. Adams, Harold B. Peacock, Jr.(Westinghouse SRC)</b> .....	51		
Electrometallurgical Treatment Demonstration at ANL-West, <b>K. M. Goff R. U. Benedict, S. G. Johnson, R. D. Mariani, M. F. Simpson, B. R. Westphal (ANL-Idaho)</b> .....	58		
Electrometallurgical Treatment of Degraded N-Reactor Fuel, <b>K. V. Gourishankar, E. J. Karel, R. E. Everhart, E. Indacchea (ANL)</b> .....	65		
Managing Epoxy-Bearing Spent Nuclear Fuel Samples, <b>Rebecca E. Lords, Douglas W. Akers (Bechtel BWXT Idaho)</b> .....	73		

\* Paper was not available at publication time. Viewgraphs.

## CRITICALITY SAFETY ISSUES FOR SPENT NUCLEAR FUEL AND FISSION MATERIAL-I

Tuesday, June 6, 2000  
Morning

Chairs: *Thomas Doering (EPRI)*  
*Jim Thornton (Duke)*  
*Mark DeHart (ORNL)*

Maximizing Criticality Control Coverage for Geologic Disposal of DOE SNF, <i>J. Wesley Davis (FCF)</i> .....	83
Generic Degradation Scenarios and Configurations for Internal Criticality Analysis of DOE Codisposal Waste Package, <i>Shyang-Fenn Deng, Dionisie R. Moscalu, J. Wesley Davis (FCF), Peter Gottlieb (TRW ESS)</i> .....	86
Disposal Criticality Analysis for TRIGA Fuels, <i>J. M. Rammsy, L. Angers, J. W. Davis (FCF)</i> .....	92
Disposal of Enrico Fermi Spent Nuclear Fuel in Yucca Mountain: Waste Package Internal Criticality Analysis, <i>Dionisie R. Moscalu, Amir S. Mobasheran, J. Wesley Davis (FCF), Paul J. Sentieri (INEL)</i> .....	98
Shielding and Criticality Calculations of MOX (FFTF) DOE-Owned Fuel, <i>Sedat Goluoglu, J. Wesley Davis, Laetitia Angers (FCF), Lee M. Montierth (INEL)</i> .....	103

## PLUTONIUM STORAGE AND CONVERSION

Tuesday, June 6, 2000  
Afternoon

Chair: *Harold McFarlane (ANL-Idaho)*

Plutonium Disposition and Storage Model, <i>Joseph F. Krupa, Richard A. Dimenna, Bruce J. Hardy (Westinghouse SRC)</i> .....	113
Management of Super-Grade Plutonium in Spent Nuclear Fuel, <i>Harold F. McFarlane, Robert W. Benedict (ANL-Idaho)</i> .....	119
Technical and Engineering Feasibility Study of the Vitrification of Plutonium-Bearing Sludges at the Krasnoyarsk Mining and Chemical Combine by Means of Microwave Heating, <i>Y. A. Revenko, K. G. Kudinov, A. A. Tretyakov, A. V. Vassilyev (KM&amp;CC-Russia), G. B. Borisov, A. V. Natarov (VNIINM-Russia), A. S. Aloy (Khlopin Inst-Russia), A. A. Shvedov, B. V. Gusakov (VNIPIET-Russia), Leslie J. Jaridine (LLNL)</i> .....	126
Generating Petri Net Driven Graphical Simulation Tool for Automated Systems, <i>Yu Zhang, Richard A. Volz (Texas A&amp;M), Anil Sehgal (Intel Corp)</i> .....	140
Nondestructive Evaluation and Assay for the Plutonium Ceramification Test Facility, <i>Mark Mitchell, Darrell Pugh, Tzu-Fang Wang (LLNL)</i> .....	148

## SPENT NUCLEAR FUEL STABILIZATION AND CONDITIONING-II

Tuesday, June 6, 2000  
Afternoon

Chairs: *John Ackerman (ANL)*  
*Joe Krupa (Westinghouse SRC)*

Recent Advances During the Treatment of Spent EBR-II Fuel, <i>B. R. Westphal, R. D. Mariani, D. Vaden, S. R. Sherman, S. X. Li, D. D. Keiser, Jr. (ANL-Idaho)</i> .....	153
Morphologies of Uranium Deposits Produced During Electrorefining of EBR-II Spent Nuclear Fuel, <i>Terry C. Totemeyer Nancy L. Dietz (ANL-Idaho)</i> .....	159 ✓
Experimental Observations on the Roles of the Cadmium Pool in Mark-IV ER, <i>S. X. Li, D. Vaden, R. D. Mariani, T. A. Johnson (ANL-Idaho)</i> .....	167 ✓
Product Consistency Test and Toxicity Characteristic Leaching Procedure Results of the Ceramic Waste Form From the Electrometallurgical Treatment Process for Spent Fuel, <i>S. G. Johnson, M. L. Adamic, T. DiSanto, A. R. Warren, D. G. Cummings, L. Foulkrod, K. M. Goff (ANL-Idaho)</i> ..	177 ✓
Analytical Electron Microscopy Study of Radioactive Ceramic Waste Forms, <i>T. P. O'Holleran, W. Sinkler, T. L. Moschetti, S. G. Johnson, K. M. Goff (ANL-Idaho)</i> .....	182 ✓
Degradation Modeling of the ANL Ceramic Waste Form, <i>T. H. Fanning, L. R. Morss (ANL)</i> .....	190 ✓
Treatment of Fermi Blanket SNF Using Laser Declad/Wash Technology, <i>James P. Adams, Christian A. Dahl, Ronald J. Ramer, Michael A. Rynearson (INEEL/Bechtel BWXT Idaho)</i> .....	198 ✓
<b>CRITICALITY SAFETY ISSUES FOR SPENT NUCLEAR FUEL AND FISSION MATERIAL-II</b>	
Tuesday, June 6, 2000 Afternoon	
Chairs: <i>Thomas Doering (EPRI)</i> <i>Jim Thornton (Duke)</i> <i>Mark DeHart (ORNL)</i>	
Disposal Criticality Analysis for the Ceramic Waste Form from the ANL Electrometallurgical Treatment Process—Internal Configurations, <i>R. M. Lell, Rupal Agrawal, E. E. Morris (ANL)</i> .....	207
Criticality Safety Issues in the Disposition of BN-350 Spent Fuel, <i>R. W. Schaefer (ANL-Idaho), R. T. Klann (ANL), S. M. Koltyshov (NNC-Republic of Kazakhstan), S. Krechetov (AEC-Republic of Kazakhstan)</i> .....	214

Criticality Safety Requirements for Transporting EBR-II Fuel Bottles Stored at INTEC, <b>R. M. Lell (ANL), C. L. Pope (ANL-Idaho)</b> .....	222	Quantitative Analysis of Hydrogen Gas Formed by Aqueous Corrosion of Metallic Uranium, <b>Jacqueline E. Fornesbeck (ANL-Idaho)</b> .....	291
<b>GEOLOGIC DISPOSAL OF SPENT NUCLEAR FUEL AND IMMOBILIZED FISSION MATERIALS</b>			
<b>Wednesday, June 7, 2000</b> <b>Morning</b>		<b>INTERIM MANAGEMENT AND STORAGE OF SPENT NUCLEAR FUEL</b>	
Chairs: <i>John Clouet (TRW)</i> <i>Woody Stroupe (TRW)</i>		Chair: <i>Ray Conatser (Westinghouse SRC)</i>	
Performance Assessment Analyses Unique to Department of Energy Spent Nuclear Fuel, <b>Henry Loo (Bechtel BWXT Idaho), James Duguid (DE&amp;S)</b> .....	231	Overview of Hanford's Spent Nuclear Fuel Project, <b>Phillip G. Loscoe (DOE, Richland), Robert B. Wilkinson (DE&amp;S), Michele S. Gerber (Fluor Hanford)</b> .....	301
Thermal Analysis of Codisposal Waste Packages in a Geologic Repository, <b>Si Y. Lee, Robert L. Sindelar (Westinghouse SRC)</b> .....	237	Criteria for the Extended Wet Storage of Research and Test Reactor Spent Fuel, <b>James Howell (Westinghouse SRC), Sindelar</b> .....	307
Spent Nuclear Fuel Source Term Calculational Methodology Used at the Idaho National Engineering and Environmental Laboratory, <b>James W. Sterbentz (Bechtel BWXT Idaho)</b> .....	246	Management of Historic Fuels at AECL Chalk River, <b>James R. Doyle (AECL-Canada), Kay A. Simpson Consult-United Kingdom</b> .....	317
ANL Calculational Methodologies for Determining Spent Nuclear Fuel Source Term, <b>R. D. McKnight (ANL)</b> .....	253	<i>The INEEL SNF Dry Storage Experience. R. D. Denney *</i>	
Repository Performance Assessment of Waste Forms from the Electrometallurgical Treatment of Sodium-Bonded Spent Nuclear Fuel, <b>E. E. Morris, T. H. Fanning, E. E. Feldman, M. C. Petri (ANL)</b> .....	259	<b>TRANSPORTATION OF DOE SPENT NUCLEAR FUEL AND FISSION MATERIAL</b>	
<b>SPENT NUCLEAR FUEL CHARACTERIZATION AND PACKAGING—I</b>			
<b>Wednesday, June 7, 2000</b> <b>Morning</b>		<b>Wednesday, June 7, 2000</b> <b>Afternoon</b>	
Chairs: <i>Denny Fillmore (INEEL)</i> <i>Robert Einziger (ANL)</i>		Chairs: <i>Scott Gladson (INEEL)</i> <i>Ken Sorenson (SNL)</i>	
Degradation of EBR-II Driver Fuel During Wet Storage, <b>Robert G. Pahl (ANL-Idaho)</b> .....	269	Department of Energy Spent Nuclear Fuel Transportation System Concept for the 21 <sup>st</sup> Century, <b>Scott C. Gladson, Arpad L. Lengyel, Dave L. Pincock (Bechtel BWXT Idaho)</b> .....	327
Evaluation of Neutron Absorbers for the Melt-Dilute Treatment of Aluminum-Based Spent Fuel, <b>Dennis W. Vinson, Thad M. Adams, Robert L. Sindelar (Westinghouse SRC)</b> .....	276	Highlights Associated with the Development of the Standardized DOE SNF Canister, <b>D. K. Morton, S. D. Snow, T. E. Rahl, A. G. Ware, N. L. Smith (INEEL)</b> .....	334
Technical Issues and Characterization for Fuel and Sludge in Hanford K Basins, <b>Bruce Makenas, Rich Sexton, Ron Baker Al Pitner, Dennis Trimble (Fluor Hanford), John Abrefah, Paul Bredt (PNNL)</b> .....	284	The COGEMA Industrial Experience in Wet and Dry Shipping Cask Unloading, <b>C. Bonnet (SGN), J. M. Cremon, Ph. Fournier (COGEMA-France), Arvid Jensen (COGEMA, Idaho Falls)</b> .....	339
		Criticality Control in Shipments of Fissile Materials, <b>J. R. Liaw, Y. Y Liu (ANL)</b> .....	347
		Use of Inelastic Analysis in Cask Design, <b>Douglas J. Amerman, Nicole L. Breivik (SNL)</b> .....	353

## SPENT NUCLEAR FUEL CHARACTERIZATION AND PACKAGING-II

Wednesday, June 7, 2000  
Afternoon

Chairs: **Denny Fillmore (INEEL)**  
**Robert Einziger (ANL)**

Repository-Related Dissolution Test Results on MOX Spent Fuel, **Walter J. Gray, Dennis W. Wester (PNNL)** ..... 361

Preliminary Microstructural Characterization of Gadolinium-Enriched Stainless Steels for Spent Nuclear Fuel Baskets, **J. N. DuPont, Z. Q. Liu, S. W. Banovic, D. B. Williams (Lehigh Univ), C. V. Robino, J. J. Stephens, P. McConnell (SNL), R. E. Mizia, D. J. Branagan (Bechtel BWXT Idaho)** ..... 369

Validation Results Based on the Spent Fuel Demonstration Program at FCF, **R. D. McKnight (ANL), J. R. Krsul (ANL-Idaho)** ..... 379

The Multi-Detector Analysis System, **Jerald D. Cole, Edward L. Reber, Mark W. Drigert, J. Keith Jewell, Rahmat Aryaeinejad (INEEL)** ..... 385

Development of Reference Materials for SNF NDA Systems, **Raymond T. Klann (ANL)** ..... 395

Technical Investigation of a Pyrophoric Event Involving Corrosion Products from HEU ZPPR Fuel Plates, **Terry C. Totemeier (ANL-Idaho)** ..... 406

## PLUTONIUM DISPOSITION BY IRRADIATION

Wednesday, June 7, 2000  
Afternoon

Chair: **David Chamberlain (ANL)**

MOX Fuel Irradiation Program for Disposition of Surplus United States Plutonium, **Richard H. Clark (Duke Cogema**

<b>S&amp;W), David Dziadosz (Virginia Power; Glen Allen), Steven P. Nesbit (Duke Power)</b> .....	417
Design of the MOX Fuel Fabrication Facility, <b>James V. Johnson (DOE), Edward J. Brabazon (Duke Cogema S&amp;W)</b> .....	423
Burnup and Fast Neutron Fluence in a MOX Fuel Experiment, <b>Gray S. Chang, John M. Ryskamp (INEEL/Bechtel BWXT Idaho)</b> .....*	430

## PLUTONIUM DISPOSITION BY IMMOBILIZATION

Wednesday, June 7, 2000  
Afternoon

Chair: **Al DiSabatino (LLNL)**

The Impact of Brannerite on the Release of Plutonium and Gadolinium During the Corrosion of Zirconolite-Rich Titanate Ceramics, <b>D. B. Chamberlain, A. J. Bakel, E. C. Buck, M. C. Hash, C. J. Mertz, M. K. Nole, J. K. Basco, S. F. Wolf (ANL)</b> .....	443
---	-----

Durability Testing of Heavy-Ion Irradiated Crystalline Ceramics, <b>Charles L. Crawford (Westinghouse SRC), Crystal R. Biddle (ORAU), Ned E. Bibler (Westinghouse SRC)</b> .....	449
--	-----

Process Development Testing in Support of the Plutonium Immobilization Program, <b>Connie Cicero Herman (Westinghouse SRC), Bartley Ebbinghaus (LLNL)</b> .....	457
---	-----

Milling and Blending of Ceramic Powders for the Plutonium Immobilization Program, <b>D. T. Herman (Westinghouse SRC/LLNL), W. E. Biehl (LLNL)</b> .....	459
---	-----

Author Index .....	461
--------------------	-----

\*Paper was not available at publication time.