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ORNL

FOREIGN TRIP REPORT

ORNL/FTR-2909

DATE: June 20, 1988

SUBJECT: Report of Foreign Travel of A. P. Malinauskas, Central Management Offices

TO: Alexander Zucker

FROM: A. P. Malinauskas

PURPOSE: To participate in the Third Chemical Congress of North America which was convened in Toronto, Canada, June 5-10, 1988, to present an invited paper entitled "Chemical Considerations in Severe Accident Analysis," and participate as a panel member for discussion of the topic "Which Severe Accident Chemistry Topics Most Deserve Further Research?"

SITE VISITED: 6/4-10/88 Toronto, Canada

ABSTRACT: The author presented an invited paper entitled "Chemical Considerations in Severe Accident Analysis" at the Symposium on Nuclear Reactor Severe Accident Chemistry which was conducted as part of the Third Chemical Congress of North America. Over 14,000 scientists attended the Congress, representing virtually all of the chemistry disciplines.

REPORT OF FOREIGN TRAVEL

June 4-10, 1988

PURPOSE OF ACTIVITIES

The purpose of this trip was to participate in the Third Chemical Congress of North America which was convened in Toronto, Canada, June 5-10, 1988. The author presented an invited paper entitled "Chemical Considerations in Severe Accident Analysis" and participated as a member of a discussion panel on the subject "Which Severe Accident Chemistry Topics Most Deserve Further Research?"

SYMPOSIUM ON NUCLEAR REACTOR SEVERE ACCIDENT CHEMISTRY

The Third Chemical Congress of North America was comprised of a number of symposia covering virtually every chemistry discipline. Not too surprising, then, is the observation that well in excess of 14,000 scientists participated.

One of the symposia, entitled "Nuclear Reactor Severe Accident Chemistry," and sponsored by the Division of Nuclear Chemistry and Technology of the American Chemical Society, occupied most of this traveler's attention. He inaugurated the Symposium with the presentation of an invited paper, "Chemical Considerations in Severe Accident Analysis," which was authored by A. P. Malinauskas and T. S. Kress. (A copy of the manuscript is available on request.)

Over 55 papers were delivered in the severe accident chemistry symposium; these are identified in Appendix A. As expected, most of the papers reported results of work being conducted in the United States, but a large number of papers were also presented by United Kingdom researchers. Moreover, the United Kingdom had a surprisingly large number of scientists in attendance. In addition, papers from Canada, India, Japan, West Germany, Switzerland, Sweden, Finland, Denmark, and Russia were delivered as well.

The symposium provided a reasonably good representation of the status of severe accident chemistry. Several issues, once thought to be critical to an understanding of the technology, now appear to have been resolved. (These include the question of the volatility of HOI and the radiation stability of CsI, as examples.) On the other hand an underlying theme of the symposium was the complexity of the chemistry issues.

In the Panel Discussion that concluded the severe accident chemistry symposium, the traveler indicated that, contrary to emphasizing the complexity of the problem, "...the challenge is not to uncover all of the possible physicochemical processes that can be involved in severe core damage accidents. Rather, it is to seek methodologies to reduce these processes to the critical few."

This traveler felt that the meeting was well organized and was of high information content. More importantly, he felt that the occasion afforded him the opportunity to exchange ideas and seek clarification on stated concepts with his professional colleagues.

APPENDIX A

The agenda of the Symposium on Nuclear Reactor Severe Accident Chemistry follows.

Nuclear Reactor Severe Accident Chemistry Symposium I -- Tuesday AM

S. J. Niemczyk (Gull Associates), Session Chair

9:00 Opening Remarks

9:15 Chemical Considerations in Severe Accident Analysis -- A. P. Malinauskas

9:45 Chemical Phenomena Under Severe Accident Conditions -- D. A. Powers

10:15 Break

10:45 Workshop on Chemcial Processes and Products in Severe Accident Accidents -- J. L. Margrave

11:10 Nuclear Reactor Severe Accident Chemistry and Academic Research: A Panel Discussion -- S. J. Niemczyk, ~~D. W. Gilles~~, J. L. Margrave, A. L. Nichols, and D. A. Powers Olander

Nuclear Reactor Severe Accident Chemistry Symposium II - Tuesday PM

A. L. Nichols (United Kingdom Atomic Energy Authority, Atomic Energy Establishment - Winfrith), Session Chair

1:30 An Overview of Separate Effects Tests and Their Contributions to Severe Accident Chemistry -- A. Taig

2:00 Mass Spectrometry Studies of Fission Product Behavior I -- I. Johnson and C. E. Johnson

2:20 Mass Spectrometry Studies of Fission Product Behavior II. Gas Species -- P. E. Blackburn and C. E. Johnson

2:40 The System $CsOH-H_2O$ -- L. G. Johansson and S. Kasikowski

3:00 Break

3:20 The Chemistry of Tellurium for the Analysis of Severe Accidents in Water Cooled Nuclear Reactors -- P. E. Potter

3:40 Possibility of Formation of Organic Telluride Under Reactor Accident Condition--An Experimental Approach -- H. Shiraishi and K. Ishigure

4:00 The Interaction and Resuspension of Fission Products in Severe Reactor Accidents -- A. M. Beard, B. R. Bowsher, S. Dickinson, A. L. Nichols

4:20 Not Given The Effect of Chemical Interactions on Fission Product Transport During Postulated Transients -- D. L. Hagrman and D. A. Powers

4:40 Chemical Reactions in LWR Reactor Vessels During Core Melt Accidents Analysed with the CELSOL Computer Code -- L. Schepper and U. S. Jensen

5:00 Dissolution of Uranium Dioxide by Molten Zircaloy -- K. T. Kim and D. R. Olander

5:20 Fission Product Migration in UO_2 Fuel -- F. Osaisai, S. G. Prussin, and D. R. Olander

Nuclear Reactor Severe Accident Chemistry Symposium III - Tuesday Evening

D. J. Osetek (Idaho National Engineering Laboratory--INEL), Session Chair

7:30 The Influence of Chemistry on Severe Accident Phenomena in Integral Tests -- R. R. Hobbins, D. J. Osetek and D. L. Hagrman

8:00 Chemistry Models in the Victoria Code -- A. J. Grimley III

Not Given 8:20 Computer Code Validation by High Temperature Chemistry -- C. A. Alexander and J. S. Ogden

8:40 Fission Product Behavior During the In-Pile Severe Fuel Damage Test SFD 1-4 -- K. Vinjamuri, D. J. Osetek and D. H. Meikrantz

Not Given 9:00 Fuel Behavior Questions Raised by TMI-2 -- R. R. Hobbins and S. Langer

9:20 Gamma Ray Emission Tomography Examinations of TMI-2 Fuel Debris -- D. W. Akers, H. Makowitz, J. K. Hartwell and R. R. Hobbins

9:40 Verification of the ORIGEN2 Code Analysis for the TMI-2 Reactor Code -- D. W. Akers and B. G. Schnitzler

Not Given 10:00 Different Options in Purification of Polluted Water Volumes -- A. Kostyrko

Nuclear Reactor Severe Accident Chemistry Symposium IV - Wednesday AM

F. Garisto ~~A. C. Vikis~~ (Atomic Energy of Canada Limited, Whiteshell Nuclear Research Establishment--AECL-WNRE), Session Chair

8:30 Vibrational Fundamentals and Thermodynamic Functions of Molecular Boric Acid: A Re-Evaluation of the CsI + H_3BO_3 Reaction -- S. Dickinson, J. S. Ogden, N. A. Young

8:50 The Influence of Radiation on the Stability of CsI in Flowing Steam -- D. J. Wren, R. K. Rondeau and M. Pellow

9:10 Radiolytic Effect on the Chemical State of Iodine in Aqueous Solution -- H. Shiraishi, T. Kimiya, M. Ohmae and K. Ishigure

9:30 Iodine Speciation and Volatility in Relation to Accidental Releases from Nuclear Reactor Accidents -- G. J. Evans and R. E. Jervis

9:50 Break

10:10 Influence of Metallic Silver and Oxygen on the Radiolysis of Cesium Iodide Solutions -- M. Furrer and T. Gloor

10:30 The Radiation-Induced Formation of Organic Iodides -- J. Paquette and B. L. Ford

10:50 Chemical Interactions Between Aerosols and Vapors in the Primary Circuit of an LWR During a Severe Accident -- C. J. Wheatley

11:10 Panel Discussion: Status and Understanding of RCS Chemistry, Including an Assessment of Outstanding Issues. -- P. C. Potter, R. R. Hobbins, A. R. Taig and D. J. Wren

Nuclear Reactor Severe Accident Chemistry Symposium V - Wednesday PM

D. J. Wren (Atomic Energy of Canada Limited, Whiteshell Nuclear Research Establishment--AECL-WNRE), Session Chair

1:30 Chemistry and Mass Transport of Iodine in Containment -- E. C. Beahm, C. F. Weber, T. S. Kress, W. E. Shockley and S. R. Daish

2:00 Iodine Revolatilization from Sumps in Annuli and Auxiliary Buildings Formed After A Severe Accident - G.-U. Greger, A. Bleier, and K. H. Neeb

2:20 Carry-Over of Fission Products By Droplets During Sumpwater Evaporation in Severe Reactor Accidents -- R. Richter, O. Fernholz, R. Rippel, A. Bleier and K. H. Neeb

2:40 Long Term Post Accident Chemistry in Source Term Analysis -- P. N. Clough and J. R. Mullins

3:00 Break

3:20 The Effect of Selected Binary and Mixed Solutions on Steam Condensation and Aerosol Behavior in the Containment -- J. Jokiniemi

3:40 Behavior of CsI-Containing Aerosols Exposed to Hydrogen Burns -- L. S. Nelson, W. B. Benedick, M. J. Eatough, K. P. Guay, and G. D. Valdez

Not Given

4:00 Validation of Ice Condenser Scrubbing Models -- P. C. Owczarski and W. K. Winegardner

4:20 The Effects of Contaminants on the Performance of TEDA Impregnated Charcoal for Removing CH_3I -- J. C. Wren and C. J. Moore

4:40 Filtered Vented Containment Design in Relationship to the Behavior of Important Chemical Species -- M. Klein

Not Given

Nuclear Reactor Severe Accident Chemistry Symposium VI - Thursday AM

M. Jankowski

~~E. Yaremi~~ (International Atomic Energy Agency--IAEA), Session Chair

8:30 N Reactor Severe Accident Chemistry -- P. C. Owczarski

Chernobyl - I. Khodakovsky

9:00 Carburization as a Mechanism for the Release of Radionuclides During the Chernobyl Accident -- D. A. Powers

9:20 UO_2 Oxidation Behavior and Chernobyl Fission Product Release -- C. E. L. Hunt, F. C. Iglesias, and D. S. Cox

9:40 Examination on Graphite Burning in High Temperature Gas Cooled Reactors -- R. Moormann

10:00 Break

10:20 Chemical Aspecrs of Core Heat-Up Accidents in High-Temperature Gas Cooled Reactors -- R. Moormann

10:40 Possible Mo Fractionation from Ru in Severe Reactor Accidents -- K. S. Venkateswarlu and S. R. Bhardwaj

11:00 Characteristics of the Chernobyl Release and Fallout of Potential Generic Interest to Severe Accident Analysis -- L. Devell

11:20 Analysis of Fine Debris Released from Chernobyl-4 -- R. J. C. Dunn, K. D. Horton, A. F. Kingsley, A. L. Nichols, G. C. Allen, and K. R. Hallam

Nuclear Reactor Severe Accident Chemistry Symposium VII - Thursday PM

S. K. Loyalka (University of Missouri-Columbia), Session Chair

1:30 An Overview of In-Vessel Release and Chemistry Modelling in Severe Accident Analysis Codes -- A. J. Grimley III

2:00 Modelling of Chemistry in the Reactor Coolant System Under Severe Accident Conditions -- P. N. Clough and C. J. Wheatley

2:30 A Survey of Chemistry Uncertainties in Severe Accident Containment Analysis -- K. D. Bergeron

3:00 Break

3:20 Effects of Ex-Plant Chemistry on Nuclear Reactor Severe Accident Consequences -- S. J. Niemczyk

Not Given 3:50 An Improved Combustion Model for Nuclear Reactor Safety Studies -- A. S. Geller and C. C. Wong

4:10 The Efficient Calculation of Chemical Interactions in the Primary Circuit of an LWR During A Severe Accident -- C. J. Wheatley

4:30 Formulation of Radiological Releases to Containment for the Design Basis and Beyond the Desing Basis Accidents -- N. Nourbakhsh, M. Khatib-Rahbar, R. Davis and J. Read

4:50 Continuous Modelling of Chemical Reactions During Severe Accident Conditions Using Chemical Thermodynamics -- R. M. Alenljung, L-G. Johansson

Nuclear Reactor Severe Accident Chemistry Symposium VIII - Friday AM

W. Tarbell (Sandia National Laboratories), Chair

8:00 FRG Perspective on Severe Accident Phenomena -- E. F. Hicken, E. J. Kersting, and J. Rohde

8:30 Some Uncertainties in Radionuclide Releases During Core-Concrete Interactions -- D. C. Williams and D. A. Powers

8:50 Fission Product Release from Core-Concrete Mixtures -- M. F. Roche, J. L. Settle, L. Leibowitz, and C. E. Johnson

9:10 The Release of Chemical Species During Core Debris-Concrete Interactions -- M. A. Mignanelli, P. E. Potter and P. N. Smith

9:30 Behavior of Concretes/Liquid Metals Under High Thermal Loads in Reactive Chemical Environments -- J. L. Margrave, G. P. Hansen and R. H. Hauge

9:50 Break

10:10 Gas Solubility in Molten Core Debris -- D. A. Powers

Not Given 10:30 Steam-Metal Reaction in Cavity During High-Pressure Melt Ejection -- N. K. Tutu and T. Ginsberg

10:50 Hydrogen Generation During Fuel-Coolant Interactions: Results from the FITS-D Series -- B. W. Marshall, Jr.

Not Given 11:10 Melt-Coolant Explosions -- F. M. Page

Not Given 11:30 The Effect of Additives on the Violence of Tin/Water Explosions -- F. M. Page

11:50 Panel Discussion: What Are the Most Important Severe Accident Chemistry Topics Deserving Further Consideration? --

APPENDIX B

ITINERARY

June 4, 1988	Travel from Oak Ridge, Tennessee to Toronto, Canada
June 5-10, 1988	Toronto, Canada
June 10, 1988	Travel from Toronto, Canada to Oak Ridge, Tennessee

DISTRIBUTION

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