

2nd International Topical Meeting on Safety and Technology of Nuclear Hydrogen Production, Control, and Management 2010

**San Diego, California, USA
13-17 June 2010**

ISBN: 978-1-61738-846-0

Printed from e-media with permission by:

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



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

Copyright© (2010) by the American Nuclear Society
All rights reserved.

Printed by Curran Associates, Inc. (2010)

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

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

Phone: (800) 323-3044
(708) 352-6611
Fax: (708) 352-0499

www.ans.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2634
Email: curran@proceedings.com
Web: www.proceedings.com

Table of Contents

MONDAY, JUNE 14, 2010, 2:30–5:00 P.M.

Opening Plenary: Nuclear Hydrogen Programs Around the World—Current Activities and Plans, sponsored by ESD; cosponsored by NISD. Session Organizer: Gail H. Marcus (Consultant for Nuclear Science and Technology). Session Chair: Gail H. Marcus

Hydrogen Production Using Nuclear Energy—A Summary of Some International Programs and the IAEA HEEP Software 1

I. Khamis, Atam Rao (IAEA)

TUESDAY, JUNE 15, 2010, 8:15 A.M.—12:00 P.M.

Experience, Testing, and Methodology Applications for Resolving Nuclear Waste, sponsored by NISD. Session Organizer: Kevin R. O’Kula (URS Safety Management Solutions). Session Chair: Tinh Tran (URS Safety Management Solutions)

Improved Hydrogen Generation Rate Model for Radioactive Waste at DOE Hanford 11

T. Albert Hu (DOE/ORP)

Flammability Limits of Hydrogen/Air Mixtures 17

H. Cheikhvat (CNRS/IRSN), N. Chaumeix (CNRS), A. Bentaib (IRSN), C.-E. Paillard (CNRS)

TUESDAY, JUNE 15, 2010, 8:30–10:50 A.M.

Production: High-Temperature Electrolysis, sponsored by ESD; cosponsored by NISD. Session Organizer: J. Stephen Herring (INL). Session Chair: Carl Stoots (INL)

- Integrated Operation of the INL HYTEST System and High-Temperature Steam Electrolysis for Synthetic Natural Gas Production** 25
Carl Stoots, Lee Shunn, James O'Brien (INL)
- Analysis of Improved Reference Design for a Nuclear-Driven High-Temperature Electrolysis Hydrogen Production Plant** 34
M. G. McKellar, E. A. Harvego, J. E. O'Brien (INL)
- Operating Experience Review of the INL HTE Gas Monitoring System** 42
L. C. Cadwallader, K. G. DeWall (INL)

TUESDAY, JUNE 15, 2010, 1:30–4:25 P.M.

Production: Thermochemical Cycles, sponsored by ESD; cosponsored by NISD. Session Organizer: Kenneth R. Schultz (General Atomics). Session Chair: Kenneth R. Schultz

- Results of the Sulfur Iodine Process Integrated Lab Scale Experiment** 48
Benjamin Russ (General Atomics), Robert Moore (SNL), Max Helie, Nicolas Pons (CEA)
- Experimental Validation of an Optimal Operating Window of Bunsen Section in Iodine-Sulfur Thermo-Chemical Water Splitting Cycle** 63
Ho Joon Yoon, Hee Cheon No, Young Soo Kim, Hyung Gon Jin (KAIST)
- Low Pressure Operation of Sulfur-Iodine Cycle in VHTR Through the Concept of Heat Exchanging-Pressure Depressurizing Loop** 68
Young Soo Kim, Hee Cheon No, Ho Hoon Yoon, Jeong Ik Lee (KAIST)
- Efficiency Improvement in the Sulfur-Iodine Hydrogen Production Process Through Thermal Integration** 75
Alexander Mendoza, Juan-Luis François, Pamela F. Nelson (UNAM)

WEDNESDAY, JUNE 16, 2010, 8:30–10:50 A.M.

Production: Hybrid Cycles and Process Technology, sponsored by ESD; cosponsored by NISD. Session Organizer: J. Stephen Herring (INL). Session Chair: Max Gorenssek (SRNL)

- Flow Sheet Analysis of Nuclear Hydrogen Production from Water and Sulfur** 83
Yong Hun Jung, Yong Hoon Jeong (KAIST)
- Sulfuric Acid Decomposition for the Sulfur-Based Thermochemical Cycles** 90
Robert Moore, Milton Vernon, Edward Parma, Paul Pickard, Gary E. Rochau, (SNL)
- Fracture Stress Estimation Method of SiC Components in the IS Process** 95
Hiroaki Takegami, Atsuhiko Terada, Ryutaro Hino, Shusaku Shiozawa (JAEA)

WEDNESDAY, JUNE 16, 2010, 8:30–11:20 A.M.

Progress in Hydrogen Mitigation by Passive Catalytic Recombiners, and Supporting Research and Development—I, sponsored by NISD; cosponsored by ESD. Session Organizer: Dana Powers (SNL). Session Chair: Phillip G. Ellison (GE Hitachi Nuclear)

- MELCOR Code Application to Hydrogen Issue for Czech NPPs** 101
Jiri Duspiva, Jiri Dienstbier, Bohumir Kujal, Miroslav Kotouc (NRI), Ervin Hofmann (Dukovany Nuclear Power Plant)
- Experimental Investigation of Passive Autocatalytic Recombiner (PAR) Units Under Accidental Scenarios** 111
Gerhard Poss, Teja Kanzleiter, Sanjeev Gupta, (Becker Technol GmbH), Gert Langrock (AREVA NP)
- Catalyst for Recombination of Hydrogen and Oxygen in Confined Spaces Under High Concentrations of Hydrogen** 117
V. Shepelin, D. Koshmanov, E. Chepelin (Russian Energy Tech)
- Influence of Hydrogen Charging and Oxidation Solutions on the Electrochemical Measurement of Hydrogen Permeation in Microalloyed Steel Sheets** 127
Xiang Chen (Univ of Illinois), Massimo De Sanctis, Renzo Valentini, Gianfranco Lovicu, Randa Ishak (Univ of Pisa), James F. Stubbins (Univ of Illinois)

WEDNESDAY, JUNE 16, 2010, 1:30–3:50 P.M.

Progress in Hydrogen Mitigation by Passive Catalytic Recombiners and Supporting Research and Development—II, sponsored by NISD; cosponsored by ESD. Session Organizer: Dana Powers (SNL). Session Chair: Anthony Cappucci, Jr. (URS Safety Management Solutions)

Simulation of PAR Operation Within Compartments—Coupling of REKO-DIREKT and CFX 135

Stephan Kelm, Ernst-Arndt Reinecke, Wilfried Jahn (FzJ), Hans-Josef Allelein (RWTH Aachen Univ)

Validation of the PAR Code REKO-DIREKT: Postcalculation of Integral PAR Experiments in the ThAI Facility 141

Ernst-Arndt Reinecke (FzJ), Ulrich Schwarz, Berno Simon, Hans-Josef Allelein (RWTH Aachen Univ)

Detailed Experimental and Numerical Study of Passive Auto-Catalytic Recombiners 149

N. Meynet (IRSN), E.-A. Reinecke, S. Kelm (FzJ), A. Bentaib (IRSN)

Numerical Study of Hydrogen Ignition by Passive Auto-Catalytic Recombiners 159

N. Meynet, A. Bentaib (IRSN)

WEDNESDAY, JUNE 16, 2010, 1:30–4:25 P.M.

Production: Systems Analysis and Modeling, sponsored by ESD; cosponsored by NISD. Session Organizer: J. Stephen Herring (INL). Session Chair: J. Stephen Herring

Integrating Nuclear and Renewables for Hydrogen and Electricity Production 169

Geoffrey Haratyk, Charles Forsberg (MIT)

Review of the Potential of Nuclear Hydrogen for Addressing Energy Security and Climate Change 179

James E. O'Brien (INL)

Synergistic Electricity Generation Using Both Carbon Resources and Nuclear Energy—Feeding Hydrogen Produced by Nuclear-Heated Steam-Reformer to Fuel Cell 189

Masao Hori (Nuclear Systems Association)

Transient Analysis of Coupled Thermochemical Hydrogen Plant and PBMR 196

Nicholas R. Brown, Shripad T. Revankar (Purdue Univ)

Development of Modeling Methodology for Analysis of Transient in Coupled Hydrogen Plant and VHTR 204

Nicholas R. Brown, Shripad T. Revankar (Purdue Univ)

THURSDAY, JUNE 17, 2010, 8:30–10:15 A.M.

Analytical Studies Supporting Nuclear Facility Safety, sponsored by NISD; cosponsored by ESD. Session Organizer: Kevin O’Kula (URS Safety Management Solutions). Session Chair: Kevin O’Kula

Hydrogen Cylinder Storage Array Explosion Evaluations at the High Flux Isotope Reactor 212

David H. Cook, Frederick P. Griffin, Clifton R. Hyman III (ORNL)

A PSA of the HTTR-IS Hydrogen Production Plant 216

Junichi Kudou (Tohoku Univ), Nariaki Sakaba (JAEA), Toshio Wakabayashi (Tohoku Univ)