

# **Fusion** technology™

**CONTENTS / SEPTEMBER 1985—VOL. 8, NO. 2, PART 2**

**Proceedings of the  
SECOND NATIONAL TOPICAL MEETING ON  
TRITIUM TECHNOLOGY IN FISSION, FUSION  
AND ISOTOPIC APPLICATIONS  
(Dayton, Ohio, April 30 to May 2, 1985)**

vii Comments / *George Miley*

ix Preface / *Harold F. Anderson, Michael L. Rogers*

## **FUSION REACTORS**

**2027** Unresolved Tritium Issues in the Magnetic Fusion Energy Program / *James L. Anderson, John R. Bartlit*

**2031** Tritium Problems in a Thermonuclear Fusion Device / *D. Leger*

**2035** Design of an Electrolysis Cell for Highly Tritiated Water / *A. Rahier, R. Cornelissen, A. Bruggeman, W. Goossens, L. Baetslé*

**2042** Experiments on a Ceramic Electrolysis Cell and a Palladium Diffuser at the Tritium Systems Test Assembly / *S. Konishi, H. Yoshida, H. Ohno, Y. Naruse, D. O. Coffin, C. R. Walthers, K. E. Binning*

**2048** Effective Method for Recovering and Enriching Tritium from Tritiated Water by Dual-Temperature H<sub>2</sub>O-H<sub>2</sub> Exchange Process / *Asashi Kitamoto, Y. Takashima, M. Shimizu*

**2054** Release Characteristics of Tritium from High-Purity Lithium Oxide / *K. R. O'Kula, W. F. Vogelsang*

**2061** Safety Aspects of Tritium in ICF Reactors with Internally-Breeding Targets / *Magdi Ragheb, George H. Miley*

**2067** Modeling and Experiments on Tritium Permeation in Fusion Reactor Blankets / *D. F. Holland, G. R. Longhurst*

(Continued)

# CONTENTS / SEPTEMBER 1985—VOL. 8, NO. 2, PART 2

(Continued)

## MONITORING AND MEASUREMENT

- 2077 A New Tritium Monitor for the Tokamak Fusion Test Reactor / *R. A. Jalbert*
- 2082 Tritium Monitoring—Canadian Experience and Instrumentation / *K. Y. Wong, R. G. C. McElroy*
- 2089 Tritium Instrumentation for the Chalk River Nuclear Laboratories Tritium Extraction Plant / *E. C. Davey, R. G. C. McElroy, S. Kupca*
- 2095 Development of an Integrated Monitoring System for a New Tritium Facility at Mound / *T. B. Rhinehammer, T. E. Burgess, E. L. Spyrou*
- 2103 A Modulated Flow Tritiated Water Vapour Monitor / *R. G. C. McElroy, M. J. Wood, R. A. Surette*
- 2108 Radioassay of Sweep Gas Tritium During In-Pile Generation / *S. K. Skiles, W. S. Diethorn*

## BLANKET AND PROCESS ENGINEERING

- 2113 Cost of Processing Fuel from a Molten Salt, Fusion/Fission, Hybrid Reactor Blanket / *J. S. Watson, W. R. Grimes, D. E. Brashears*
- 2121 Mass Transfer Operational Units Applied to the Liquid Breeding Material of Fusion Reactors for Tritium Recovery / *G. Pierini, R. Baratti, A. M. Polcaro, P. F. Ricci, A. Viola*
- 2127 Experimental Verification of Tritium Breeding Performance of Simulated Aqueous Slurries / *Michael Schuller, Theodore A. Parish*
- 2133 Tritium Control in Helium-Cooled Blankets / *C. P. C. Wong, I. Maya, K. R. Schultz, C. Kessel, D. Roelant*
- 2143 Tritium Release from CTR Solid Blanket / *Takayuki Teraj, Satoru Tanaka, Yoichi Takahashi*
- 2149 Thermodynamic and Kinetic Research of  $\text{Li}_2\text{O-H}_2\text{O}$  System / *V. G. Vasilyev*
- 2153 Tritium Needs to Achieve a Fusion Demonstration Reactor / *Layton J. Wittenberg, Edwin M. Larsen, Eike Hutter*
- 2160 Optimization of Tritium Transfer in Fusion Reactor / *H. Djerassi, F. Rancillac*
- 2168 A Low Temperature Distillation System for Separating Mixtures of Protium, Deuterium, and Tritium Isotopes / *Michael C. Embury, Reed A. Watkins, Richard Hinckley, Arthur H. Post, Jr.*
- 2175 Cryogenic Hydrogen Isotope Distillation for the Fusion Fuel Cycle / *Robert H. Sherman*
- 2184 Early Operating Experience with the Tritium Systems Test Assembly Tritium Waste Treatment System / *R. V. Carlson, S. P. Cole, F. A. Damiano, W. A. Stone*
- 2190 Operation of the Room Air Tritium Removal System at the Tritium Systems Test Assembly / *R. V. Carlson, F. A. Damiano, K. E. Binning*

(Continued)

# CONTENTS / SEPTEMBER 1985—VOL. 8, NO. 2, PART 2

(Continued)

- 2196** Removal of Tritiated Water Vapor by Adsorption on Molecular Sieves—Effects of Co-Existing H<sub>2</sub>O / *S. Tanaka, F. Ono, Y. Takahashi, R. Kiyose*
- 2202** The Application of Zeolites of Predetermined Permeability to the "Water Gas Shift Reaction" / *H. Dworschak, G. Pierini, G. Peeters, E. F. Vansant, P. De Vievre*
- 2206** Development of a Catalytic Water Gas Shift Reactor for Fusion Fuel Exhaust Streams / *A. M. McKay, C. H. Cheh*
- 2213** Modeling Tritium Containment in High Temperature Fusion Reactors / *D. Roelant, T. Kammash*
- 2217** Predicted Effects of Tritium Exposure on Fast-Acting Piezoelectric Valves for Gas Fueling at TFTR / *J. T. Gill, C. W. Pierce*
- 2224** Radiological Protection Instrumentation and R&D Requirements for Tritium Plants Used in Fusion Technology / *J. A. B. Gibson*
- 2228** Tritium System Concepts for the Next European Torus Project / *P. J. Dinner, M. Chazalon, S. K. Sood, O. K. Kveton*

## RESEARCH AND DEVELOPMENT

- 2239** Ultraviolet Radiation-Damage Absorption Line in Solid Deuterium-Tritium / *E. M. Fearon, R. T. Tsugawa, P. C. Souers, J. D. Poll, J. L. Hunt*
- 2245** Reaction Rates for the Formation of Deuterium Tritide from Deuterium and Tritium / *G. T. McConville, D. A. Menke, R. E. Ellefson*
- 2257** Research and Development in Tritium Technology at the Institute of Radiochemistry, Nuclear Research Center Karlsruhe / *H. J. Ache*
- 2265** Tritium Labeling of Peptides and Proteins. A Review / *C. T. Peng, R. L. Hua*
- 2273** Development of a Laser Based Detritiation System at Ontario Hydro / *J. A. O'Neill, K. B. Woodall, J. R. Robins, F. E. Bartoszek, H. D. Morrison*
- 2278** Separation of Hydrogen Isotopes by Thermal Diffusion / *W. M. Rutherford, C. N. Lindsay*
- 2285** Tritium Pumping Based on Asymmetric Permeation / *W. T. Shmayda, F. Waelbroeck, J. Winter, P. Wienhold, T. Banno, N. P. Kherani*

## MATERIALS INTERACTION

- 2293** Tritium-Helium Effects in Metals / *G. R. Caskey, Jr.*
- 2299** Permeation of Deuterium Implanted into Fusion Reactor Materials / *R. A. Anderl, G. R. Longhurst, D. F. Holland, D. A. Struttman*
- 2306** Mathematical Description of Measuring Results of the Tritium and Hydrogen Permeation Through Surface Oxidized Alloys / *M. Andritschky, H. P. Buchkremer, R. Hecker, H. J. Leyers, D. Stöver*

(Continued)

# CONTENTS / SEPTEMBER 1985—VOL. 8, NO. 2, PART 2

(Continued)

- 2312 Permeability of Protective Coatings to Tritium / *J. M. Braun, A. S. Williamson*
- 2318 Interaction of Polyethylene and Tritium Gas as Monitored by Raman Spectroscopy / *J. T. Gill*
- 2330 Use of Metal Hydrides for Handling Tritium / *Mark S. Ortman, Thomas J. Warren, Daniel J. Smith*
- 2337 Long-Term Behavior of the Tritides Formed by Nickel-Based Intermetallic Compounds / *R. C. Bowman, Jr., R. H. Steinmeyer, L. K. Matson, A. Attalla, B. D. Craft*
- 2344 Interaction of Hydrogen Isotopes with Stainless Steel 316 L / *F. Reiter, J. Camposilvan, M. Caorlin, G. Saibene, R. Sartori*

## MATERIAL PROPERTIES AND TRITIUM CONTROL

- 2355 Tritium Contamination of Structural Components After Five Years of Insertion in the TRIPERM-Installation / *H. P. Buchkremer, R. Smolka, D. Stöver, K. Wegner*
- 2360 A Novel Technique for Measurement of Tritium Permeation Through Resistant Materials near Room Temperature: Demonstration of Method with Copper at 50-170°C / *Jon Maienschein, Virgil DuVal, Fred McMurphy, Frank Uribe*
- 2366 Isotope Effects and Helium Retention Behavior in Vanadium Tritide / *R. C. Bowman, Jr., A. Attalla, B. D. Craft*
- 2373 Analysis of Calculation Codes for Metal Tritium Interaction and Numerical Evaluation of the Tritium Behaviour in the NET First Wall / *G. Gervasini, F. Reiter*
- 2379 Development of Oxide Layers on High-Temperature Alloys as Protection Against Hydrogen Permeation / *G. Luthardt, W. Mallener*
- 2384 Diffusion and Solubility of Tritium in Path A Prime Candidate Alloy / *R. A. Causey, L. M. Steck, R. Van Nemen*
- 2388 Metallurgical Considerations on Pd, Pd-Alloy and Their Metal-Hydrogen Systems / *Hiroshi Yoshida, Kenji Okuno, Yuji Naruse, Toshihiko Kashiwai*
- 2395 Practical Experience with Uranium Tritide Containers up to 50 kCi / *G. Luthardt, H. Ebinger*
- 2399 Gas Handling Systems Using Titanium-Sponge and Uranium Bulk Getters / *N. P. Kherani, W. T. Shmayda*
- 2407 Recovery and Storage of Tritium by Zr-V-Fe Getter / *K. Ichimura, M. Matsuyama, K. Watanabe, T. Takeuchi*
- 2413 Some Tips on Tritium Technology / *J. L. Anderson, D. O. Coffin, J. E. Nasise, R. H. Sherman, R. A. Jalbert*

(Continued)

# CONTENTS / SEPTEMBER 1985—VOL. 8, NO. 2, PART 2

(Continued)

- 2420** Recent Developments in Magnetically Coupled Vane Pumps for Tritium Service / *F. C. Capuder, L. T. Quigley, C. K. Baker*
- 2423** Process Calculations for a Moderator Detritiation Plant / *M. Rodman, D. W. Howard*
- 2427** A Comparison of Two HTO Air Sampling Techniques / *C. T. Bishop, D. G. Carfagno, B. M. Farmer, V. C. Lacy, W. H. Yanko*
- 2432** The Functional and Performance Requirements for Tritium in Air Monitors Provided at CANDU Reactors and Associated Facilities for Occupational Radiation Protection / *R. T. Watts*
- 2438** Experimental Design to Study Tritium Oxidation as a Means of Tritium Control / *P. A. Finn, E. H. Van Deventer*
- 2444** Tritium Surface Contamination / *Charles J. Sienkiewicz*
- 2455** Surface and Gas Phase Production of HTO from HT: Review and Recommendations / *J. R. Robins, F. E. Bartoszek, K. B. Woodall*
- 2461** Contamination of Ionization Chamber Due to Tritium Exposure / *M. Matsuyama, K. Ichimura, K. Ashida, K. Watanabe, H. Sato*
- 2467** The Determination of Deuterium and Tritium in Effluent Wastewater by Pulsed Nuclear Magnetic Resonance Spectroscopy / *A. Attalla, J. C. Birkbeck*

## FISSION REACTORS

- 2473** Recovery and Packaging of Tritium from Canadian Heavy Water Reactors / *W. J. Holtslander, T. E. Harrison, V. Goyette, J. M. Miller*
- 2478** Removal and Immobilization of Tritium from Ontario Hydro's Nuclear Generating Stations / *S. K. Sood, R. A. P. Sissingh, O. K. Kveton*
- 2486** Tritium Removal from Circulating Helium by Hydriding of Rare Earth Metals / *T. Serpekian, H. P. Buchkremer, R. Heinen, D. Stöver, K. D. Fischmann*
- 2491** Moderator Detritiation at the Savannah River Plant / *P. K. Baumgarten, D. W. Howard*
- 2495** The Licensing Aspects of the Tritium Extraction Plant at the Chalk River Nuclear Laboratories / *P. R. Ballantyne*

## CONTAINMENT AND CONTROL

- 2505** Operating Experience with the Sandia Tritium Facility Cleanup Systems / *P. Gildea*
- 2511** Tertiary Containment in a Multi-Room Tritium Facility / *L. R. Kent*
- 2517** A Low-Cost Tritium Handling Facility / *Vincent A. Vis*

(Continued)

# CONTENTS / SEPTEMBER 1985—VOL. 8, NO. 2, PART 2

(Continued)

**2520** Conceptual Design of the Tritium Laboratory of the Karlsruhe Nuclear Research Centre / *E. Hutter, H. Sebening, G. Klein, G. Luthardt*

**2526** Design of Tritium Processing Facilities and Equipment for Aqueous and Gaseous Streams / *A. Stuecheli, R. Zmasek, M. Schaub*

## ENVIRONMENTAL STUDIES

**2535** Tritium Hazard via the Ingestion Pathway / *C. C. Travis*

**2539** HT and HTO in the Environment at Chalk River / *R. M. Brown*

**2544** Tritium Production, Releases and Population Doses at Nuclear Power Reactors / *Harold T. Peterson, Jr., David A. Baker*

**2551** Elemental Tritium Deposition and Conversion in the Terrestrial Environment / *T. G. Dunstall, G. L. Ogram, F. S. Spencer*

**2557** HT/HTO Conversion in Mammals / *B. F. Peterman, J. R. Johnson, R. G. C. McElroy*

**2564** Low Concentration Conversion of Tritium Gas to Tritiated Water / *C. E. Easterly, H. Noguchi, M. R. Bennett*

**2569** Global Environmental Transport Models for Tritium / *G. G. Killough, D. C. Kocher*

**2575** International Comparison of Computer Codes for Modelling the Dispersion and Transfer of Tritium Released to the Atmosphere / *T. F. Kempe, S. B. Russell, K. J. Donnelly, H. J. Reilly*

**2582** Development of a Tritium Dispersion Code / *R. P. Bell, M. W. Davis, K. Y. Wong, S. Joseph*

## DEPARTMENT

**2587** Author Index