State of Molybdenum-99 Production and Utilization and Progress toward Eliminating Use of Highly Enriched Uranium

Committee

S. J. Adelstein

Chair

S. JAMES ADELSTEIN (IOM)

S. James Adelstein, Ph.D., M.D., is the Paul C. Cabot Distinguished Professor of Medical Biophysics at Harvard Medical School and a nuclear medicine specialist. His research interests include radionuclide dosimetry, the molecular and cellular effects of radiation, and the diagnosis and experimental treatment of cancer using radionuclides. He is a member of several professional organizations including the Radiation Research Society and the Society of Nuclear Medicine and Molecular Imaging, and he is an elected fellow of both the American College of Nuclear Medicine and the American Association for the Advancement of Science. He was chair of the National Academies Board on Radiation Effects Research from 2002-2005, vice chair of the Nuclear and Radiation Studies Board from 2005-2009, and served on several National Academies committees. He also has served on public and private committees that have addressed issues concerning radiation protection, research collaboration, and biomedical isotopes. He received his B.S., M.S., and Ph.D. degrees from the Massachusetts Institute of Technology and his M.D. degree from the Harvard Medical School. He was elected to the Institute of Medicine in 1985.

Lin-Wen Hu

Member

Lin-wen Hu, Ph.D., is associate director for research development and utilization and principal research scientist at the Massachusetts Institute of Technology (MIT) Nuclear Reactor Laboratory (NRL), which operates the 6-megawatt MIT Research Reactor (MITR). Dr. Hu directs NRL's research and utilization program and leads the development, design, and safety reviews of major reactor irradiation facilities and experiments. She also serves as MITR's technical lead for DOE's Advanced Test Reactor National User Facility at Idaho National Laboratory, of which MITR is a partner facility; as the group leader of the research and test reactors working group of the nuclear technology subcommittee of International Standards Organization (ISO/TC85/SC6/WG2); and as a steering committee member of the International Group of Research Reactors. Her research interests include enhanced heat transfer of nanofluids and nanostructure materials; nuclear energy systems; research reactor design, safety analysis and applications in advanced fuel and materials irradiations; radioisotope production; as well as advanced nuclear energy systems. Current research projects include the MITR low enriched uranium fuel conversion study and fluoride salt-cooled high-temperature reactor development. Dr. Hu is a licensed professional engineer in the Commonwealth of Massachusetts and previously held a senior reactor operator license for the MITR. She has been active in the Isotope and Radiation (IRD) professional division of the American Nuclear Society since 1996 and is currently a member of the IRD Executive Committee. She has authored or co-authored more than 150 peer-reviewed journal papers, conference papers, and technical reports. She received her S.M. and Ph.D. degrees in nuclear engineering from the Massachusetts Institute of Technology.

Joseph C. Hung

Member

Joseph C. Hung, Ph.D., is professor of pharmacy and professor of radiology, Mayo Clinic College of Medicine, and director of Radiopharmaceutical Laboratories & PET Radiochemistry Facility, Mayo Clinic. He is certified by the American Board of Science in Nuclear Medicine (certified as a nuclear medicine scientist in radiopharmaceuticals and radiochemistry) and by the Board of Pharmaceutical Specialties (certified as a nuclear pharmacist). Dr. Hung has served as chair of the Nuclear Pharmacy Practice Section, Academy of Pharmacy Practice and Management, American Pharmacists Association (APhA); president of the Chinese American Society of Nuclear Medicine (SNM); chair of the Committee on Pharmacopeia, SNM; and acting chair of the Expert Committee on Radiopharmaceuticals and Imaging Agents, United States Pharmacopeia. He was inducted as a fellow of the American Society of Health-System Pharmacists in 1995 and as an APhA fellow in 1996. He received his B.S. degree in pharmacy from Taipei Medical University and his M.S. and Ph.D. degrees in nuclear pharmacy from the University of Oklahoma Health Sciences Center.

Robert T. Jubin

Member

Robert T. Jubin, Ph.D., is project manager for the U.S. Department of Energy's Fuel Cycle Technologies—Material Recovery and Waste Form Development Programs at Oak Ridge National Laboratory. He has over 35 years of experience with nuclear fuel reprocessing, including solvent extraction and development of advanced centrifugal contactors; management of volatile radionuclides; and management of gaseous radioactive wastes. His solvent extraction experience includes an extended assignment with the Commissariat à l'énergie atomique et aux énergies alternatives at Fontenay-aux-Roses in France, where he helped to develop the DIAMEX process for separation of actinides and lanthanides from high-level liquid wastes. Dr. Jubin is a member of the American Institute of Chemical Engineers and received its 2013 Robert E. Wilson Award for outstanding chemical engineering contributions and achievements in the nuclear industry. He also chairs the American Society of Mechanical Engineers' Gas Processing Subcommittee. He received his B.S. degree in chemical engineering from the University of Akron and his M.S. degree in engineering management and Ph.D. degree in chemical engineering, both from the University of Tennessee. He retired from the U.S. Air Force Reserve in 2007 at the rank of Colonel.

Emmett B. Keeler

Member

Emmett B Keeler, Ph.D., is a professor in the Pardee RAND Graduate School and an adjunct professor at the University of California-Los Angeles Public Health School, where he has taught about cost-effectiveness, cost-benefit, and decision analysis in medicine and public health for many years. He led the multi-site Improving Chronic Illness Care Evaluation and the Management of Childbirth Patient Outcomes Research Team. He also analyzed health outcomes and episodes of spending for the RAND Health Insurance Experiment. His recent work has examined the costs of lung cancer screening and policies to promote cost-lowering new technologies. An elected member of the Institute of Medicine (IOM), Dr. Keeler has participated in IOM committees on the polygraph, on incorporating uncertainty into environmental decisions, the economic costs of uninsurance, the use of health measures in regulatory analysis, national health accounts, and geographic variation in health care spending. Dr. Keeler received his Ph.D. degree in mathematics from Harvard University.

Gerald L. Kulcinski

Member

Gerald L. Kulcinski, Ph.D., is the Grainger Professor of Nuclear Engineering-Emeritus and the director of the Fusion Technology Institute at the University of Wisconsin-Madison. He was the associate dean of research for the College of Engineering from 2001 to 2014. His current research involves the assessment of the technological and environmental aspects of the production of electricity from renewable, fossil, and nuclear energy sources. He has published over 300 peer-reviewed scientific articles, over 300 additional reports and articles in conference proceedings, and is a co-author or contributor to four books. He was elected to the National Academy of Engineering in 1993 and was awarded the National Aeronautics and Space Administration (NASA) Public Service Medal in 1993 and the NASA Exceptional Public Service Medal in 2010. Dr. Kulcinski received his B.S. degree in chemical engineering and his Ph.D. degree in nuclear engineering from the University of Wisconsin.

Jason S. Lewis

Member

Jason S. Lewis, Ph.D., is the Emily Tow Jackson Endowed Chair, vice chair of research in radiology, chief attending of the Radiochemistry & Imaging Sciences Service, and director of the Radiochemistry & Molecular Imaging Probe Core at Memorial Sloan Kettering Cancer Center (USA). He holds a joint appointment in the Molecular Pharmacology and Chemistry Program at the Sloan-Kettering Institute and in radiology at the Weill Cornell Medical College in New York. Dr. Lewis received his B.S. and M.S. degrees in chemistry from the University of Essex, his Ph.D. degree in biochemistry from the University of Kent, and did his postdoctoral work at the Washington University School of Medicine (WUSM). Subsequently, he joined the WUSM faculty as an assistant professor of radiology (2003-2008) at which point he joined MSKCC. Dr. Lewis’ research program is a molecular imaging-based program focused on radiopharmaceutical development as well as the study of multimodality (PET, CT & MRI) small- and biomolecule-based agents and their clinical translation. He has published more than 130 peer-reviewed articles as well as numerous book chapters and reviews. His research is supported by grants from the United States National Institutes of Health.

Kathryn A. Morton

Member

Kathryn A. Morton, M.D., is professor of radiology at the University of Utah with specialty training in diagnostic radiology and nuclear medicine. She previously served as chief of nuclear medicine at four academic centers (VA medical centers in Portland and Salt Lake City; Wake Forest University Medical Center; and University of Utah). Dr. Morton has 30 years of clinical experience with PET, PET/CT, conventional nuclear medicine, and diagnostic radiology. She also has academic experience as a researcher in molecular and cellular biology. She has served on over 60 NIH study sections and is currently the chairman of the Grant Programs Committee for the Radiological Society of North America. She received her M.D. degree from the University of Utah.

Eugene J. Peterson

Member

Eugene Peterson, Ph.D., is executive advisor to Los Alamos National Laboratory's associate director for chemistry, life, and earth sciences and is leading the laboratory's strategic planning efforts for the Science of Signatures science pillar. Previously, he was the chemistry division leader at Los Alamos, where he was responsible for 350 chemical professionals and a budget of approximately $150 million. Before his tenure as chemistry division leader, Dr. Peterson specialized in medical isotope production and applications research and development. He was responsible for technical management of the laboratory's isotope production efforts and associated research and development, business management of isotope distribution and marketing, and procuring adequate funding for these programs. Notable program successes during his tenure included the construction of a new $23.5 million 100 MeV Isotope Production Facility at the Los Alamos Neutron Science Center for the production of accelerator isotopes and the lease by the Department of Energy of the laboratory's cryogenic distillation columns for the separation and purification of isotopes of carbon, nitrogen, and oxygen to the private sector. Dr. Peterson served on the National Academies Committee on Medical Isotope Production without Highly Enriched Uranium. He received his B.S. degree from the Illinois Benedictine College and his Ph.D. degree in inorganic chemistry from Arizona State University.

Tor Raubenheimer

Member

Tor Raubenheimer, Ph.D., is a professor at the SLAC National Accelerator Laboratory and Stanford University. He is an expert in accelerator physics and design, especially for high-energy linear accelerators. Since 2011, Prof. Raubenheimer has been leading the accelerator physics design for the LCLS-II, a new high-power X-ray free electron laser based on a 4 GeV superconducting RF linac. He previously served as division director for the SLAC Accelerator Research Division, where he helped launch the Facility for Advanced Accelerator Experimental Tests as well as Large Hadron Collider accelerator research and muon accelerator research and development efforts at SLAC. Prior, he was head of the International Linear Collider Division and head of accelerator physics for the Next Linear Collider Project. He has authored over 40 refereed journal articles and 250 conference papers. He is a fellow of the American Physical Society and received the American Physical Society's Division of Beam Physics Dissertation Award (1994) as well as the U.S. Particle Accelerator School Prize for Achievement in Accelerator Physics and Technology (2001). Prof. Raubenheimer received his B.S. degree in physics and computer science from Dartmouth College and his Ph.D. degree in applied physics from Stanford University.

Henry D. Royal

Member

Henry D. Royal, M.D., is professor of radiology at Washington University School of Medicine in St. Louis and associate director of nuclear medicine at the Mallinckrodt Institute of Radiology. He is trained in internal medicine and nuclear medicine and has been practicing nuclear medicine for 40 years, working in both academic and hospital settings. Dr. Royal was a member of the American Board of Nuclear Medicine from 1993 to 1999 and served as its executive director from 2004 to 2014. He also served as president of the Society of Nuclear Medicine from 2003 to 2004 and received its Lifetime Achievement Award in 2008. Dr. Royal was a member of the U.S. delegation to the United Nations Scientific Committee on the Effects of Atomic Radiation from 2002 to 2005; co-team leader of the health effects section of the International Atomic Energy Agency’s International Chernobyl Project; a member of the Presidential Advisory Committee on Human Radiation Experiments; chair of the National Council on Radiation Protection and Measurements Scientific Committee on Radiation Effects on the Thyroid; and scientific chair of the Veterans’ Advisory Committee on Environmental Hazards (2001 to 2010). He has been listed in “Best Doctors in America” since 1992. He received his M.D. degree from St. Louis University.

Thomas J. Ruth

Member

Vice-Chair

THOMAS J. RUTH

Thomas Ruth, Ph.D., is emeritus senior research scientist at TRIUMF and emeritus senior scientist at the British Columbia Cancer Research Centre. He holds adjunct professorships in chemistry at Simon Fraser University, physics at the University of Victoria, and medicine at the University of British Columbia. Dr. Ruth is a leader in the production and application of radioisotopes for research in the physical and biological sciences. He has served on a multitude of national and international committees, including National Academies Committee on Biomedical Isotopes (1993-1995), Committee on State of the Science in Nuclear Medicine (2006-2007), Committee on Medical Isotope Production without Highly Enriched Uranium (2007-2009), and Committee on an Assessment and Outlook for Nuclear Physics (2010-2012). He currently serves as an expert on radioisotope production for the International Atomic Energy Agency (IAEA) and was appointed by the IAEA director general to serve on the Standing Advisory Group on Nuclear Applications. He previously served on the Nuclear Science Advisory Committee's (NSAC's) Subcommittee on Isotopes for the Nuclear Physics Program of the US DOE (2009 and 2014) and on another NSAC subcommittee to review the National Nuclear Security Administration's program for removing highly enriched uranium from civilian use and supporting the development of U.S. sources of molbdenum-99. Dr. Ruth has published more than 290 peer reviewed papers and book chapters. He received an M.A. degree in nuclear chemistry from the College of William and Mary and a Ph.D. degree in nuclear spectroscopy from Clark University. He is the 2011 recipient of the Michael J. Welch Award from the Society of Nuclear Medicine for his contributions to radiopharmaceutical chemistry.

Felicia L. Taw

Member

Felicia L. Taw, Ph.D., is group leader of the Nuclear and Radiochemistry Group at Los Alamos National Laboratory (LANL). This group, which comprises approximately 100 staff, undertakes research and development and provides operational support for the lab's stockpile stewardship, threat reduction, and global security missions. Specific capability and program areas include nuclear forensics, treaty monitoring, weapons assessment, nuclear chemistry, radiochemistry, radioanalytical measurements, mass separations and mass spectrometry, and analytical chemistry. Dr. Taw previously served as deputy group leader for the Inorganic, Isotope, and Actinide Chemistry Group, where she helped manage the production of medical isotopes in support of LANL's isotope program, as well as research and operations in actinide and inorganic chemistry. She also previously served as Chemistry Division's project manager for the National Nuclear Security Administration's Mo-99 Production Program. She has contributed to research on spent nuclear fuel, the development of gamma and neutron detectors, actinide chemistry, and fundamental inorganic and organic chemistry. Dr. Taw was a director's postdoctoral fellow at LANL and received her Ph.D. degree in organometallic chemistry from the University of North Carolina, Chapel Hill.