Merits and Viability of Different Nuclear Fuel Cycles and Technology Options and the Waste Aspects of Advanced Nuclear Reactors

Committee

Janice Dunn Lee

Chair

Janice Dunn Lee retired in January 2017 after a 40-year career in nuclear policy and regulatory fields. Ms. Dunn Lee served for more than 30 years at the U.S. Nuclear Regulatory Commission (USNRC) in Washington, D.C., in senior management positions focused on nuclear nonproliferation, national security, and nuclear safety policy. Her most senior position at the USNRC was Director of International Programs for more than eight years. This was followed by 10 years with international nuclear organizations in Paris, France, and Vienna, Austria. In particular, for almost five years, she served as Deputy Director General of the Nuclear Energy Agency of the Organization for Economic Cooperation and Development. She then served a five-year term as Deputy Director General and Head of the Department of Management at the International Atomic Energy Agency and was the highest ranking American in the United Nations agencies based in Vienna, one of the UN headquarters cities. In January 2019, Ms. Dunn Lee came out of retirement for a one year assignment to be the Acting CEO of the United Nations Joint Staff Pension Fund in New York City. She graduated from University of California, Berkeley, with a Bachelor’s degree in sociology, and has a Master’s degree in international relations from the Fletcher School of Law and Diplomacy at Tufts University.

Patricia A. Baisden

Vice Chair

Patricia Ann “Trish” Baisden retired in 2013 from the Lawrence Livermore National Laboratory (LLNL) after a career spanning over 37 years. Since retiring, Dr. Baisden became an Adjunct Professor at San Jose State University and has been the primary instructor for the American Chemical Society/Department of Energy (ACS/DOE) Summer School in Nuclear Chemistry, an intensive 6-week undergraduate fellowship program designed to introduce nuclear and radiochemical concepts to outstanding upper level undergraduate science and engineering majors and to stimulate their interest to pursue graduate studies in the field. At the time of her retirement from LLNL, Dr. Baisden was the Deputy Program Manager for the Inertial Confinement Fusion Program, a position she assumed in 2012 upon the conclusion of National Ignition Campaign (NIC). NIC was a multi-laboratory scientific and technology development program at LLNL focused on using NIF to achieve ignition and thermonuclear burn in the laboratory via inertial confinement fusion. For NIC, Dr. Baisden served as its Director for Operations and LLNL Institutional Deputy. Dr. Baisden is a nuclear chemist, and during her career at LLNL, she has held a number of technical and management positions including division leader for analytical sciences, deputy director of the Seaborg Institute, materials program leader for NIF, chief scientist and deputy associate director for the Chemistry and Material Sciences Directorate. Professionally, she has served on numerous study panels and review committees, as an editor of the journal Radiochimica Acta, and chairperson of the American Chemical Society’s Division of Nuclear Chemistry and Technology. Notably, she has served on five National Academies consensus studies committees. Dr. Baisden’s research interests include nuclear fusion, lasers and optical materials, heavy ion reactions, heavy element fission properties, the chemistry of 4 and 5f elements, and nuclear power and advanced fuel cycles. Dr. Baisden earned a B.S. in 1971 and Ph.D. in 1975 in chemistry under Prof. Gregory R. Choppin from the Florida State University. Before joining the staff at LLNL, she held a two-year postdoctoral appointment with Prof. Glenn T. Seaborg at the University of California, Lawrence Berkeley National Laboratory.

Margaret S. Chu

Member

Margaret S.Y. Chu (NAE), PhD, provides consulting services to domestic and international clients in nuclear waste management, nuclear fuel cycle analysis, nuclear security analysis, and research and development. Her entire career has been devoted to promoting safe nuclear energy and nuclear fuel cycle. She has extensive experience in successfully managing large, multidisciplinary projects and in negotiating with customers, regulators and stakeholders. She has over 20 years' experience serving at Sandia National Laboratories in several capacities, including Director of the Nuclear Waste Management Program Center, Manager of the Environmental Risk Assessment and Waste Management Department, and Deputy Manager of the Waste Isolation Pilot Project (WIPP) and Technical Integration Department. In 2002, she was appointed by President George W. Bush as director of the Department of Energy's Office of Civilian Radioactive Waste Management, which is responsible for developing the nation's waste disposal system for spent nuclear fuel and high-level radioactive waste at Yucca Mountain. She has authored nearly 50 publications and has received numerous awards. She was a board member of the National Academies' Nuclear and Radiation Studies Board, a member of the Advisory Committee of Reactor Safeguards at the U.S. Nuclear Regulatory Commission and a member of the Nuclear Energy Advisory Committee at the U.S. Department of Energy. She was elected to the National Academy of Engineering in 2018 for her contributions for permanent disposal of radioactive waste in deep underground repositories. She holds a BS degree from Purdue University in chemistry and a PhD from the University of Minnesota in physical (quantum) chemistry.

Paul T. Dickman

Member

Paul Dickman is a Senior Policy Fellow, based in Washington, D.C., with Argonne National Laboratory focusing on international nuclear energy, non-proliferation, and national security policy. He has held several senior leadership positions. At the U.S. Nuclear Regulatory Commission, he served as Chief of Staff to Chairman Dale E. Klein. At the Department of Energy's National Nuclear Security Administration, he served on the Undersecretary's staff as Deputy Director for the Office of Policy. During his career he has held technical and senior staff positions within the Department of Energy and national laboratory system. Mr. Dickman is also an active member in the American Nuclear Society, currently chairs their External Affairs Committee, and served as the Study Director for the Society's Special Committee Report on the nuclear accident at the Fukushima-Daiichi. He is also an advisor to the Japanese government agency responsible for the decommissioning of the Fukushima accident site and is the President-Elect for the World Council on Isotopes. He serves on the National Academy of Sciences' Nuclear and Radiation Studies Board and was a committee member for the Academy's study on Independent Assessment of Science and Technology for the Department of Energy's Defense Environmental Cleanup Program. He has published technical and policy papers on radioactive waste management, nuclear materials recycling and disposition, and international nuclear non-proliferation. He holds a Bachelor's degree in history (of science) and a Master's degree of Natural Sciences in nuclear chemistry and physics.

Craig S. Hansen

Member

Craig S. Hansen is an independent business consultant with 27 years of executive and senior-level experience in facility/site management; business and product line management; executing large and complex nuclear plant manufacturing, construction, decommissioning, and nuclear reactor servicing contracts; and in successful leadership of complex technical projects facing a wide range of stakeholder challenges. Mr. Hansen has extensive experience with BWXT, formerly the nuclear technology business of the Babcock & Wilcox Company (B&W). His most recent service was as president and board member (2013-2014) at B&W's American Centrifuge Manufacturing, LLC (ACM), where he was responsible for management and operations of the American Centrifuge Technology and Manufacturing Center located in Oak Ridge, Tennessee, overseeing direction, management, and operation through bankruptcy and program re-alignment; managed a sophisticated technical manufacturing operation in a highly automated facility; and led product line diversification and demobilization due to government funding cuts. In B&W's nuclear manufacturing division (2008-2013), he was the vice president of nuclear equipment where he was responsible for B&W's global commercial nuclear equipment business along with U.S. and Canadian manufacturing sites, worldwide contracts, and product lines. From 2003 through 2008, Mr. Hansen organized and managed B&W's government relations team. As B&W's deputy site manager (2001-2003), he accelerated the cleanup and public relations at the U.S. Department of Energy Miamisburg Environmental Management Project (Mound Plant), a site on the National Priorities List since 1989 due to past disposal practices and releases to the environment. Prior to B&W he worked on the Naval Nuclear Propulsion Program in Washington, DC, and Idaho (1988-2001) in a series of progressively responsible positions at the nuclear reactor headquarters and naval reactor site management. He also served as the first chairman of the U.S. Department of Commerce Civil Nuclear Trade Advisory Committee. Mr. Hansen has a BA from Eastern Washington University in operations management.

Edwin S. Lyman

Member

Edwin S. Lyman is the Director of the Nuclear Power Safety Project at the Union of Concerned Scientists (UCS) and is an internationally recognized expert on nuclear proliferation and nuclear terrorism as well as nuclear power safety and security. He is a member of the Institute of Nuclear Materials Management and the American Nuclear Society and has testified numerous times before Congress and the U.S. Nuclear Regulatory Commission. Since joining UCS in 2003, he has published articles in a number of journals and magazines, including Science, the Bulletin of the Atomic Scientists, Science and Global Security, and Arms Control Today. Dr. Lyman also co-authored the critically acclaimed book, Fukushima: The Story of a Nuclear Disaster (New Press, 2014). In 2018, Dr. Lyman was awarded the Leo Szilard Lectureship Award from the American Physical Society. Before joining UCS, Dr. Lyman was president of the Nuclear Control Institute, a Washington, D.C.-based organization focused on nuclear proliferation. From 1992 to 1995, he was a postdoctoral research associate at Princeton University's Center for Energy and Environmental Studies (now the Science and Global Security Program). He earned a B.A. in physics from New York University in 1986 and a Ph.D. in physics from Cornell University in 1992.

Allison M. Macfarlane

Member

Allison M. Macfarlane is currently Professor and Director, School of Public Policy and Global Affairs, Faculty of Arts, the University of British Columbia (UBC). Dr. Macfarlane has held both academic and government positions in the field of energy and environmental policy, especially nuclear policy. Most recently, she directed the Institute for International Science and Technology Policy at the George Washington University. She recently held a fellowship at the Wilson International Center for Scholars in Washington, DC, and was Fulbright Distinguished Chair in Applied Public Policy at Flinders University and Carnegie Mellon Adelaide in Australia. She was the first geologist (and the third woman) to chair the U.S. Nuclear Regulatory Commission; her tenure was from 2012 to 2014. She has held fellowships at Radcliffe College, the Massachusetts Institute of Technology (MIT), Stanford, and Harvard Universities, and she has been on the faculty at Georgia Tech in Earth Science and International Affairs, at George Mason University in Environmental Science and Policy, and in the Elliott School of International Affairs at George Washington University. From 2010 to 2012, Dr. Macfarlane served on the White House Blue Ribbon Commission on America's Nuclear Future, created by the Obama Administration to recommend a new national policy on high-level nuclear waste. She has also served on National Academies committees on nuclear energy and nuclear weapons issues, and she has chaired the Science and Security Board of the Bulletin of Atomic Scientists, the group that sets the Bulletin’s famous “doomsday clock.” In 2006, MIT Press published a book she co-edited, Uncertainty Underground: Yucca Mountain and the Nation's High-Level Nuclear Waste. Dr. Macfarlane has published extensively in Science, Nature, Environmental Science and Technology, the Bulletin of the Atomic Scientists, and other journals. Dr. Macfarlane’s research has focused on technical, social, and policy aspects of nuclear energy production and nuclear waste management and disposal as well as regulation, nuclear nonproliferation, and energy policy. Dr. Macfarlane holds a B.S. from the University of Rochester and a Ph.D. in earth science from the Massachusetts Institute of Technology.

Albert J. Machiels

Member

Albert J. Machiels retired from the Electric Power Research Institute (EPRI) in June 2017. During his 35-year tenure at EPRI, his responsibilities included the oversight and/or management of several R&D programs in the following technical areas: Nuclear Fuel Industry Research (NFIR); Severe Accident Issue Resolution; Severe Accident Technology; Control and Diagnostics; Advanced Light Water Reactor (ALWR); Primary System Corrosion Research; Pressurized Water Reactor (PWR) Materials Reliability Program (MRP); Boiling Water Reactor (BWR) Vessel Integrity Program (VIP); Risk and Reliability; Balance-of-Plant Corrosion; and Used Fuel and High-Level Waste (HLW) Management. From 1996 to 2017, Dr. Machiels was actively engaged in topics related to spent fuel management (storage and transportation) and advanced fuel cycles, areas in which his contributions gained international recognition. Dr. Machiels served as the EPRI executive liaison to the Nuclear Management and Resources Council (NUMARC, now part of the Nuclear Energy Institute, NEI) from August 1988 to October 1989. Before joining EPRI, Dr. Machiels was a tenured, associate professor of nuclear engineering at the University of Illinois, Urbana-Champaign. Prior to coming to the United States in 1970, Dr. Machiels was a lecturer at the University of Liège, Belgium. Dr. Machiels is the author of over 200 publications and technical contributions. He has managed and contributed to the publication of over 100 EPRI reports. He has served on several national and international panels and committees. In April 2012, Dr. Machiels received a Lifetime Achievement Award in recognition of his strategic and technical contributions to the nuclear generation of electricity. He was only the eighth individual (and the first one from the Nuclear Generation Sector) to receive such an award over the 40+ years of EPRI’s existence. Presently, he is a part-time consultant on topics related to the management of spent nuclear fuel. Dr. Machiels received Ingénieur Civil Chimiste and Ingénieur en Génie Nucléaire degrees from the University of Liège, in Belgium, and a Ph.D. in engineering from the University of California, Berkeley.

Christophe Poinssot

Member

Christophe Poinssot is Nuclear Counsellor at the French Embassy in China and the Commissariat à l'Énergie Atomique et aux Énergies Alternatives (CEA) representative at the embassy. In November 2020, he will be appointed Deputy General Director and Scientific Director of the French Geological Survey (BRGM, Bureau de Recherche Géologiques et Minières). He has had more than 25 years of experience in the CEA, where he occupied various positions. Since August 2018, he was the Nuclear Counselor at the French Embassy in Beijing (China), representing the French government in China for the civilian nuclear domain, and supporting the industrial and scientific French nuclear partnerships within China. He was also the representative in China of the CEA, in charge of developing R&D and industrial partnership in the field of low-carbon technologies, numeric and digital technologies and health technologies. From 2011 to 2018, he was the Head of the Research Department on Mining and Fuel Recycling Processes at the Nuclear Energy Division, CEA Marcoule. Prior to joining this department in 2008, he spent 15 years in CEA Saclay working in the field of nuclear waste and used fuel management. In particular, he launched and coordinated the French research program on spent nuclear fuel long-term evolution and headed the CEA labs working on radionuclides migration in the environment. Since 2011, he has been a professor of nuclear chemistry at the National Institute of Nuclear Science and Technology (INSTN) and has been appointed CEA international expert in fuel cycle and actinides chemistry. He has been for a long-time involved in international collaborations and has been a member of several scientific committees of international conferences and for the evaluation of research teams. In particular, he was a steering committee member of the study Reset of America's Nuclear Waste Management Strategy and Policy, published in 2018. In 2017, he was awarded Officer from the French order "Palmes Académiques" and also received the Van Geen Prize and Chair from SCK-CEN (Belgium). He has authored more than 60 international articles and 110 presentations in international scientific conferences. Among other, his most recent research deals with developing holistic approach to assess the relative sustainability of the different fuel cycles and nuclear systems. He earned two Master's Degrees in 1995 at the École Normale Supérieure de Paris in earth sciences and material sciences and a Ph.D. in 1997 in material sciences at the Université Pierre and Marie Curie (Paris, France).

Jeffrey D. Semancik

Member

Jeffrey D. Semancik has served as the Director of the Radiation Division for the Connecticut Department of Energy and Environmental Protection since joining the state in July 2014. In this role Jeff is responsible for policy development, decision-making, program implementation, compliance and enforcement in the areas of radiation safety, radiological emergency preparedness and response, radioactive materials licensing and inspection, nuclear and radioactive waste management, and transportation of nuclear and radioactive material. Jeff serves as a member of the State of Connecticut's Nuclear Energy Advisory Council, as the Compact Secretary for the New England Radiological Health Committee, the State Liaison Officer to the U.S. Nuclear Regulatory Commission, Alternate Commissioner for State of Connecticut on the Atlantic Interstate Low-Level Radioactive Waste Compact, representative to the Northeast High Level Radioactive Waste Transportation Task Force at the Council of State Governments, and as a Nuclear Advisory Committee member for Three Rivers Community College (Norwich, Connecticut). Jeff serves on the board (including Chairperson in 2019) of the Conference of Radiation Control Program Directors (CRCPD), as well as a member of the Government Coordinating Council to the Cyber and Infrastructure Security Agency's (CISA) Nuclear Sector Critical Infrastructure Protection Advisory Council, an advisor on the Committee for Evaluation of Guidelines, Resources, and Tools for Radiological and Nuclear Emergency Response and Recovery, and the Chairperson of the Committee on Naval Nuclear Propulsion. Jeff is qualified as and has contributed to the development of the Radiological Operations Support Specialist for emergency response to radiological emergencies including participating in various multi-agency nuclear power plant, improvised nuclear device, and radiological dispersal device exercises. Prior to state service, Jeff worked in commercial nuclear power for 23 years in a variety of positions including licensed senior reactor operator, Operations Manager, Engineering Director, and Plant Manager. Jeff began his career as an officer in the United States Navy serving on board the nuclear powered aircraft carrier USS Abraham Lincoln and the guided missile destroyer USS Scott during Operation Desert Shield. He holds a B.S. in physics from the United States Naval Academy, an M.S. in electrical engineering from Rensselaer Polytechnic Institute, and an M.B.A. from the University of Connecticut.

Ken B. Sorenson

Member

Ken B. Sorenson retired from Sandia National Laboratories in January 2018 after 35 years of service. For 23 of these years, Ken served as a Technical Manager, overseeing technology development for the back-end of the commercial nuclear fuel cycle. The focus of this work was on long-term storage and transportation of spent nuclear fuel. Aspects of this work included materials degradation of fuel cladding, response of storage and transportation packages to severe mechanical and thermal environments, safeguards and security of nuclear materials, systems analyses, and regulatory analyses. Ken led the development and managed the national laboratory component of the U.S. Department of Energy's Office of Nuclear Energy (DOE-NE) program to assess the integrity of spent nuclear fuel under long-term storage and transportation conditions. This program, in collaboration with the DOE national laboratories, the U.S. Nuclear Regulatory Commission (USNRC), and industry, is still active today. Ken managed the work at Sandia for the USNRC after the 9/11 attack to assess the radiological consequence of various potential terrorist attacks on licensed storage and transportation systems. Ken served as the President of the Institute of Nuclear Materials Management (www.inmm.org) from 2013 through 2014. INMM is an international organization focused on instilling best practices in the areas of nuclear materials safeguards, security, and safety management around the world. Ken was the technical editor and wrote two chapters in a reference book titled, Safe and Secure Transport and Storage of Radioactive Materials, and wrote and co-authored numerous journal articles and conference presentations. Currently, Ken is consulting with Sandia in the areas of knowledge transfer, technical report writing and reviewing, and strategic planning support. He earned a B.S. in 1975 in civil engineering from the University of Arizona, an M.S. in 1982 in civil (structural) engineering from Colorado State University, and an M.B.A. in 2000 from the University of New Mexico. Ken is a licensed Professional Engineer in the state of Colorado; P.E. 0018367.

Nathalie A. Wall

Member

Nathalie A. Wall is an internationally recognized radiochemist. Her research focuses on the environmental behavior of radionuclides for applications to the nuclear fuel cycle and nuclear forensics. She is best known for her work on the thermodynamic properties of actinides and fission products. Dr. Wall worked in the Department of Nuclear Waste Management at the Commissariat à l'Energie Atomique (CEA, the French Alternative Energies and Atomic Energy Commission) and as a staff scientist at Sandia National Laboratories. She was a faculty member of the Chemistry Department at Washington State University, prior to moving to the University of Florida's Department of Materials Science and Engineering in 2019. Dr. Wall is a native of France; she earned her undergraduate degree in physical sciences in 1989 at the University of Paris (France). She completed her Ph.D. with Prof. R. Guillaumont and Dr. V. Moulin in radiochemistry at the University of Paris in 1993 and was a postdoctoral research associate with Prof. G.R. Choppin at the Florida State University.

Charles Ferguson

Staff Officer

Charles D. Ferguson is the director of the Nuclear and Radiation Studies Board in the Division on Earth and Life Studies at the National Academies of Sciences, Engineering, and Medicine. Previously, he was the president of the Federation of American Scientists (FAS). Prior to FAS, he worked as the Philip D. Reed senior fellow for science and technology at the Council on Foreign Relations (CFR), where he specialized in nuclear issues, and served as project director for the Independent Task Force on U.S. Nuclear Weapons Policy chaired by William J. Perry and Brent Scowcroft. Before CFR, he was the scientist- in-residence at the Monterey Institute's Center for Nonproliferation Studies, where he co-authored the book The Four Faces of Nuclear Terrorism (Routledge, 2005) and was lead author of the January 2003 report Commercial Radioactive Sources: Surveying the Security Risks. For his work on security of radioactive sources, he was awarded the Robert S. Landauer Memorial Lecture Award from the Health Physics Society in 2003. He is also the author of Nuclear Energy: What Everyone Needs to Know (Oxford University Press, 2011). In addition, he has worked as a physical scientist in the Office of Nuclear Safety at the U.S. Department of State, and he has served as a nuclear engineering officer and submarine officer in the U.S. Navy. He is an elected fellow of the American Physical Society in recognition of his service to public policy and public education on nuclear issues. Dr. Ferguson earned a BS in physics with distinction from the U.S. Naval Academy and MA and PhD degrees, also in physics, from Boston University.