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

### May 17 and 18, 2021 **Virtual Meeting**

# PUBLIC AGENDA Draft: May 11, 2021

Day 1: Monday, May 17, 2021 (All times are FT.)			
PUBLIC SESSION 1			
WEBEX connection details for May 17:			
https://nas-sec.webex.com/nas-sec/j.php?MTID=m83e2c6d0e10574bf9f034a1d2fbc6b88 Meeting number: 199 521 1133			
Join by video system Dial 1995211133@nas-sec.webex.com You can also dial 207.182.190.20 and enter your meeting number. Join by phone +1-415-527-5035 US Toll +1-929-251-9612 USA Toll 2 Access code: 199 521 1133 Global call-in numbers			
Need help? Go to http://h	elp.webex.com		
11:00 am – 11:05 am	Call Open PUBLIC SESSION 1 to Order and Welcome Janice Dunn Lee, Committee Chair, and Charles Ferguson, Study Director		
	Theme: Nonproliferation, Safeguards, and Security		
11:05 am – 11:25 am	Application of Safeguards by Design to Advanced Reactors Jeremy Whitlock, Ph.D., Section Head for Concepts and Approaches, Department of Safeguards, International Atomic Energy Agency (confirmed)		
11:25 am – 11:55 pm	Q&A for Academies committee and staff		
11:50 am – 12:15 pm	Perspectives on Proliferation-Resistance: Fuel Cycles and Advanced Reactors Matthew Bunn, Ph.D., Co-Principal Investigator, Managing the Atom Project, Belfer Center, Harvard University ( <i>confirmed</i> )		
12:15 pm – 12:45 pm	Q&A for Academies committee and staff		
12:45 pm – 1:25 pm	Break		

1:25 pm – 1:50 pm	<b>Safeguards and Security Analysis for Fuel Cycle Facilities</b> Ben Cipiti, Ph.D., Sandia National Laboratories ( <i>confirmed</i> )
1:50 pm – 2:15 pm	Q&A for Academies committee and staff
2:15 pm – 2:30 pm	New Approaches Utilizing Process Monitoring Data and Machine Learning Ben Cipiti, Ph.D., Sandia National Laboratories ( <i>confirmed</i> )
2:30 pm – 2:45 pm	Q&A for Academies committee and staff
2:45 pm – 2:55 pm	Break
2:55 pm – 3:20 pm	Advanced Reactor Safeguards and Security Ben Cipiti, Ph.D., Sandia National Laboratories ( <i>confirmed</i> )
3:20 pm – 3:40 pm	Q&A for Academies committee and staff
3:40 pm – 4:00 pm	Safeguards Considerations Associated with Widespread Use of HALEU Warren Stern, Deputy Chair, Nonproliferation and Security, Brookhaven National Laboratory ( <i>confirmed</i> )
4:00 pm – 4:20 pm	Q&A for Academies committee and staff
4:20 pm – 4:30 pm	Public Comment Period
4:30 pm	Adjourn PUBLIC SESSION – Day 1

### Day 2: Tuesday, May 18, 2021 <mark>(All times are ET.)</mark>

### PUBLIC SESSION 2

#### WEBEX connection details for May 18:

Same connection info for BOTH days.

11:00 am – 11:05 am	Call Open PUBLIC SESSION 2 to Order and Welcome Janice Dunn Lee, Committee Chair, and Charles Ferguson, Study Director
	Theme: Nonproliferation, Safeguards, and Security
11:05 am – 11:25 am	Aspects of Material Accounting and Control for Advanced Reactors Robert K. Larsen, Senior Nuclear Security Officer, Nuclear Security of Materials and Facilities Section, Division of Nuclear Security, Department of Nuclear Safety and Security, International Atomic Energy Agency ( <i>confirmed</i> )

11:25 am – 11:55 pm Q&A for Academies committee and staff

11:50 am – 12:15 pm	Proliferation Risks of Laser Enrichment of Uranium Ryan Snyder, Ph.D., Visiting Fellow, University of Hamburg, Institute of Peace Research and Security Policy( <i>confirmed</i> )
12:15 pm – 12:45 pm	Q&A for Academies committee and staff
12:45 pm – 1:15 pm	Break
1:15 pm – 1:35 pm	Overarching Civil-Nuclear Framework for Defense Nuclear Nonproliferation Jeffrey Chamberlin, Associate Assistant Deputy Administrator, Office of Material Management and Minimization, Office of Defense Nuclear Nonproliferation, National Nuclear Security Administration, U.S. Department of Energy ( <i>confirmed</i> )
1:35 pm – 2:00 pm	Q&A for Academies committee and staff
2:00 pm – 2:20 pm	Defense Nuclear Nonproliferation's Civil Nuclear Security Program Katherine C. Holt, Program Director for Analytics and Innovation, Office of International Nuclear Security, National Nuclear Security Administration, U.S. Department of Energy ( <i>confirmed</i> )
2:20 pm – 2:45 pm	Q&A for Academies committee and staff
2:45 pm – 2:55 pm	Break
2:55 pm – 3:15 pm	Defense Nuclear Nonproliferation's Advanced Reactor International Safeguards Engagement Program Anagha Iyengar, Ph.D., Program Manager, Office of International Nuclear Safeguards, National Nuclear Security Administration, U.S. Department of Energy ( <i>confirmed</i> )
3:15 pm – 3:40 pm	Q&A for Academies committee and staff
3:40 pm – 3:55 pm	Security of HALEU at Fuel Cycle Facilities and In Transit Tim Harris, Senior Program Manager, Office of Nuclear Security and Incident Response (NSIR), U.S. Nuclear Regulatory Commission (confirmed)
3:55 pm – 4:15 pm	Q&A for Academies committee and staff
4:15 pm – 4:30 pm	Safeguards and Material Accounting for Advanced Reactors and Associated Fuel Cycles James Rubenstone, Ph.D., Chief of the Material Control and Accounting Branch in the Division of Fuel Management, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission (confirmed)
4:30 pm – 4:50 pm	Q&A for Academies committee and staff
4:50 pm – 5:00 pm	Public Comment Period
5:00 pm	Adjourn PUBLIC SESSION – Day 2

### **Reading Materials**

Ryan Snyder, "<u>A Proliferation Assessment of Third Generation Laser Uranium Enrichment</u> <u>Technology</u>," Science & Global Security, 24:2, 68-91, 2016.

### **Presenter Biographies**

# Matthew Bunn, Ph.D., James R. Schlesinger Professor of the Practice of Energy, National Security, and Foreign Policy, and Co-Principal Investigator, Managing the Atom Project, Belfer Center, Harvard University

Professor Bunn's research interests include nuclear theft and terrorism; nuclear proliferation and measures to control it; the future of nuclear energy and its fuel cycle; and policies to promote innovation in energy technologies. Before joining the Kennedy School in January 1997, he served for three years as an adviser to the Office of Science and Technology Policy, where he played a major role in U.S. policies related to the control and disposition of weapons-usable nuclear materials in the United States and the former Soviet Union, and directed a secret study for President Clinton on security for nuclear materials in Russia. Previously, Bunn was at the National Academy of Sciences, where he directed the two-volume study Management and Disposition of Excess Weapons Plutonium. He is the winner of the American Physical Society's Joseph A. Burton Forum Award for "outstanding contributions in helping to formulate policies to decrease the risks of theft of nuclear weapons and nuclear materials," and the Federation of American Scientists' Hans Bethe Award for "science in service to a more secure world," and is an elected Fellow of the American Association for the Advancement of Science. He is a member of the Department of Energy's Nuclear Energy Advisory Committee and a consultant to Pacific Northwest and Oak Ridge National Laboratories. He is a member of the Board of Directors of the Arms Control Association. Dr. Bunn holds a doctorate in technology, management, and policy from the Massachusetts Institute of Technology.

#### Jeffrey Chamberlin, Associate Assistant Deputy Administrator, Office of Material Management and Minimization, Office of Defense Nuclear Nonproliferation, National Nuclear Security Administration, U.S. Department of Energy

Jeffrey Chamberlin is the Associate Assistant Deputy Administrator for the Office of Material Management and Minimization, where he leads NNSA programs to achieve permanent threat reduction by managing and minimizing the use of nuclear materials, including the conversion of research reactors to non-weapons-usable materials and the removal and disposition of excess weapons-usable nuclear materials from civilian facilities in the United States and around the world. Mr. Chamberlin has over 17 years of federal service, including 13 years at NNSA in program management roles of increasing responsibility. Prior to joining NNSA in 2007, Mr. Chamberlin entered federal service as a Presidential Management Fellow, and served as the White House Office of Management and Budget's Program Examiner for the U.S. Army's \$150 billion annual investment portfolio. Since joining NNSA, Mr. Chamberlin has led efforts to minimize weapons-usable nuclear materials in civilian applications as the Deputy Director of the Global Threat Reduction Initiative's Office of European and African Threat Reduction: Director of the Office of Material Management and Minimization's Office of Conversion; and as a Senior Advisor to the Principal Assistant Deputy Administrator for Defense Nuclear Nonproliferation and the Assistant Deputy Administrator for the Office of Material Management and Minimization. In addition, Mr. Chamberlin led efforts to arrest the declining state of NNSA infrastructure during his time as Director of the Office of Infrastructure and Operations' Office of Innovative Solutions.

#### Ben Cipiti, Ph.D., Sandia National Laboratories

Ben Cipiti has worked in Nuclear Energy and Fuel Cycle Programs at Sandia National Laboratories for over 16 years with a focus on nuclear material safeguards and security. He is the current National Technical Director for the Advanced Reactor Safeguards program in DOE NE. His research activities include safeguards and security design and analysis for the full suite of fuel cycle facilities. He developed the Separation and Safeguards Performance Model (SSPM) which provides a unique capability to analyze the safeguards design for fuel cycle facilities. His work supports both domestic and international challenges through DOE NE and NNSA program areas. He received his PhD in Nuclear Engineering from the University of Wisconsin-Madison and BS in Mechanical Engineering from Ohio University.

# Tim Harris, Senior Program Manager, Office of Nuclear Security and Incident Response (NSIR), U.S. Nuclear Regulatory Commission

Tim Harris is a Senior Program Manager in NRC's Office of Nuclear Security and Incident Response (NSIR). Working in the Division of Physical and Cyber Security Policy, he has extensive experience in the protection of special nuclear material at fuel cycle, research and test reactor, and medical isotope production facilities, as well as protection of radioactive sources. Prior to joining NSIR, Mr. Harris was the Chief of the Source Safety and Security Branch in the Office of Federal and State Materials and Environmental Management Programs. Since joining the NRC in 1994, Mr. Harris has a Bachelor's Degree in Civil Engineering from the University of Maryland and a Master's Degree in Environmental Engineering from the Georgia Institute of Technology.

### Katherine C. Holt, Program Director for Analytics and Innovation, Office of International Nuclear Security, National Nuclear Security Administration, U.S. Department of Energy

Ms. Holt has served in the legislative and executive branches of the U.S. Government since 2004, where she has held a variety of program and policy positions in the WMD threat reduction, nonproliferation and arms control fields. She was a staff member of the House Armed Services Committee and served in the State Department's Bureau of International Security and Nonproliferation. In 2010, she joined the U.S. Department of Energy's National Nuclear Security Administration (DOE/NNSA), serving as Deputy Director for NNSA Congressional Affairs supporting ratification of the New START Treaty, and later as a Policy Advisor in the Office of the Administrator. In 2015, she joined NNSA's Defense Nuclear Nonproliferation organization, where she currently serves as the Program Director for Analytics & Innovation in the Office of International Nuclear Security, responsible for developing innovative approaches to advancing nuclear security worldwide. She holds a BA from the University of Virginia and an MA in Security Policy Studies from George Washington University's Elliot School of International Affairs.

### Anagha Iyengar, Ph.D., Program Manager, Office of International Nuclear Safeguards, National Nuclear Security Administration, U.S. Department of Energy

Dr. Anagha lyengar is the program manager for DOE/NNSA's advanced reactor international safeguards engagement efforts in the Office of International Nuclear Safeguards (OINS). She also currently manages DOE/NNSA's international safeguards engagement activities with

partners in Western Europe. Prior to her time at DOE/NNSA, she worked at Oak Ridge National Laboratory from 2016–2019, where she contributed to the development of detection systems in support of International Atomic Energy Agency (IAEA) safeguards. She holds a B.Sc. in Nuclear Engineering from the University of California, Berkeley and a M.S. and PhD in Nuclear Engineering from the University of Tennessee, Knoxville.

# Robert K. Larsen, Department of Nuclear Safety and Security, International Atomic Energy Agency

Mr. Larsen is a Senior Nuclear Security Officer in the Division of Nuclear Security (NSNS), Nuclear Security of Materials and Facilities Section (MAFA). Mr. Larsen is responsible for assisting Member States in establishing systems and measures to ensure that nuclear material is appropriately accounted for and effectively controlled. Mr. Larsen has developed a number of training courses and E-Learning modules on nuclear material accounting and control (NMAC) and insider threats. He is the author of the "Hypothetical Facility Databook: The Shapash Nuclear Research Institute", the corresponding 3-D model and virtual reality serious game. Mr. Larsen has 35 years of experience in nuclear material accounting and control as a Senior Technical Advisor at the US Department of Energy for International Material Protection, Control, and Accounting (MPC&A); as the MPC&A Program Manager at Los Alamos; and Nuclear Materials Control Manager at Rocky Flats (Golden, Colorado).

#### James Rubenstone, Ph.D., Chief of the Material Control and Accounting Branch in the Division of Fuel Safety, Safeguards, and Environmental Review, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission

Dr. James Rubenstone is Chief of the Material Control and Accounting Branch in the Division of Fuel Safety, Safeguards, and Environmental Review, Office of Nuclear Material Safety and Safeguards. He joined the NRC in 2003. In addition to his present responsibilities for international safeguards and material control and accounting, he has worked on issues related to disposal and storage of high-level radioactive waste and spent nuclear fuel. He is a graduate of the College of William and Mary and has a Ph.D. in geological sciences from Cornell University.

# Ryan Snyder, Ph.D., Visiting Fellow at University of Hamburg, Institute for Peace Research and Security Policy

Dr. Snyder is a nuclear physicist working on issues related to nuclear proliferation, arms control, U.S. defense and foreign policy, and nuclear security. He has been a Visiting Fellow at the University of Hamburg since August 2019. Prior to that, he worked as UN Institute for Disarmament Research (UNIDIR) in Geneva Switzerland, from January 2018 to July 2019. He was a visiting research fellow with the Arms Control Association from September 2016 until March 2018. His focus was on the intercontinental ballistic missile (ICBM) modernization debate, assisting with briefings to Congressional staff, media, and think tanks in Washington, DC to explain the issues involved in ICBM replacement and how it may be feasible to eliminate the ICBM force altogether. In August 2016, he completed a postdoc at Princeton University's Program on Science and Global Security where he worked on the proliferation risks of laser isotope separation and multinational uranium enrichment in the Middle East. He was previously a Fellow for Energy Studies at the Federation of American Scientists and an adjunct lecturer in physics at American University, both in Washington, DC. In graduate school, he worked at the Thomas Jefferson National Accelerator Facility as part of a collaboration that used parityviolating electron scattering to measure the strange-quark contribution to the structure of the nucleon. He received a Ph.D. in nuclear physics from the University of Virginia and a B.A. in physics from Kenyon College.

# Warren Stern, Deputy Chair, Nonproliferation and National Security, Brookhaven National Laboratory

Warren Stern is currently Brookhaven National Laboratory's Deputy Chair for Nonproliferation and National Security. Stern has held leadership positions at the CIA, the Department of State, the International Atomic Energy Agency and the Department of Homeland Security. He was appointed in August 2010 by President Obama to lead DHS's Domestic Nuclear Detection Office. Before that, he directed the IAEA's Incident and Emergency Centre, and before that he was the Department of State's Senior Coordinator for Nuclear Safety. Stern earned a B.A. in physics from Brandeis University in 1985, and an M.S. in nuclear engineering from MIT in 1989. He also holds an M.S. in national security studies from the National War College, awarded in 1997.

# Jeremy Whitlock, Ph.D., Section Head for Concepts and Approaches, Department of Safeguards, International Atomic Energy Agency

Dr. Whitlock has been the Section Head for Concepts and Approaches in the IAEA's Department of Safeguards since 2017. Prior to that, he had 22 years' experience as a reactor physicist and manager in the Canadian nuclear industry, mostly at Chalk River Laboratories. From 2006-2016 he was the manager for Non-proliferation and Safeguards R&D at Chalk River Laboratories (now operated by Canadian Nuclear Laboratories). Dr. Whitlock has a Ph.D. and Masters in reactor physics from McMaster University, and a B.Sc. in physics from the University of Waterloo. He is a Fellow, and a former President, of the Canadian Nuclear Society. He currently lives in Vienna, Austria.