The National Academies of
SCIENCES • ENGINEERING • MEDICINE

Radioactive Sources: Applications and Alternative Technologies

Virtual Meeting

PUBLIC AGENDA

June 10-12, 2020, Eastern Time (ET)

International Atomic Energy Agency
Vienna, Austria

Wednesday, June 10, 2020, Times are ET

Connection details for June 10:

Link: https://nasem.webex.com/nasem/j.php?MTID=m569c4b0f0cfc40cb156049db59975c18
Meeting ID: 165 273 8525
Password: YxW2mYBG63g
Telephone: +1-650-215-5228 or +1-301-494-9606
Access code: 165 273 8525

PUBLIC SESSION 1

9:00 am – 9:15 am	**Call Open PUBLIC SESSION 1 to Order and Welcome** Bonnie Jenkins, Committee Chair and Charles Ferguson, Study Director
9:15 am – 9:35 am	**1.1: Categorization of Radioactive Sources and Safety Considerations** Ronald Pacheco, Head, Control of Radiation Sources Unit, IAEA
9:35 am – 9:50 am	**Q+A and Discussion on IAEA Presentation 1.1**
9:50 am – 10:10 am	**1.2: Security of Radioactive Material in Use and Storage** Muhammad Waseem, Division of Nuclear Security, IAEA
10:10 am – 10:25 am	**Q+A and Discussion on IAEA Presentation 1.2**
10:25 am – 10:45 am	**1.3: Incident and Trafficking Database** Jose Garcia Sainz, Nuclear Security Information Officer, Division of Nuclear Security, IAEA
10:45 am – 11:00 am	**Q+A and Discussion on IAEA Presentation 1.3**
11:00 am – 11:20 am	**1.4: Dosimetry and Medical Radiation Physics: IAEA Activities in support of alternative technologies in medicine** Karen Christaki, Head, Dosimetry Laboratory, Seibersdorf, Dosimetry and Medical Radiation Physics Section, IAEA
11:20 am – 11:35 am	**Q+A and Discussion on IAEA Presentation 1.4**
11:35 am – 11:55 am	**1.5: Activities in Support of Electron Beam and X-ray Technologies** Valeriia Starovoitova, Radiation Technology Coordination Officer, Radioisotope Products and Radiation Technology Section, IAEA
11:55 am – 12:10 pm	**Q+A and Discussion on IAEA Presentation 1.5**
12:10 pm	**Adjourn PUBLIC SESSION 1**

Thursday, June 11, 2020, Times are ET

Connection details for June 11:

Link: https://nasem.webex.com/nasem/j.php?MTID=m0882a7cbe2ac1b626fd6ef73715f45f7
Meeting ID: 165 432 8319
Password: tAPsmsXr493
Telephone: +1-650-215-5228 or +1-301-494-9606
Access code: 165 432 8319

PUBLIC SESSION 2

9:00 am – 9:10 am	**Call Open PUBLIC SESSION 2 to Order and Welcome** Bonnie Jenkins, Committee Chair and Charles Ferguson, Study Director
9:10 am – 11:30 am	**2.1. USNRC Presentations and Remarks** Margaret Cervera, Source Management and Protection Branch, Division of Materials Safety, Security, State, and Tribal Programs, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission Note: The presenter will cover the following 7 topics (about 10-15 minutes on each topic). 1. NRC actions in response to the 2008 NAS study 2. Cost effectiveness determination of requirements 3. The Integrated Source Management Portfolio: the National Source Tracking System (NSTS), the Web-based Licensing system (WBL), and the License Verification System (LVS) 4. Category 3 source control 5. Financial responsibility for disposition 6. Operating experience with lost, abandoned, and stolen sources 7. Regulatory authority in the transportation sector The presenter will engage in Q+A (about 5-10 minutes) with the committee following each topic.
11:30 am – 11:50 am	**2.2 The 2019 Sealed Source Recovery Incident at the University of Washington and NNSA Lessons Learned** Lance Garrison, Office of Radiological Security, National Nuclear Security Administration (NNSA)
11:50 am – 12:05 pm	**Q+A and Discussion**
12:05 pm	**Adjourn PUBLIC SESSION 2**

Friday, June 12, 2020, Times are ET

Connection details for June 12:

Link: https://nasem.webex.com/nasem/j.php?MTID=m2efeb19a9360c24fe3108b02703585e0
Meeting ID: 165 347 7790
Password: XNfSh3Sry28
Telephone: +1-650-215-5228 or +1-301-494-9606
Access code: 165 347 7790

PUBLIC SESSION 3

9:45 am – 10:00 am	**Call Open Session to Order and Welcome** Bonnie Jenkins, Committee Chair and Charles Ferguson, Study Director
10:00 am – 10:30 am	**3.1: Alternatives to Radionuclide-based Well Logging Techniques** Ahmed Badruzzaman, Consultant, Pacific Consultants and Engineers, Hayward, CA; Adjunct Faculty, University of California, Berkeley
10:30 am – 10:45 am	**Q+A and Discussion**
10:45 am – 11:05 am	**3.2: Use of Radioisotopes in the Performance of Industrial Radiography** David Tempo, Director/Cooperate Radiation Safety Officer, TeamInc
11:05 am – 11:30 am	**Q+A and Discussion**
11:30 am	**Adjourn PUBLIC SESSION 3**

List of Sample Questions Sent to the Presenters

IAEA

1. Please provide an overview of the 2003 document Categorization of Radioactive Sources, IAEA-TECDOC-1344.
    - Does the IAEA have plans to re-evaluate the proposed categorization system? If yes, what are some factors the agency is reevaluating and what are the timelines for publication?
    - The committee is particularly interested in understanding the IAEA's position on considering the socioeconomic risks posed by the sources in the categorization system.
    - Please provide information on the feedback the IAEA receives from Member States on the document and its usefulness in setting regulatory guidance for radiation sources
    - What are the IAEA's views on the adequacy of regulatory control of category 3 sources in the United States and worldwide?
    - Does the IAEA keep an inventory of radioactive sources worldwide? If not, does the agency have some idea of the number of sources, e.g., blood irradiators, sterilization sources available worldwide?
2. Please provide an overview of the IAEA's Incident and Trafficking Database
    - How have security concerns evolved the past 10 years? What are the IAEA's top security concerns today?
    - How has the ability to track sources changed the past 10 years?
3. Please provide an overview of IAEA's work on alternative technologies.
    - Examples of the IAEA providing assistance for adopting alternative technologies. What challenges have some countries faced in adopting alternative technologies?
    - What technologies and for what applications does the IAEA see emerging the next 10 years?
    - What applications do not have viable alternatives?
    - Does the agency have information on dependence on Cesium-137 worldwide? For example, the committee is aware that India is replacing Cobalt-60 with Cesium-137 because India's nuclear establishment sees it as a viable option?
    - Decision making process for helping countries with technology/replacement. Is there a checklist? Are there any case studies?

NRC

1. Please provide an overview of the National Source Tracking System (NSTS).
    - How does the NSTS account for licenses within Agreement States?
    - What are the requirements for providing information from the NSTS to requestors? For example, could the committee receive a breakdown of number of licenses for cat 1 and 2 sources, if requested?
2. Can the USNRC provide information on its assessment to include cat 3 sources in the NSTS? What types of comments did the agency receive following the 2017 public meeting on the topic?
3. How many new licenses were issued the past 5 years for CsCl irradiators in the United States? How does the USNRC deal with financial assurance issues related to disposing

of these irradiators due to the luck of an avenue for permanent disposal of these sources?

4. Does the USNRC consider changing its ranking system of radiation sources to consider risks other than deterministic health effects, such as socioeconomic risks?
5. Has the USNRC conducted security analyses of the facilities licensed to use Cat 1 and cat 2 sources to examine factors other than potential deterministic health effects? (to address Finding 2a of 2008 Academies report).
6. Please provide information on the costs to the licensees for complying with security requirements posed for facilities that host cat 1 and cat 2 sources.
7. Please provide an overview of the USNRC's database for lost, misplaced, and stolen radioactive sources.
    - What are some main conclusions about risks that one can draw from analyzing the data?
    - What sources are the most likely to be lost, misplaced, or stolen?
    - What is the process for providing information from the database to requestors? For example, could the committee receive a breakdown of number of incidents and circumstances they occurred?

University of Washington incident

1. Please provide an overview of the May 2019 breach of a cesium-137 sealed source and resultant spread of contamination.
2. What are some lessons learned related to the source removal process and how will these be implemented in future operations?
3. What are the estimated costs of remediation following the incident?
4. What impact has the accident had on future CIRP and Offsite Recovery activities?

Industrial radiography

1. Please describe the types of services your company provides and the types of clients that request these services for different applications.
2. Which testing methods you provide rely on radioisotopes and what specific areas of the industry rely exclusively on radioisotopes?
3. Please, to the extent possible, provide visuals (including videos) for the committee to understand how the radiation sources your company uses operate.
4. How are these sources regulated? What are the safety and security concerns, if any?
5. What improvements in the radiation sources occurred the past 10 years that improved the services you provide and safety/security of operations?
6. Please discuss how you envision the services/sources will evolve the next decade. What improvements do you expect to see?
7. Given that there is always turnover of technologies, continued development, improvements, disruptors; how long would it take for the industry to completely phase out radioisotopes? Would there be any areas of irreversible, unrecoverable loss of capability?
8. What would be the motivation for your company to consider alternative technologies? What are some of the challenges and possible solutions?
9. How big is the industry you are in and what types of events/meetings bring the different vendors together to inform each other about developments in these services?

10. Please provide any additional information you think is relevant to this committee's work.

Well Logging Consultant

2. Please comment on safety and security issues related to radiation sources in well logging.
3. What are some technical challenges to implementing replacements for well logging radioactive sources?
4. What progress has been made the past decade to address these challenges?
5. Please discuss how you envision the well-logging services/sources will evolve the next decade. What improvements do you expect to see and will alternative technologies be adopted?
6. Given that there is always turnover of technologies, continued development, improvements, disruptors; how long would it take for the industry to completely phase out radioisotopes? Would there be any areas of irreversible, unrecoverable loss of capability?
7. Can you confirm that spinning pipe gauges using radioactive sources are no longer used in the petroleum industry?
8. If that is true, what does it say about the practicality of replacing other isotopic sources in the industry?
9. How much of the change was due to new techniques offering better/more capability and how much was due to the challenges of using a radioactive source? (poor cost/benefit?)
10. There appear to be non-isotopic alternatives for just about every isotopic tool currently in use.
    a. Are the deficiencies in the non-isotopic alternatives truly great enough to preclude replacement?
    b. What incentives would be necessary to facilitate a rapid transition?

Reading Material

Presentation 1.1

- Categorization of Radioactive Sources No RS-G-1.9 https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1227_web.pdf
- General Safety Requirement "Governmental, Legal and Regulatory Framework GSR-part 1 https://www.iaea.org/publications/10883/governmental-legal-and-regulatory-framework-for-safety
- General Safety Requirement " Radiation Protection and Safety of Radiation Sources https://www-pub.iaea.org/MTCD/publications/PDF/Pub1578_web-57265295.pdf
- Code of Conduct of safety and security of radioactive sources : https://www-pub.iaea.org/MTCD/publications/PDF/Code-2004_web.pdf

Presentations 1.2 and 1.3

- IAEA Nuclear Security Series No. 14 - Nuclear Security Recommendations on Radioactive Material and Associated Facilities
- IAEA Nuclear Security Series No. 11-G (Rev.1) - Security of Radioactive Material in Use, Storage and Associated Facilities
- IAEA Nuclear Security Series No. 6 – Combating Illicit Trafficking in Nuclear and Other Radioactive Material

Presentation 1.4

- Radiotherapy Facilities: Master Planning and Concept Design Considerations. https://www.iaea.org/publications/10561/radiotherapy-facilities-master-planning-and-concept-design-considerations
- Setting Up a Radiotherapy Programme: Clinical, Medical Physics, Radiation Protection and Safety Aspect. https://www.iaea.org/publications/7694/setting-up-a-radiotherapy-programme
- Transition from 2-D Radiotherapy to 3-D Conformal and Intensity Modulated Radiotherapy https://www.iaea.org/publications/7907/transition-from-2-d-radiotherapy-to-3-d-conformal-and-intensity-modulated-radiotherapy
- The Transition from 2-D Brachytherapy to 3-D High Dose Rate Brachytherapy. https://www.iaea.org/publications/10705/the-transition-from-2-d-brachytherapy-to-3-d-high-dose-rate-brachytherapy
- Staffing in Radiotherapy: An Activity Based Approach https://www.iaea.org/publications/10800/staffing-in-radiotherapy-an-activity-based-approach

Presentation 1.5

- IAEA, 2019, Recent Achievements on Irradiation Facilities http://www-naweb.iaea.org/napc/iachem/working_materials/Report%20IF.pdf
- IAEA Consultancy Meeting on 'Economical Feasibility of Transitioning from Gamma Sterilization to Accelerator-based Sterilization' http://www.naweb.iaea.org/napc/iachem/working_materials/Report%20Eco%20Feas%20Ste r.pdf

- IAEA, 2019, Radiation Effects on Polymer Materials http://www-naweb.iaea.org/napc/iachem/working_materials/IAEA%20Consultancy%20Meeting%20Final%20Report.pdf

Presentation 2.1

1. Policy Statement of the U.S. Nuclear Regulatory Commission on the Protection of Cesium-137 Chloride Sources https://www.nrc.gov/reading-rm/doc-collections/commission/policy/
2. 10 CFR Part 110 Import and Export of Nuclear Equipment and Material https://www.nrc.gov/reading-rm/doc-collections/cfr/part110/
3. 10 CFR Part 37 Physical Protection of Category 1 and Category 2 Quantities of Radioactive Material https://www.nrc.gov/reading-rm/doc-collections/cfr/part037/
4. Integrated Source Management Portfolio (links to information on NSTS, WBL, and LVS) https://www.nrc.gov/security/byproduct/ismp.html
5. Regulations.gov 10 CFR Part 37 rulemaking docket NRC-2008-0120 (includes the regulatory analysis and estimated costs of implementation) https://www.regulations.gov/docket?D=NRC-2008-0120
6. Program Review of 10 CFR Part 37 (includes report and summary) https://www.nrc.gov/security/byproduct/10-cfr-part-37-program-review.html
7. Category 3 Source Security and Accountability Re-Evaluation (includes Federal Register notice, public meeting announcements and transcripts, and link to Commission paper plus attachments that include cost-benefit analysis and comments) https://www.nrc.gov/security/byproduct/category-3-source-security-accountability-reevaluation.html
8. SECY-16-0115 Rulemaking Plan on Financial Assurance for Disposition of Category 1 and 2 Byproduct Material Radioactive Sealed Sources https://www.nrc.gov/docs/ML1620/ML16200A223.pdf
9. Greater-Than-Class-C and Transuranic Waste: A Proposed Rule by the Nuclear Regulatory Commission. Rulemaking docket NRC-2017-0081 (includes links to the draft regulatory basis, public meeting transcripts, and relevant DOE products) https://www.nrc.gov/waste/llw-disposal/llw-pa/gtcc-transuranic-waste-disposal.html
10. 10 CFR 30.35 Financial assurance and recordkeeping for decommissioning https://www.nrc.gov/reading-rm/doc-collections/cfr/part030/part030-0035.html
11. Consolidated Guidance About Materials Licenses (NUREG-1556) (each volume contains specific commitments of applicants/licensees for provision of adequate resources) https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1556/
12. Nuclear Regulatory Commission's Nuclear Material Events Database (NMED, includes links to annual reports spanning 2007 to current) https://nmed.inl.gov/
13. Memorandum of Understanding between DOT and NRC for transport of radioactive materials https://www.nrc.gov/about-nrc/regulatory/enforcement/moudot.pdf
14. Memorandum of Understanding between DOT, NRC, and DHS for transport security https://www.nrc.gov/docs/ML1534/ML15344A371.pdf

Presentation 3.1

1. Non-Radioisotopic Alternative Technologies White Paper, U.S. Department of Homeland Security,September,2019,https://www.cisa.gov/sites/default/files/publications/19_1211_cisa_non_radioisotopic_alternative_technologies-white_paper.pdf
2. Basic Research Needs Workshop on Compact Accelerators for Security and Medicine *Tools for the 21st Century*, US Department of Energy, Office of Science, Released January 24, 2020: https://science.osti.gov/-/media/hep/pdf/Reports/2020/CASM_WorkshopReport.pdf
3. For a full discussion on well Logging: - Nuclear and non-nuclear alternatives tested "Scoping Study on Developing Alternatives to Radionuclide-based Logging Technologies," LLNL-TR- 679101, October 30, 2015: USDepartment of Energy, Lawrence Livermore National Laboratory, Livermore, California. Posted April, 2018: https://e-reports-ext.llnl.gov/pdf/803033.pdf
4. Recent Developments on Alternatives to the three key radioactive source logging techniques:
    - Density- Cs-137 (Co-60) replacement: Simon, M., et al., "A Novel X-Ray Tool for True Sourceless Density Logging," Petrophysics, Vol. 50, No. 5, October 2018.
    - Neutron Porosity - Am-Be (Pu-Be) Replacement: Badruzzaman, A., et al.,"Neutron Generators as Alternatives to Am-Be Neutron Sources in Well Logging: An Assessment of Fundamentals," Petrophysics, Vol. 60, No.1, pages 136-170, 2019.
    - Mineralogy/n-gamma spectroscopy- Am-Be replacement: Radtke, R.J., et al., A Capture and Inelastic Spectroscopy Tool Takes Geochemical Logging to Next Level, Proc. 53rd SPWLA Annual Symposium, Cartagena, Columbia, June 16-20, 2012
5. Badruzzaman et al., 2009, Radioactive Sources in Petroleum Industry: Applications, Concerns and Alternatives, presentation at the 2009 SPE Asia Pacific Health, Safety, Security, and Environment Conference and Exhibition held in Jakarta, Indonesia

Presenter Biographies

Ahmed Badruzzaman earned a PhD in Nuclear Engineering and Science from Rensselaer Polytechnic Institute, Troy, NY, in 1979. During a 40-yr R&D journey on nuclear technologies through Babcock & Wilcox, Schlumberger-Doll, Sandia National Laboratories, and Chevron, and teaching at University of California, Berkeley, he studied novel fission reactors, inertial confinement fusion and subsurface nuclear probing. On the latter, a major focus has been on alternatives to radionuclide-based devices. Ahmed's interest in alternatives began in early 1980's at Schlumberger-Doll, where he studied response of an experimental LINAC tool designed to replace Cs-137 for density measurement. Later at Chevron, he developed industry's first multi-detector, multiple-parameter D-T generator logging tool concept gaining a 1998 patent on through-casing inelastic n-gamma density (INGD). In two recent peer-reviewed papers, he explored the fundamentals one needs to be cognizant of, to utilize electronic sources to replace Cs-137 for density and neutron generators to replace Am-Be sources for neutron porosity.
Ahmed is currently an SME consultant to US Department of Energy on alternatives. He led the NNSA-supported 2015 Scoping Study on the topic, supported NNSA's 2017 Workshop in Kazakhstan on Well Logging Source Risk Mitigation in ISTC and STCU Member States, contributed to the 2019 DHS-sponsored Non-Radioisotopic Alternative Technologies White Paper, and the 2020 report on DOE Office of Science Workshop on Basic Research Needs in Compact Accelerators for Security and Medicine. He was an official reviewer of US National Academies' 2008 report to Congress, "Radiation Source Use and Replacement." In addition to studying alternatives, Ahmed helped develop Chevron's in-house Source Handling Guideline, prepare IAEA's draft logging source safety guide, and revise Vienna-based WINS' Best Practice Guide on logging source security.

Engrossed in energy/climate issues for decades, Ahmed jointly developed, and has taught since Fall 2016, U C Berkeley's Big Ideas Course, *Energy and Civilization*, to allow students to explore the related conundrum. Author of 45+ papers, two US patents, and an upcoming textbook on subsurface nuclear measurements, Ahmed is a Fellow of American Nuclear Society, a two-time SPE Distinguished Lecturer, and a two-time SPWLA Distinguished Speaker. He is a former editor of the journal, *Petrophysics*, and the founder-chair of SPWLA Nuclear Logging SIG, the Society's technical group focused on the science, technology and application of downhole nuclear measurements.

Margaret Cervera is a project manager for both health physics and physical protection at the United States Nuclear Regulatory Commission (NRC). Her responsibilities have included the integration of radiation safety and physical security for power reactor, spent fuel storage, fuel cycle, transportation, and complex decommissioning facilities throughout the United States. Since 2015 her focus has been on radioactive materials in the civilian sector in use, storage, and transport, as well as for cybersecurity activities related to such materials. Additionally, she provides her expertise as a dose assessor for the incident response organization of the NRC, and is an expert for the *Ask The Experts* feature of the Health Physics Society. Ms. Cervera holds Bachelor's degrees in both Microbiology and Chemistry, and a Master's degree in Health Physics – all from Colorado State University.

Karen Christaki gained her PhD in radiation physics at University College London. For twenty years she worked in the dosimetry section at the primary standards laboratory in U.K. the National Physical Laboratory and then spent a further 10 years working as a clinically qualified Medical Physicist in various radiotherapy departments close to London, UK. In 2014 she joined

the IAEA as a radiotherapy medical physics technical officer and then in 2019 she became head of the IAEA dosimetry laboratory.

Jose Garcia-Sainz is a law enforcement officer of the Spanish Guardia Civil with over 30 year experience in counter-terrorism, criminal analysis and CBRN threats. Prior to his recruitment by the IAEA in 2013, he served as a counterterrorism and CBRN specialist at the European Law Enforcement organization (EUROPOL) for 11 years.

Lance Garrison, PhD, manages the Domestic Alternative Technology Portfolio, including the Cesium Irradiator Replacement Project, in the National Nuclear Security Administration Office of Radiological Security. Lance holds a Ph.D. in nuclear physics from Indiana University and bachelor's degrees in physics and mathematics from the University of Missouri.

Ronald Pacheco, Head, Control of Radiation Sources UNIT in the Regulatory and Transport Safety Section, IAEA, has started his functions with the IAEA in November 2004. In his sixteen years of experience with the IAEA, Mr Pacheco main task has been to Support Member States in the establishment and strengthening of the National Regulatory Framework for Radiation Safety. Mr Pacheco has a master's degree in Nuclear Sciences from University of Buenos Aires, Argentina and two post graduate training courses in Medical and Industrial Radiation Safety from the University of Sao Paulo, Brazil. He joined the IAEA from the Costa Rican Nuclear Regulatory Authority in the Ministry of Health where he worked for over twenty years. The last position he held there was Deputy Director. He is also an Adjunct Professor at the University of Costa Rica in Physicist and Radiation Protection, having also the honour to work as Advisor to the President of the Republic of Costa Rica in Science and Technology from 1999-2001.

After receiving her PhD at Purdue University, **Valeriia Starovoitova** started working at the Idaho Accelerator Center (IAC), Idaho State University. She was involved in several applied nuclear physics projects focused on various uses of electron linacs. In 2013 joined Niowave, Inc., a company that delivers and commissions superconducting electron accelerators. Dr. Starovoitova's task was to establish and lead the Applied Physics Group, which by 2018 grew to ten researchers including nuclear physicists and engineers, radiochemists, health physicist, and material scientists. In 2018 Dr. Starovoitova started working at IAEA as a radiation technology coordination officer. Her current work is focused on assessment of alternative radiation technologies, particularly uses of particle accelerators for medical device sterilization, material processing, environmental applications, and other uses. In addition to the aforementioned work, for over 15 years Dr. Starovoitova has been teaching various physics and radiation technology courses as well as mentoring students– at Purdue University, Idaho State University, and World Nuclear University.

David Tebo is the Corporate Radiation Safety Officer for TEAM Industrial Services, Inc. He has held this position for the last 13 years. Prior to TEAM, Mr. Tebo held a similar position for 8 years with a small Non-destructive Testing Lab in Indiana. He has been in the NDT field for 35 years performing field inspections in the Oil & Gas, Petrochemical, Power & Energy, Construction and Nuclear Industries. Majority of his career has been spent performing, overseeing or supervising Industrial Radiography Operations using radioisotopes, including Iridium-192, Co-60, and Selenium-75, in activities ranging from 10 to 150 curies. He currently holds ASNT Level III certifications in the Radiography, Magnetic Particle and Liquid Penetrant Methods and has limited Level II experience in Ultrasonics.

Mr. Muhammad Waseem is a Pakistani National, holds a Master's Degree in Physics and Diploma in Physical Protection Systems. He has been working in nuclear field since 2007. Before joining the IAEA's Division of Nuclear Security in 2018, Mr. Waseem served for over 11 years as nuclear safety and security regulator with Pakistan Nuclear Regulatory Authority. Mr. Waseem has been engaged to coordinate activities related to physical protection of radioactive material and associated facilities.