

Workshop on the Security of Disused Radioactive Sources

Vienna, Austria. 08- 09 October 2019

REPORT

BACKGROUND

Each year, thousands of radioactive sources become disused worldwide. Many are exchanged for new ones to continue operation (e.g. industrial radiography and medical teletherapy). Other disused sources are covered by agreements to return to their original supplier. However, many users cease operations or have no more use for their sources and have not planned for the adequate or affordable long-term storage or disposal of their disused sources. Occasionally, poor management of disused high activity radioactive sources has led to significant incidents, which have caused severe damages, including human casualties.

In addition, many users are unaware of the costs associated with the management of radioactive sources when they become disused. They do not know that transportation and disposal costs might be comparable to the purchase price of the source itself. When confronted with these costly options, some users may decide not to declare their sources as disused; instead, they store them onsite for an extended period of time, sometimes under substandard circumstances. This poses unnecessary safety and security risks because such sources could become orphan or vulnerable to theft and potentially be used to create a radiological dispersal device (RDD) or a radiation exposure device (RED).

In addition, the return of a disused source to a supplier or its transfer to a safe and secure interim storage facility is not always feasible at the time the source becomes disused. Reasons for this could include: a lack of authorised transport packages, documentation and necessary certificates for sources and devices; insufficient interim storage capabilities; complex import/export processes; legislative and regulatory constraints from the countries of origin; and the absence of disposal pathways.

The World Institute for Nuclear Security (WINS) and the International Source Suppliers and Producers Association (ISSPA) therefore decided to partner together to conduct a 2-day international workshop that reviewed best practices for the effective end of life management of radioactive sources and identified the security issues and solutions related to the management of disused radioactive sources.

OBJECTIVES OF THE WORKSHOP

The key objectives of the workshop were to help participants:

- Develop a better understanding of the usual challenges associated with the management of disused sources.
- Review the international recommendations for the end of life management of radioactive sources and discuss national strategies for effective management of disused sources.

- Share good practices for the secure management of disused sources.
- Discuss specific issues, such as recycling, financial assurances, low cost storage solutions, processes for designating a source as waste, and long-term storage and disposal opportunities.
- Identify areas where further work is needed and propose solutions for improving security and safety when managing high activity disused sealed radioactive sources.

Forty-two experts from nineteen countries and two international organisations attended the round table. They represented the main stakeholders involved in the management of disused radioactive sources, including end users, source suppliers, device manufacturers, regulators, transport experts, international support programmes and waste management specialists. Participants were expected to have open discussions, express their own perspectives, and offer suggestions for improving end of life management of sources.



The event, which was professionally facilitated by Mr Carl Reynolds, included expert presentations and plenary and breakout sessions to provide maximum engagement. In addition, an instant electronic voting system was used to allow participants to anonymously share their views on selected questions. Some of the e-voting questions are included in this report.

WORKSHOP PROGRAMME AND KEY FINDINGS

DAY 1: TUESDAY, 08 OCTOBER 2019

OPENING SESSION

Mr Richard Wassenaar greeted participants on behalf of ISSPA and expressed the pleasure his association had in co-hosting the workshop and cooperating again with WINS on the topic of radiological security. Mr Wassenaar stressed the importance of effectively managing disused radioactive sources to sustain their use and ensure their multiple benefits are accessible for medical, industrial and other applications. He also explained ISSPA's expectations for the workshop, such as engaging all stakeholders in the topic, suggesting solutions to remaining challenges in radioactive source end of life management, networking and open discussions from a variety of perspectives.

Pierre Legoux, WINS Head of Programmes, welcomed the participants on behalf of WINS, explained the objectives of the workshop, and provided a preliminary overview of the agenda. Mr Legoux also displayed and commented on the most relevant results from the pre-event survey.

Participant Introductions and Expectations

To start the discussions, participants were asked to introduce themselves at their tables and discuss their expectations in coming to this event. Examples included:

- Open discussions and interactions. Interact with a range of professionals and increase my knowledge. Get better at my job!
- Learn from best international experiences on developing a national approach, complying with regulations, ensuring security, identifying recycling opportunities, etc.
- Express my needs and challenges. Explore possible solutions, not just discuss the problem.
- Understand remaining gaps and how my company can contribute.
- Develop a comprehensive and consistent approach for all steps of the source lifecycle.
- End the workshop with actions we can take back to improve end of life management.

SESSION 1: THE BIG PICTURE

Session 1 was organised to conduct an initial review of the different options for managing disused radioactive sources, identify the main elements of a national strategy, explore the roles and responsibilities of various stakeholders, and assess progress made in the last few years.

On behalf of ISSPA, **Mr Greg Fulford, Nordion, Canada**, opened the session with a presentation on *Managing Disused Radioactive Sources – A Global Perspective*. He began with a quick overview of ISSPA's mission, member organisations and key objectives. He then discussed the characteristics and risks associated with managing sources during various stages of their lifecycle and conducted a detailed review of possible options for managing disused sources. Mr Fulford also stressed the commitment of ISSPA members to the principles of effective end of life management as laid out in the association's Articles of Incorporation and Code of Good Practices. In addition, he addressed some remaining challenges and possible solutions to achieving effective returns to suppliers, repatriation to another country and/or proper disposal.

Small Group Discussion

In a small group discussion that followed the presentation, participants were asked to reflect on the key messages delivered by Mr Fulford, as well as on the major findings of a WINS workshop titled *End of Life Management of Radioactive Sources* that was conducted in Paris, France in 2014. The objective was to identify where progress has been made on this issue in the last five years and where challenges remain.

Participants agreed that significant progress has been made in all areas and stressed the importance of establishing a robust international regime that is complemented by support programmes conducted by major countries. They also agreed that some areas, such as transport and disposal options, remain a challenge. In addition, they emphasised the need to fully involve and integrate all stakeholders and countries to solve remaining issues and ensure the sustainability of achievements. Participants agreed that adequate financial, human and technical resources are prerequisites to effectively managing disused sources.

Security of Disused Radioactive Sources

In her presentation titled *Disused Radioactive Sources – Security Threats and Vulnerabilities*, **Ms Sarah Norris, DOE/NNSA Office of Radiological Security, USA**, explained the mission of the DOE/NNSA Office of Radiological Security (ORS) and then reported on the main findings of a study conducted by Argonne National Laboratory on cases of malicious use of radioactive material. This information was drawn from 110 cases that are available in open source literature. Ms Norris also used a couple of recent examples to demonstrate the risk caused by orphan sources. In addition, she briefly summarised the international regime for the safe and secure management of disused radioactive sources and explained how good end of life management policies and practices contribute to radioactive source security.

Small Group Discussion

In a small group discussion following the presentation, participants further explored security matters associated with disused sources. Some of their findings included:

- End of Life management is an essential part of security risk management.
- The risks of disused sources should be considered similar to those of sources in use, because safety or security incidents would have the same consequences. Lack of attention (and therefore of resources) increases the risk.
- Regulatory requirements vary greatly from one country to another. Security levels are inconsistent. We are starting to see security fatigue and growing complacency.
- An accurate inventory is the foundation of end of life management and security.
- Transport security remains challenging. Incidents do happen during transport, and human factors are involved.
- Good security culture is essential. Some people still believe that good safety will cover security. Insiders remain a very credible threat.
- Cyber threats need to be considered (e.g. blended attack, tampering with records). The corruption of national registry or import/export data would create a mess.

National Approaches to End of Life Management

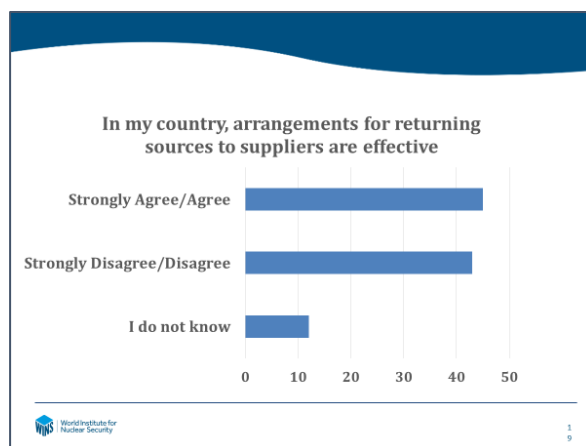
In her presentation, **Ms Maryna Khalalovich, UE “EKORES”, Belarus**, addressed international recommendations, regulations and national strategies. She discussed Belarus’ national approach to managing radioactive waste, the role of her organisation in this effort, and the storage practices and capabilities that are available in Belarus. Ms Khalalovich also talked about security measures for storage facilities and transport operations, highlighting the support Belarus has received from international programmes for strengthening security arrangements. In addition, she explained some of the challenges that remain for establishing a comprehensive approach to managing disused radioactive sources.

Ms Olha Marinich, Central Enterprise for Radioactive Waste Management, Ukraine, provided similar information on the overall approach taken in Ukraine. She gave examples of what is working effectively in her country, as well as areas that still require improvement. She also mentioned the assistance Ukraine has received from international support programmes and explained what some of the major evolutions are expected to be in the coming years.

SESSION 2: RETURNING DISUSED SOURCES TO THE SUPPLIERS

Session 2 was primarily designed to discuss the current practices and challenges for returning sources to suppliers or repatriating them to their country of origin. In particular, the session explored the role of various stakeholders, including end users, source suppliers, regulators and international assistance programmes, in supporting the effective return of disused sources to the supplier or their repatriation to the country of origin.

Mr Jens Baldeweg, Eckert & Ziegler / Gamma Services Recycling, Germany, opened Session 2. Prior to beginning his presentation, he was asked to comment on a pre-workshop survey question about the effectiveness of arrangements for returning sources to suppliers. The 2019 responses to this question do not show any improvements from the responses to a similar question asked in 2014. Mr Baldeweg said that improving these results will take a lot of work to educate end users on end of life management, in particular on options and opportunities to return sources to suppliers. He also said that return to supplier matters are mostly driven by cost issues and that further efforts should be made to reduce such costs and incentivise end users to make better use of return to supplier opportunities.



Mr Baldeweg then delivered a presentation titled *Security of Disused Radioactive Sources – Return to Supplier, Re-use and Recycling*. After a brief introduction to his company, he described the process, best practices and challenges to returning a source to its supplier. He then talked about the re-use and recycling of Cs-137 and Co-60 sources. Finally, Mr Baldeweg discussed some of the challenges faced when re-using or recycling disused Co-60 sources, in particular when their storage conditions are inadequate or when the original suppliers/manufacturers have disappeared.

Small Group Discussion

Prior to the small group discussion, Mr Carl Reynolds talked with **Ms Margaret Cervera, NRC, USA**, on the role of regulatory agencies in effectively managing disused sources and the process of returning or repatriating sources. Ms Cervera mentioned some relevant regulations in the US and some good practices for regulating the security of disused sources. Participants were then asked to form small groups and explore the following:

The role of international guidance and regulations

- Is the international regime for end of life management adequate?
- What has been achieved in this area recently? What needs to be done on an ongoing basis to strengthen the international regime for end of life management?
- Do existing regulations and legislation support or impede the return of sources to their suppliers?

Financial matters

- Is it feasible to estimate future costs of source return? Are the necessary financial resources available? How should users plan to pay for removal? What are the financial planning options?
- Would users manage the end of life stage of their sources more effectively if doing so were less expensive? How could the costs be lowered?

The role of source suppliers

- What are best practices for source suppliers/producers? Are they currently being implemented?
- What happens when suppliers or producers no longer exist?

Following are some of the most important conclusions from the group discussions:

- The international regime is robust, and certain documents such as the Supplementary Guidance to the Code of Conduct are a big step forward. However, by definition, international recommendations are quite generic; consequently, the way in which they are implemented can differ from one country to another, so the practices become inconsistent. Participants emphasised that they would welcome more technical guidance to implement their national regulations.
- Sources should either be used or returned to a supplier or someone who is authorised and qualified to accept them. Storing sources on the premises of end users with no specific purpose is not a good practice. Suppliers are committed to taking the sources back and have the ultimate responsibilities/liabilities; however, customers (end users) should cover the cost. Participants insisted on the importance of not limiting returns to the original supplier as they may not give the most favourable terms or may not exist anymore.
- Return to supplier is a risk transfer, not a risk removal. Suppliers need to have excellent safety and security arrangements and access to a disposal pathway.
- Industry has lifecycles, and the type and number of disused sources follow these cycles. End users need to better understand and anticipate end of life matters. In particular, end of life management costs need to be anticipated and integrated into the operational cost of using the sources. Actions should be taken to reduce end of life management costs and make interim storage and disposal more appealing to end users.
- Return to supplier/disposal costs are estimated at a given date and do not remain valid 10-15 years later. It is good practice for the supplier and end users to review and update the costs periodically (e.g. every 2 years).
- Several countries are requiring financial guarantees. Approaches vary greatly from one country to another.
- Without clear disposal pathways, anticipated end of life management costs are simply best guest estimates.
- Re-use and recycling have not been sufficiently explored. Some discussions initiated during the IAEA CoC meeting are continuing in order to improve this situation.

- Sharing of experience and lessons learned is essential, and collaboration between countries and amongst key stakeholders needs to be maintained at the highest level.
- Information on sealed sources, including national registries, exist in some countries and international organisations, as well as among manufacturers. Unfortunately, the various databases are difficult to access, and there are limited opportunities to cross-check their contents. Participants strongly supported holding discussions on how to simplify access and identify opportunities to connect different databases together.
- Some terminology in this area needs to be harmonised. An example includes ‘waste’ and ‘disused sources’.
- Regulations are evolving and beginning to include end of life cost requirements. Financial guarantees (based on inventory) need to be established upfront. When voluntary efforts to address costs fail, regulations should come into force. However, developing regulation takes time and end products might differ from initial expectations. If users and industry cannot agree on costs in 20 years, how could the regulator know what to require?
- If the supplier disappears, the State may take the lead. Some countries have started to develop insurance mechanisms to cover this risk.

International Support Programmes for Repatriating Disused Radioactive Sources

In his presentation, **Mr Mladen Novakovic, Division of Nuclear Fuel Cycle and Waste Technology, IAEA**, talked about IAEA activities that support the removal of high activity disused sealed radioactive sources. He began by providing some background information on the role of his division in helping IAEA member states enhance their management practices for disused sources. He then described the IAEA’s process for supporting the removal of disused sources and offered some practical examples of removal operations that his section has conducted. Mr Novakovic also provided more information on a new decision aiding tool, Disused Sources Integrated Decision-making Evaluation (DSIDE), that the IAEA has developed. He concluded with a summary of the key findings of a technical meeting organised in Vienna in August 2019 to exchange and consolidate lessons learned from IAEA source removal activities.

Mr John Zarling, Idaho National Laboratory, USA, talked about lessons learned from US efforts to repatriate hundreds of disused sources from more than 25 countries. He emphasised the need to anticipate and address the import and export requirements of technical equipment that supports the repatriation of sources to their countries of origin. He also highlighted the challenges that occur when transport containers are certified in one country but not in another. Another issue is that sources often need to be reconditioned and consolidated in a manageable way. This can be challenging because it requires specialised tools, particularly expertise and robust quality management programmes that few companies possess. Mr Zarling congratulated the IAEA for its instrumental support to the repatriation of sources and its facilitator role with countries that receive US assistance. He said that the feedback received from these countries was almost unanimously positive. He also said that a lot of work is still needed and that the US is committed to continuing its support.

Small Group Discussion

A brief discussion was conducted to explore how source end of life management requirements affect decisions to use alternative technologies and if end of life management needs are properly considered in the on-going effort to replace sources with non-isotopic alternatives, when existing. Participants highlighted costs and performance as a common rationale for adopting alternative technologies. They also said that security, both in terms of costs and concerns, is a more recent factor. Many agreed that organisations and countries need to take a global approach to disused source matters and that replacing one source will not remove the need for end of life management.

Final Activity of Day 1

As the final activity of Day 1, participants were asked to reflect on the findings of the last two speakers and share their perspectives and lessons learned from existing repatriation programmes. They said that they were grateful for the multiple multilateral and bilateral repatriation efforts and consider them to be an effective approach to risk reduction. They also confirmed that the feedback from beneficiary countries is very positive.

Participants identified some of the remaining challenges (e.g. missing special form certificates, lack of information on a source, etc.) and praised ISSPA members for coordinating their efforts to find solutions. They also remarked that some legacy sources originate from Russia, India and China and hence were not supplied by ISSPA members. In such cases, the engagement and sharing of information is more challenging. On-going efforts are being made, however, to improve this.

Participants also said that disused sources are too often considered to be—and designated as—waste, which is a significant obstacle to export and subsequent import to an authorised party in another State. They also said that the numerous regulatory requirements and constraints applied to class 7 shipments significantly increase the costs of these operations. Some participants said it is preferable to extract sources from the devices and transfer them to a transport container. When this isn't possible, transport must take place in over-packs that weigh several tons, dramatically increasing transport costs.

SESSION 3: INTERIM STORAGE OF DISUSED RADIOACTIVE SOURCES

Session 3 was organised to review and discuss all aspects of short-term (interim) storage of disused sources. It gave participants the opportunity to listen to the people who are designing and operating such storage facilities, better understand the related security concerns, and learn how they are being addressed.

Mr Milos Mladenovic, Public Company Nuclear Facilities of Serbia (PCNFS), opened Session 3 with a presentation titled *Management of Disused Sources and Associated Security Challenges*. He began with some background information on his company, its strategy for managing disused sources located onsite, the relevant regulations, and international projects that are strengthening waste management capacities and security arrangements at his facility. He also provided additional details on key security matters, such as training needs, the interface between safety and security, and security culture.

During the follow-up discussion, Mr Mladenovic said that Serbia has not yet decided on a disposal strategy and that several options are under consideration. He also said that once licensees have declared a source as disused, they have a maximum of one year to organise its transfer to the central storage located at PCNFS. He also said that long-term storage costs for disused sources are fixed by the State and publicly available.

Mr Vladyslav Ignatov, from the State specialized enterprise "Dnipropetrovsk state interregional specialized combine" in Ukraine, also talked about interim storage practices in his country. He said there are five governmental storage facilities for collecting and consolidating disused radioactive sources and other radioactive waste from the country. These facilities are funded through a special fund of the Ukrainian State budget, which is supported by the nuclear power plants operated in the country. Source users do not contribute to this fund. Mr Ignatov also said that Ukraine has robust regulatory security requirements for radioactive sources, including those that are disused. Although there are some challenges, in particular financial matters, Ukraine has received good international support for strengthening its radiological security. He also said that the current political situation has impacted perception of security needs and reinforced awareness of security among various stakeholders. Finally, Mr Ignatov quoted a 2009 national strategy for radioactive waste management and explained that all interim storage facilities will send all long-term storage waste to specialised facilities in the Chernobyl exclusion zone.

In her presentation, Ms Lisa Bruedigan, Texas Department of Health Services, USA, talked about *RAM Storage and the Two-Year Storage Rule*. She explained a rule that applies to RAM storage in Texas that states that licensees may not hold unused sources longer than 24 months. If they can't meet this 24-month time limit, they must have a disposal plan in place. Ms Bruedigan also explained why disposal of unused sources is important and addressed some issues related to site termination and decommissioning matters. She concluded her presentation by walking the audience through a few *what if* scenarios and specific cases that have occurred in Texas.

In answer to a participant question, Ms Bruedigan said that the recognition of the need to regulate the amount of time a disused source can remain on the end user's premises emerged from the continuous improvement process that is in place at her organisation. Field inspectors identified the issue and reported it. She also emphasised how important it is for regulations to find a balance between ensuring high levels of safety and security and remaining a business enabler.

Mr John Zarling, INL, USA, concluded Session 3 with a presentation titled *Innovative Consolidation and Storage Solutions*. He described two overpack containers that can be used for transporting devices or high activity sources, as well as a project that is redesigning and improving mobile hot cells used for reconditioning disused sources in the field. Mr Zarling also talked about efforts being made to enhance disused source management through the use of robotics and vision technologies. In addition, he described a possible low-cost, short-term storage opportunity involving the storage of disused sources in underground silos.

Small Group Discussions

Follow-up discussions highlighted the need to keep storage equipment and practices as simple as possible. Participants thought that some of the options mentioned by Mr Zarling were good examples of simple solutions that rely mostly on traditional civil engineering practices. (Mr Zarling said that a generic safety assessment and environmental impact study has been made on the silo storage option and is available.) The discussions also covered the life expectations of various storage containers and solutions. Some participants voiced the concern that some organisations or countries might extend their use far above initial plans. Mr Zarling emphasised that the solutions he presented are only interim ones whose purpose is to buy time until a country has a clear path towards a disposal solution.

SESSION 4: TRANSPORT CHALLENGES INCLUDING IMPORT/EXPORT REQUIREMENTS

Session 4 was designed to review the necessary transport activities to support the management of disused sources. In particular, its purpose was to discuss the necessary legal and technical infrastructure for domestic and international transport and review security needs and arrangements. The session also provided the opportunity to review the import/export framework and discuss potential challenges.

Mr Jairo Menes, Golden Security Services, talked about some lessons his company has learned as a result of organising the transport of multiple high activity disused sources. He described the transport containers used to transport Category 1 sources and some of the common operational and security challenges faced during the planning phase of a Category 1 source transport. Mr Menes also described some of the real-life challenges his company has had during transport operations in South America.

Mr Richard Wassenaar, Nordion, Canada, offered an *Industry Perspective on Import and Export of (Disused) Sealed Sources*. He reminded participants that transport is a common and essential element of the source lifecycle and that shipments of either new or disused sources are identical. He recognised the instrumental role of the IAEA Code of Conduct on the Safety and Security of Radioactive Sources and its supplementary guidance on import/export in supporting the development of an international framework and consistent regulations and then highlighted some of the main challenges to an effective import/export regime.

Mr Wassenaar described the constraints put on some import/export matters—such as prescriptive return locations, denials of class 7 shipments or special form requirements—and offered some possible solutions to reduce the operational burden. He concluded his presentation by stating that import/export should be allowed to any competent end user and should not restrict end-of-life management options.

Small Group Discussion

During the follow-up discussion, participants exchanged their views on shipper and carrier responsibilities and how they vary from country to country. They also discussed other differences between countries such as the use of licensed transport companies and the certification of transport packages. They agreed that transport operations involve numerous stakeholders and that it is essential to raise awareness all along the supply chain, socialise class 7 transport, and properly educate key individuals such as seaport and airlines operators.

Participants also said that certain rules are sometimes too strict. For example, when sources are licensed only after production, the administrative burden in granting permission may delay the shipment and transfer the costs of the delay to the end user. In addition, participants noted that the application, even if justified, of multiple regulations from diverse authorities greatly adds to the complexity of transport operations and significantly impacts their cost. However, participants also agreed that security needs do not usually create a barrier to effective shipments.

SESSION 5: MANAGEMENT OF DISUSED SOURCES AS WASTE AND THEIR FINAL DISPOSAL

The final technical session of the workshop was conducted to review existing and future options for final disposal of disused radioactive sources. In particular, it explored the associated costs and remaining technical, regulatory and political barriers.

Mr Philippe Van Marcke, IAEA, talked about *The IAEA Coordinated Research Project on Borehole Disposal*. He reminded participants about how boreholes can be used to dispose of disused sealed radioactive sources and described two projects taking place in Malaysia and Ghana that are supported by the IAEA. Mr Van Marcke also explained how these projects led to the development of a Coordinated Research Project (CRP) on borehole disposal involving more than 40 countries. He then explained the goal and process of the CRP as well as key upcoming activities.

In the final presentation of the workshop, **Mr Flavien Tetart, ANDRA, France**, addressed the French strategy for the long-term management of disused sealed radioactive sources. He briefly described the mission of his organisation and then talked about the relevant regulatory framework, the inventory of disused sources in France, and the national strategy for their long-term management. Mr Tetart also described two near-surface disposal facilities in operation in France (CSA and Cires) and a deep geological disposal project titled Cigéo.

WAY FORWARD AND CONCLUSION

In the last activity of the workshop, participants were asked to form small groups, reflect on what they had heard and discussed during the last two days, and identify concrete steps they will personally take to enhance the effective management of disused sources. They were also asked to identify within their group what could be done collectively to improve end of life management for radioactive sources. Participants then discussed the main findings of the event as a whole group and shared a few of their take-aways and possible follow-up actions.

In his concluding remarks, **Mr. Legoux** thanked ISSPA for partnering with WINS on this important topic and expressed his wish to further expand an already very successful cooperation. He also thanked the participants for their active contributions during the workshop, which made the event a success. He encouraged them to be proud of what had been achieved in the last few years and to continue exchanging their ideas and experiences for enhancing the end of life management of radioactive sources. He also committed WINS to building on this success and to update WINS publications and programme of work to support effective radioactive source security throughout the lifecycle.

Mr Richard Wassenaar closed the event by expressing thanks to WINS for the excellent coordination and execution of the workshop, both on the part of participating ISSPA members and, more broadly, from all participants. He concluded by saying that the results of the workshop not only provided excellent information but will lead to additional opportunities to strengthen this important topic.

During the evaluation session, 100% of attendees expressed satisfaction with the event and facilitation process and 96% indicated they would recommend this type of event to others. In their individual comments, participants confirmed a high level of satisfaction and said they particularly valued the amount of information shared during the two days, the atmosphere of trust and the networking opportunities.