



IAEA

International Atomic Energy Agency
Atoms for Peace and Development

End of Life Management of Radioactive Sources

WINS Session on Alternative Technologies to High Activity Radioactive Sources

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Overview



- Life cycle of a radioactive source
- End of life management options (EOL)
- National Strategies
- Barriers to conversion
- Current and future activities
- Thoughts going forward

Life Cycle

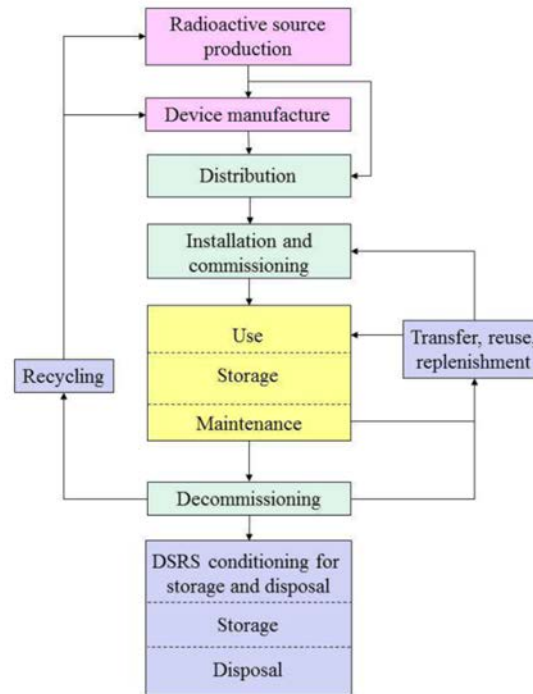
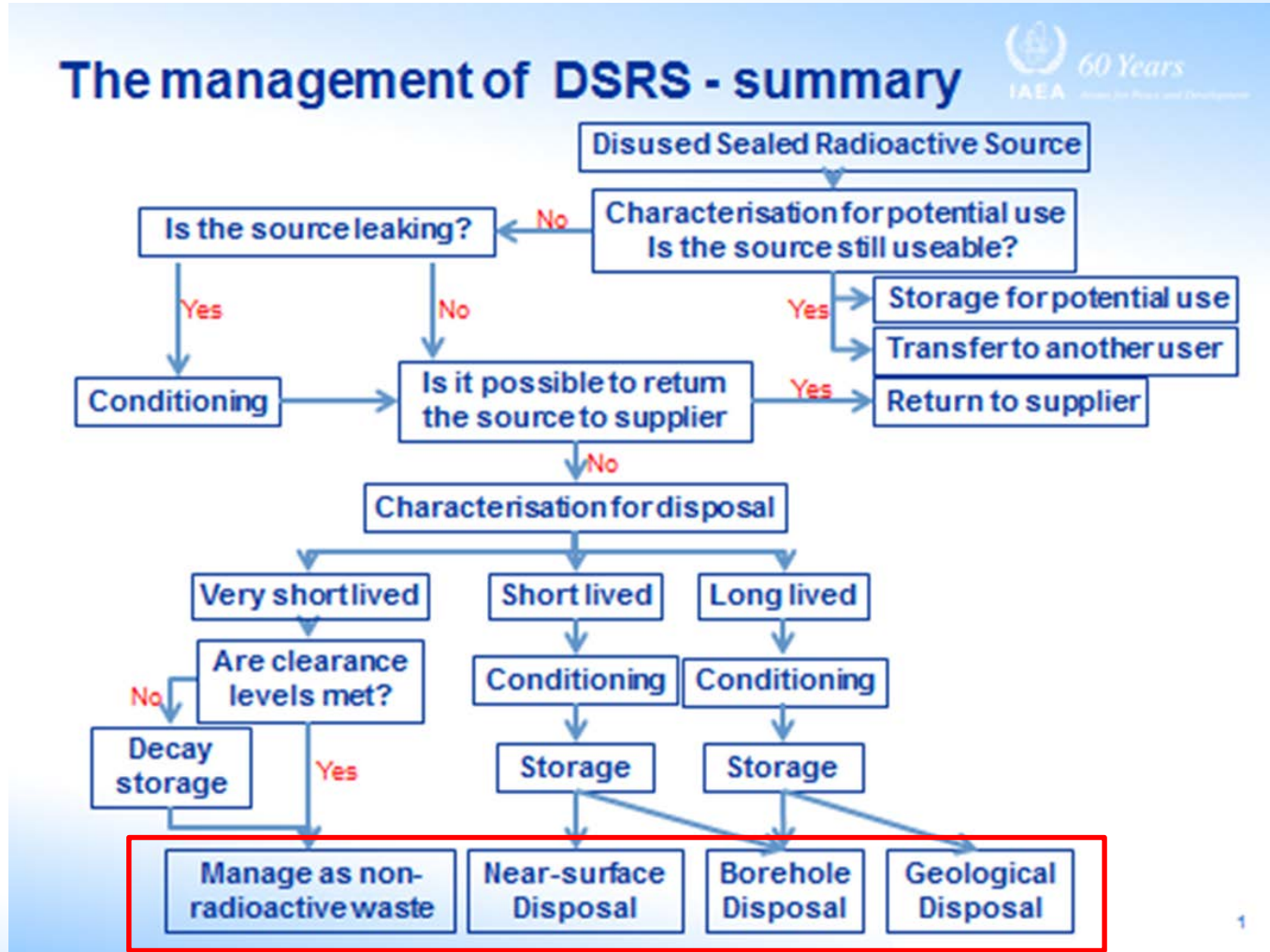


FIG. VI-1. Life cycle of sealed radioactive sources.

End of Life Management Options



Options for end of life management

- Reuse/recycle (eventually will lead to removal, disposal, or clearance/exemption)
- Storage (interim option)
 - End user
 - Centralized
- Removal
 - Exportation
 - Repatriation
- Disposal (after conditioning)
 - Near surface
 - Borehole Disposal System (BDS)
 - Geological
 - Others
- Clearance, exemption
 - Just in a few cases

Options for Management of Cat 1-2 DSRS

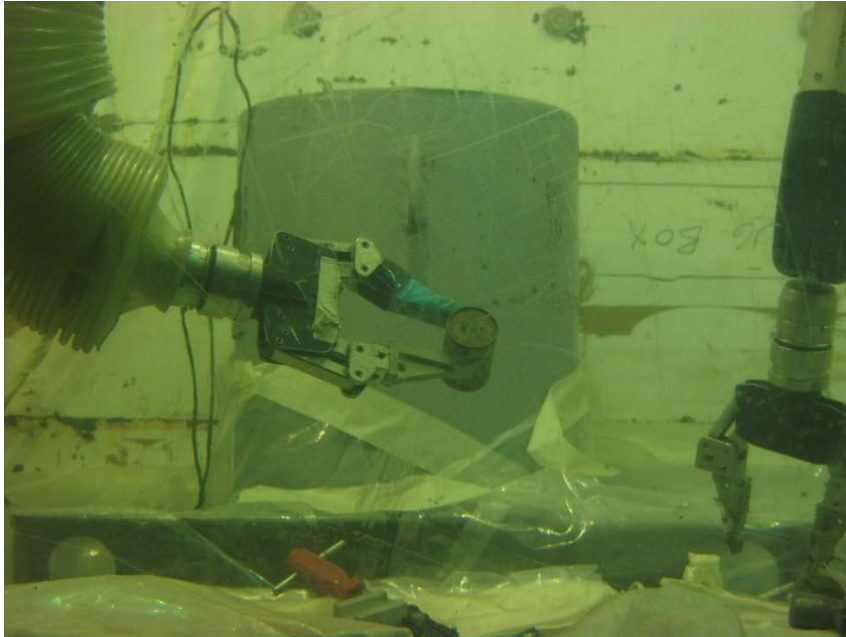
- Return to supplier or authorized facility
- Transfer of existing DSRS from user facilities to centralized long-term storage with physical protection, assure sustainable by country
- Recycling or re-use wherever possible
- Transfer of sources from device/bunker into safe and secure storage
- Disposal in near-surface repositories (where they can accept DSRS), deep geologic repositories, or boreholes.

Technologies developed through IAEA – Mobile Hot Cell



Mobile Hot Cell – used to remove and condition high activity sources in devices

Technologies - Long Term Storage Shield



Completed Missions

Category 1 and 2 DSRS



Country	No. of Devices	Action	Cost
Sudan	5	Sources removed and placed into storage (MHC)	EUR 204,918
Tanzania	5	Sources removed and placed into storage (MHC)	EUR 199,233
Philippines	16	Sources removed and placed into storage (MHC)	EUR 356,553
Uruguay	14	Repatriated (MHC)	USD 786,694
Costa Rica	5	Recycled (MHC)	EUR 942,000
Morocco	5	Repatriated	EUR 543,000
Cameroon	2	Repatriated	EUR 530,000
Honduras	3	Recycled	EUR 380,000
Lebanon	2	Repatriated	EUR 487,000

Options for Managing Cat 3-5 DSRS

- Removal of sources from devices/gauges and conditioning of the bare sources into shielded containers – reduce volume
- Safe and secure storage
- Return to supplier
- Reuse and recycle



Conditioning Cat 3-5 DSRS



Provide hands on training and guidance documents for conditioning Category 3-5 DSRS



Costs for Conditioning Category 3-5 DSRS

- Conditioning within Member State
 - Two experts, one week
 - MS provides basic equipment and consolidation of sources
 - Less than EUR 30,000 – does not include storage
- Repatriation
 - Costs of shipment to return

EOL Financial Considerations



- Need to consider costs of disposal when considering the purchasing of radiation versus non radiation technology
 - Consider risk reduction and ongoing maintenance costs of the chosen technology
- Set up financial assurance policies for EOL
- Supplier of alternative technology removes source at no cost or minimum cost
 - One for one exchange
 - But “last” or legacy source no replacement with new non radioactive technology
- Establish take back agreements

National Strategy

- Member States need to have a National Strategy with plans and time line to replace radioactive sources with non radioactive
- Determine best EOL option for country
- Assure plans have financial assurance considerations
- Establish take back agreements

Barriers to Conversion

- Costs
- Can not return to supplier
- Unauthorized transport packages
- Limited pool of experts and facilities to manage sources at EOL
- Refurbishment of existing facilities to fit new equipment

IAEA Current Activities



- Tools and technologies to manage disused sealed radioactive sources
- Work proactively with PACT/TC to remove sources when converting
- Guidance documents and training on end of life management options
 - Decision aiding document (DAD)

DAD- Objective

To develop a comprehensive **decision-aiding document** to support **decision-makers** in taking an **informed decision** regarding the **end-of-life management of radioactive sources**

- Focus only on sealed radioactive sources
- Based on national inventories
- A guidance document to be used and adapted to national needs – NOT a prescriptive tool!

DAD – Objective (cont)

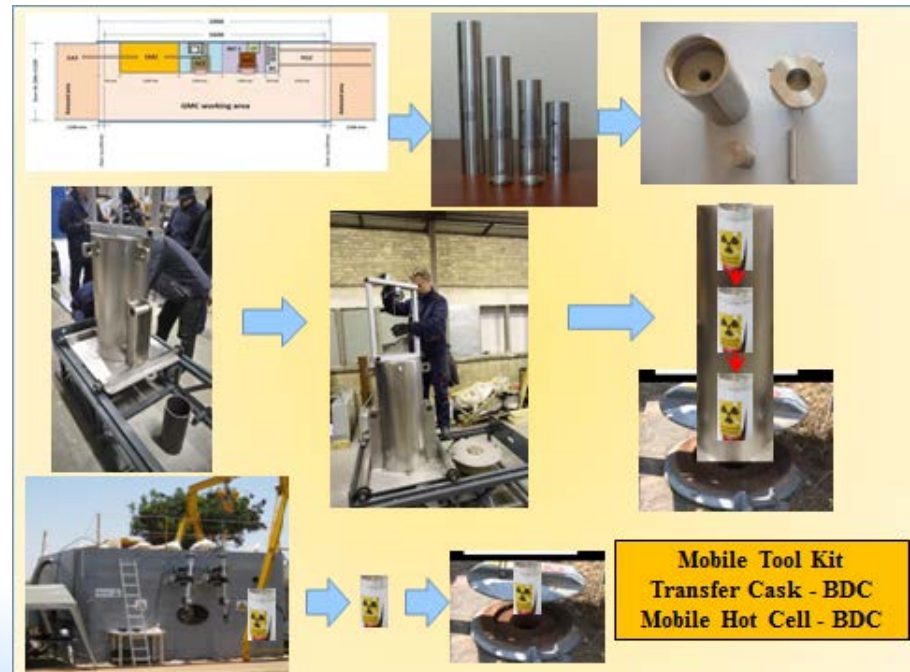
- This document aims to:
 - Review in a simple yet comprehensive way the different end-of-life management options
 - Offer guidance of which options are more suitable for which inventories ie Cat 1-2 and Cat 3-5
 - Identify what physical, regulatory and human infrastructure is needed to successfully implement those options

DAD Objective (cont)

- Provide an estimate of the financial and non-financial costs for those options (including cost impact of the regulatory and technical requirements)
- Provide a methodology for weighing different decision-making factors
- Based on country specific situation and inventory – best solution for you!

Going Forward - Enhance Services and Reduce Costs

- Mobile Tool Kit for Cat 3-5 conditioning
- Borehole Disposal
- Type B(U) shipping package
- Qualified Technical Centres
- Reuse Recycle



IAEA Consultancy on Alternative Technology - Chair Report



- Consideration of alternatives to radioactive sources represents an interdisciplinary field of global importance and one in which continued, significant research is needed for optimized and sustainable solutions.
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- Additionally, the consideration of alternative technologies must be evaluated in relation to comprehensive source management factors – including their respective applications, safety, security, and **end-of-life management**.
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- The IAEA has an important role in facilitating the development, analysis, and consideration of alternative technology. This role will require coordination among multiple IAEA departments and should follow a balanced and neutral approach.
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- The responsibility for decision-making with respect to adoption of alternative technologies within a State rests entirely with that State.

Thoughts going forward



- What can be done to facilitate removal of old sources
- What role should IAEA play
- What specific factors are countries considering to make transition



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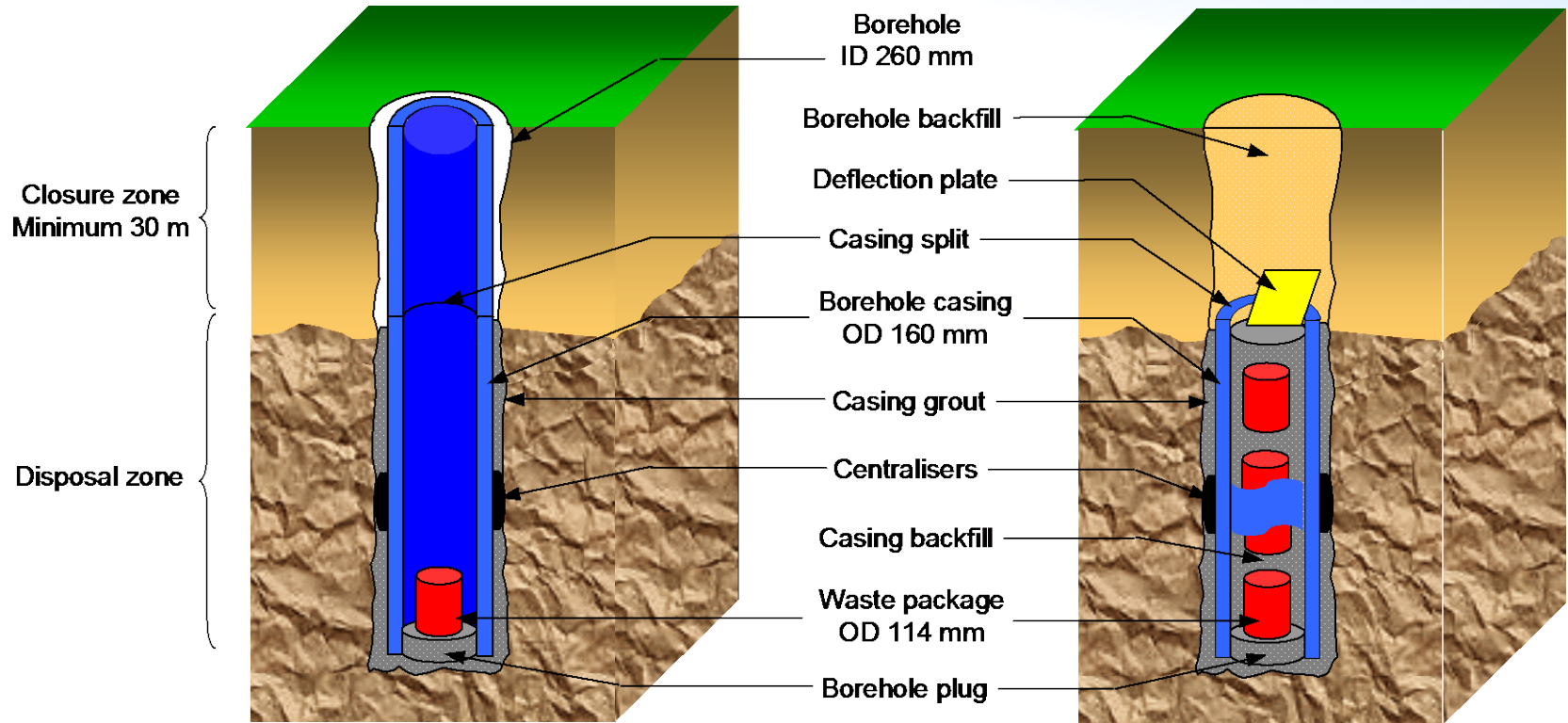
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Thank you!

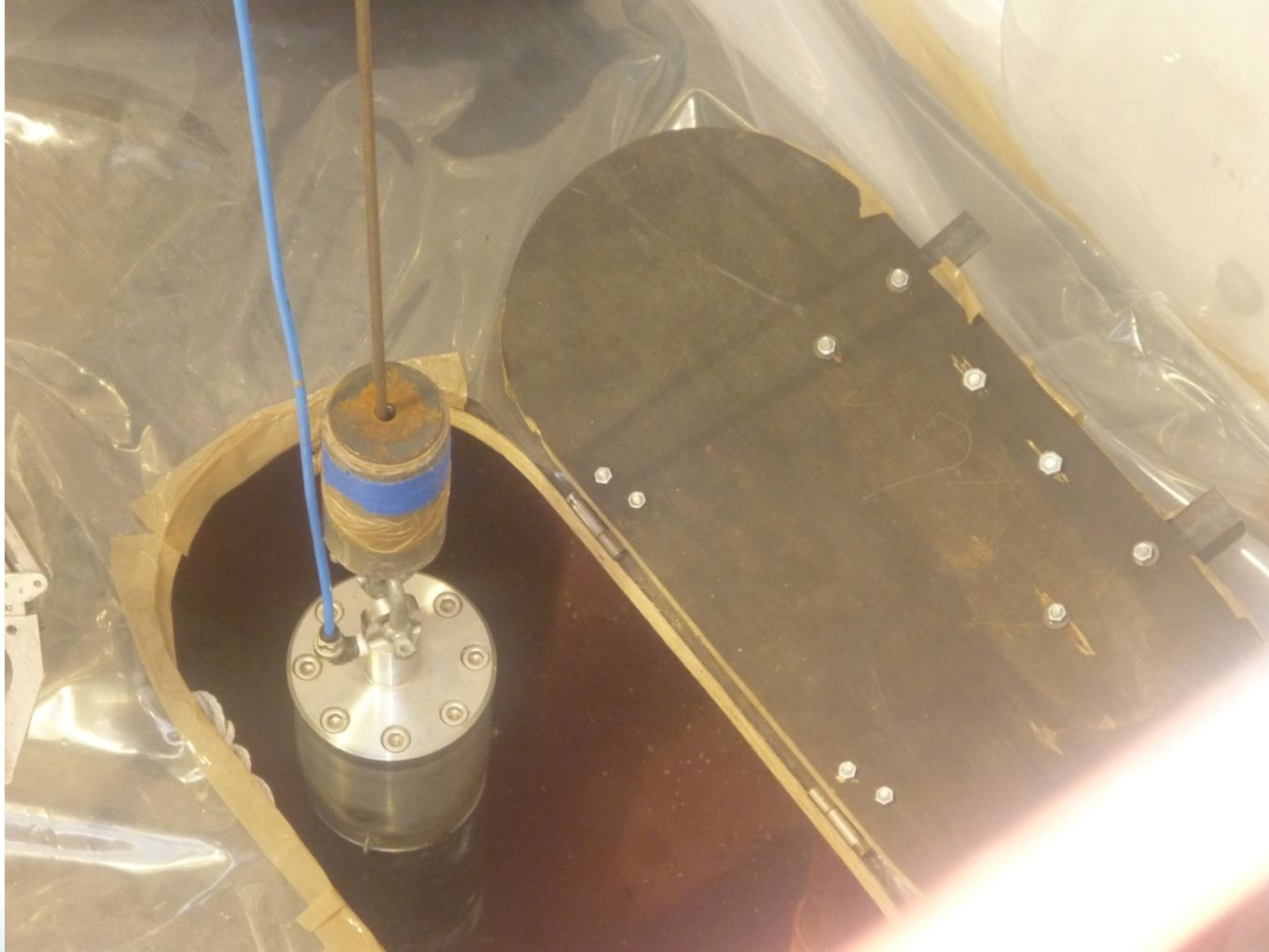


Borehole Disposal Concept



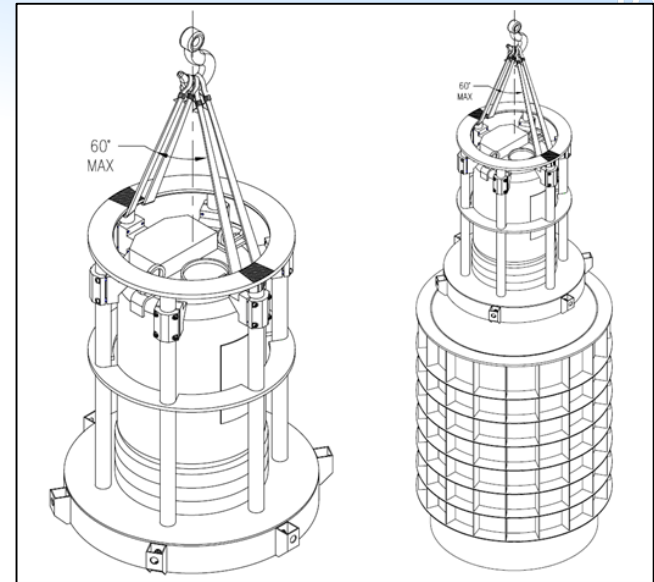
Generic Post-Closure Safety Assessment demonstrated that the concept provides an appropriate degree of long-term safety for the vast majority of systems, scenarios, and radionuclides



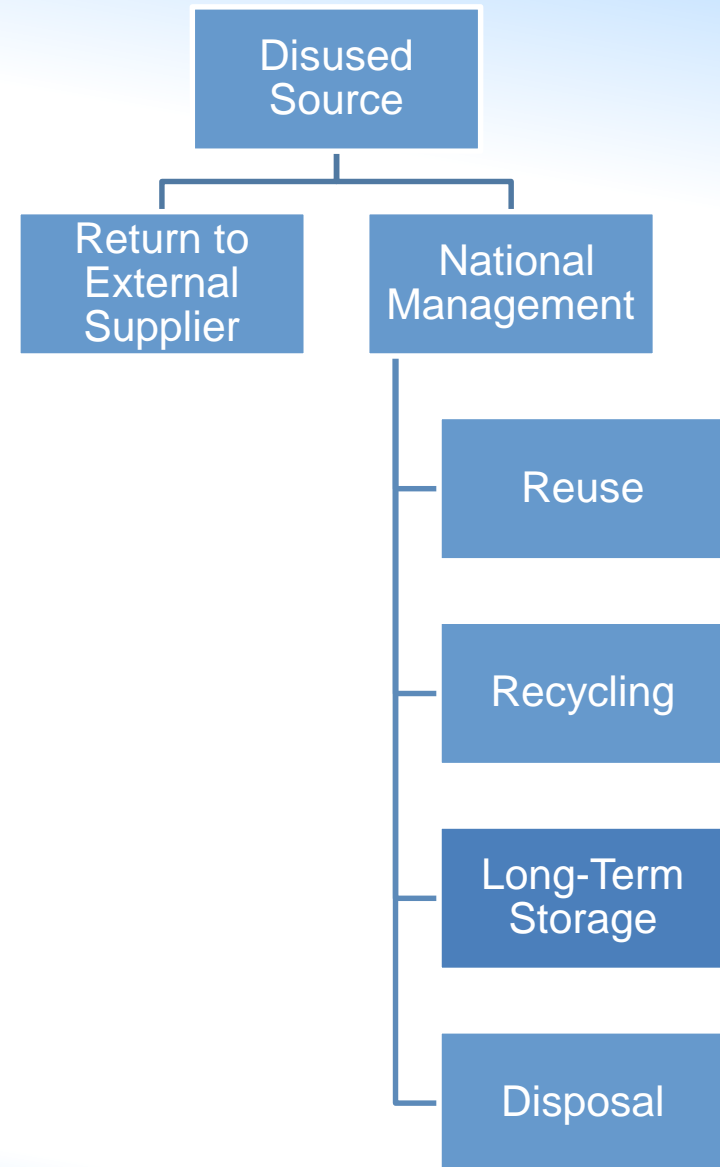


DoE Type B(U) – Model 435 - B

- DOE/NNSA pledge to gift new type B container
- Container in manufacture now
 - Projected manufacture completion and shipment of container to LANL of Sept 2018
 - Anticipate 435-B in Vienna late 2018, early 2019
 - Working on ISO-Container for shipment as well as storage for closure tools and leak test equipment
 - Anticipate starting process of certification in the EU Q2-Q3
 - Procedure preparation for IAEA internal Q2/Q3
 - Will compliment BDC work for HASS



MANAGEMENT OPTIONS



- Reuse
- Recycling
- Long-term Storage
- Disposal
- Return to a Supplier

Projects Cont



- Qualified Technical Centres
 - Regional centres for conditioning Category 3-5 sources
 - Mobile Hot Cell for Category 1-2 sources
 - Integration with MTK
 - “Qualification” of Centre
 - Working on financial structure and procedures
 - CM in March 2018
 - Working on finalization of designation process
 - By GC have call for MS to self-designate

Projects Cont

- Scaling up Resources for DSRS management
 - Mobile Tool kit
 - Demonstration of welding at Siebersdorf in Feb
 - Finalization of MTK Iso Containers April 2018
 - Set of Procedures
 - Final draft in review
 - Pool of qualified experts
 - Working with MS to develop pool of operators
 - Train the trainer methodology
 - Eventually tie to QTC

Qualified Technical Centres for DSRS Management



- Building on existing capability in MS
- Providing a range of services, available within their own MS, regionally and beyond.
- Sustainable operations, in terms of both personnel and funding.
- Focused on regions with the highest unserved demand for DSRS services.
- High requirements, based on international standards, peer reviewed through the IAEA, using a transparent and rigorous process

Sharing solutions – building capacity through involvement

Alternative Technology Chair report



- **Recommendations**
- Based on the findings established during the meeting, the consultants developed the following recommendations:
- The IAEA should establish a programme on alternative technology with a defined scope, mission, and timeline.
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- The IAEA should promote and support research efforts on the development and deployment of alternative technology to radioactive sources with the involvement of stakeholders in the process, and similar engagement on the part of Member States.
- Based on the findings of the consultancy meeting, the IAEA should convene an internal meeting with participation from all IAEA departments to identify relevant IAEA activities and to share information on alternative technology to HASS.
- The IAEA should facilitate access to information related to alternative technology to support the decision-making of operators, regulatory bodies, and other competent authorities.
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- The IAEA should conduct additional information-collection and analysis to develop comparative, lifecycle evaluations and share experiences with applications of technologies using radioactive sources and equivalent alternative technology.
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- The IAEA should engage with external organizations (e.g., professional and trade associations, national government authorities, nongovernmental organizations, and international organizations) with respect to the impact, use, risks, benefits, implementation, challenges, and opportunities of alternative technologies and encourage similar engagement on the part of Member States.
- The IAEA should consider opportunities to enhance the capacity of Member States to acquire, operate, and maintain alternative technologies.
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- The IAEA should make a particular effort to involve R&D organizations, manufacturers, and suppliers in activities related to the implementation of the Alternative Technology Programme.