

**TM on the Implementation of the CoC  
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# **Sustainable Management of Disused Sealed Radioactive Sources**

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International Atomic Energy Agency

# Sustainability

The **sustainable** management of disused sealed radioactive sources needs

- National policy, strategy and definition of responsibilities
- Adequate legal and regulatory framework
- Adequate infrastructure (including know-how, facilities, operators and funding system)

Adequate = corresponding to the current and future inventory of disused sources

# Policy

**A national policy should be in place (*be established*) with regard to**

- **”Legacy” sources vs. “new” sources**
- **Responsibilities of parties involved**
- **Define preferences** (*such as 1. return to supplier, 2. transfer to other user, 3. national waste management options*)

# Responsibilities

Principle parties involved in the management of disused radioactive sources:

- **User/owner of sources**
- **Waste management organizations**
- **State**
- **Regulatory body**

# Responsibilities of the user/owner

**The prime responsibility for the safety and security of sources in use and disused rests with the user/owner** (*International Basic Safety Standards*)

- **Establishes a safe and secure temporary on-site storage**
- **Notifies the regulator if a source becomes disused and propose an acceptable destination for them** (*storage for decay, return to supplier, transfer to a waste management organization*)
- **Keeps records of all sources at the site including disused sources**

# Responsibilities of waste management organization

**A (centralized) Waste Management Organization is designated (by the regulatory body) to manage radioactive waste including disused/spent radioactive sources from different (all) users in the country**

- **Has qualified staff and technical infrastructure for characterization, collection, transport, conditioning and storage of disused/spent radioactive sources**
- **Takes over legal ownership for all disused/spent radioactive sources within its facilities**
- **Keeps records of all radioactive sources within its facilities**

# Responsibilities of waste management organization *(cont.)*

- **Keeps the regulatory body informed about the inventory of disused/spent radioactive sources**
- **Advises the regulatory body on acceptable long term disposition of disused/spent sources** *(return to supplier, transfer to another user, conditioning, long term storage at the organization's designated facility, disposal if a suitable disposal site is available)*
- **Advises users on adequate management of their disused/spent sources until transfer to appropriate destination occurs**
- **Ensures safety and security of disused/spent sources during transport and long term storage at its facilities.**

# Responsibilities of the State

## Fundamental Safety Principles

IAEA Safety Standards Series No. SF-1

### Principle 2:

**An effective legal and governmental framework for safety, including an independent regulatory body, must be established and sustained.**

- **Law**
- **Regulatory body - regulations**
- **Funding** (*for the regulatory framework, not necessarily for operations*)

**Waste management may be covered by other relevant law, regulatory body and funding** (*such as radiation safety, environment protection, public health and safety*)



# Responsibilities of the Regulatory Body

- **Develops regulations on the safe management of disused/spent radioactive sources** (*should cover criteria for declaring a source disused, temporary storage at the users site, transfer to WM organization, establishment of a WM organization and its activities such as collection, conditioning, long term storage, disposal*)
- **Issues authorizations/licences for users and WM organizations based on licence applications and safety assessments** (*licence conditions are important, such as obligation to present a disposition route!*)
- **Conducts inspections of sources at users and WM organizations** (*local inventories, safety and security status of sources*)

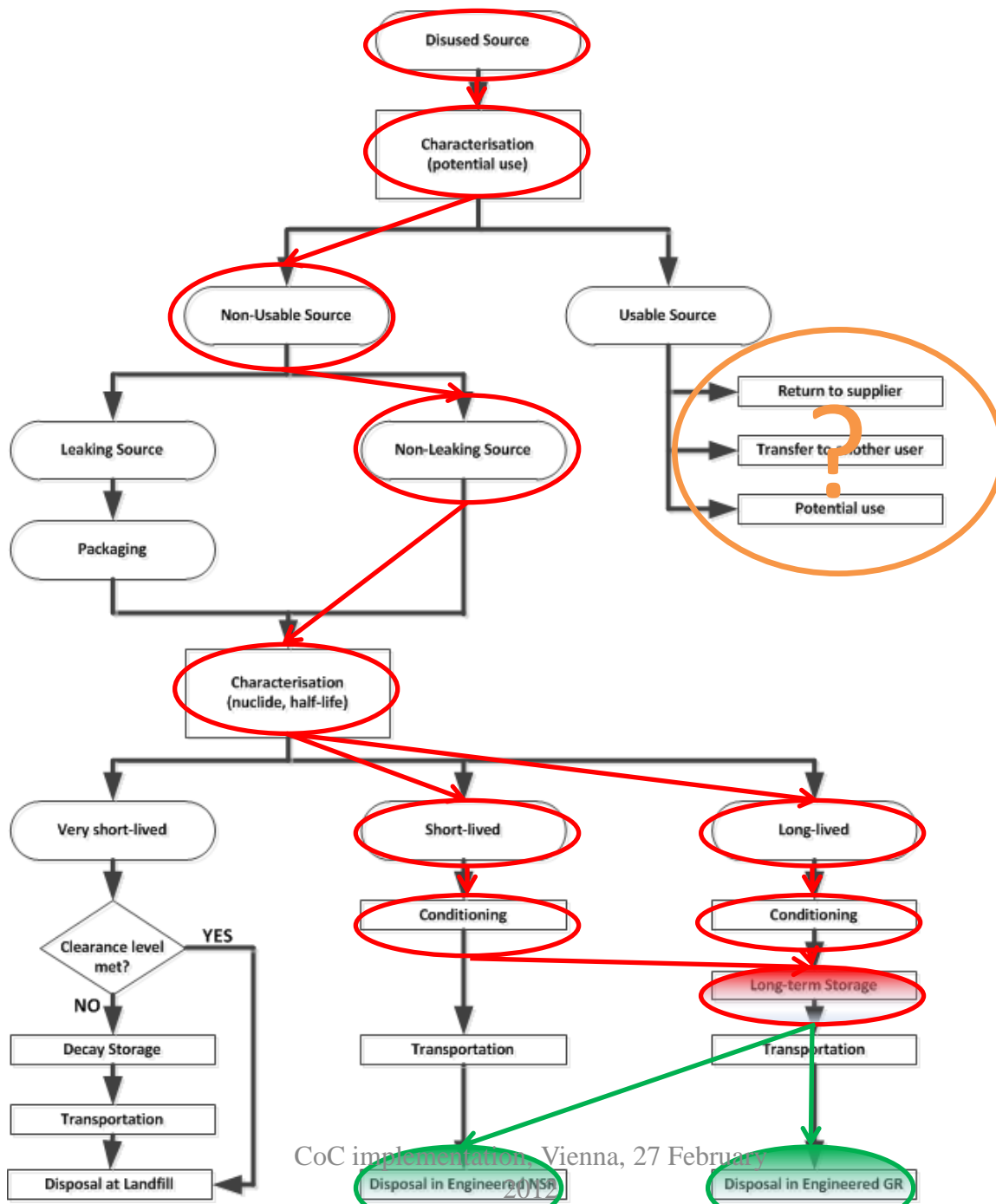
# Responsibilities of the Regulatory Body *(cont.)*

- **Enforcement actions** (*suspension or withdrawal of the licence, fines, in case of non-compliance with regulations or licence conditions*)
- **Keeps records of all radioactive sources** (*verified inventories, tracking "from cradle to grave"*)

# Management strategy

A logical, prioritized list of actions aiming at achieving the goals set by the policy

- Collection, characterization, segregation
- Reuse, recycling, return to supplier
- Conditioning, storage, disposal



# 6. Management strategies (cont.)

## Conditioning

**Purpose: to produce a waste package acceptable for handling, storage, transport, disposal**

- Irretrievable conditioning – if a disposal facility and its waste acceptance criteria are available
- **Retrievable conditioning** – waste package for safe and secure long term storage but sources can be retrieved and repackaged to meet transport requirements and waste acceptance criteria for disposal

## 6. Management strategies (cont.)

### Storage

- At the user's site (*on-site storage*) – the storage period should be kept **as short as possible** for technical, safety and security reasons
- At the site of a designated radioactive waste management organization until export or disposal will be available (*may be long term – decades!*)

# Technical options for conditioning

**Purpose:** to produce a **waste package** acceptable for handling, storage, transport, disposal

**Factors influencing the selected conditioning option:**

- **Source characteristics (type of radiation, activity, half-life, chemical toxicity, physical integrity);**
- **The number and physical size of sources;**
- **Chemical and physical form of the radioactive material;**

# Conditioning (cont.)

- **Compliance with regulations (e.g. acceptance requirements for storage and/or disposal, radiation protection and safety requirements);**
- **General infrastructure;**
- **Manpower and personnel competence;**
- **Cost and resources (equipment and materials required for conditioning);**
- **Storage period, space and location.**



# Conditioning Cat. 1-2 sources

**High activity sources** (*teletherapy, industrial and research irradiators, typically  $^{60}\text{Co}$  and  $^{137}\text{Cs}$* ) – *removal of sources from devices and conditioning requires sophisticated and expensive equipment (hot cell) and special expertise.*

## Options:

- Transportation of the device containing the source to a qualified facility for conditioning or recycling– normally source manufacturer or specialized recycler
- Removal of the source from the device on site using mobile hot cell or other mobile technology

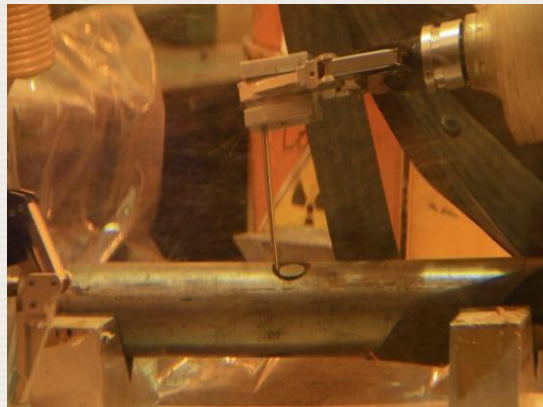
# Conditioning Cat. 1-2 sources *(cont.)*

At source manufacturers: re-encapsulation or over-encapsulation for recycling or long term storage and disposal



# Conditioning Cat. 1-2 sources (cont.)

On-site conditioning using **mobile hot cell** to produce a waste package suitable for long term storage, transport and disposal – **special form capsules, long term storage shield**



# Conditioning Cat. 3 - 5 sources

## Embedding in concrete

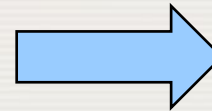
- Simple and well established technique
- A 200 l steel drum filled with concrete and closed is suitable for a Type A package for transportation – total activity limitation
- Provides barrier against loss of containment due to mechanical shock
- Provides for some degree of security, unauthorized removal (e.g. theft) would be difficult due to weight and robustness
- May be acceptable for near surface disposal
- **"Irretrievable" and "retrievable" versions** – i.e. grouting or prefabricated cavity
- **With or without removing the sources from the devices** (**optimization:** available storage space vs. occupational exposure)

# Conditioning of Cat. 3 – 5 sources (cont.)

”Irretrievable”  
conditioning



”Retrievable”  
conditioning



# Conditioning of Cat. 3 – 5 sources *(cont.)*

Removing sources from devices, encapsulating in stainless steel capsules and packaging in shielded containers



# Conditioning of Cat. 3 – 5 sources *(cont.)*

For manipulation and encapsulation of bare sources special tools, equipment and expertise are needed



# Selection of conditioning options for Cat. 3-5 sources

## 1. Emplacement of devices containing the radioactive sources in concrete lined drums

**Advantages:** no risk of radiation exposure of operators from unshielded sources, retrievability for further processing and disposal

**Disadvantages:** **more space** required for storage

## 2. Removal of sources from devices, encapsulation and packaging

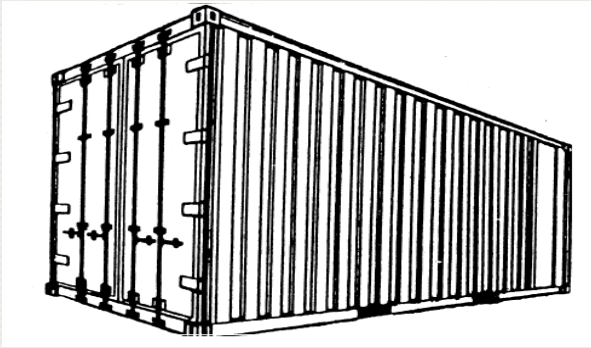
**Advantages:** significant volume reduction, capsules may be accepted for disposal (e.g. for bore hole disposal)

**Disadvantages:** manipulation of unshielded sources of Cat.3 may increase the **risk of radiation exposure** if operators are inexperienced

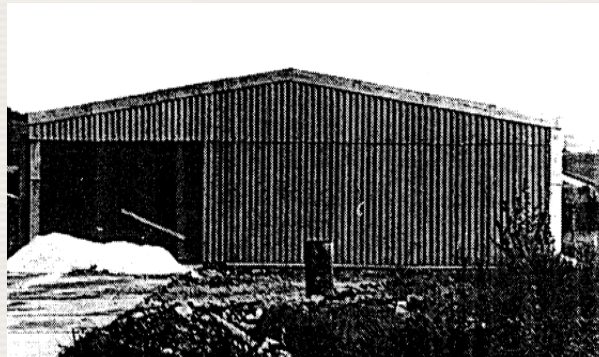


# Storage

- Technical, safety and security guidance are available for storage facilities
- Size, sophistication, safety and security features of the storage facility depend on the number and category of sources to be stored



ISO container for waste storage



Light construction storage building



Concrete storage building

Storage **in conditioned form only**

# Conclusions

- Sustainable management of disused sealed radioactive sources needs national policy, strategy, adequate legal and regulatory framework and adequate infrastructure
- Appropriate technologies are available for all steps of disused source management
- The sustainability of long term storage varies from country to country and may not be sufficient until source activities decay to low enough levels
- **The sustainable end-point is disposal**