PREDIS

2.3.3 Secondary Waste Management

Domain Insight with EURAD Roadmap

TH. MENNECART (SCK CEN)

VERSION DRAFT (JAN. 2024)

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Outline

1 Introduction to DI

2 Typical overall goals and activities in the domain

3 International legislation

4 Planning and Program Initiation

5 Program Implementation

6 Program Operation and Closure

7 Critical issues, information, data or knowledge

...

8 Future advances

9 Future optimisation challenges and innovations

10 Past RD&D projects

11 Uncertainties

12 Guidance, training and communities of practice

13 Additional references and future reading

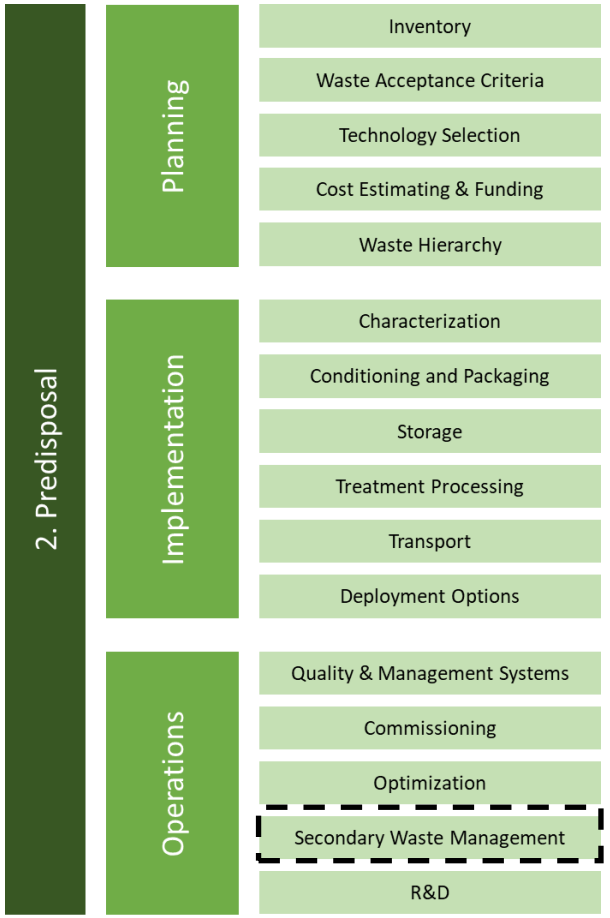
14 Figures

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Introduction to DI 2.3.3

With the objectives to optimize the management of radioactive waste throughout the predisposal phase, waste producers and repository operators have to consider the **generation of secondary radioactive waste in every operations and processes they apply, the classification of this waste and the route in which it is subsequently treated**.

By definition, secondary waste is a form or a type of waste that results as a by-product from waste processing and can be generated from different sources and be of a different nature.



This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Typical overall goals and activities in the domain (Based on EURAD Roadmap GBS)

- Domain Goals: Manage secondary waste streams produced during initial processing, for lifecycle approach (Secondary Waste Management)

- Domain Activities

Phase 1: Planning and Programme Initiation	Anticipate the generation, the nature, and if possible, the quantity of secondary waste generate during the treatment of radioactive waste (DI treatment) and decontamination processes. Treatment of the secondary waste as a service in remote facility and its shipment Comparison of the processing options to minimize the volume of secondary waste generated with the assurance that there is a mature solution for their management
Phase 2: Program Implementation	Characterisation of the secondary waste to apply the most appropriate solution for their management (DI waste hierarchy, characterisation)
Phases 3–4: Program Operation/Optimisation and Closure	Manage iterative reviews and updates of waste hierarchies and WAC

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

International Legislation

- There is no international legislation strictly related to the Secondary Waste Management. Once generated, this category of waste must follow the same protocol and rules than primary waste.

- More detailed information related to the international legislation can be found in the DIs. In general each country has its own nuclear waste management policy and its national regulations that influence the management of radioactive waste including the secondary waste

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Planning and Program Initiation 1/2

- In the early phases of pre-disposal program initiation, it is essential to consider the full ‘life cycle’ of the processes that may produce primary waste and to **anticipate the generation**, the **nature** and, if possible, the **quantity** of secondary waste from these processes. The nature of the secondary waste is likely to differ from that of the primary waste streams treated and must be identify beforehand.
- Examples of expected type of secondary waste:
  - Liquid organic waste: liquid-liquid extraction (aqueous waste), absorption (solid waste absorbents), incineration (ash residue, off gases filters)
  - Solid organic waste: compaction (liquid waste), thermal treatment (off gases, slag residues)
  - Decontamination of concrete and metallics: mechanical methods (abrasive, debris, dust), chemical methods (toxic or corrosive solution of gases)
  - Aqueous solution: filtration (filters), chemical precipitation (sludge), ion exchange (spent resins)
  - Biohazardous radioactive waste: sterilization (off gases), disinfection (toxic chemicals liquid waste)
  - Reprocessing of Spent Nuclear Fuel: filters, scrub solution, off-gases (conditioning of the LILW generated during the processing of HLW)

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Planning and Program Initiation 2/2

- Whatever the type of primary waste and the process envisaged for its treatment, it should be emphasized the importance of secondary waste when **waste is treated in remote facility as a service for waste owner**. This is particularly the case when the primary waste must be shipped to other sites, or even to another country, where the treatment facilities are located. The management of secondary waste need to be solved and **contractual covered**, either considering the treatment of the secondary waste on-site together with the primary waste, or by returning it to the owner of the waste.

- Comparison of the processing options to **minimize the volume** of secondary waste generated with the **guaranty that a mature solution exist** for their management. The selection of a process must lead to a **safe and already mature process option**.

EURAD Roadmap Domains of Inventory (2.1.1), Waste Acceptance Criteria (2.1.2), Technology selection (2.1.3), Waste hierarchy (2.1.4), Conditioning (2.2.3), Transport (2.2.5)

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Program Implementation

- Characterization of the secondary waste to **apply the most appropriate solution** for their management. No specific implementation related to the secondary waste management is needed since this category of waste streams must follow the same recommendations and legislations than primary waste streams.

EURAD Roadmap Domains of Waste hierarchy (2.1.4), Characterization (2.2.1), Treatment and Processing (2.2.2), Storage (2.2.4), Transport (2.2.5)

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Program Operation and Closure

- During operation of (pre-disposal) waste management facilities there is a **continuous process of reviewing the management of radioactive waste** is not a static process. Annual reviews of on-site and centralized programmes should be conducted, as:
  - New uses and procedures may alter the characteristics of the radioactive waste;
  - Changes of regulations in Member States may require revisions of management procedures and strategies;
  - Changes in volumes and composition of the radioactive waste may result in new pricing structures, or the final disposal route may increase its pricing structure, making use of that disposal route no longer viable.

EURAD Roadmap WAC (2.1.2), Technology Selection (2.1.3), Treatment and Processing (2.2.2), Optimization (2.3.2)

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Critical issues, information, data or knowledge in the domain of Secondary Waste Management

- The secondary radioactive waste management faces with the similar critical issues than considering the management of primary waste. This concerns:
  - the type of processing option or the primary waste and the minimisation of the subsequent secondary waste.
  - the nature of the materials: they must be compatible with a technology option already mature; several treatment technologies are already quite advanced (TRL 9) and are commonly used at the present time in multiple countries or in a large number of nuclear plants. **The secondary waste should not be problematic to manage**.

EURAD Roadmap Technology Selection (2.1.3), Treatment and Processing (2.2.2), Optimization (2.3.2)

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Future advances

- The entire life cycle of the of a process is taken into account to assess its potential environment impacts on related costs: Life Cycle Assessment (LCA) and Life Cycle Costing (LCC). The problematic of the secondary waste is included in such assessments and was part of the PREDIS activities.

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Future optimisation challenges and innovations

- The optimisation challenge in the secondary waste management is directly connected with the optimisation and innovations in the management of LILW. The optimisation would be related to the development of new technologies for the treatment of primary wastes and decontamination activities.
  - As an example: the segmentation process to cut metallic assemblies may be optimise using robotics and reduce secondary effluents.

- Optimisation challenges and innovations in the reduction of the generation of secondary waste can be done by:
  - improvements to water cleaning technologies
  - decontamination systems to reduce waste volume
  - concentration of sludge
  - absorption of liquid allowing to dispose of solid waste
  - absorption and removal of contaminant while releasing clean water

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Past RD&D projects on Secondary Waste Management

The problematic of secondary waste management is usually associated to the management of radioactive waste, only far few projects or RD&D programs were devoted to the secondary waste management.

- Reduction on secondary waste generation: Modular/mobile effluent and waste retrieval plants. Nuclear Engineering Services (NES) is supplying Sellafield Ltd on behalf of the Nuclear Decommissioning Authority (NDA) with three silo emptying plant (SEP) Mobile Cave waste retrieval machines, for the removal of intermediate-level wastes (ILW) from the 22 silos.

  (https://www.onr.org.uk/pars/2022/sellafield-21-016.pdf)

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Uncertainties

- The uncertainties in the secondary waste management are mainly associated with the management of the primary waste.

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Guidance, training and communities of practice

- Guidance
  - No guidance specifically related to secondary waste management. This activity is included in the various activities covered by the EURAD Roadmap Inventory (2.1.1), Technology Selection (2.1.3), Waste hierarchy (2.1.4), Characterization (2.2.1), Treatment and Processing (2.2.2), Conditioning and Packaging (2.2.3), Storage (2.2.4), Transport (2.2.5)

- Training

- Active communities of practice and networks

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Additional references and future reading

- IAEA-TECDOC-1817 - “Selection of Technical Solutions for the Management of Radioactive Waste”, 2017 online
- IAEA-TECDOC-655 - Treatment and conditioning of radioactive solid wastes (1992) online
- IAEA-TECDOC-656 - Treatment and conditioning of radioactive organic liquids (1992) online
- IAEA-TECDOC-1041 - Management of small quantities of radioactive waste (1998) online
- IAEA-TECDOC-1130 - "Recycle and Reuse of Materials and Components from Waste Streams of Nuclear Fuel Cycle Facilities," 2000 online
- IAEA TECHNICAL REPORTS SERIES No.402 - Handling and Processing of Radioactive Waste from Nuclear Applications (2001) online
- IAEA-TECDOC-1336 - Combined methods for liquid radioactive waste treatment (2003) online
- IAEA-TECDOC-1538 - Categorizing Operational Radioactive Wastes (2007) online
- IAEA Safety Standards Series (2009):
  - GSG-1: Classification of Radioactive Waste online
  - GSG-5: Predisposal Management of Radioactive Waste online
- EURAD ROUTES Deliverable D9.12 “Studies and plans for developing shared solutions for radioactive waste management in Europe” online
- [OECD] – R&D and Innovation Needs for Decommissioning Nuclear Facilities (2014)

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Test of knowledge

- What is a secondary waste ?
  - A category of waste with a lower priority to manage
  - Waste generated during initial processing
  - The new name of the waste after processing
- Is primary and secondary waste always of the same type ?
  - Yes
  - No
- When designing a new facility or process, what factors need to be taken into account?
  - The type of secondary waste generated during operations
  - The volume of secondary waste generated
  - The treatment for its disposal
- During operation, should (secondary) waste management remain strictly the same until closure?
  - Yes
  - No

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.