Integrated Waste Management Routes and Strategic Options, Domain Insight 1.5.1

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Overview

The International Atomic Energy Agency (IAEA) defines an “Integrated Approach” as a logical and preferably optimised strategy used in the planning and implementation of a radioactive waste management programme as a whole from waste generation to disposal such that the interactions between the various stages are taken into account so that decisions made at one stage do not foreclose certain alternatives at a subsequent stage.

Integrated Waste Management (IWM) is a high-level framework for flexible decision-making, to ensure safe, environmentally acceptable and cost-effective solutions that reflect the nature of the radioactive waste concerned. This is commonly connected to the key stages of the waste lifecycle: planning & preparation, treatment & conditioning, storage and disposal. These stages all have options for alternative waste routing and strategic decision-making, which can result in diversion away from or further support future disposal at a deep geological repository (DGR). Examples of which are captured within this domain insight document.

Keywords

Integrated Waste Management, Waste Lifecycle, Waste Hierarchy, Planning & Preparation, Treatment, Thermal, Chemical, Storage, Disposal, Optiomsation, Flexibility, Practicality.

Key Acronyms

ALARA	As Low as Reasonably Achievable
ALARP	As Low as Reasonably Practicable
BAT	Best Available Technology
BPM	Best Practicable Means
DGR	Deep Geological Repository
ERDO	European Repository Development Organisation
ERDO-WG	European Repository Development Organisation – Working Group
EURAD	European Joint Programme on Radioactive Waste Management
GBS	Goals Breakdown Structure
HIP	Hot Isostatic Pressing
ICV	In-container Vitrification
IAEA	International Atomic Energy Agency
ILW	Intermediate Level Waste
IWM	Integrated Waste Management
JHCM	Joule-heated Ceramic Melter
LLW	Low Level Waste
LLWR	Low Level Waste Repository
NDA	Nuclear Decommissioning Authority
NWS	Nuclear Waste Services
PREDIS	Predisposal Management of Radioactive Waste
RD&D	Research, Development & Demonstration

SFAIRP	So Far As Is Reasonably Practicable
SIMS	Small Inventory Member States
THERAMIN	Thermal treatment for Radioactive Waste Minimisation and Hazard reduction
WAC	Waste Acceptance Criteria

1. Typical overall goals and activities in the domain of integrated waste management routes and strategic options

The IAEA has published details of the five phases for implementation of a DGR (IAEA, 2021a). The first phase is policy, framework and programme establishment.

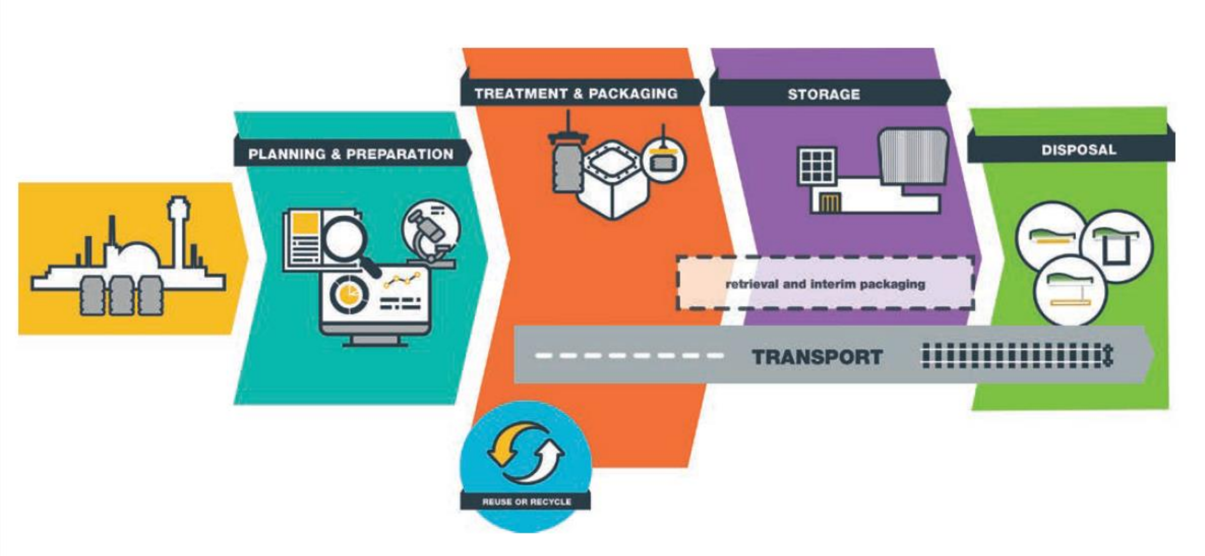
The European Joint Programme on Radioactive Waste Management (EURAD) has developed a Roadmap (see chapter 7.1 Further reading EURAD, 2021) that explains how aspects related to disposal facility design and safety case development (and supporting safety analyses) span across all phases (see table below). This section provides the overall goal for this domain, extracted from the EURAD Roadmap goals breakdown structure (GBS). This is supplemented by typical activities, according to the phase of implementation, needed to achieve the domain goal. Activities are generic and are common to most DGR programmes.

Domain Goal	
1.5.1 Identify and evaluate potentially available concepts and technical solutions for spent fuel and radioactive waste management, taking account of national or local conditions, such as available predisposal and storage options, geological environments, national technical and economic resources and expertise etc. (Integrated Waste Management Routes and Strategic Options).	
Domain Activities	
Phase 1: Programme Initiation	Planning and preparation is the first stage of the waste lifecycle (see below) and is where strategic options are initially developed. Business cases and strategic outline cases are defined. Costs are estimated and funding routes established. Infrastructure (treatment facilities, stores, etc.) can be identified. Resources can be allocated. Optioneering is used to underpin decision-making. Routes are identified.
Phase 2: DGR Site Identification	Once a site has been established, strategic options can be reviewed and updated. Plans for storage can be refined based on timescales for first waste emplacement. Transport routes and options can start to be developed. Storage requirements can be confirmed. Application of the waste hierarchy (Section 2) supports the inventory definition for the DGR.
Phase 3: DGR Site Characterisation	Generic options can be updated to site specific. Safety assessments can be updated.
Phase 4: DGR Construction	Strategic options focus on the back end of the waste lifecycle (transport and disposal). The inventory for geological disposal is refined and sequencing of waste emplacements defined.
Phase 5: DGR Operation and Closure	As the waste is now being emplaced, the focus of this phase is on the transport and disposal steps of the waste lifecycle. Application of the waste hierarchy is less important.

The IAEA defines an "Integrated Approach" as *a logical and preferably optimised strategy used in the planning and implementation of a radioactive waste management programme as a whole from waste generation to disposal such that the interactions between the various stages are taken into account so that decisions made at one stage do not foreclose certain alternatives at a subsequent stage" (IAEA, 2003).*

Integrated Waste Management (IWM), as defined by the UK Nuclear Decommissioning Authority (NDA) in their Radwaste Strategy (NDA, 2019), is a high-level framework for flexible decision-making, to ensure safe, environmentally acceptable and cost-effective solutions that reflect the nature of the radioactive waste concerned.

Another important concept relevant to this domain is the whole waste lifecycle. This is illustrated in the figure below (NDA, 2019):



The key phases of the waste lifecycle are:

- Planning and preparation – This includes understanding opportunities for the application of the waste hierarchy (see section 2), inventory, characterisation (both radiological and non-radiological (e.g., chemotoxic and hazardous) properties of the waste), optioneering, waste management plans development and strategy definition. This stage usually precedes initial treatment of the waste. Planning also continues throughout the remainder of the waste lifecycle. The wastes can be solid, liquid or gaseous.
- Treatment and conditioning – Often occurs following initial treatment and interim packaging (optional, e.g., if the raw waste cannot be transported safely, some preconditioning may be required). Initial treatment includes:
  - Sorting & segregation,
  - Size reduction, decontamination,
  - Thermal / chemical (e.g., using ion exchange media to extract radionuclides from liquids) / physical (e.g., filtration) treatment, and
  - Conditioning / immobilisation (e.g., grouting or encapsulation in resins) activities.

  The aim of waste treatment and conditioning is to process raw waste into a form suitable for disposal (if not already disposable), where routes are readily available, or for storage pending the development of suitable disposal routes.
- Storage, pending disposal or further conditioning – This includes raw waste storage, conditioned waste storage and buffer storage, pending onward treatment, conditioning and/or disposal. Storage can be defined as *"the holding of radioactive waste or material in a facility that provides for its containment with the intention of retrieval"* (NDA, 2019).

- Disposal – The location and form of disposal utilised depends on the waste acceptance criteria of the disposal facility, the risks associated with the waste and whether it requires *isolation* or *containment.*

Transport is a cross-cutting theme across the whole waste lifecycle. It is required at the planning stage, e.g., where wastes are sampled for characterisation, for taking the waste retrieved to a treatment or conditioning plant for processing, for transporting raw unconditioned waste or conditioned waste to stores and for transporting wastes from storage to the final disposal site. It can be transported by air, sea, rail or road and is subject to tight international and national regulations.

2. Contribution to generic safety functions and implementation goals

2.1 Features, characteristics, or properties of IWM routes and strategic options that contribute to achieving storage safety as well as long-term safety of the disposal system

2.1.1 Primary goal – Relied upon for optimisation of the disposal system design and operation

IWM routes and strategic options EURAD Roadmap specific goal – <u>Optimisation.</u>

Evaluating strategic options leads to opportunities being identified early (usually during planning and preparation) that may continue to accrue benefits throughout the whole waste lifecycle, allowing for optimisation at different stages. As many countries do not have disposal facilities for all their waste inventory, there are opportunities to optimise their disposal system design and operation through shared international collaboration and learning from those countries with successful programmes. Development of new management techniques on a given site may allow major efficiencies to be realised, including the potential to share advances in treatment technologies, infrastructure and waste management routes.

Characterisation and understanding the waste inventory play an important role in the decommissioning of nuclear facilities and for site restoration by forming the basis for:

- Understanding the nature and quantities of the waste.
- Evaluating hazards and the assessment of potential risk impacts.
- Supporting cost estimation.
- Underpinning decision-making / optioneering.
- Enabling safety, radiological protection and protection of the environment.

In the UK, the NDA requires each site in the NDA Estate to describe how waste producers optimise their approach to waste management, the wastes they expect to generate during the lifetime of the site and the actions required to improve their approach to waste management.

Optioneering concepts such as Best Available Technology (BAT) / Best Practical Means (BPM) are widely used to assess strategic options. These usually include key concepts such as stakeholder engagement, environmental impact, cost and achievability. These are carried out inside a regulatory framework, with legal obligations such as “So Far As Is Reasonably Practicable” (SFAIRP) and regulatory concepts such as “As Low As Reasonably Practicable” (ALARP) and “As Low As Reasonably Achievable” (ALARA), and by requirements such as justification and optimisation.

2.1.2 Secondary goal – Acknowledged but not relied upon for operational flexibility of the disposal system

IWM routes and strategic options EURAD Roadmap specific goal – Flexibility.

Flexibility within the disposal system enables accelerated decommissioning through innovation, working with waste producers to overcome challenges and to capitalise on new opportunities. The outcome is achieving the right waste form, in the right package, which is then managed or disposed of at the right facility. The benefits are integration between government, regulators, waste owners and the supply chain, delivering missions in an optimised way, by providing industry wide solutions to radioactive waste challenges.

An example here is not to condition a waste for disposal if practicable, as it may preclude options to move it up the waste hierarchy (see Section 3) if a new treatment is developed in the years before disposal. In the UK, some short-lived Intermediate Level Waste (ILW) is being used to fill up vault spaces at the low level waste repository (LLWR), and utilising decay storage as a management route will be disposed of there as it will become low level waste (LLW).

2.2 Features, characteristics, or properties of IWM routes and strategic options that contribute to achieving long-term storage stability and feasible implementation of geological disposal

2.2.1 Primary goal – Relied upon for optimisation of the disposal system design and operation

IWM routes and strategic options EURAD Roadmap specific – Optimisation.

Optimisation, within the boundary conditions to implement safe storage and geological disposal within reasonable timescales and costs, allows new buffer materials to be developed, generic concepts (within a known host geology for DGR) to be improved with site specific data and safety cases be evaluated for potential / chosen disposal sites. Monitoring of waste packages during storage is a key enabler, as is the development of a new suite of standardised containers that would allow disposal without further conditioning or repackaging. It also allows waste to be treated as new technology is developed, tested, and eventually brought to the market.

2.2.2 Secondary goal – Acknowledged but not relied upon for operational flexibility of the disposal system and providing technical practicality

IWM routes and strategic options EURAD Roadmap specific – Flexibility and practicability.

Flexibility and practicability are key to adapting to changes in the future, e.g., new nuclear build programmes with existing designs (e.g., pressurised water reactors) or new advances (such as small modular reactors), which will bring additional inventories of waste that require future management. Therefore, the stores and disposal facilities must have the ability to adapt to incorporate these. In practice, unlike legacy wastes, these may generate more heat and be more radioactive, so the design of stores and the disposal facility must be able to flex and comply with safety requirements to allow implementation. New package designs, e.g., the use of larger multi-purpose disposal containers may offer benefits over smaller dimension containers (less transports, better management of heat, etc.) and the stores and disposal facility must have the ability to incorporate these developments and not be constrained. Security of supply of materials (encapsulation grouts, metals used to manufacture containers, etc.) and availability of plants for existing package designs represent a risk as storage pending disposal may be required for many 10’s of years.

3. International examples of IWM routes and strategic options

ERDO and ERDO-WG

For small inventory member states (SIMS), the strategy for dealing with their most hazardous and long-lived radioactive wastes is an ongoing issue (Vuorio, 2022). It requires the investment of significant financial, technical, and human resources. The costs are high relative to the quantities of materials involved, and independent disposal facilities represent a sub-optimal use of limited national resources. To address this, the European Repository Development Organisation (ERDO) association was initiated by organisations from Croatia, Denmark, Italy, Netherlands, Norway and Slovenia, in order to work collaboratively to enable the establishment of one or more operational and shared multi-national solutions through knowledge sharing. cooperative research, development & demonstration (RD&D) has resulted in optimised technical solutions, implementation of common designs and facilities, and cost optimisation for their inventories (ERDO, 2011a).

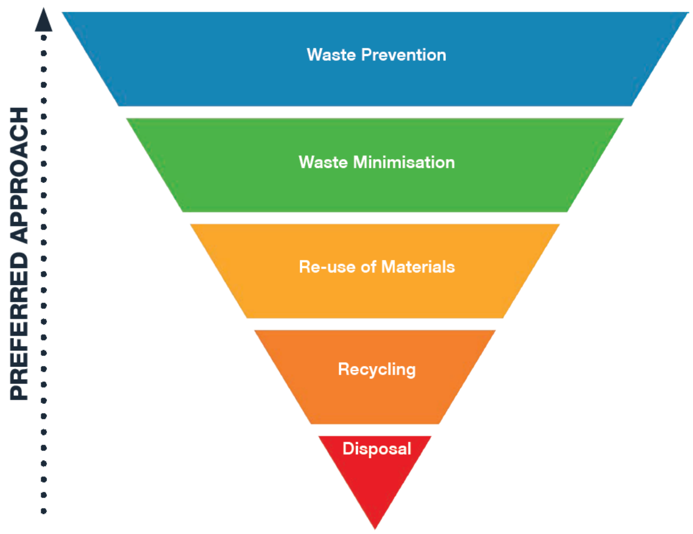
The ERDO Working Group (ERDO-WG) initiated a joint project on characterisation of legacy waste, which includes collecting, from participants and the literature, information on problematic legacy wastes and trying to derive minimum waste acceptance criteria (WAC), which could be used in a joint facility. The project did not include development of methodologies but was a conduit for information sharing (ERDO, 2011b).

The IAEA established the International Network of Laboratories for Nuclear Waste Characterisation (LABONET) to enhance sharing internationally in the application of proven, quality assured practices for the characterisation of LLW to ILW and waste packages. Their objectives are listed in their webpage as follows (IAEA, 2021b):

- To support organisations or member states with less advanced nuclear programs for characterisation of radioactive waste.
- To develop an expanded range of training and demonstration activities.
- To facilitate sharing and exchange of knowledge and experience amongst organisations with characterisation facilities in operation.
- To create a forum in which experts' advice and technical guidance may be provided.

NDA’s Strategy for IWM Optimisation in the UK.

In NDA’s Strategy IV document (NDA, 2021), the UK is moving to a more risk-informed approach to radioactive waste management based on the nature of the waste and the hazard that the properties of the waste pose to people and the environment. This is a change to earlier practice, where the waste classification system prescriptively guided the waste management solution. The risk-informed approach will enable wider and deeper application of the “Waste Hierarchy” (shown below, figure taken from NDA, 2019) and will allow optimisation of appropriate treatment, storage, and disposal infrastructure.



The importance of waste optimisation is defined in UK Nuclear Waste Services' (NWS) *"Inventory for Geological Disposal"* (NWS, 2021). It highlights that only a small fraction, less than 8% of the total stored volume detailed in the UK Radioactive Waste Inventory, is destined for a DGR. LLW and ILW designated for DGR disposal represents approximately 89% of that packaged volume. By reviewing alternative management options and through application of the waste hierarchy, a significant volume of these waste could be removed from requiring a DGR solution, reducing costs and the need for storage over long timescales.

4. Critical background information

4.1 Integrated information, data or knowledge (from other domains) that impacts understanding of IWM routes and strategic options

- 1.1.1 Establish and maintain a national plan for radioactive waste management, including a nuclear fuel cycle strategy (e.g., open or closed cycle) for those countries with, or intending to use, nuclear power (National Radioactive Waste Management Policy).
- 1.1.2 Develop and maintain broad timescales and schedule for implementing radioactive waste management activities using a stepwise decision-making process (Timetable for decision making).
- 1.1.4 Establish a process for progressive development and optimisation of the plan (safety, security, use of resources).
- 1.2.2 Establish regulatory criteria for waste management facilities, based on international standards (Licensing criteria).
- 1.2.4 Implement a system of appropriate oversight, a management system, regulatory inspections, documentation, and reporting obligations for radioactive waste and spent fuel management activities (Waste management System).
- 1.2.5 Establish and implement a research, development and demonstration strategy with activities clearly related to timeframes, concepts, plans, and milestones defined in the national programme (RD&D Strategy).
- 1.3.4 Work collaboratively with delivery and specialist organisations nationally and internationally to obtain value for money (Procurement & Supply Chain Arrangements).
- 1.4.1 Develop and maintain an inventory of all spent fuel and radioactive wastes from all sources and activities, together with estimates for future quantities arising, including the characteristics, location, ownership (responsible organisation) and amounts, in accordance with an appropriate classification scheme (National radioactive waste inventory).

- 1.5.2 Perform iterative evaluation of options and concepts at each stage of programme development taking account of international technological advances (Options and Concept selection).

5. Maturity of knowledge and technology

This section provides an indication of the relative maturity of information, data and knowledge of IWM Routes and Strategic Options. It includes the latest developments for the most promising advances, including innovations at lower levels of technical maturity where ongoing RD&D and industrialisation activities continue.

5.1 EURAD ROUTES and PREDIS

As part of EURAD, a strategic study has been undertaken on “Waste Management routes in Europe from cradle to grave” (ROUTES, 2024), covering radioactive waste characterisation, processing and storage options (ROUTES, 2024). Its aims were to:

- Provide an opportunity to share the experience and knowledge on waste management routes between interested organisations (from different countries, with programmes at different stages of development, with different amount of radioactive waste to manage).
- Identify safety relevant issues and their RD&D needs associated with the waste management routes (cradle to grave), including the management routes of legacy and historical waste, considering interdependencies between the routes.
- Describe and compare the different approaches on characterisation, treatment and conditioning and on waste long-term management routes, and identify opportunities for collaboration between member states.

A subsequent EU-project “Predisposal Management of Radioactive Waste” (PREDIS) was also launched, with the aim to increase the technical readiness and achieve implementation of predisposal treatment options for four groups of radioactive wastes (PREDIS Project, 2020). The objectives were to:

- Develop solutions (methods, processes, technologies and demonstrators) for treatment of radioactive wastes for which no industrially mature or optimal solutions are available.
- Improve existing solutions to achieve measurable benefits in safety, cost or efficacy in implementation across member states.
- Analyse the waste acceptance criteria associated with pre-disposal and disposal activities to support homogenisation of waste management processes across Europe.

Its output is the development of new waste treatment technologies, including metal decontamination, alternative cement binders, and thermal treatment.

5.2 Treatment options – Thermal treatment

Across member states, there are several commercially available incinerators that can treat radiologically contaminated liquid and solid wastes. The product is an ash that can be further treated or disposed of with volatile species managed through off-gas infrastructure. Benefits of incineration include waste volume reduction and removal of Carbon-14 and organic species, which are a major contributor to risk in post-closure safety cases for disposal facilities.

For metallic wastes, commercial smelting facilities are operated in Germany, Sweden, France, and the USA (amongst others). These can recover metals for “re-use or recycle” purposes and can provide an income stream in the metals recovered.

The Thermal Treatment for Radioactive waste Minimisation and Hazard reduction project (THERAMIN, 2017-2020), aimed to provide improved understanding and optimisation of the application of thermal treatment to radioactive waste management programmes across Europe, in order to accelerate industrial implementation. It included the demonstration of different technologies across a range of waste groups at facilities across the European Union. The trials undertaken included GeoMelt® In-container Vitrification (ICV), (THERAMIN, 2020a), thermal gasification (THERAMIN, 2020b) and Hot Isostatic Pressing (HIP) (THERAMIN, 2020c).

Joule-heated melting is a thermal method which processes waste in situ into a vitrified waste form. The method can be subdivided into ICV, where the melter also provides the containment system, an example of which is the GeoMelt® system, or continuous vitrification such as Joule-heated Ceramic Melter (JHCM) technology. The latter has been successfully implemented for the vitrification of liquid High Level Waste at United States Department of Energy sites, as well as in Germany, Belgium, Russia and Japan as well in a test treatment of American “Low Activity Waste”, which was recently completed at the Hanford Vitrification Plant in Hanford, USA (Bechtel, 2024).

GeoMelt® is an industry-leading example of ICV, developed in 1980. Since then, it has processed over 26,000 tonnes of waste, predominantly through in-situ vitrification. It has been demonstrated within the last 5 years at both pilot plant-scale in the UK (NNL, 2020) and full operational scale in the USA (Veolia, 2022)

Waste volume reduction is achieved through HIP, a process which involves the simultaneous application of high pressure and high temperature. The product is a glass, ceramic, glass-ceramic, metallic, or metal encapsulated product with the radioactivity incorporated, embedded or encapsulated in the waste form. This technology is undergoing trials for disposal of the UK’s civil nuclear plutonium stockpile.

Plasma melting uses a very high temperature to decompose combustible materials and achieve melting of radioactive waste and additives, to produce a vitrified or slag waste form, together with a separate metal phase, depending on the metallic waste fraction and processing conditions. Technologies include refractory melter systems, a system where the plasma chamber is lined with refractory materials resistant to plasma temperatures, pressure and chemical degradation, and cold crucible melting, a system where the melt is held in a water-cooled cold crucible and enables the operation of higher temperature melts which would normally be in excess of the melting point of the containment material. Refractory plasma melting treatment systems have been deployed worldwide for the treatment of radioactive wastes, specifically lower activity wastes (Deckers, 2020). The Zwilag plasma melter in Switzerland has been operating since 2004 for the treatment of 200 tonnes of LLW per year.

5.3 Treatment options – Chemical treatment processes

Wet oxidation is a low temperature, ambient pressure decomposition system. The technique involves the use of hydrogen peroxide and a metal catalyst to break down organic material to carbon dioxide and water. This method of treating radioactive wastes has been championed for the destruction of organic materials for around 40 years as it can significantly reduce solid waste volumes and potentially re-categorise wastes for acceptance into national repositories (Walling, 2021). Globally, several pilot facilities have been constructed to understand the application of the process at a larger scale, including sites in Sweden, Japan and the USA, however there are limited instances of actual industrial application to radioactive wase treatment.

Chemical decontamination agents have been developed for over 50 years and include chemical solutions, acids, gels and foams, either water-based or non-aqueous liquids (IAEA, 1999). For example, the Westinghouse Clean Technology Park at Springfields in the UK operates an acid decontamination facility for the treatment of metallic wastes.

In the UK, cement encapsulation is the existing baseline treatment option for ILW. It comprises mixing radioactive waste with a cementitious grout. This process reduces the activity per tonne of the waste and renders it appropriate for storage and disposal but does add significant volume. Historically, polymeric encapsulants have been used for certain waste streams. Recent developments in this field are focused on phosphate cements (Gardner, 2021) and geopolymers (Lucideon, 2021, Cantaral, 2017).

5.4 Past and ongoing (RD&D) projects relevant to IWM routes and strategic options

Past RD&D projects:

- **CARBOWASTE,** Treatment and disposal of irradiated graphite and other carbonaceous waste, 2008-2013.
- **CHANCE,** Characterisation of conditioned nuclear waste for its safe disposal in Europe, 2017-2022.
- **COMPAS,** Comparison of alternative waste management strategies for long-lived radioactive waste, 2001-2003
- **EURAD ROUTES,** 2019-2024 (see Section 5 for full details).
- **INSIDER,** Improved nuclear site characterisation for waste minimisation in dismantling and decommissioning operations under constrained environment, 2017-2021.
- **MICADO,** Measurement and instrumentation for cleaning and decommissioning operations, 2019-2022.
- **PREDIS,** 2020-2024 (See Section 5 for full details).
- **SAPIERR,** Support action: pilot initiative for European regional repositories,
- **SAPIERR** 2003-2005, and **SAPIERR II,** Strategy action plan for implementation of European regional repository - stage 2, 2006-2009, which led to the formation of the **ERDO-WG** and the **ERDO Association**. The SAPIERR and SAPIERR II projects were specifically focussed on small inventory countries, where a national geological repository may not be the most practical solution.
- **THERAMIN,** Thermal treatment for radioactive waste minimisation and hazard reduction, 2017-2020.

5.5 Lessons learnt

Joint research projects in various forms are currently the favoured way for collaboration, but some small inventory countries are also interested in shared facilities. However, in some countries, this option is not feasible, due to the legislation in place (Vuorio, 2022).

The shared facilities option has been more modest, despite early proposals for major multinational fuel cycle centres and the implementation of large, shared facilities for enrichment and reprocessing. The fuel cycle centre initiatives concluded that most of the proposed arrangements were technically feasible and economically attractive, but they all failed for a variety of political, technical and economic reasons. The main reason was that the parties could not agree on the non-proliferation commitments and conditions that would entitle participation in the multilateral activities (Vuorio, 2022).

6. Uncertainties

The high-level key uncertainties are:

- Changes in government policy and/or the regulatory framework that the country operates under.
- Changes in stakeholder perception and approval, e.g., a site that might be optimal for disposal may not be acceptable to civil society or a local host community.
- Waste inventories are typically based on estimates (from assays / fingerprints, etc.) before the waste is retrieved and characterised. This can lead to sub-optimal outcomes, e.g., a waste that could have been treated at a point in time is not treated, resulting in additional cost.
- Advances and innovation in treatment technologies may open up new management routes that impact on existing and / or future store and disposal facility designs.
- Until a site and its host geology is known, disposal is based on generic concepts that potentially drive sub-optimal solutions, e.g., waste owners cannot optimise routes for management as WAC are not finalised.
- Security of supply of materials for packaging wastes that arise in the future.

7. Further reading, external links and references

7.1 Further reading

Further Reading EURAD (2021), EURAD Roadmap, extended with Competence Matrix. https://www.ejp-eurad.eu/sites/default/files/2021-09/EURAD%20-%20D1.7%20Roadmap%20extended%20with%20Competence%20Matrix.pdf

7.2 External links

IAEA www.iaea.org

ERDO-WG ERDO - Working Group (erdo-wg.com)

EURAD https://www.ejp-eurad.eu

EURAD ROUTES EURAD - D9.9 ROUTES Suggestions for the management of challenging wastes | Eurad (ejp-eurad.eu)

GEOMELT® New GeoMelt® Vitrification System Successfully Completes Hot Commissioning and its First Demonstration Melt | Veolia Nuclear Solutions

PREDIS - EU-project PREDIS (predis-h2020.eu)

THERAMIN Project THERAMIN (theramin-h2020.eu)

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