2.1.3 Technology Selection

Assess potential technologies for implementation phase, considering cost-benefit ratio and availability (Technology Selection)

Theme 2: Pre-disposal

Sub-theme 2.1: Planning predisposal management of radioactive waste in close cooperation with waste generation (Planning)

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OVERVIEW

Technology selection is an **important part of the planning process** when setting up a **waste management programme.** This continues to be crucial during implementation of the programme to evaluate if suitable technologies are being implemented. This Domain Insight document provides guidance on the assessment and selection of potential technologies for implementation during the pre-disposal phase of the waste management lifecycle, considering factors such as cost-benefit ratio and availability (EURAD Pre-disposal theme overview, domain 2.1.3, Technology Selection), as a part of the sub-theme "Planning pre-disposal management of radioactive waste in close cooperation with waste generators" (Planning) and, on the broader theme 2 "Pre-disposal Activities prior to geological disposal" (Pre-disposal).

In the planning process for a waste management programme, it is critical for the waste owner to assess the **feasibility of technologies for processing, storage, and monitoring**, taking economic constraints into account and considering subsequent stages in the waste management lifecycle, including final disposal. In addition, technology selection must be based on the waste inventory that has been generated, planned waste stream composition and the evolution of resulting waste packages in storages. The accuracy, effectiveness and efficiency of the technologies deployed in a facility require periodic review and update, as needed, throughout the lifetime of the facility.

KEYWORDS

Radioactive waste management, planning, technology selection, multi-attribute analysis

KEY ACRONYMS

DGR - deep geological repository
GBS - goals breakdown structure
EURAD – European Joint Programme on Radioactive Waste Management, 2019-2024
HAZOP - HAzard and OPerability analysis
IAEA - International Atomic Energy Agency
LCA – lifecycle assessment
LCC – lifecycle costing
MS - Member State
NPP - Nuclear Power Plant
PREDIS –Euratom project on pre-disposal of nuclear waste, 2020-2024
R&D – Research and Development
RW – radioactive waste
RWM - radioactive waste management

1 TYPICAL OVERALL GOALS AND ACTIVITIES IN THE DOMAIN OF STORAGE

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 phases of implementation, needed to achieve the domain goal. Activities are generic and are common to most regional and geological disposal programmes.

Domain Goal	
2.1.3 Technology Selection Assess the feasibility of technologies taking economic constraints into account and considering subsequent stages in the waste management lifecycle, including final disposal, based on the waste inventory that has been generated, planned waste stream composition or the evolution over time of waste packets that result from storing fractions of the waste stream according to the regulations or procedures.	
Domain Activities	
Phase 1: Planning and programme Initiation	Gather detailed information on the waste stream and available technologies. Compile and scale boundary conditions, regulations and other decision criteria. Match technology parameters vs. decision criteria, then decide.
Phase 2: Programme Implementation	Continuously monitor the selected technology for performance, upgrades, and alternatives as well as changes in regulation, and optimise the procedures and their descriptions, whenever new opportunities arise.
Phases 3-4: Programme Operation/Optimisation and Closure	Phase 3: Continue monitoring as in phase 2 Phase 4: Final evaluation of the technology, documentation, and compilation of "lessons learned".

According to the EURAD Theme 2 Overview, the process of technology selection includes:

- Comparison of pre-disposal processing technology options with respect to economic and environmental lifecycle parameters.
- Evaluation of spent fuel reprocessing options as well as free release and recycling opportunities for very low radioactivity materials to avoid disposal altogether in accordance with the waste hierarchy.
- Understanding of regulatory requirements for both pre-disposal and disposal aspects.

The EURAD Theme 2 Overview also notes that there are numerous mature technologies and services available in the international market reflecting the extensive experience of EU Member States in Nuclear Power Plant (NPP) operation, including pre-disposal waste management. Some countries and companies have been operating pre-disposal waste management facilities for decades, including interim storage, final disposal, and, in some cases, free release of waste for reuse in other industries. However, the availability of pre-disposal waste management technologies and market offerings is highly dependent on the type of waste and its geographical location. This opens significant market opportunities for new companies to provide innovative technologies and services in the pre-disposal field, with high market costs and potential profits associated with pre-disposal processing.

2 INTERNATIONAL LEGISLATION, REGULATION, AND REQUIREMENTS

To the best of the authors' knowledge, there is no international legislation specifically on Technology Selection. However, other relevant national and international legislation and standards must be considered in the Technology Selection process. This includes considerations related to radiation safety, environmental safety, occupational health and safety, as well as national nuclear policies.

The IAEA issued guidance on Technology selection in 2017 [1][3]. According to these documents, the following Influence factors and criteria, clarified by the questions they relate to must be addressed:

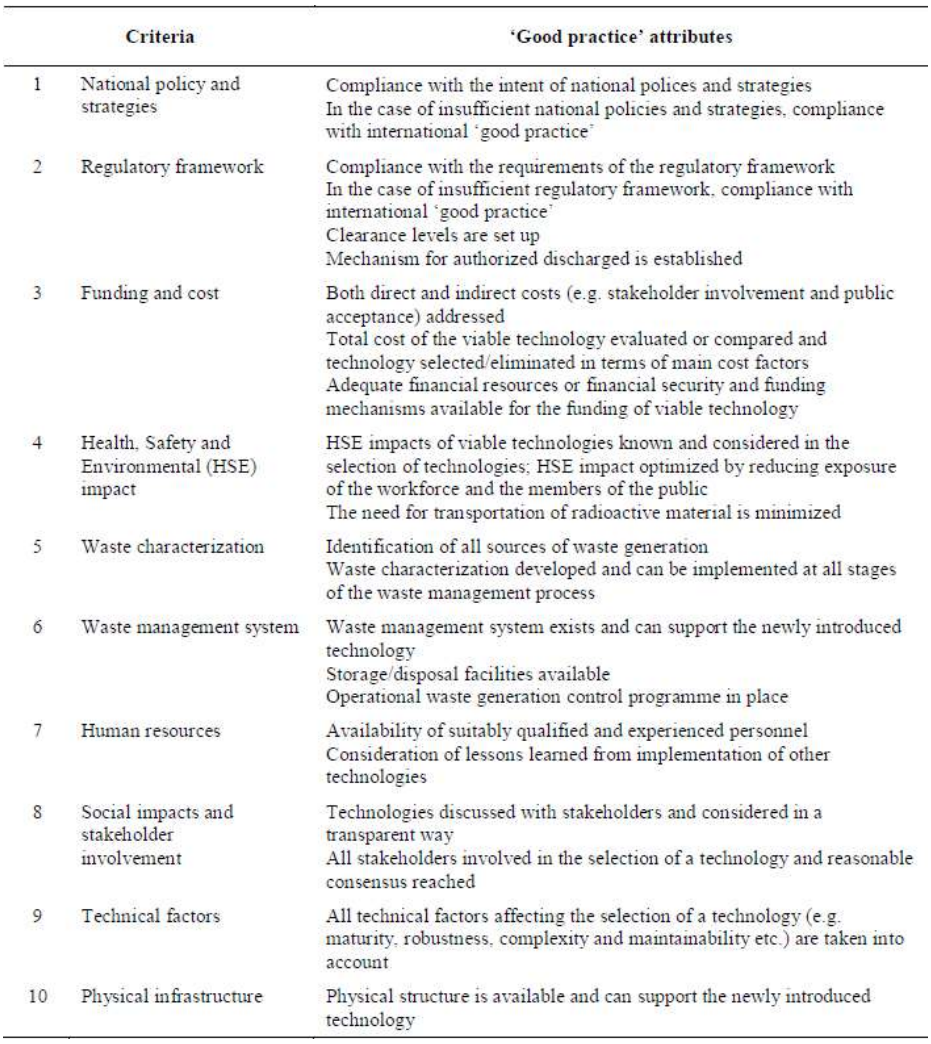
- Political and socioeconomic criteria
    - Compliance with regulations – Will the technology gain regulatory approval?
    - Financial resources – Can funding be secured for both investments and ongoing operations?
    - Manpower and personnel competence – is the right personnel available or can they be acquired?
    - Physical infrastructure – Does the technology seamlessly integrate with existing infrastructure?
    - Research and development – Is there capacity to advance emerging technologies to maturity?
    - Public involvement and political acceptance – Is there sufficient political support, and can the safety of the technology be effectively communicated to the public?
    - Facility location - Have all relevant factors, such as transportation, been considered in selecting an appropriate facility location?
    - Opportunity for international cooperation – Should collaboration with other entities be sought to share the workload and expertise?
- Technical criteria
    - Scale of technology application – Can the technology effectively process the entire waste stream of interest?

  - Maturity of the technology - Will the technology be developed and available within the required timeframe for implementation?
  - Robustness of the technology – Is the technology resilient enough to function reliably even when parameters or regulations undergo changes?
  - Flexibility and adaptability of the technology – Can the technology be easily adapted to variations in the waste stream or changes in regulatory requirements?
  - Complexity and maintainability – Are the technologies manageable, and can they be maintained effectively over the long term?
  - Integrated programmes – Does the technology fit into the portfolio of the other technologies used in waste management?
  - Safeguards and nuclear safety – Will the technology adhere to safety standards, and will regulatory bodies approve its safety measures?
  - Site availability and location – Where is the optimal location to implement the technology, considering site availability and overall efficiency?

The selection of a preferred or optimised waste processing technology is best achieved through the evaluation of the general criteria and constraints in terms of their attributes for a specific waste stream or facility (see Table 1). This evaluation can benefit from the use of formal decision-aiding techniques that address the influencing factors and associated good practice indicators. Commonly used techniques in this regard include **[1]**:

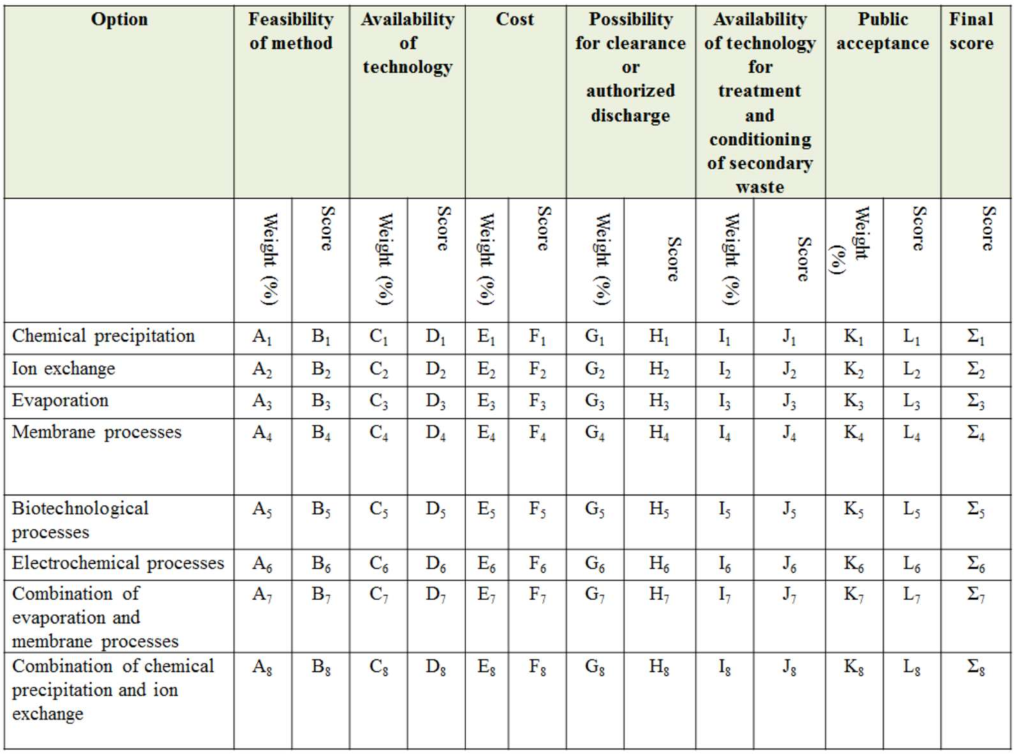
- **Linear Decision Tree Approach:**
  - *Advantages:* Provides a structured framework for decision-making.
  - *Limitations:* Constrained by multiple, non-linear objectives and dependencies of criteria/factors.
- **Cost-Based Approach with Work Breakdown Structure:**
  - *Advantages:* Utilises a systematic breakdown for cost evaluation.
  - *Limitations:* May prioritise cost and speed over the quality and safety of the technology, especially in complex environments.
- **Multi-Attribute Analysis:**
  - *Advantages:* Offers transparency and accommodates the complexity and interdependence of criteria.
  - *Limitations: Time-intensive, requiring a comprehensive evaluation due to its consideration of multiple attributes. An example decision matrix for a multi-attribute analysis outcome is provided in* Table 2.

Table 1: Technology related criteria and attributes ***[1]***



	Criteria	'Good practice' attributes
1	National policy and strategies	Compliance with the intent of national polices and strategies In the case of insufficient national policies and strategies, compliance with international 'good practice'
2	Regulatory framework	Compliance with the requirements of the regulatory framework In the case of insufficient regulatory framework, compliance with international 'good practice' Clearance levels are set up Mechanism for authorized discharged is established
3	Funding and cost	Both direct and indirect costs (e.g. stakeholder involvement and public acceptance) addressed Total cost of the viable technology evaluated or compared and technology selected/eliminated in terms of main cost factors Adequate financial resources or financial security and funding mechanisms available for the funding of viable technology
4	Health, Safety and Environmental (HSE) impact	HSE impacts of viable technologies known and considered in the selection of technologies; HSE impact optimized by reducing exposure of the workforce and the members of the public The need for transportation of radioactive material is minimized
5	Waste characterization	Identification of all sources of waste generation Waste characterization developed and can be implemented at all stages of the waste management process
6	Waste management system	Waste management system exists and can support the newly introduced technology Storage/disposal facilities available Operational waste generation control programme in place
7	Human resources	Availability of suitably qualified and experienced personnel Consideration of lessons learned from implementation of other technologies
8	Social impacts and stakeholder involvement	Technologies discussed with stakeholders and considered in a transparent way All stakeholders involved in the selection of a technology and reasonable consensus reached
9	Technical factors	All technical factors affecting the selection of a technology (e.g. maturity, robustness, complexity and maintainability etc.) are taken into account
10	Physical infrastructure	Physical structure is available and can support the newly introduced technology

*Table 2: Example of a generic (and simplified) decision matrix with aqueous waste treatment options [1]. The scores Bi, Di, Fi, should use the same scale (e.g., 0…10) for all attributes. The weights Ai to Ki, which must be adjusted according to the importance for the users, the regulators, and other stakeholders, should sum up to 1 along a row. The weights will be constant in each column (e. g. A1 to A8), except e. g. if a certain attribute is not applicable for one of the options. The score for an option is calculated along a row by summing up the products of weights and scores (Ai*Bi + Ci*Di + … + Ki*Li).*



Option	Feasibility of method		Availability of technology		Cost		Possibility for clearance or authorized discharge		Availability of technology for treatment and conditioning of secondary waste		Public acceptance		Final score
	Weight (%)	Score	Weight (%)	Score	Weight (%)	Score	Weight (%)	Score	Weight (%)	Score	Weight (%)	Score	Score
Chemical precipitation	A_1	B_1	C_1	D_1	E_1	F_1	G_1	H_1	I_1	J_1	K_1	L_1	Σ_1
Ion exchange	A_2	B_2	C_2	D_2	E_2	F_2	G_2	H_2	I_2	J_2	K_2	L_2	Σ_2
Evaporation	A_3	B_3	C_3	D_3	E_3	F_3	G_3	H_3	I_3	J_3	K_3	L_3	Σ_3
Membrane processes	A_4	B_4	C_4	D_4	E_4	F_4	G_4	H_4	I_4	J_4	K_4	L_4	Σ_4
Biotechnological processes	A_5	B_5	C_5	D_5	E_5	F_5	G_5	H_5	I_5	J_5	K_5	L_5	Σ_5
Electrochemical processes	A_6	B_6	C_6	D_6	E_6	F_6	G_6	H_6	I_6	J_6	K_6	L_6	Σ_6
Combination of evaporation and membrane processes	A_7	B_7	C_7	D_7	E_7	F_7	G_7	H_7	I_7	J_7	K_7	L_7	Σ_7
Combination of chemical precipitation and ion exchange	A_8	B_8	C_8	D_8	E_8	F_8	G_8	H_8	I_8	J_8	K_8	L_8	Σ_8

Owing to the lack of specific legislation on technology selection in waste management, a waste owner, waste generator, or waste management organisation have some flexibility in planning and executing activities within their mandates. However, compliance with applicable legislation and regulations in specific application fields (such as treatment, storage, and transport) is necessary. The technical oversight of the programme is generally provided by the company management and involves engagement with regulators and key stakeholders. Independent technical reviews should be incorporated into the internal technical oversight process before major decisions are made.

The technology selection, value assessment, and decision making for each waste management process should include the following steps:

- Assessment of the “What-is” situation (Existing waste streams, regulations, stakeholders, technologies already implemented, existing storage facilities, etc.)

- Assessment of the “What will be” situation (upcoming waste streams, expected changes in regulations, etc.)
- Assessment of “What is available” (technologies available on the market, potential partners/contractors, etc.)
- Assessment of “What is missing” (technology gaps, R&D needs, etc.)
- Assessment of “Can we to do ourselves” (e.g., can a certain part of waste management be done by a consultant/contractor/service provider, potentially in other countries)

In each part of the assessment process, the main drivers are (not in order of importance, that may vary):

- Safety (radiation safety, occupational health and safety, environmental safety)
- Regulations and legislation
- Waste acceptance criteria (WAC) for final disposal
- Cost
- Time scale

The tools used in this process might include:

- Feasibility Study, technology selection and concept design: This consists of evaluation of existing techniques and selection of mature techniques that have been successfully applied for similar purposes. Where there are no common practices, a new approach and new dedicated solutions may be investigated.
- HAzard and OPerability analysis (HAZOP): This is a methodical and rigorous tool to proactively identify potential issues by scrutinising safety aspects in designs and reassessing ongoing processes within the nuclear industry. HAZOP is a crucial component of risk management as it facilitates the comprehensive identification, evaluation, and control of hazards and risks inherent in intricate processes. This analysis extends to systems, components, and structures that are pertinent to the nuclear safety of the facility, encompassing both routine and emergency conditions.
- A detailed project report: This outlines the selected technology, characteristics of the materials to be treated with the chosen technology, and the complex process defined to produce the final waste packages. Furthermore, the report identifies the requirements and safety criteria for the implementation of the waste management process.

3 GENERIC SAFETY ISSUES FOR CHARACTERISATION

In any radioactive waste management activity, safety is the top priority. Therefore, it is imperative to ensure that all safety-related parameters and information are included in the technology selection process. After selection, the technology and its operation require close monitoring to verify the performance and, if required, to implement changes or upgrades.

To ensure that the specific safety issues and regulations for the technology and its application are considered, all available information on existing safety assessments and regulations must be collected. If such information is lacking, relevant programmes to address these deficiencies must be initiated.

The generic safety issues for other domains, detailed in the respective Domain Insight documents, must be considered in the Technology Selection process, including:

- Waste acceptance criteria
- Characterisation
- Treatment
- Conditioning and Packaging
- Transport
- Storage
- Deployment options

In the following sub-sections, the essential steps for the selection of a safe, (and reliable, robust, and economically viable) technology are outlined.

3.1 Planning and Programme Initiation

In the initial phase, information needs to be gathered on:

- Waste stream(s)
- Specific waste characterisation
- Treatment, conditioning, and packaging options
- Intermediate and final storage potential
- Associated costs
- Stakeholders to be involved
- Legal situation.

Utilising the collected information, a comprehensive list of assessment criteria and their respective importance must be derived. These criteria should include detailed descriptions for objective judgment, accompanied by a well-defined quantitative scale and relative weights. Inclusion of regulators and relevant stakeholders is vital for acceptance.

In a subsequent stage, all available and emerging technology options need evaluation against established boundary conditions and influencing factors, employing methods such as multi-attribute analysis (refer to section **Error! Reference source not found.**). Addressing information gaps requires dedicated R&D efforts. The assessment outcomes should align with the previously developed scale.

Following the assessment, involving stakeholders is recommended during the evaluation of results, ultimately leading to the selection of a technology. The entire process should be thoroughly documented. A performance monitoring system for the chosen technology, encompassing upgrades and alternative considerations, is strongly advised for later programme phases. This should include monitoring for technology upgrades and potential upcoming alternative options.

3.2 Programme Implementation

During implementation, the selected technology should be continuously monitored for robustness (e.g., by considering availability and capability to cope with changes in waste streams or regulations), performance, and compliance with regulations. Any emerging safety issues should be documented and addressed.

Continuous monitoring and re-assessment of available technologies should be conducted by considering alternatives based on new developments in technology, changes in regulations, new options for final disposal, as well as the relevant (and potentially changing) boundary conditions (e.g., changes in duration of plant operation or duration of interim storage). If the need arises, R&D programmes could be established to address changes or unforeseen gaps in the technology. For significant changes, the assessment described for the planning/initiation phase (section **Error! Reference source not found.**) should be revisited to include the new information/data. Any changes and modifications made to the technology should be documented.

3.3 Programme Operation and Closure

The monitoring should continue (section **Error! Reference source not found.**). The performance of the technology and any issues should be documented in detail to allow adaptation. During closure, a set of reports (management, technical) for final disposal and as input for next generation technology selection (”lessons learned”) should be compiled.

4 CRITICAL ISSUES, INFORMATION, DATA OR KNOWLEDGE IN THE DOMAIN OF STORAGE

The most critical generic issues in the process of Technology Selection are:

- **Precision in criteria and relative importance:** Ensuring accurate selection criteria and their respective weightings.
- **Inclusive engagement with regulators and stakeholders:** Actively involving regulators and relevant stakeholders throughout the selection process.
- **Comprehensive insight into technologies:** Gaining a comprehensive understanding of available and emerging technologies, considering their maturity levels.
- **Periodic re-evaluation:** Regularly reassessing technologies to incorporate the latest data, experiences, research, and legislative updates.

Technology Selection criteria and weights to be applied will depend on several factors such as the waste stream of interest, country context, envisaged disposal type, etc. Therefore, it is important to select these appropriately for the specific application scenario. This can be done based on guidance provided in section **Error! Reference source not found.**, which aligns with recommendations from the IAEA [1]. Involving regulators and relevant stakeholders is crucial to gaining acceptance for the selected technology.

To ensure an optimal solution in Technology Selection, a comprehensive overview of available and emerging technologies, including potential limitations and level of maturity, is required. This insight can be gained through existing institutional knowledge, national and international research programmes, documents from relevant organisations, and participation in conferences and trade fairs within the domain.

It is anticipated that during the lifetime of pre-disposal waste handling facilities, new technologies may come onto the market. These should be evaluated for relevance and return-on-investment potential before implementing the technology in practice. In instances where information on a promising technology is lacking or trust is insufficient, initiating R&D projects and/or conducting demonstrations on a realistic scale in authentic environments becomes imperative. For instance, the EC PREDIS project has tested specific wireless technologies within an actual facility in the context of waste package monitoring to substantiate the feasibility of transmitting data across multiple storeys and through thick slabs of reinforced concrete. However, it is crucial to acknowledge the inherent risk associated with immature technologies as they may prove non-optimal after evaluation, resulting in a loss of both time and budget.

Technology Selection extends beyond programme implementation and the start of operation. Periodic re-evaluation is necessary to align technologies with new experiences, emerging technologies, and changes in boundary conditions such as legislation, WAC, and the availability of final disposal sites.

The specific critical issues as well as data and knowledge issues of a particular technology depend on the domain of its application.

5 MATURITY OF KNOWLEDGE AND TECHNOLOGY

This section provides an indication of the maturity of information, data and knowledge within the domain of Technology Selection. It includes the latest developments for the most promising advancements, including innovations at lower levels of technology maturity, where ongoing Research and Development and Industrialisation Activities continue to improve.

The IAEA has developed a comprehensive guideline with an extensive list of references for technology selection [1]. This guideline is directly applicable to Technology Selection and can be considered mature and up to date. However, the list of key factors and decision criteria and the relative importance must be tailored for each specific case. Currently, there is a lack of shared best practices in this field, suggesting a potential avenue for creating a database or case studies to guide users towards best practices.

The technologies under evaluation in the technology selection process may have limited maturity, despite being the most suitable solution for a given application scenario. To gather sufficient data for a full evaluation, R&D or demonstration projects are required (see section 4)

5.1 Advances in characterisation issues

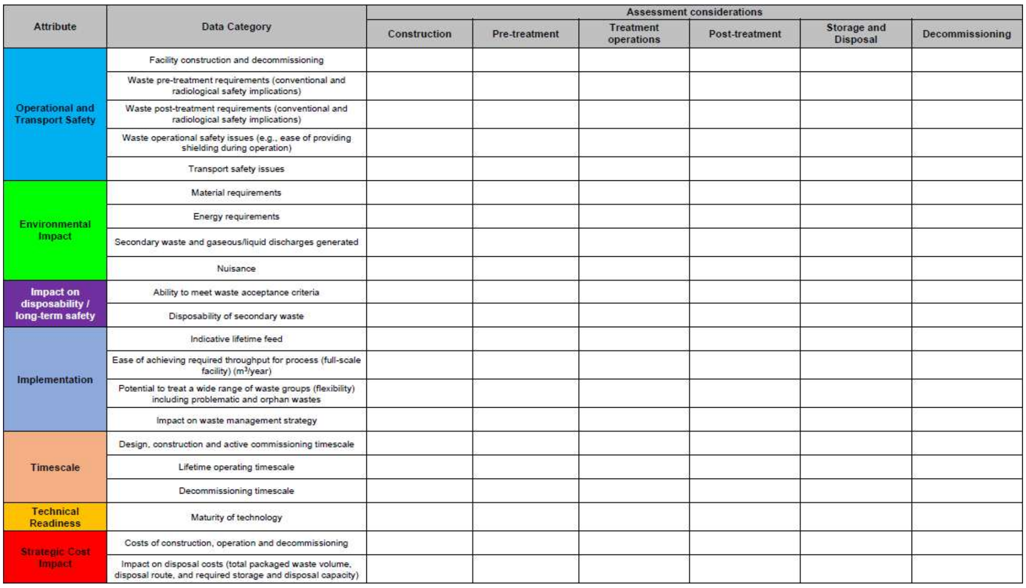
Emerging tools within Technology Selection that are being implemented or could be applicable and have relevance in the radioactive waste domain encompass Value Assessment, Life Cycle Assessment (LCA), and Life Cycle Costing (LCC). The following provides an overview of each tool, offering valuable insights to owners and decision-makers regarding the benefits and potential implementation of new technologies.

Value Assessment is a crucial tool utilised in decision-making processes to evaluate the performance of various options against multiple attributes or criteria. In the realm of radioactive waste management, Value Assessment provides a structured approach to assessing the 'value' associated with a chosen waste management / treatment / monitoring technology. The term 'value' is defined as the realisable benefit in terms of safety, monetary aspects, and environmental outcomes resulting from the implementation of a specific option at a designated time. This assessment comprehensively considers benefits and challenges across all stages of the waste management lifecycle.

Typically, a defined set of attributes is used to assess the value of an option in comparison to an established baseline option. These attributes may encompass environmental impacts, operational and transport safety, implementation, timescales, technical readiness, and cost impact (see Table 3). It is essential to acknowledge that the perception of value can vary among stakeholders, as individuals may assign varying degrees of importance to different attributes.

Value Assessment has been successfully employed in recent EURATOM projects [5] to evaluate various options, underscoring its effectiveness as a decision support tool.

Table 3: Example for a value assessment table (from [5]).



Attribute	Data Category	Assessment considerations					
		Construction	Pre-treatment	Treatment operations	Post-treatment	Storage and Disposal	Decommissioning
Operational and Transport Safety	Facility construction and decommissioning						
	Waste pre-treatment requirements (conventional and radiological safety implications)						
	Waste post-treatment requirements (conventional and radiological safety implications)						
	Waste operational safety issues (e.g., ease of providing shielding during operation)						
	Transport safety issues						
Environmental Impact	Material requirements						
	Energy requirements						
	Secondary waste and gaseous/liquid discharges generated						
	Nuisance						
Impact on disposability / long-term safety	Ability to meet waste acceptance criteria						
	Disposability of secondary waste						
Implementation	Indicative lifetime feed						
	Ease of achieving required throughput for process (full-scale facility) (m^3/year)						
	Potential to treat a wide range of waste groups (flexibility) including problematic and orphan wastes						
	Impact on waste management strategy						
Timescale	Design, construction and active commissioning timescale						
	Lifetime operating timescale						
	Decommissioning timescale						
Technical Readiness	Maturity of technology						
Strategic Cost Impact	Costs of construction, operation and decommissioning						
	Impact on disposal costs (total packaged waste volume, disposal route, and required storage and disposal capacity)						

Life Cycle Assessment (LCA) and Life Cycle Costing (LCC) are used in many branches of engineering to assess the potential environmental impacts and related costs of a product or process throughout its entire life cycle. In the field of radioactive waste management, this concept is relatively new, but its application may lead to identification of approaches to mitigate harmful impacts and reduce costs. The methodologies are established for LCA and LCC when comparing a new technology to an existing option as a basis for decision making. The input boundary conditions, both upstream and downstream, over the lifetime of the material, product or technique must be clearly defined. In the EC PREDIS project, the LCA and LCC concepts have been applied to estimate the impacts of several treatment and monitoring technologies, providing insights for the strategic research direction of future development of these technologies.

5.2 Optimisation challenge and innovations

Challenges exist with some technologies because there can be a limited number of facilities or commercial companies offering related services. the feasibility of utilising certain technologies may be hindered by factors such as the unsuitability of local facilities, necessitating the transport of waste to other processing facilities. In addition, some technologies may be constrained in their applicability due to handling only specific types of waste (i.e., liquids but not solids). Other challenges may include lack of spare parts, lack of operators, emissions that do not meet local regulations, etc. Some technologies may become rapidly obsolete or encounter scale-up issues. There may be challenges associated with transport of waste across international borders to access specialised facilities, emphasising the need for mobile or transportable facilities that can bring technological tools to areas with local needs.

6 PAST RD&D PROJECTS ON STORAGE

Previous projects funded by the IAEA and/or the European Commission that have addressed aspects of Technology Selection include:

- Pre-disposal management of radioactive waste (**PREDIS**). EC EURATOM project 2020-2024. https://predis-h2020.eu/
- Thermal treatment for radioactive waste minimization and hazard reduction (**THERAMIN**), EC H2020 project, 2014-2018, http://www.theramin-h2020.eu/ [5]
- Innovative and Adaptive Technologies in Decommissioning of Nuclear Facilities, IAEA CRP 2004-2008 [6]
- Development and try-out of an on-site process for sharing knowledge created in the frame of the nuclear decommissioning assistance programme. Project N° ENER/D2/2020-273 , https://joint-research-centre.ec.europa.eu/scientific-activities-z/eu-nuclear-decommissioning-knowledge-management_en

7 UNCERTAINTIES

The Technology Selection process must deal with several uncertainties. This is unavoidable as a selected technology is likely to be used for decades. The uncertainties can be grouped into two clusters:

Uncertainties directly related to the technology:

- Is the technology performing as promised?
- Is the technology robust in the face of changing boundary conditions outside the tested range?
- Is the technology available for the long term (e. g., considering the possibility of providers going bankrupt)?
- Will the necessary personnel be available over the long term?
- If the technology is not fully mature, will the required R&D result in the necessary progress?
- Can the development costs be reasonably anticipated?
-

Uncertainties related to the boundary conditions:

- Will there be changes in legislation or standards affecting the selected technology?
- Will there be a final disposal facility available when needed?
- Will there be changes in WAC for final disposal?
- Will the required funding be available throughout the lifespan of the technology?
- Will the transport between facilities, and potentially across countries, be possible?
- Will there be public acceptance for the selected technology?

8 GUIDANCE, TRAINING AND COMMUNITIES OF PRACTICE

This section provides links to resources, organisations, and networks that can facilitate connections within the domain of Technology Selection.

Guidance
IAEA, 2017. Selection of Technical Solutions for the Management of Radioactive Waste. IAEA Tecdoc-1817, Vienna [1] IAEA Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS), https://www.iaea.org/services/review-missions/integrated-review-service-for-radioactive-waste-and-spent-fuel-management-decommissioning-and-remediation-artemis
Training
• There is no specific training on Technology Selection to our knowledge available yet. However, some aspects are included in the IAEA Nuclear Energy Management School and some of the online **IAEA Spent Nuclear Fuel training courses available in Learning Management System: https://elearning.iaea.org/m2/course/index.php?categoryid=60** • Some guidance will be provided in the PREDIS 2024 training course
Active communities of practice and networks
• IAEA INTERNATIONAL RADIOACTIVE WASTE TECHNICAL COMMITTEE (WATEC) HTTPS://WWW.IAEA.ORG/RESOURCES/DATABASES/WATEC • WESTERN EUROPEAN NUCLEAR REGULATORS ASSOCIATION (WENRA), WORKING GROUP ON WASTE AND DECOMMISSIONING (WGWD) (HTTPS://WWW.WENRA.EU/WGWD)

Key competences that are required in the domain of Technology Selection for radioactive waste management include a general background in waste management, treatment and storage options, an understanding of relevant legislation and the safety principles underlying it, knowledge in the relevant engineering domains (mechanical, processing, materials science, building materials, etc.) and chemistry, experience in risk assessment and cost-benefit analysis, as well as generic competences in stakeholder involvement, project management, teamwork and economics.

9 ADDITIONAL REFERENCES AND FUTURE READING

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