

Radioactive Waste Management:

A national responsibility

at a global scale

requiring a local solution

...and some of the things IAEA can do to help



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EURADWASTE '19

9th European Commission Conferences on

EURATOM Research and Training in Radioactive Waste Management

4-7 June 2019, Pitesti, Romania



IAEA

International Atomic Energy Agency

Atoms for Peace and Development



Statute

“....accelerate & enlarge the contribution of atomic energy to peace, health and prosperity....”

Established in 1957

171 Member States

~2,560 multidisciplinary professional & support staff from more than 100 countries

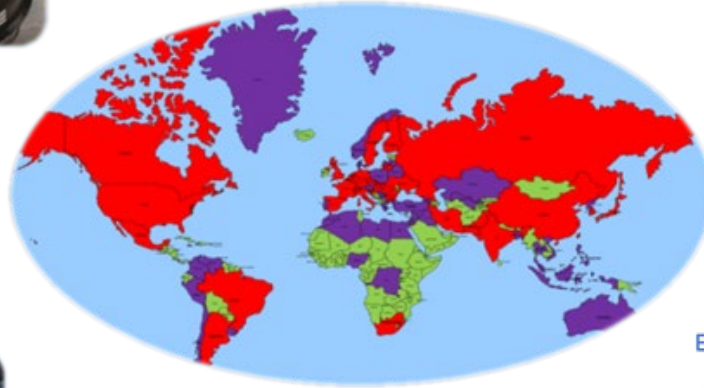


Radioactive Waste World-Wide

Front-End Fuel Facilities



Hospitals, R&D, Disused Sealed Sources



Decommissioning & Environmental Remediation



NPP, Research Reactor & Back-End Operations

 NPPs  Research Reactors  DSRS

Radioactive Waste World-Wide

Front-End Fuel Facilities



Hospitals, R&D, Disused Sealed Sources



Decommissioning & Environmental Remediation

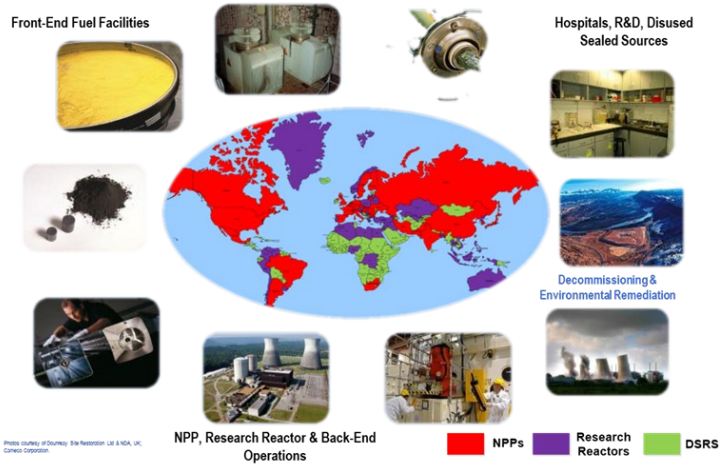


NPP, Research Reactor & Back-End Operations

 NPPs  Research Reactors  DSRS

All MSs have radioactive waste arising from nuclear fuel cycle operations, nuclear power generation, research reactors, radiopharmaceutical production, and/or other uses of nuclear technologies in hospitals, for research, agriculture, industry etc... as well as from the associated decommissioning and environmental remediation needs.

Radioactive Waste World-Wide



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All countries are responsible to provide solutions for the safe, secure & safeguarded management of their national inventories. From generation to disposal.

Radioactive Waste & SF Inventory

SRIS – Waste Inventory Database

- SRIS is the agency's new waste inventory information tool **Spent Fuel & Radioactive Waste Information System**
- **Developed in collaboration with EC**
- SWIFT – an associated **information tool** that allows Member States to compile their national reports – EC Waste Directive, JC etc.
- Meeting to “beta-test” functionalities in June 2019 – Release planned 2019

Inventory data are reported once and can be used by MSs for several different purposes

Status and Trends in RWM & SF

- Provides an international overview of SF & RW inventories, global status and trends
- **Prepared in collaboration with MSs, EC, OECD NEA & WNA**
- The next update will be published in 2020



Provides visibility of shared challenges & proven solutions

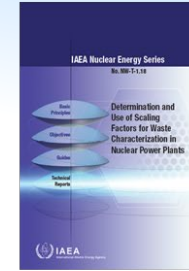
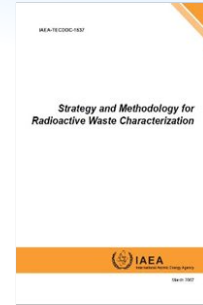
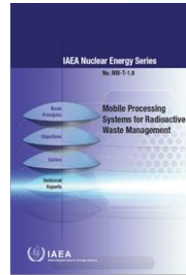
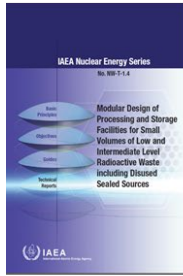
IAEA's Services & Products



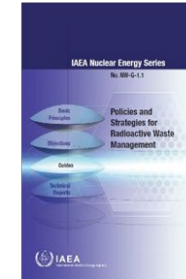
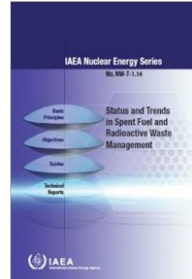
- Organize meetings and conferences
- Provide the secretariat for international conventions
- Develop Standards and Guides
- Publish documents reflecting experiences and good practices
- Manage Coordinated Research Projects
- Provide the secretariat for communities of practices (Networks)
- Manage databases (SRIS, Intl. Catalogue for Sources and Devices...)
- Host the worlds largest nuclear information library (INIS)
- Develop training material (Lectures, Workshops, eLearning)
- Provide expert missions and training courses (Technical Cooperation)
- Provide peer review services (Artemis...)
- And through the Safeguards Department, we are also known as the “nuclear watchdog”

...always with Member States, for Member States

→ PUBLISH DOCUMENTS REFLECTING EXPERIENCES AND GOOD PRACTICES



Publications

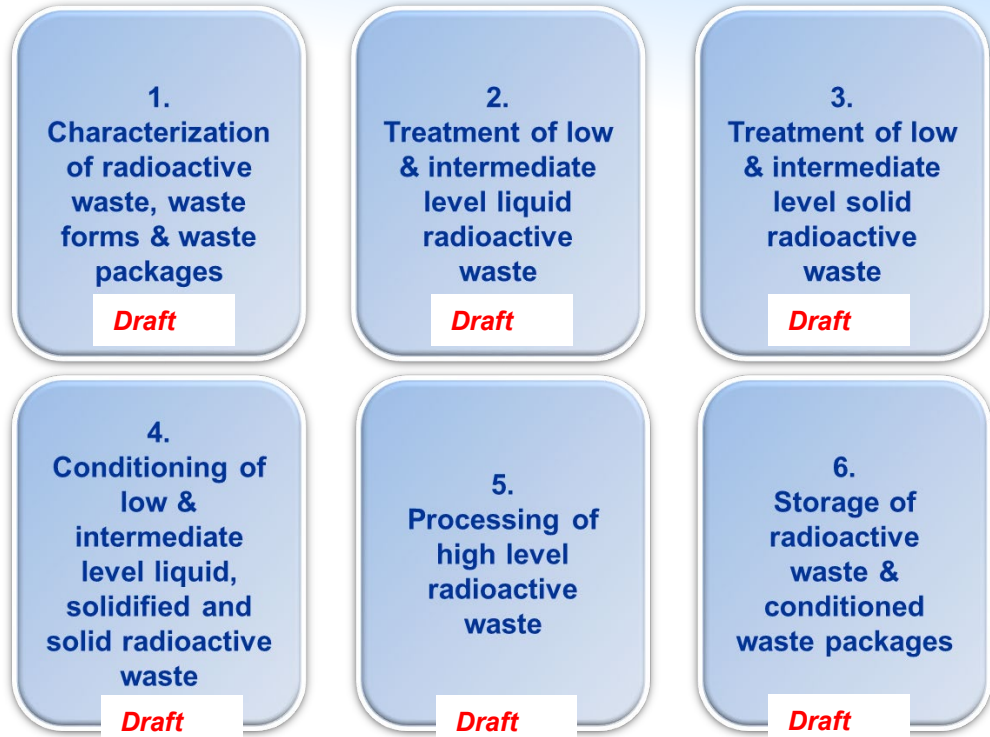


>120 publications in the area of pre-disposal radioactive waste management
All available on iaea.org

Pre-disposal Handbook Series

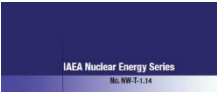
Part I: Technical Overview – provides a concise summary of technical information.

Part II: Annexes* – provide detailed information on technical options, design basis, operational requirements, best practices, lessons learned, emerging technologies



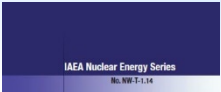
Part I published as paper report and Part II will be electronic (CD/network 'cloud' based)

Implementing disposal programmes



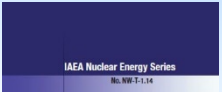
Concepts - Overview

In Publication



Cost estimation method

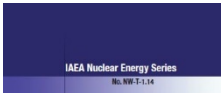
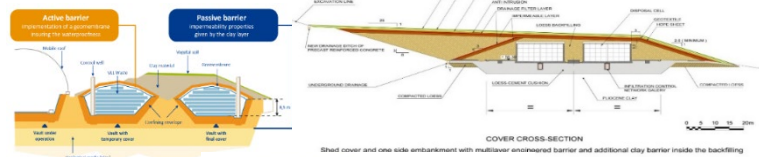
In Publication



Stakeholder engagement

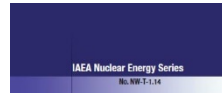
In Publication

VLLW and LLW - Near Surface



Generic DGR Roadmap

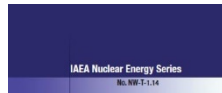
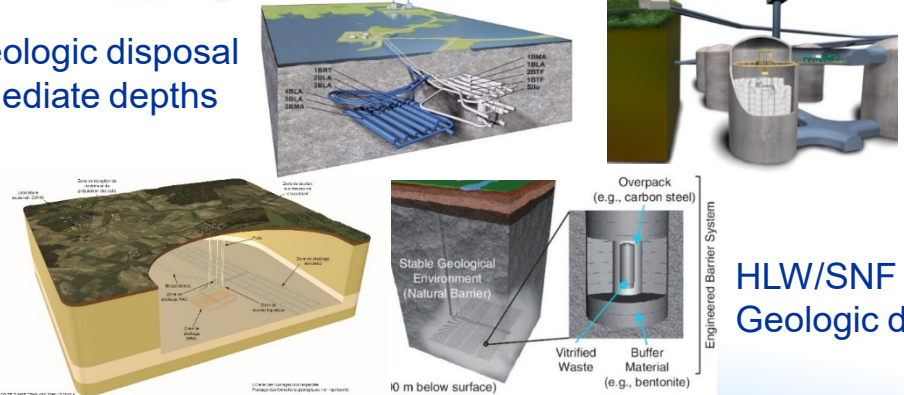
Draft



Site investigations

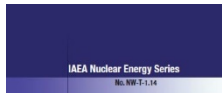
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ILW - Geologic disposal at intermediate depths



Post-accident waste

Draft



60 years URF Compendium

Draft

HLW/SNF – Deep Geologic disposal

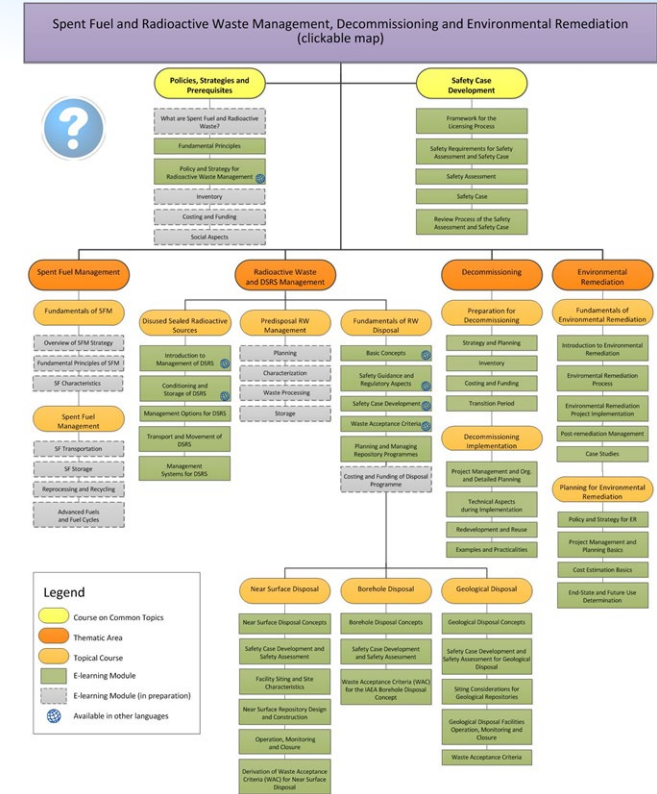
Building Capacities - Spent Fuel and Radioactive Waste Management eLearning



The IAEA has an [online learning platform](#) (former CLP4Net) available with eLearning materials, free of charge.

The materials on Spent Fuel and Radioactive Waste Management, Decommissioning and Environmental Remediation are organized by thematic areas and distributed into courses for better understanding and use. Altogether, there are currently 45 modules with a total of 93 lectures. Some are available in other languages as well. More are underway.

Access is possible also through the [IAEA CONNECT platform](#), via the professional Networks.



[Link to "walk-through" video here](#)

Building capacities - Technical Cooperation



Home / Services / Technical Cooperation Programme



Technical cooperation programme

The [technical cooperation programme](#) is the IAEA's primary mechanism for transferring nuclear technology to Member States, helping them to address key development priorities in areas such as health and nutrition, food and agriculture, water and the environment, industrial applications, and nuclear knowledge development and management.

Technical Cooperation in RWM/SFM

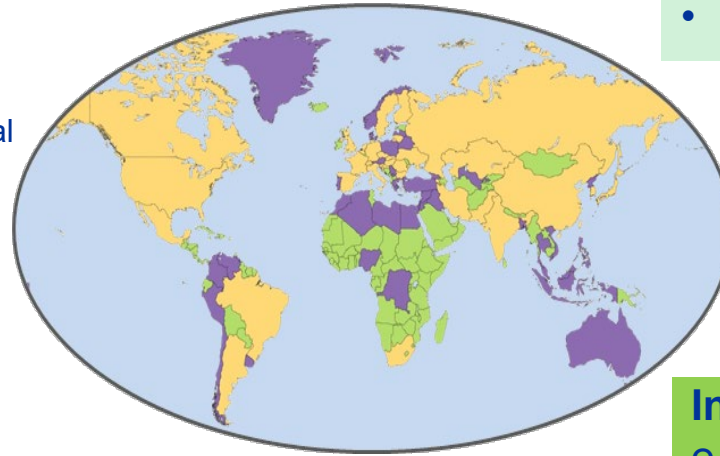


Regional Projects

- Latin America, Africa, Asia-Pacific, Europe

e.g. TC-RER 2020-23 addressing:

- Life-cycle waste management
- Strategy & planning
- Integrated national RWM plans
- Inventory to disposal



Inter-regional Projects

e.g.: Cradle-to-grave management of disused sealed sources

National Projects

(Pakistan, Croatia, Romania, Brazil, Egypt, Libya, Moldova, Georgia, Serbia, Ukraine)

- Policy and strategy
- Planning & siting for disposal
- Waste management optimization
- Characterization
- Legacy waste management
- Modular processing
- Procurement of key equipment

 Nuclear power plants

 Research reactors

 Use of radioactive sources

Example: Capacity Building Workshops & Training Courses

Courses organized to transfer radioactive waste management knowledge and best practice usually on topics of common interest to MS

Workshop on Problematic Waste from Decommissioning

- Expert lectures
- Group exercises
- Technical visit to FGUP RADON to observe different treatment technologies being applied in practice

Advanced Training on Management of Large Components with Complex Geometries

- Provide decommissioning professionals with necessary theoretical and practical basis for the management of large components



Co-ordinated Research Projects (CRPs)



- CRPs are tools to encourage information exchange/cooperation on on-going R&D activities in MS on selected topics of common interest
- Usually participants from 10-15 countries
- Periodic Research Coordination Meetings organized to facilitate exchange of progress, discussions
- Results of CRP published as Agency Reports

IAEA-TECDOC-1701



*The Behaviours of
Cementitious Materials in
Long Term Storage and
Disposal of Radioactive Waste*

Results of a Coordinated Research Project

IAEA TECDOC SERIES

IAEA-TECDOC-1790

*Processing of Irradiated
Graphite to Meet Acceptance
Criteria for Waste Disposal*

Results of a Coordinated Research Project

In Publication

IAEA-TECDOC-1790

*Processing Technologies for
HLW, Formulation of Matrices
and Characterization of Waste
Forms*

New Proposal

IAEA-TECDOC-1790

*Long-lived Alpha Bearing Waste
Management – Characterization,
Processing & Storage*

New Proposal

IAEA-TECDOC-1790

*Standardised Framework for
DSRS borehole disposal*

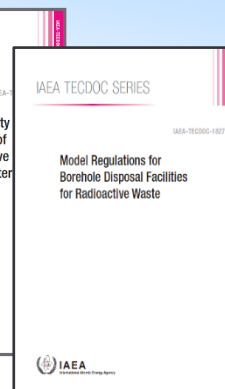
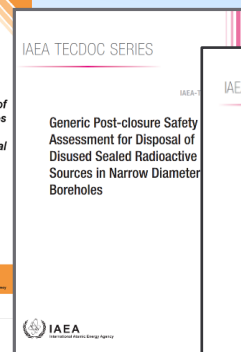
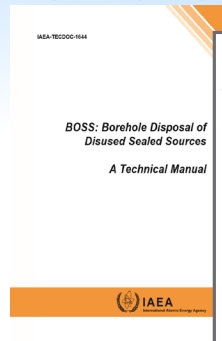
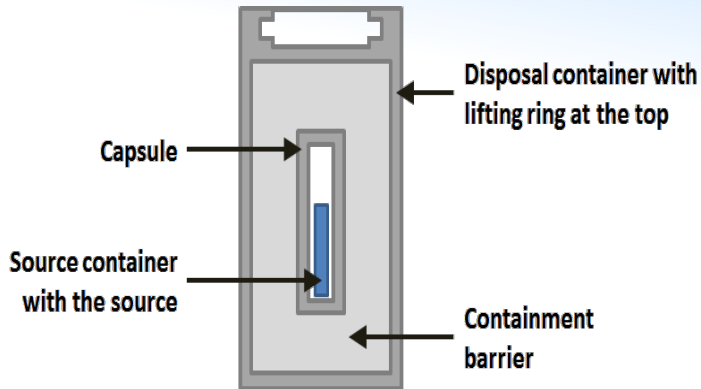
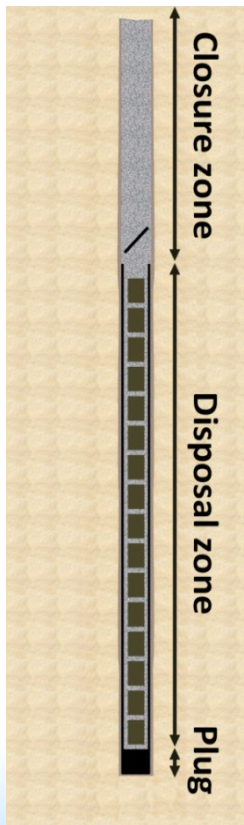
Results of a Coordinated Research Project

NEW

NEW



DSRS-inventories and the borehole disposal system



- Mobile Hot Cell – Mobile Tool Kit
- Capsules and Disposal Containers
- Detailed Design
- Generic Safety Assessment
- School of Drafting Regulations
- ...

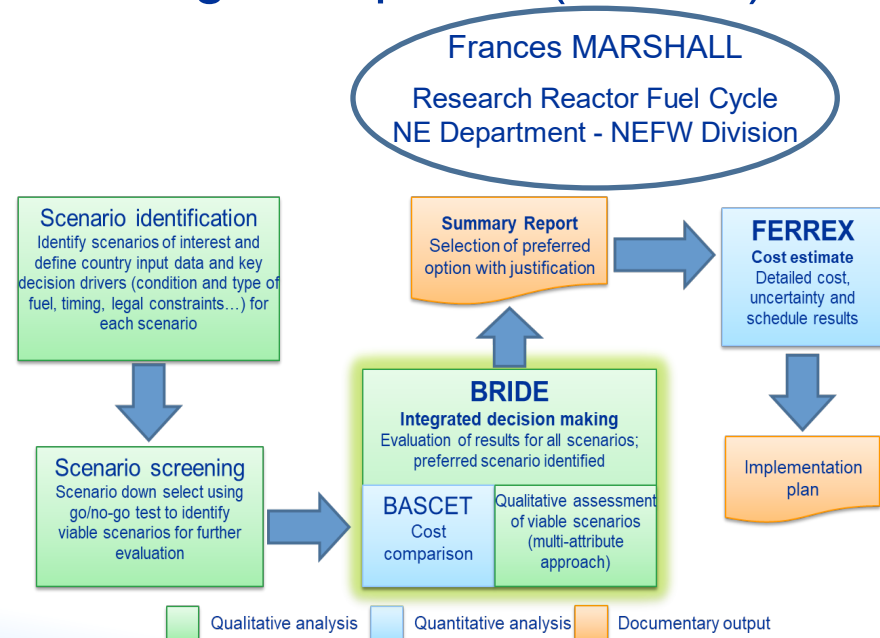
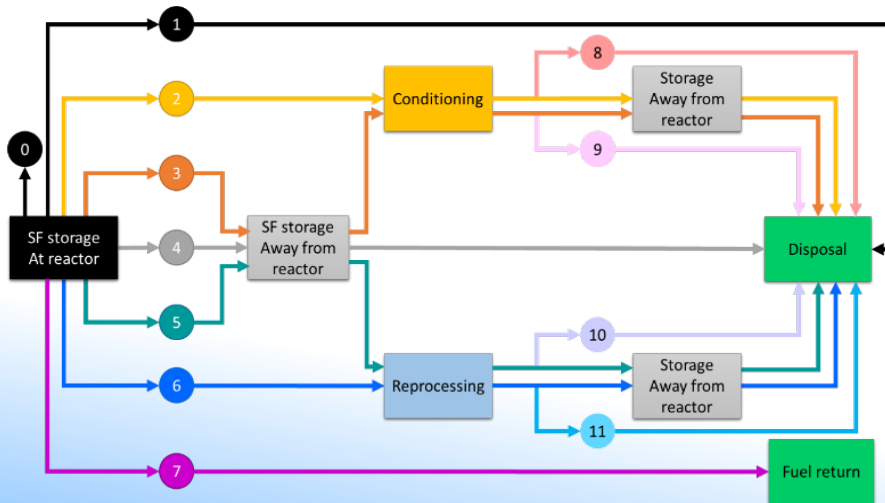


Many Member States' national inventory comprises "only" DSRS

CRP on RR - Spent Fuel Management

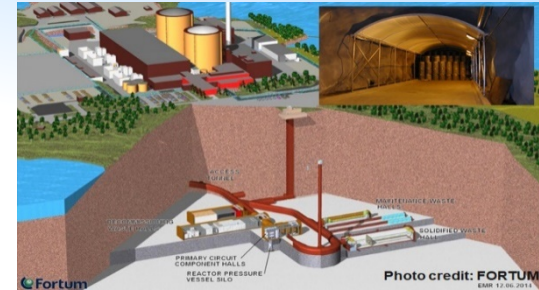
Raise Awareness among Member States about RR SNF Management Responsibilities

- Technology options for spent fuel management
- Decision support tool – Scenario from range of options (BRIDE)
- Cost estimation tool (FERREX)



Small inventories of ILW or HLW

Exploring a portfolio of disposal concepts that **show potential** of providing a safe and effective disposal solution for small waste inventories.

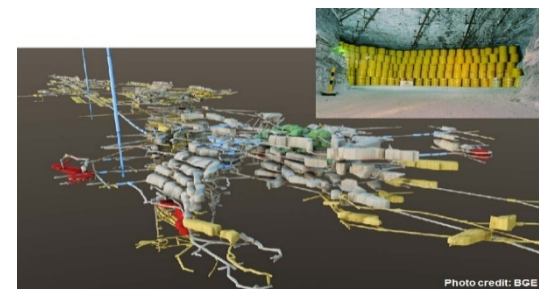
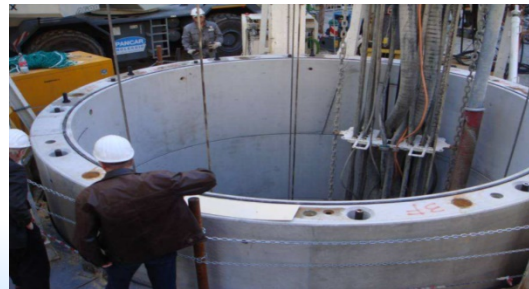
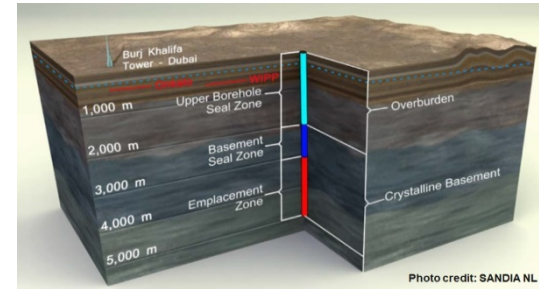
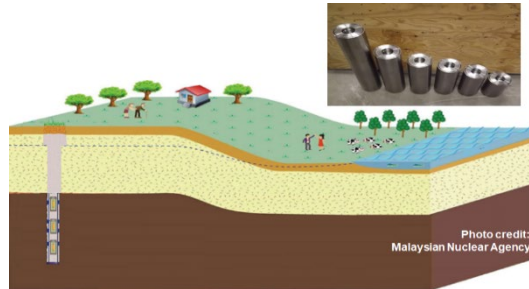


IAEA TECDOC SERIES

Disposal options for small radioactive waste inventories

DRAFT

Draft



Access to waste processing facilities

- Mobile Processing Systems

Key benefits:

- Lower capital cost
- Alternative to centralized facilities
- Easy replacement
- Shared use
- Useful for small volume streams
- Potential to cross borders
- Disposability
- Ability to schedule processing campaigns

Common uses:

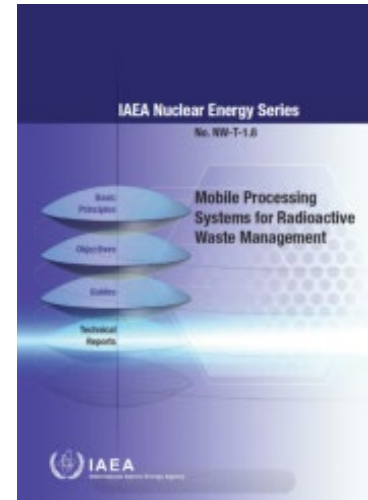
- Smaller volume, problematic waste streams
- Accident/urgent response situations
- Decommissioning & remediation



Unit for drying solids (IX resins, sludges, concentrates)



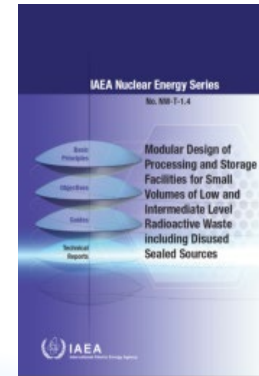
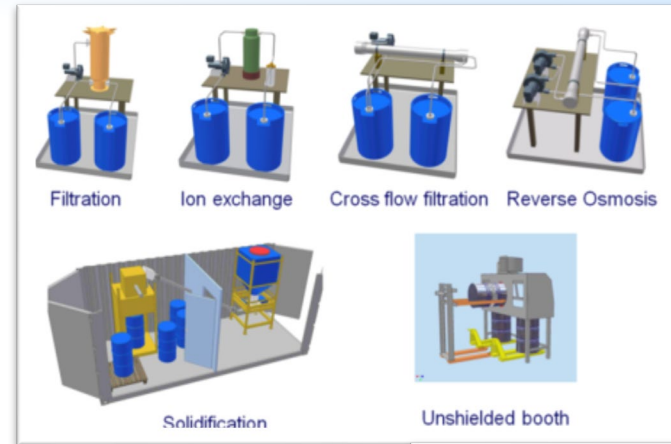
Mobile Supercompactor



Access to waste processing facilities

- Modular Designs for Small Volumes

- Ideal for small waste quantities
- Flexible size & configuration
- 11 pre-designed modules that can be assembled & factory-tested off-site before being transported to waste processing/storage site
- **Processing modules** available for:
 - High & low volumes of liquid waste
 - All types of solid waste:
 - compactable & non-compactable
 - Sludges, ion-exchange resins, DSRS
- Can be **combined** to form an integrated process scheme
- **Storage modules** are available for all types of LLW packages/DSRS and sizes of inventory



RWM Wiki

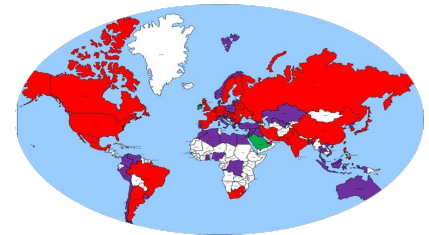
- Decommissioning wiki fully functional on IDN Network 
- Currently expanding wiki content to cover all of radioactive waste management
 - Predisposal
 - Disposal
 - Decommissioning
 - Environmental Remediation
- Type of content:
 - Facilities
 - Technologies
 - Lessons Learned
 - Good practices
 -



Tool-kit for predisposal

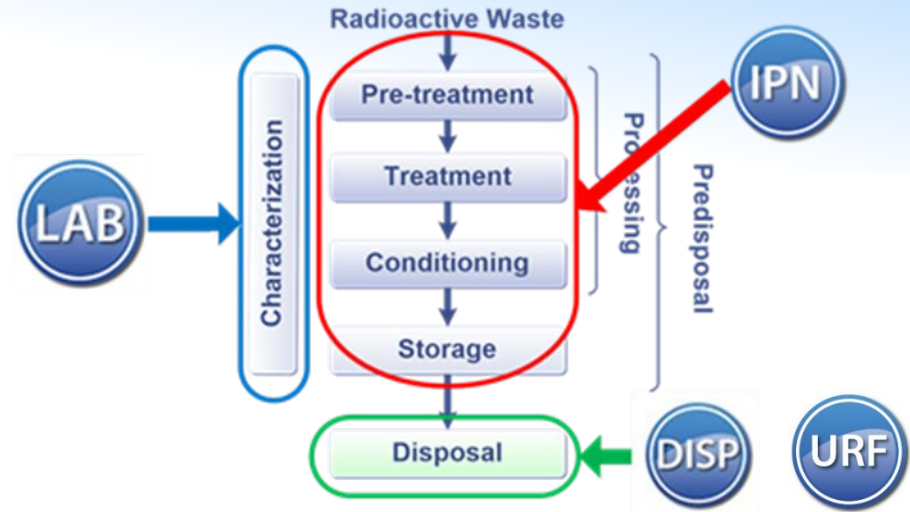


Technologies & Practices



Disposal Facilities World-wide

RWM Networks



Communities of practice

Guidance, Tools & future developments

Waste

DSRSs

RR SF

Generation

Synergies across organizations?

Processing

Storage

Transport

Disposal

Synergies across organizations?

- Pre-disposal technology handbook series
- Optioneering for RR-SF management
- Steps and components of a disposal program
- Integrated Waste Management Plans
- Strategies and tools for DSRS Management
- Cradle-to-grave strategies for small inventories
- Waste Inventory
- Waste Acceptance Criteria



Continuous Improvements – Gap Analysis – RD&D Needs

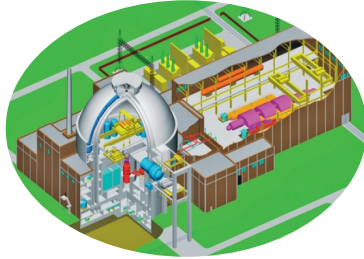
The future of RWM World-wide



- **Life-cycle radioactive waste management planning** begins **before** any waste is generated
- **Waste hierarchy principles** are adopted (avoid, minimize, recycle, reuse, dispose) to **minimize waste** going to disposal
- **End-of-life plans** are in place for all new sealed sources (i.e. recycle, return, disposal)
- All waste is **characterized** at the **point of generation**
- A **waste inventory** is created and tracked at all life-cycle stages
- **Fit-for-purpose** processing, storage and **disposal** solutions are selected and implemented in a timely manner
- Adequate **provision** is made for radioactive waste management **resources** at all stages – financial, technical and human

Future RWM responsibilities can be planned and provided for.

Management of Waste from Advanced Reactors & Fuel Cycles



SMRs

CAREM-25, HTR-PM, KLT-405, RITM-200, AHWR, NuScale, SMART, 4S, PRISM...



EVOLUTIONARY

ABWR, ACR 1000, AP1000, APWR, Atmea-1, CANDU 6, EPR, ESBWR, WWER 1200, CAP1400, APR1400, HPR1000...



INNOVATIVE

LFR, GFR, SFR, SCWR, VHTR, MSR, ADS

New initiative to develop IAEA guidance regarding radioactive waste management considerations during the design phase of new reactors, fuel types and advanced fuel cycles



IAEA

International Atomic Energy Agency

International Conference on the

Management of Spent Fuel from Nuclear Power Reactors 2019

Learning from the Past, Enabling the Future

24–28 June 2019
Vienna, Austria



Organized by the



#SFM19

CM-272

More information:

<https://www.iaea.org/events/management-of-spent-fuel-conference-2019>

The 43rd MRS Symposium on

Scientific Basis for Nuclear Waste Management

21–24 October 2019
Vienna International Centre



Symposium proceedings to be published by "MRS Advances" Special Volume Editors N.A. Smith and R.A. Robbins

Registration details and Call for Papers will be announced in early 2019

Organized by the



Advancing materials. Improving the quality of life.

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Atoms for Peace and Development

Thank you!

