

Steps to Sharing

Opportunities for Sharing in Radioactive Waste Management Programmes

An ERDO-WG Workshop hosted by the IAEA

IAEA, Vienna: 25th – 26th September 2019

Note of the Workshop

1 Introductory Sessions

The meeting was organised by the ERDO Working Group and hosted by the IAEA at its headquarters in Vienna. The Agenda for the meeting is provided as an Annex to this note. The meeting was attended by 26 participants, representing 14 countries, along with IAEA staff and members of the ERDO-WG secretariat. The numerous presentations made at the meeting will be uploaded to the ERDO-WG website www.erdo-wg.com.

In addition to representatives of ERDO-WG member countries (Austria, Croatia, Denmark, Italy, Netherlands, Norway and Slovenia) there were also participants from the Czech Republic, France, Greece, Hungary, Portugal, Romania and Slovakia.

The meeting began with overviews of the current landscape of multinational co-operation projects in radioactive waste management, with a focus on the needs of smaller nuclear power programmes and countries with small inventories of waste. Presentations were made by the IAEA and ERDO-WG representatives and included outlines of current European projects (within the EC EURAD framework) and wider, global initiatives (e.g., within IFNEC, IAEA/INPRO, WNA and US organisations such as NTI, CSIS and AAAS).

The workshop then began to focus on opportunities for sharing, beginning with a generic overview of the areas and types of co-operation that might be possible and how they might work. The sharing areas identified were:

- R&D on procedures for waste management
- Services and equipment
- Training and knowledge management, including staff exchange
- Transfer of knowledge, competence and technology
- Stakeholder engagement experience
- Costing and funding mechanisms

The benefits are in improved safety and security, stronger economic basis, reduction of environmental burdens and common planning approaches and levels of competence and expertise.

As well as involvement in international projects and discussions (such as those organised by IAEA, EU, NEA, EDRAM etc), the means of co-operation identified were commercial (between licensees), bilateral agreements, joint financing and leasing of services, and direct interaction between specialists and competent authorities.

Joint studies are possible on technologies and methods, implementation and stakeholder engagement strategies, regulatory requirements and shared facilities (fixed or mobile, that can be deployed at multiple sites).

Sharing opportunities include:

- solutions to technical problems of siting, design, technology and equipment for disposal facilities
- staff exchanges

- shared pre-disposal facilities
- moving progressively to shared disposal in small but concrete steps by sharing facilities
- deep borehole disposal
- public procurement directive 2014/24/EU (Article 39) allows joint procurement between countries and authorities

2 Specific Ideas for Sharing

Specific ideas for shared projects had been suggested by the ERDO-WG in advance of the meeting, with a questionnaire circulated to solicit participant views in advance of the workshop. The outcome is given below, with some of the comments received from participants listed as sub-bullets. Extended feed-back sheets requesting participants to rate the importance of the numerous suggested project ideas were distributed at the start of the meeting and a number were returned. This will enable the ERDO-WG to complement the 11 prior returns that led to the analysis presented below.

The highest priority was given to:

- Sharing knowledge/competences
 - Important step to be considered before future steps on facilities sharing.
 - Crucial to safe handling of RW in longer perspective.
 - Especially education of young colleagues and cooperation on specific topics.
 - Important to coordinate and ensure synergy with other initiatives, such as knowledge management projects in EURAD, IAEA and NEA initiatives.
- Strategic technical and non-technical cooperation
 - Use already existing experience for extending strategic cooperation.
 - Can be useful for education of young colleagues and cooperation on e.g. public and political acceptance.
 - There is a lot of interest in this area – can we define two pilot projects of mutual interest? E.g. one technical and one non-technical.
- Disposal costing and financing approaches
 - Very important for decision makers in MS. SIMs need commensurate solutions that they can pay.
 - Very interesting for RWM programs and future R&D.
 - Disposal costing often difficult to assess – decision makers interested in as precise figures as possible.
- Borehole disposal – intermediate and deep
 - No current priority for Italian RW (sources etc.) but of interest considering the not too large ILW-HLW inventory.
 - From the point of view of development of regional (e.g. states of former Yugoslavia, Caucasian states etc.) DSRS disposal.
 - Strong interest, ongoing work on IAEA CRP on borehole disposal.
 - Very interesting for small amounts. Research needed.
 - Deep borehole disposal could be an alternative to geological disposal of CANDU SF and might be suitable for RR SF.
 - Currently not a priority, but has great potential as a technology that can be used in the future.
 - Could be relevant for smaller fractions, primarily spent research fuel.

Also of high priority were:

- Shared access to treatment/conditioning facilities
 - Desirable step in framework of EU MS collaboration on RWM
 - Not only for HLW
 - Possible difficulties in characterization/WAC, capacity, transportation, avoidance of relevant cross contamination, avoiding of mixing of waste from different producers.
 - Potentially useful for all countries with small inventory to reduce overall predisposal and disposal costs. Regional orientation to ensure cost-benefit.
 - Good economic reasons – RW technology and equipment often very expensive.
 - Possible savings compared to commercial solutions.
 - Important to be aware of mentioned challenges.
- Harmonization of waste characterization
 - And also of WAC.
 - A subject of many international programmes and activities, also under auspices of IAEA (Labonet).
 - Very important for sharing of facilities. Cost of techniques should be considered.
 - Essential if end point is shared repositories where each organization has to meet same WAC.

Lower priority was given to:

- Jointly financed RWM entity
 - Of benefit for countries with small amounts of RW and limited resources, knowledge and competences.
 - Difficulties for joining – could be of legal, political and economic character.
 - Difficult to co-finance supplementary to national entity.
 - Too early. Activities can be coordinated within ERDO-WG.
 - An intellectual or waste handling entity?
 - Pooling competences could be a long-term benefit.
- Disposal of RR fuel (because few of the participants had RR problems)
 - Most RR SF to be returned to country of origin.
 - Most of RR SF from former socialist states returned to Russian Federation.
 - Very important for some countries.
 - Many smaller countries have had some sort of return agreements. For countries like DK with a small amount of SF not covered by agreements, it could be interesting.
- Joint procurement of services/facilities
 - Difficult, different budget of each user, different options.
 - Very dependent on national legislation.
 - Could be very important for Croatia and Slovenia due to joint NPP and obligations regarding decommissioning and SF/RW management.
 - Possible alternative: one country purchasing, selling services to other countries.

The reason why a jointly financed RWM entity scored low was discussed. It was appreciated that this would be a major step, and it certainly does remain the longer-term objective; indeed, many countries currently have a dual-track approach. However it is recognised that getting to a formalised MNA needs to begin with easier sharing steps. It is acknowledged that it is most logical that we start with sharing in the pre-disposal area: for example, because some services are commercially available but would be more economic if shared instead. Participants recognised that pre-disposal is a promising way to 'socialise' sharing by getting organisations and individual working closely together in a way that will eventually lead to shared disposal.

Participants also made additional suggestions for projects or studies that could be valuable:

- Stakeholder engagement (It).
- Shared access to interim storage facilities (It).
- Shared guidelines on disposability assessment and WAC (It).
- Shared treatment/conditioning facilities for challenging ILW streams (It).
- Availability of suitable geological formations within Eu related to ERDO mission (It).
- Safety assessment methodology (Hu).
- Harmonization of concept of site selection process (Hu).
- Concept for record keeping of the information gained during site selection.
- Evaluation of possibility to develop uniform waste package type (Hu).
- Shared management of RW and SF, including disposal, as the political concern (SK).
- Waste packaging and sorting in different fractions (DK).
- Volume reduction (DK).

3 Sharing in Pre-Disposal Topics

The wide range of IAEA work on pre-disposal was described.

IAEA's working definition of small inventories includes those with only MIR wastes (IAEA Groups C, D and E), or with MIR and one or few NPPs (IAEA Group B): but there is no universally accepted definition. Example countries vary from those that are just collecting and storing wastes but have no disposal or treatment facilities, to those with treatment facilities, LLW disposal facilities and decommissioning programmes.

Problems are often lack of policy, no end point goals, lack of human resources, insufficient financial resources, no WAC, no proper inventory etc. This often leads to lack of RWM activity and frozen programmes. In order to make progress, ideally a full life cycle RWM plan is needed at the earliest stage possible.

The vision for stabilising situations where the problems listed above pertain is that an early objective should be that all wastes can be moved to passively safe storage in a form that is flexible enough for disposal in a range of likely options.

Opportunities for cooperation that the IAEA has identified include:

- Development of WAC.
- Comparison and benchmarking of existing WAC.
- Carrying out disposability assessments and approaches for moving from storage in the absence of WAC (i.e. no defined disposal concept/facility).
- Sharing good practices and lessons learned on inventory and WAC.
- Waste characterisation methodology
- Methods and techniques to establish an inventory.
- Technologies for clearance and exemption.

- Characterisation to meet WAC.
- Compilation of characterisation services that can be offered.

There are numerous examples where the IAEA has supported the development of technical concepts and facilities, some of which have multinational uses and many of which are benchmarks for facilities that could be developed in a shared context.

Examples include work on providing a procedure for deciding on which of a range of standardised modular packaging designs can be used for small inventories and work on mobile hot cell services (for DRSR in Africa).

Opportunities exist to take this further:

- Mapping available processing facilities in Europe.
- Using available facilities to manage peaks and troughs.
- Developing reference technical specifications.
- Regional processing hubs (e.g. DSRS dismantlement).
- Producing a catalogue of qualified services.
- Establishment a set of reference designs.
- Producing a vendor database.
- Mobile hot cell.

These important topics identified by the IAEA are parallel to those that have been discussed in ERDO over the last few years.

The ROUTES work package within EURAD was described. It will involve collection and cataloguing of EU experiences in, and needs for, sharing and will not involve significant new research work. Task 6 of the ROUTES WP includes work that will (a) summarise the knowledge on and approaches to sharing technology and facilities between member states, (b) prepare a general description of experience with sharing (one or more cases) and the lessons learned, (c) prepare a viability matrix identifying waste processing steps and streams against technologies, (d) perform a gap analysis on the interests and needs of member states to share technologies and facilities, (e) compare and assess possible approaches to and structures for sharing technologies and facilities. Finally, it will define the needs for R&D, identify strategic priorities and opportunities for collaboration and undertake a value assessment of key opportunities for sharing.

Several country-specific presentations identified national views on topics for sharing. The Italian suggestions include establishing a common set of waste package characterisation data, WAC and generic disposability assessments, standards for treatment and conditioning of similar waste streams, in view of possible future shared WM activities. Fostering the use of common WM facilities to avoid duplication, and of common interim storage facilities could also be of interest.

Croatia looked at the joint procurement of services and facilities and described the experiences of ARAO and Fond in successfully forming an agreement for joint procurement of two background studies within the framework of the EC Procurement Directive. Each country procured one of the shared studies.

Greece raised the question of how shared projects could be organised/supported. The ROUTES WP covers part of it: IAEA has an operational framework. Are there other mechanisms? A network of SIMS might be useful. A feasibility study, possibly by each participant in a project, could look at the possibility of shared waste treatment and processing facilities, costing etc.

3.1 Session 3: Discussion on possible pre-disposal project topics

A specific proposal (PD1) to look at common characterisation methods for legacy wastes was supported by Denmark, Italy, Norway, Netherlands and Greece. The IAEA would be interested in this and has no significant ongoing work at present that would overlap. It would be useful to link this to development of a common WAC approach and a set of generic

disposability assessments. Much work can be done through advance discussions of what information is already available or 'discoverable' prior to, and to help bound, such a project.

A further proposal (PD2) aimed at cataloguing of available facilities for treatment and conditioning was also discussed.

Potential participants in developing further these proposals were discussed in Session VI of the Workshop, as described in Section 6 below.

4 Session 4: Borehole Disposal

Presentations were made on the current international status of borehole disposal, including R&D and concept development on deep (several kilometres) borehole disposal (DBD) and the IAEA-supported work on intermediate depth (100-200 m) disposal of DSRS. The IAEA has launched a CRP on BD this year and will have meetings in 2020, 21 and 22 focussing on aspects of technology, safety assessment and siting BD facilities.

A suggestion was made for possible shared projects on:

- Concept development for a borehole facility that handles all higher activity wastes at different depths, including large packages (c.f. current studies in Australia).
- Costs study for disposal of complete small NPP-SF inventories of higher activity wastes in a DBD facility.
- Evaluation of RR-SF performance under DBD conditions and options for packaging RR-SF for DBD.

This was refined into a suggested project (BD1) that would use country-specific data to:

- Identify design and operating concepts of BD facilities that would suit national inventories:
 - Develop country-specific scenarios for how BD might be implemented.
- Assess strategic implications of incorporating BD into national disposal planning.
 - Identify what other facilities would be needed in national strategy.
 - Consider how inclusion of BD might affect timing of storage and disposal planning:
- Assess cost implications of using BD.
 - Evaluate the strategic and design scenarios developed above.

Norway is interested in assessing how its extensive offshore industry could help in BD. They would like to see some results of any BD assessment project by 2021. Greece intends to have landfill and borehole, but doesn't have a chosen concept at present. Slovenia wishes to evaluate BD as a potential component of future RWM strategy. Danish policy states that all waste should go into a DGR but acknowledges that different solutions could be used for different fractions of the inventory: e.g., RR-SF might be considered for DBD. In the Netherlands, BD is not an option but they need to answer questions as to whether it could be used, so they have an interest. Croatia does not foresee BD in its national programme but is interested in its potential, particularly for DSRS. Slovakia, Austria and the Czech Republic would also be interested in a high-level study.

A high-level project such as outlined could be interfaced with the IAEA CRP and participants could be invited to CRP meetings. The input of real inventory and, possibly, geological data would be really useful and move forward from most studies, which are purely generic.

The potentially interested countries are: SLO, N, GR, NL, DK, CRO, CZ, SK, A.

5 Session V: Shared costing and financing experience

Presentations were made on the background to cost estimation, with a focus on geological disposal costs, on the specific situation of costing and funding mechanisms in Croatia, the Netherlands, Denmark and Norway, and on experience with considering financing

mechanisms for MNA facilities. Participants were also made aware off the draft IAEA guidance on costing of disposal and a copy was distributed electronically.

An outline costing-financing project proposal (CF1) was presented for discussion, involving the following four main elements:

1. Collect and review national cost and financing data.
2. Review cost estimates of MNA storage and disposal.
3. Assess specific savings by sharing facilities of all kinds.
4. Formulate specific organisational proposals for co-funded implementation projects in any agreed areas.

Interest in such a project was expressed by Slovenia and Croatia, with the additional proposal that, under item (1), a comparison should be made of costing methodologies and underlying assumptions used by national programmes (e.g., each country includes different items under similar headings). The last item is of less interest and may be too ambitious.

Other interested countries are GR, NL, SK, A, CZ and DK.

6 Session VI: Organisational Concepts for Projects

Four potential projects were identified and had significant support from participants, who were invited to volunteer to be involved in the preparation of more extensive project proposals setting out the work scope, the schedule and the resources required. The possible ways of structuring, managing and financing the projects were discussed. For each project it was decided to form a core group that would be responsible for drafting a first fuller proposal that would then be circulated for review and comment by all potential participants.

6.1 Pre-disposal 1 (PD1)

Interested participants were confirmed as: Denmark, Italy, Norway, Netherlands, Greece, Portugal, Austria, Slovenia and Croatia.

Proposed core group: Italy (leader), Denmark and the Netherlands. The appropriate IAEA liaison was identified.

Legacy wastes: linking characterisation to WAC to achieve disposability. Project would gather data on each nation's legacy waste and the options that they have for disposal, then consider WAC (related to disposability). Italy developed a list of objectives and deliverables that met with broad agreement. The milestones proposed are:

1. List main legacy wastes in each country
2. Collect existing characterisation data
3. Qualitative survey of WACs of operating repositories (possible connection with ROUTES)
4. Survey of disposability assessments for GDF reference projects and WACs
5. Establish minimum set of characterisation data to be compared with WACs
6. Suggest possible solutions for deriving missing characterisation data

Greece wanted to go further and look at technologies and approaches for characterisation. This could be included in the final objective.

6.2 Pre-disposal 2 (PD2)

Interested participants were confirmed as: Denmark, Italy, Norway, the Netherlands, Greece, Portugal, Slovakia, Austria, Slovenia and Croatia.

However, a proposed core group and leader with sufficient in-house resources to progress the proposal could not be identified, so it was decided not to pursue this project further for the time being.

The project would comprise a survey of available and potentially available waste treatment and processing facilities and their capacity, which have a potential for sharing (both Europe and globally). It was noted that a recent survey carried out for the EC had shown that all EU countries only had storage capacity for their own needs, plus a flexibility margin. It was therefore decided to remove storage capacity and facilities from the original proposal.

6.3 Borehole Disposal (BD)

Interested participants were confirmed as: Denmark, Norway, the Netherlands, Greece, Austria, Portugal, Czech Republic (to be confirmed), Slovenia and Croatia. (Slovakia was removed from the original list, but Javys has some interest in its relevance to its Caucasian countries regional project).

Proposed core group: Norway (leader), Czech Republic (if confirmed) and the Netherlands. The appropriate IAEA liaison was identified.

The project would also need to consider impacts of using BD solutions on conditioning requirements and planning of each programme. IAEA will send a list of what the outputs of the CRP are planned to be, technically.

6.4 Costing and Financing (CF)

Interested participants were confirmed as: Denmark, Netherlands, Greece, Austria, Czech Republic (to be confirmed), Slovakia, Slovenia and Croatia.

Proposed core group: Slovenia (leader) and Croatia. The appropriate IAEA liaison was identified.

6.5 Project framework and organisation

Three projects were thus taken forward from this meeting. The key topics to be decided by the project core groups are:

- The appropriate management framework: simple models for joint projects.
- The most suitable time schedules.
- The practical deliverables.
- How to develop the project specifications.
- The resources that will be needed and where they will come from.
- How projects will be financed.
- Ensuring effective interface with ongoing work in IAEA and/or EURAD.

Projects should be relatively small, run by in-kind contributions mainly, and run on short timescales of one or two years, with clear deliverables. Specifications and terms of reference should be produced before the next ERDO-WG meeting. Core groups should send out first drafts to other participating countries by November 1st, with the intention of getting initial feedback, so that the specifications can be discussed at the November 20th – 21st ERDO-WG meeting in Croatia.

Taking part in developing the project proposal does not involve a commitment to become a project partner. It was emphasised that participation in the projects was not dependent on countries being members of the ERDO-WG and that project participants are organisations (rather than countries), are not restricted to WMOs and may ultimately include organisations not represented in the present Workshop. It was agreed to discuss at the November ERDO-WG how WG Members and also non-ERDO members should provide In-kind and/or financial contributions to participate in the projects.

7 Close

The meeting closed with thanks to the IAEA for hosting the meeting and providing an excellent environment for the discussions.

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Wednesday 25 th September		
0900 - 0920	Opening: welcome and aims <ul style="list-style-type: none"> • Round table introductions 	Stefan Mayer Ewoud Verhoef
Session I: Background: Overviews:		
0920 - 1040 (4*20min)	Summary of past and current Cooperation Projects <ul style="list-style-type: none"> • MNA and small inventory activities at the IAEA • MNA in Europe: SAPIERR and ERDO-WG • Current developments in EC EURAD ROUTES project • Global MNA interest and activities 	Stefan Mayer Ewoud Verhoef Ole Kastbjerg Nielsen Charles McCombie
1040 - 1110	Overview: Opportunities for Sharing <ul style="list-style-type: none"> • Sharing knowledge, facility designs; technologies • Exchanging staff • Sharing pre-disposal facilities • Moving towards shared disposal • Short intro of Sessions III – V 	Leon Kegel
1110 - 1140	Coffee	
Session II: Opportunities for Sharing in RWM		
1140 - 1200	Overview of currently suggested Potential Projects <ul style="list-style-type: none"> • Suggestions circulated in Invitation • Responses in Feedback Forms 	
1200 - 1330	Lunch	
Session III: Sharing pre-disposal capabilities		
1330-1500	Potential scope of pre-disposal projects Introduction of topics and review of existing experience in sharing, including IAEA International Predisposal Network: <ul style="list-style-type: none"> • Sharing of knowledge and competences • Strategic cooperation: technical and non-technical • Shared access to treatment/conditioning facilities • Harmonization of waste characterizations etc. • Participant suggestions 	Ole Kastbjerg Nielsen Rebecca Robbins Marja Vuorio Short presentations from participants
1500 -1600	Discussion <ul style="list-style-type: none"> • Comments • Additional ideas • Priorities of participants 	
Session IV: Deep Borehole Disposal (DBD)		
1600 - 1700	Status and potential applications of DBD <ul style="list-style-type: none"> • Overview of DBD status • Inventories and packaged materials suDBD: potential DBD user scenarios • The IAEA Borehole CRP 	Neil Chapman and Philippe van Marcke

Thursday 26th September

Session IV (continued): Deep Borehole Disposal

0900 - 0930	<p>Potential scope of deep borehole disposal projects</p> <ul style="list-style-type: none"> • Costs study for BD of a small inventory • Borehole disposal of research reactor fuel 	<p>Neil Chapman and Philippe van Marcke</p>
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Session V: Sharing costing and Financing Experience

0930 - 1045	<p>Costing and funding of RWM programmes: CFP</p> <ul style="list-style-type: none"> • Overview of work to date • IAEA Guidance specific to disposal • Comments from small NP programmes – Slovenia, Netherlands • Comments from non-NP nations – Denmark, Norway 	<p>Charles McCombie Philippe VanMarcke Leon Kegel Ewoud Verhoef Ole Kastbjerg Pal Mikkelsen</p>
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1045 - 1115	Coffee	
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1115 - 1145	<p>Models for a financing an MNR</p> <ul style="list-style-type: none"> • Sharing options • Service provider options (IFNEC study) 	<p>Neil Chapman Charles McCombie</p>
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1145 - 1215	<p>Potential scope of a project on costing and funding of RWM programmes: CFP</p> <ul style="list-style-type: none"> • Project outline • Open discussion 	<p>Charles McCombie Participants</p>
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1215 - 1345	Lunch	
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Session VI: Discussion on Potential Organisational Concepts

Interested parties; relationships with on-going work; possible project structures

1345 - 1420	Pre-Disposal Cooperation	Ole Kastbjerg
1420 - 1445	Deep Borehole Cooperation	Neil Chapman
1445 - 1510	Cost Studies Cooperation	Charles McCombie
1510 - 1545	Coffee	
1545-1630	Case for establishment of a European entity to procure RWM services for its members	Neil Chapman
1630 - 1700	Summary of Workshop and Forward Actions	Ewoud Verhoef
1700	Close	Stefan Mayer