

**SHARED SOLUTIONS FOR SPENT FUEL
AND RADIOACTIVE WASTES**
responding to EC Directive 2011/70/EURATOM



Summary

This document is intended to assist Member States interested in the possibility of sharing radioactive waste management solutions in meeting the requirements of European Directive 2011/70/EURATOM.

All European countries are responsible for managing their own radioactive wastes, whether these arise from nuclear power production or in the course of industrial, medical and research activities. There is increasing pressure on all countries from international instruments such as the IAEA Joint Convention and the 2011 EU Spent Fuel and Radioactive Waste Directive to develop a credible strategy that shows how these wastes can be safely managed, from their production through to their final disposal. A credible waste management strategy requires comprehensive planning, sufficient financial and personnel resources, and a competent management organization.

By collaborating in a shared, multinational European Repository Development Organisation, EU Member States will gain the following benefits:

- an efficient and cost effective solution that will demonstrate to the public and other EU governments that their obligations under international agreements are being transparently fulfilled
- strengthened national capabilities, through access to extensive know-how, information and data essential for the planning of a national or multinational waste management strategy, including both storage and disposal activities
- short term and long term financial requirements that are significantly lower than those associated with developing a purely national solution
- co-ownership of a small but effective waste management organization that will interact on an equal basis with the national waste management organisations of countries with large nuclear programmes and will have equal weight when dealing with international organizations

1 Objective

- 1.1 All European countries are responsible for managing their own radioactive wastes, whether these arise from nuclear power production or from other nuclear activities. This responsibility is clearly stated in European Directive 2011/70/EURATOM, which stipulates that every country must have an operational strategy and programme leading to a final disposal solution for its wastes.
- 1.2 The amounts of radioactive wastes from nuclear power and industrial, medical and research activities are comparatively small, but no country in the world has yet implemented a comprehensive disposal solution for all of its national waste arisings. Although many countries have operating disposal solutions for the least radioactive wastes that they produce, the problem lies with getting facilities into operation for the storage and disposal of the higher activity and longer-lived wastes. For such wastes, it is accepted in the EU and worldwide that deep underground disposal in a geological disposal facility (GDF) or repository is the most appropriate solution.
- 1.3 After more than 30 years of research and development on geological disposal in Europe, only a few of the EU's major nuclear power nations are at an advanced stage of developing GDFs and the most advanced programmes (in Finland, France and Sweden) will have operational geological disposal facilities by around 2020-2025. Each of these countries has decided that these facilities will only be used for their own national radioactive waste arisings.
- 1.4 Over the last decade, research and feasibility studies supported by the European Commission have explored the practicalities and implications of countries with smaller waste inventories sharing some elements of their radioactive waste management strategies – specifically, sharing one or more GDFs sited within the interested Member States, rather than each developing its own facilities¹.
- 1.5 In early 2009, these studies culminated in the formation of the European Repository Development Organisation (ERDO) Working Group, with representatives nominated by the governments of ten countries working together to establish the basis for a commonly owned, not-for-profit organisation that could develop and implement shared solutions. The ERDO-WG has now completed the first stage of this work, producing a model structure and plan for the ERDO.
- 1.6 The second part of the ERDO-WG's tasks is to present its model structure and plan for the ERDO to the governments of potentially interested Member States in order to establish which countries now wish to go ahead with the formal establishment of a jointly owned ERDO.
- 1.7 Establishing the ERDO, with a clear development plan and associated work schedule, would fulfil part of the requirements placed on its owner countries by EU Council Directive 2011/70/EURATOM. The other associated element of these requirements is that a shared solution should not be pursued on its own; it should lie within the framework of a national plan and programme in each country. This approach has become known as a "dual track" approach.

¹ The reports of the SAPIERR I and SAPIERR II projects provide detailed analyses of the technical, legal, economic and societal aspects of shared European disposal and are available at: www.erdo-wg.eu

1.8 This document is thus intended:

- to indicate how the dual track approach can help Member States to respond to the European Directive in a co-ordinated manner;
- to point out the benefits and also the commitments that are associated with a decision to enter into a partnership;
- to assist Member States, in particular those with limited inventories of long-lived radioactive wastes, in moving forward with decisions about whether to come together to establish the ERDO.

2 The 2011 EU Council Directive

- 2.1 The European Union Council Directive 2011/70/EURATOM establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste came into force on 23rd August 2011 and placed a number of requirements and obligations upon Member States, aimed at ensuring that each of them has a practical and operational programme for managing their radioactive wastes, up to and including final disposal. The Directive requires that Member States bring into force the laws, regulations and administrative provisions necessary to comply with it by 23rd August 2013 and notify the Commission, for the first time, of the contents of their programmes two years later, by 23rd August 2015.
- 2.2 In this section, the intention is not to repeat the text of the Directive, but to draw attention to those elements that are relevant to the implementation of shared EU radioactive waste management solutions through the establishment of the ERDO. Within this context, key background aspects raised in the preamble to the Directive are that:
- Radioactive waste, including spent fuel considered as waste, requires containment and isolation from humans and the living environment over the long term. Its specific nature, namely that it contains radionuclides, requires arrangements to protect human health and the environment against dangers arising from ionising radiation, including disposal in appropriate facilities as the end location point. The storage of radioactive waste, including long-term storage, is an interim solution, but not an alternative to disposal.
 - It is broadly accepted at the technical level that, at this time, deep geological disposal represents the safest and most sustainable option as the end point of the management of high-level waste and spent fuel considered as waste. Member States, while retaining responsibility for their respective policies in respect of the management of their spent fuel and low, intermediate or high-level radioactive waste, should include planning and implementation of disposal options in their national policies.
 - It should be an ethical obligation of each Member State to avoid any undue burden on future generations in respect of spent fuel and radioactive waste, including any radioactive wastes expected from decommissioning of existing nuclear installations. Through the implementation of the provisions of this Directive, Member States will have demonstrated that they have taken reasonable steps to ensure that that objective is met.
 - The ultimate responsibility of Member States for the safety of spent fuel and radioactive waste management is a fundamental principle reaffirmed by the IAEA Joint Convention.
- 2.3 The core provision of the Directive with respect to national responsibilities in radioactive waste management is stated in the preamble (and elaborated in Articles 4 and 5) as follows:
- Member States should establish national programmes to ensure the transposition of political decisions into clear provisions for the timely implementation of all steps of spent fuel and radioactive waste management from generation to disposal. It should be possible for such national programmes to be in the form of a single

reference document or a set of documents.

2.4 The preamble then acknowledges that:

- Some Member States consider that the sharing of facilities for spent fuel and radioactive waste management, including disposal facilities, is a potentially beneficial, safe and cost-effective option when based on an agreement between Member States concerned.

2.5 In Article 4 (General principles) of the Directive, this translates into the following legal requirements:

- Radioactive waste shall be disposed of in the Member State in which it was generated, unless at the time of shipment an agreement, taking into account the criteria established by the Commission in accordance with Article 16(2) of Directive 2006/117/Euratom, has entered into force between the Member State concerned and another Member State or a third country to use a disposal facility in one of them.
- Prior to the shipment to a third country, the exporting Member State shall take reasonable measures to be assured that:
 - o the country of destination has radioactive waste management and disposal programmes with objectives equivalent to those established by this Directive;
 - o the disposal facility in the country of destination is authorised for the radioactive waste to be shipped, is operating prior to the shipment, and is managed in accordance with the requirements set under the radioactive waste management and disposal programmes.

2.6 In summary, and in the context of this document, the Directive thus requires each Member State to have a clearly defined and operational radioactive waste management programme (placing a range of specific requirements upon elements of that programme, its operation and the maintenance and development of the necessary expertise and skills) and acknowledges that while each Member State is responsible for organising safe disposal of its radioactive wastes, this need not be done within the State - shared disposal of wastes can be a part of a national programme.

3 The Dual-Track Approach

- 3.1 Throughout the formative studies that have led up to the present ERDO initiative, it has been clearly recognised that the possibility of a shared GDF being developed in one country should not remove the obligation of potential user countries to consider potential solutions of their own. Past experience shows that, in every national programme, the route to an operational GDF is long and beset with uncertainties, and any specific initiative could end in failure. The same must be acknowledged for a shared GDF. Consequently, Member States interested in sharing need to explore national solutions in parallel to supporting a shared solution. This has become known as the 'dual-track approach' and, *although it is not a specific requirement of the Directive*, it is considered to be a necessary feature to underpin the credibility of the ERDO model.
- 3.2 Running a national R&D programme on geological disposal as part of a dual-track approach not only ensures that a national alternative might be available should sharing fail, but also provides a solid basis of competence and knowledge for each country that is involved in a sharing project. In a well-organised partnership, moreover, sharing expertise and knowledge can significantly reduce the resources required by each country.
- 3.3 It is apparent that some Member States with very small amounts (e.g. a few cubic metres or a few tens of tonnes) of waste for which geological disposal is the only solution, cannot support a comprehensive GDF programme themselves. Such countries, without nuclear power and its associated infrastructure and knowledge base, will find it extremely difficult to develop all the components of a GDF programme. Economic considerations must also come into play in such cases, even though they cannot override safety requirements or legal obligations. The dual-track approach must thus be able to accommodate participating countries with very different nuclear infrastructures and radioactive waste inventories.
- 3.4 The **international** benefits of being part of a shared programme can be summarised as follows:
- increased national visibility and influence in addressing a widely acknowledged issue of global environmental protection and nuclear security;
 - contributing to Europe-wide investment savings of several billions of EUR;
 - increased influence in European and international agencies dealing with nuclear energy and nuclear safety;
 - increased influence on suppliers of nuclear technologies and fuels.
- 3.5 The **national** benefits of being part of a shared programme can be summarised as follows:
- clear demonstration of a credible approach to responsible management of national radioactive wastes;
 - a reduced R&D burden;
 - increased, pooled resources to develop a realistic and timely solution;

- large economic incentives and infrastructure improvements to the host country;
 - access to wider skills and technology.
- 3.6 The local benefits of being part of a shared programme can be summarised as follows:
- involvement in modern, stakeholder-led approaches to solving environmental problems;
 - increased influence of local host communities in national environmental decision-making;
 - large economic and infrastructure benefits to the host communities, both today and for many decades to come
- 3.7 It is clear that the requirements of the Directive will not be met by simply including a conceptual objective of eventual shared disposal into a national programme: a concrete and feasible way forward is required and this is provided by the proposed establishment of the ERDO.
- 3.8 The principles of the dual-track approach are thus partly ethical (related to equity and societal obligations) and partly practical. They can be stated as follows, in reference to membership of the ERDO:
1. Participating countries should develop, maintain and promote knowledge and expertise in the safe management of radioactive wastes: this is, in any case, a requirement of both the Directive and the Joint Convention and translates into the existence of competent bodies in each Member State.
 2. The minimum level of activity required of participating countries is that they maintain a credible capacity to act as 'intelligent clients' of a shared solution: this means that they must maintain a continuing national expertise in some aspects of geological disposal, including supporting a minimum level of academic or institutional research.
 3. Participating countries with wastes from nuclear electricity generation programmes are expected to have an active parallel national GDF programme on their own territory and are expected to operate this programme in an interactive and complementary manner to the ERDO programme.
 4. All participating countries will thus contribute in varying measure to shared knowledge and will receive the benefit of shared R&D and technology development for all aspects of their national radioactive waste management programmes.

4 The Sensitive Issues of Siting

Siting the repository

- 4.1 The most commonly posed question when the issue of shared repositories is raised is *"which country will be the host?"* The ERDO-WG has considered this question and some of the key conclusions reached are summarised here.
- 4.2 Initiatives aimed at developing regional, multinational waste disposal facilities have been criticised as not being credible until such time as a country agrees to host one. In practice, multinational siting strategies can be modelled directly on successful, modern, national siting approaches since both approaches face very similar challenges. National and multinational disposal projects both have to go through exactly the same technical and stakeholder involvement steps; they may take many years to achieve siting successfully (and, indeed, should avoid the premature selection of potential sites). The essence of any successful siting programme is that it is consensual and inclusive from the outset and all aspects of the repository project are transparent. The process must allow for active inclusion of local communities at all stages.
- 4.3 For a multinational project, the suggested approach is one that can run for some considerable time in parallel with national siting efforts without prejudicing the outcome of either. A key aspect of the process proposed here is that it allows a progressive approach to identifying both host countries and host sites. The approach specifically avoids requiring partners in a shared multinational project to commit themselves at the outset to being a potential host country for a repository, or even to agree on a common, optimised development timescale.
- 4.4 A very important challenge is to develop a suitable process for ensuring that all stakeholders are involved in appropriate ways, especially national governments and local communities. Current international views are that an entirely prescriptive approach (where technical choices are made by experts and then attempts are made to convince specific communities) is unworkable. The strategy proposed here is a volunteer model incorporating stakeholder involvement at all stages. It is technically guided at the outset only insofar that clearly unsuitable regions are excluded at the start. Consequently, it incorporates the flexibility to evaluate objectively any proposals that might emerge from volunteer communities or regions or countries, from the start of the programme.
- 4.5 The intention of the ERDO is that finding an appropriate site or sites² should be a 'bottom-up' process that begins by identifying local and regional communities that may be interested in acting as hosts and develops into an inclusive partnership between the ERDO and the potential hosts. An important aspect of the approach envisaged is that governments and national agencies will not be required to have to take an active lead in contacting and eventually negotiating with potentially interested communities, unless they wish to be so involved.

A domicile for the ERDO

- 4.6 An earlier key decision concerns the domicile of the ERDO. It is assumed here that it will be established in a volunteer country, without prejudice to the final repository siting. The country providing a home for the ERDO will acquire a small, high-technology organisation with extensive links to national waste management organisations and to

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It is conceivable that a group of countries might decide to have more than one shared disposal facility.

international bodies. All work through to the point of site selection will be coordinated by the ERDO. Since site investigations may be carried out in various countries, this allows efficient utilisation of a central pool of expertise. Clearly, however, local liaison to, and involvement of, the potential host countries and communities must be strong. At the time of a decision to submit a license, a new entity (perhaps a daughter organisation) should be established in the host country: in fact, in the host community. This will almost certainly be necessary for licensing purposes and, in any case, sends an important public signal. In the model presented here, this second organisation, which will be responsible for implementation and operation of the repository, is called the European Repository Organisation: ERO.

5 How can the dual-track approach be implemented in response to the Directive?

- 5.1 All EU Members States must ensure that they have the infrastructure, mechanisms and documentation in place to meet their legal obligations under the new Directive by 2015. For all countries, large elements of this will already have been in place under the IAEA Joint Convention.
- 5.2 Given that competent agencies are in place, a major requirement of the Directive is the definition of a national programme for radioactive waste management. Among other things, the programme should include (Articles 10 and 11 of the Directive) concepts, plans and technical solutions from production to disposal; research, development and demonstration activities that are needed in order to implement solutions; major milestones, clear timeframes and responsibilities for implementation; an assessment of programme costs.
- 5.3 The value of the dual-track approach is that the ERDO will become a specific component of the national programmes of its participating countries. In concrete terms, this means that Members States that wish to have a dual track approach as part of their programme will need to agree to establish the ERDO and take the necessary steps to do so – these steps are described in the roadmap in Section 6.
- 5.4 A model structure and plan for the ERDO that has been developed by the ERDO-WG, based on two scenarios for the number of founding members and a generic model of their waste inventories. This model is available as a separate document. Upon foundation of the ERDO, it will clearly be necessary for founding countries to consider and revise this model structure and plan to suit their specific requirements.
- 5.5 It would be beneficial with respect to meeting the requirements of the Directive to have made demonstrable progress to establishment of the ERDO by the time of the first deadline in August 2013. This means that the optimum timescale is around two years. The next section sets out a possible road-map to meet a timescale of two years.

6 Road-map for establishment of the ERDO

6.1 A roadmap has been developed showing the activities that will be needed as a precursor to the foundation of the ERDO. It is assumed that these pre-cursor activities will take about two years, although it may be that they move more quickly and some or all of the Initiation Stage can be accommodated in this two-year period.

6.2 The main milestones in the stage leading up to formation of the ERDO are:

1. circulation of the present document in the appropriate government departments and decision-making bodies in potentially interested Member States;
2. a period for national consultations in countries that are considering involvement, including informal meetings among representatives of these countries and iterations with decision-makers (for both this and the previous milestone, the ERDO-WG can act as a clearing house to co-ordinate activities efficiently and as an information source, with representatives giving presentations in potentially interested countries, if requested);
3. the agreement in principle of a group of founding Member Countries to establish the ERDO and the formation of a group of representatives to implement the subsequent steps;
4. agreement on the proposed legal form of the ERDO;
5. agreement on the country of domicile of the ERDO by the founding Member Countries;
6. the signing of the Articles of Incorporation by the founding Member Countries;
7. nomination by the Member Countries of individuals to the ERDO Board;
8. agreement among the founding Member Countries on a common approach to how to position and present the ERDO in their national responses to the Council Directive.

6.3 The diagram below presents a proposed timescale and a programme for the milestones in the pre-cursor stage. This will probably need to be revised after the first two milestones have been completed.

Pre-cursor Milestones	Month																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
ERDO document circulation in potentially interested countries; information exchange meetings	█	█																						
National consultations and meetings between potentially interested countries				█	█	█	█																	
Agreement in principle of a group of founding Member Countries to establish the ERDO										█	█	█	█											
Agreement on the proposed legal form of the ERDO															█	█	█	█	█					
Selection of the country of domicile of the ERDO																	█	█	█					
Signing of the Articles of Incorporation by the founding Member Countries																					█	█	█	
Nomination by the Member Countries of individuals to the ERDO Board																							█	█
Agree common approach to presenting the ERDO in national responses to the Council Directive																								█

- 6.4 The pre-cursor stage will begin when the current document has been approved by the ERDO-WG and formally circulated to the government of potentially interested Member Countries by the WG representatives or the WG Secretariat.

7 Key Aspects of the Early Period of ERDO Development

- 7.1 The model structure and plan explain how the management and financing of the ERDO can be implemented practically. Key aspects are summarised here.

Fundamentals

- 7.2 The European Repository Development Organisation (ERDO) is a not-for-profit, international co-operative organisation, established to work for the benefit of its Member Countries.
- 7.3 The ERDO is a development organisation. It will not own or operate any waste management facilities. Prior to submission of a license application and before the point of repository construction, the ERDO may decide to restructure itself as, or hand over responsibility to, a successor implementer organisation(s), domiciled at the chosen repository site(s), that will be the license holder and will build and operate the requisite shared and commonly owned facilities for the storage, transport and ultimate geological disposal of radioactive wastes.
- 7.4 The facilities and solutions developed by the ERDO and any successor implementer organisation will be made available to all of the ERDO Member countries on mutually agreed timetables designed to optimise Members' economic and strategic needs.

Aims of the ERDO in the first years of operation

- 7.5 During the first years of operation of the ERDO, some of the key objectives are as follows:
1. Establish a governance structure comprised of a Board of Directors, oversight and/or advisory bodies and a Management Executive.
 2. Establish a fully functional headquarters office in the country of domicile, with high levels of quality control and management and staffed by a modest number of well-motivated individuals who might be employees, or secondees from participating Member States.
 3. Place the ERDO on the map as an active, operational development organisation and become an acknowledged member of, or have representation on, appropriate European and international groupings of radioactive waste management organisations.
 4. Commence implementation of ERDO operations.

Stages in ERDO Development

- 7.6 The Stages included in the model plan consist of a 6-month **Initiation Stage**, a one-year **Preliminary Operations Stage** and the first 4 years of the **Project Operations Stage**.
- 7.7 The Initiation Stage begins as soon as the Board has been established by the Member Countries (towards the end of the pre-cursor stage) and has met to discuss and agree the Operational Guidelines and the Business Plan. The activities in this Stage will be dominated by setting up the ERDO office, appointing staff etc.

- 7.8 The Preliminary Operations Stage during the first year of operations will involve establishment and consolidation of the extensive external contacts network that will be required for the ERDO's work and planning for the main stages of project work aimed at the eventual identification of a GDF site.
- 7.9 The Project Operations Stage covers the next four years of operation of the ERDO and the beginning of the main project work leading up to GDF siting. The detailed work schedule is not defined here, as this will be dependent on the specific possibilities that emerge during the Preliminary Operations Stage. For the purposes of this plan, however, it is possible to identify the main topics of work that will be required and these can be used to produce the financial model. The activities in this Stage will be dominated by running the R&D Programme and developing the GDF Siting Programme, based on establishment of and close interaction with [community liaison partnerships](#) in potentially interested areas. The number of employees or secondees by the end of this Stage would be around 15.

Financial issues

- 7.10 The Business Plan proposes a Start-up Model for the ERDO, two additional Start-up Scenarios that address membership variants and a Financial Plan and Budget that address all resource issues for the Model and the Scenarios.
- 7.11 In the model structure and plan, a budget has been developed making conservative assumptions on costs based on mid- to high-end figures for infrastructure and salaries/benefits. Depending on the domicile of the ERDO, some of these costs may thus be lower than those estimated so far. The budget will be updated each year by the Executive and estimated in advance for each rolling five-year period.
- 7.12 In the model structure and plan, it is proposed that annual working capital requirements are divided into Management Costs and Project Costs.³ The Management Costs cover the costs of the Executive, the secretariat, the ERDO offices, legal and accountancy and other infrastructure items. Project Costs cover all support staff costs (support staff will predominantly be assigned to project work rather than management), external contracted-out project costs, internal travel and advertising/media costs and the contingency allowance, all of which are directly associated with carrying out the ERDO programme of work.

In the model structure and plan, it is proposed that annual contributions to the [Management Costs](#) of the working capital are divided equally between Member Countries. Annual contributions to the [Project Costs](#) of the working capital are scaled according to a formula based upon the inventory of wastes that a Member Country intends to dispose of in the shared disposal facilities. For Member Countries with only small amounts of non-NPP wastes or only spent sources to dispose of, a flat rate contribution is set, which is not scaled on the actual amount of waste. The resulting costs to each partner are far below the funds needed to run even a modest purely national disposal programme.

³ Role models for cost sharing exist in countries where independent utilities share a repository programme and often also include governmental institutional wastes in their planned inventories.

