



Contract Number: 653951

Deliverable n°3.2
Conditions for implementing a JP
Work Package 3

Date of issue of this report: 19/01/2017
Report number of pages: 30
Start date of project: 01/06/2015
Duration: 30 Months

Project co-funded by the European Commission under the Euratom Research and Training Programme on Nuclear Energy within the Horizon 2020 Framework Programme		
Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the partners of the JOPRAD project	
CO	Confidential, only for partners of the JOPRAD project	

ABSTRACT:

The overall objectives of this study were to allow the waste management organisations, technical support organisations, research entities and civil society organisations involved in the radioactive waste management process to build a shared view on the opportunities offered by joint research and knowledge management to better interact and share progresses on the scientific aspects linked to radioactive waste management.

For that purpose, the current study was divided into several tasks which addressed the following issues :

- Identification of the key aspects of the IGD-TP's strategic research agenda that could be included in a common programme,

- Identification of the nature and the key aspects of the RD&D needs and activities identified in SITEX that could be shared within the programme in the framework of a Joint Program ;

- Identification of the areas of interest of Research Entities that could be shared within the programme in the framework of a Joint Program ;

- Identification of the horizontal activities to be included in the Joint Program and the means to implement them. The activities include documentation on Knowledge, Guidance, Training, Strategic Studies for identification of further needs and Dissemination ;

- Identification of the mechanisms for interacting with the Civil Society on the different activities and determine research topics where technical, scientific and social topics are particularly challenging for the public and citizen with scientific background ;

- Identification of the conditions that should be met for allowing the construction and management of a joint scientific programme that balances the interests of the parties involved in the research associated with radioactive waste management, fostering cooperation and coordination but without any prejudice of independency required between the different communities.

- Identification of the preferred instrument to implement the joint program

This WP provided a specific financial support for potential mandated actors and Civil Society representatives with a specific focus on less advanced programmes (travel and subsistence for meetings).

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Approbation for submission

This document was approved for submission on 19 January 2017

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1. Introduction

The objective of the document is to set the conditions that should be met for allowing the construction and management of a joint scientific programme embarking waste management organisations, technical support organisations, research entities and representatives of the civil society. These conditions should allow considering the interests, expectations and concerns of the different entities in the research associated with radioactive waste management. A major challenge for the joint programming is to balance different views, fostering cooperation and coordination without any prejudice to the independence required between the implementers, the experts supporting the regulatory bodies and experts from the Civil Society.

This document describes first the community involved in the construction of the joint programming, then develops the types of scientific and horizontal activities as they are identified by the different groups of actors, expresses the reasons why the different actors see high interest in developing cooperation on research and horizontal activities. It also addresses major challenges to be faced in order to ensure success in the definition of a joint programme and proposes a legal scheme to implement the joint programme in the framework of EURATOM research programme.

2. What is the community? How is it organized?

i. The Waste Management Organisations

The Waste Management Organisations (WMO) which are contributing to the JOPRAD project are in charge of designing, constructing, operating, closing and monitoring radioactive waste disposals in their respective countries. During a previous phase of the project, 17 WMOs have been identified. Among the 17 WMOs, 14 of them are public or state-owned companies: Belgium, Czech Republic, Estonia, France, Germany, Greece, Hungary, Italy, Lithuania, the Netherlands, Slovakia, Slovenia and Spain. Three of them, part of the most advanced are private or partially private: Finland, Sweden and Switzerland.

Breadth of the activities

Among the 17 WMOs:

- 6 are or could be responsible for decommissioning nuclear installations (most of the time their own installations)
- 7 are involved in treatment and conditioning of waste. However most of them are involved with the waste generators on the subject of waste acceptance criteria
- 11 of them operate interim storage
- 15 are directly and practically involved in designing and operating nuclear waste disposal. EEAGE (Greece) and ALARA (Estonia) are not yet at a stage of taking over this responsibility.
- 7 countries are following alternative studies to geological disposal, such as deep boreholes¹.

¹ JOPRAD regards scientific and knowledge management issues related to RWM management for the purpose of developing a geological disposal. The deep borehole concept for disposing radioactive waste is not considered in JOPRAD as a potential solution to dispose radioactive waste (unless disused sealed sources, which are not in the scope of JOPRAD). But other forum could be envisaged to explore the deep borehole concept as a design option for disposing HLW or SF.

Organisation of the R&D

Among the 17 WMOs:

- 11 have, at a stage or another, an R&D plan for radioactive waste management (RWM). Not surprisingly the most advanced programmes all have a detailed plan and a regular strategy for updating it,
- 9 have a specific plan for R&D in geological disposal,
- 7 have in house scientific and technical competences. However, except in the most advanced programmes the scope of activity is limited to the strategy and specification of the research. The R&D concrete activities are subcontracted to research entities.

Several European waste management organizations have established a technology platform to accelerate the implementation of deep geological disposal of radioactive waste in Europe. The technology platform, called Implementing Geological Disposal of Radioactive Waste (IGD-TP), was launched in November 2009. It has over 130 members sharing the vision that “*by 2025, the first geological disposal facilities for spent fuel, high-level waste and other long-lived radioactive waste will be operating safely in Europe*”. Its aims are to:

- Reduce overlapping work;
- Produce savings in total costs of research and implementation; and
- Make better use of existing competence and research infrastructures.

To achieve this goal, the platform led by eleven European organisations in charge of the radioactive waste management in their respective countries, have produced a Strategic Research Agenda (SRA) [i] and a Deployment Plan (DP) [ii] to implement the remaining Research, Development and Demonstration (RD&D) issues through technical projects and cross-cutting activities.

ii. The Technical Support Organisations

The acronym “TSO” can stand for either “Technical Safety Organization” or Technical (and scientific) Support Organisations”. These terms have similar meanings, as used by the IAEA or ETSON.

According to the IAEA² definition, Technical (and Scientific) Support Organizations comprise experts who deliver technical and scientific services to national nuclear regulatory authorities and industry and may advise governments to assist them in achieving the highest possible levels of safety and security for nuclear, waste management, radiation protection, etc. To avoid any conflict of interest by providing services to industry and national nuclear regulatory authorities, according to IAEA TECDOC under preparation by the nuclear safety department, a Technical and Scientific Support Organizations is an organization designated or otherwise recognized by a regulatory body and/or a government to provide expertise and services, to support nuclear and radiation safety and all related scientific and technical issues, to the regulatory body.

² http://www-pub.iaea.org/MTCD/publications/PDF/Pub1583_web.pdf

For ETSON³, the European Technical Safety Organisation Network, TSOs are nuclear assessment bodies that implement the technical safety review of safety cases in support of their national nuclear safety authorities. The members are professional science based organisations from the nuclear countries in Europe. In order to be involved in the network, candidates must sign a charter that describes the values of the network and the activities performed by the members in their country.

The term « Technical Support Organisation » is used in the JOPRAD Project as a generic term referring to organisations fulfilling an « Expertise Function » as defined by the SITEX project⁴ (2012-2013). In the context of the regulatory review of the Safety Case, it provides the technical and scientific basis of safety for:

- Supporting decisions made by the national regulatory body,
- Ensuring that regulatory expectations are clearly communicated to and interpreted by the implementer,
- Improving the quality of the interactions with civil society in the decision making process in order to contribute to build a robust review of the Safety Case.

These activities include:

- the safety review and the development of the capacities to understand and assess the Safety Case (in particular training and tutoring),
- the implementation of RD&D in safety,
- the interaction with citizens along the review process and the development of appropriate governance patterns to conduct this interaction.

This set of activities in combination with the strategic research agenda developed by SITEX-II⁵ are used by the JOPRAD TSO working group in order to identify possible kinds of activities that could be shared in a joint programme.

16 TSOs, potentially mandated, were nominated by Member States for JOPRAD. 10 TSOs are participating in the JOPRAD TSO working group: Bel V, CV Rez and IRSN as partners who have signed the Grant Agreement and seven other TSOs as third parties. In order to clarify how technical and scientific support is provided to the national regulatory body, a questionnaire was established on the basis of criteria derived from the definition of the expertise function developed by SITEX. A wide range of situations is thus encountered in the national frameworks of EU Member States. This diversity needs to be taken into consideration in the development of a Joint Programming.

iii. The Research Entities

Various European research entities are working to different degrees on the challenges of nuclear waste management including disposal. Some of them have been involved since more than 40 years. Today it includes actors of national research centres, research organisations and universities of 17 countries. In some countries, a single well organised large national research organisation may represent many institutes, laboratories (ENEA, CNRS, HGF...). Many scientific teams gather the geophysical, hydrological, geochemical, radiochemical and

³ <http://www.etsn.eu>

⁴ <http://sitexproject.eu>,

⁵ <http://sitexproject.eu>,

materials science data and models sustaining parts of the building blocks of safety analyses. In addition to developing own fundamental long-term research programmes of relevance to nuclear waste management and disposal, many research entities (REs) also work directly in contractive or collaborative manner for/with either WMOs or TSOs.

Research entities support waste management and disposal development by seeking for robust understanding of the scientific and technical complexity inherent to the geological disposal, basing their work on scientific excellence. In order to organise this research, research entities have created a Strategic Research Agenda (SRA) that allow assuring a long term vision of fundamental research in geological disposal. Within this vision, REs expect to drive a roadmap for long-term, and jointly implement real-scale mock-up and/or in situ testing, which is frequently beyond the financial capabilities of several individual member states, let alone research entities. This will result in a more focussed approach, exploiting the full potential of cooperation and partnership to tackle some of the more demanding technical, experimental and scientific difficulties encountered in R&D.

iv. The Civil Society

The JOPRAD project provides an opportunity for involved Civil Society to access information, to express expectations, concerns and recommendations vis-a-vis the definition and governance of a Joint Programming (JP) of R&D on Radioactive Waste Management (RWM) and Geological Disposal (GD), between national WMOs, TSOs, and REs at the European level. “Civil society” is here to be understood as the interest expressed by the civil society organisations (CSOs) involved in a network interacting with JOPRAD project in the frame of task 3.5. The network has been assembled under the auspices of the working group for radioactive waste management from the association Nuclear Transparency Watch⁶ (NTW). The CSOs in the network do not represent NTW as an organisation but are able to provide a variety of CSO viewpoints. It is gathering 35 organisations coming from 18 countries in Europe, encountering a variety of situations at national level, sometimes very unfavourable for participation. The group identified key research areas that it would like to see included into the activities of the joint programme, notably regarding the involvement of public in the definition and implementation of RWM solutions.

This group of CSOs is also involved in the SITEX-II project that developed⁶ an innovative way of interactions between experts and civil society: a core of civil society partners actively contributes to the research by providing technical inputs. They also periodically inform the extended network of CSO of the development of the project, collect their recommendations and organize workshops allowing dialogue between experts and civil society representatives. This experience constitutes a model that JOPRAD recommends to use in the governance of the future joint programme, regarding the potential involvement of civil society.

But the position of the CSOs in JOPRAD is specific in the sense that they are not research actors and have a specific concern on RWM safety and are involved in the perspective of the implementation of the Aarhus Convention. The commitment of CSOs representatives to

⁶ [The thought on the model of interactions with civil society was already initiated in the SITEX \(2012-2013\) project.](#)

contribute to JOPRAD is based on the principles of the UNECE Aarhus Convention [on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters](#) (1998). The CSOs participation to defining the potential R&D joint programming on geological disposal fits with the principle of access to information and also participation to the process of identifying scientific domains where knowledge must be improved and shared . According to the Aarhus Convention, an effective interaction with CSOs also implies that their contribution is duly acknowledged. Involved CSOs express views on what matters for them and they will consider the extent to which their views will be duly taken into account, but the final responsibility lies in the hands of JOPRAD, as well as in the hands of the European Commission as Public Authority.

The participating CSOs have a specific interest in the safety of RWM and, in this perspective, in the safety of geological disposal (it is the very purpose of NTW in this RWM field). It is understood that while concerning geological disposal, at least part of the Joint Programming will develop research in the perspective of reinforcing confidence in safety. CSOs have underlined the need to consider in the research programming the impact of (technical and non technical) decisions associated with the development of geological disposal on the safety and radiation protection of the global RWM strategy that includes geological disposal as a part of it. This socio-technical dimension is further captured in the definition of potential activities of the future Joint Programming by defining, in close interaction with scientific topics, social topics addressing the governance of the geological disposal project at different phases of development.

3. What is the common vision?

The JOPRAD partners have established a vision statement for joint programming entitled: “A step change in European collaboration towards safe radioactive waste disposal through a credible and sustained science and technology programme fostering shared understanding and trust”. This common vision entails in particular :

- To elaborate a shared programme between technical support organisations, implementers (waste management organisations) and researchers throughout the decades covering the development and operation of disposal facilities;
- To improve the understanding of the risks and uncertainties;
- To ensure the societal visibility and transparency of research and development; and
- To develop and make available a high level science on geological disposal.

In order to translate this common vision into practical collaborative works:

The different communities of JOPRAD recognise that:

- Much RD&D work has been done previously, that allow now to move to application of licensing for some European countries; such work could be better integrated in the forthcoming years,
- It is possible for different parties with different roles to work together, without prejudice of their own role in the governance of the system,
- Different parties can have common agreement of what work should be done and how, but can take their own view and interpretation on results and data generated,
- RD&D activities must be focused on contributing to;

- Progressively deeper trust in the safety of geological repositories, and
- Increase qualitative and quantitative robustness of repository, in particular dealing with remained phenomenological uncertainties by generating more or better data, thereby improving overall system understanding from frontier science to large system integration, without any prejudice to safety,
- Develop improved materials and solutions through innovative approaches
- Independence of the actors is a way of reinforcing the vision; and
- A joint programming is a shift in gear from past work (and other collaborative working) on geological disposal. This changing approach is a paradigm shift where we ensure the knowledge developed to date and in the future is effectively integrated, managed and maintained accessible for interested parties.

4. What are the areas of activities?

i. What are the challenges for the upcoming next 20 years?

The community involved in the management of radioactive waste and the development of the GD will during the upcoming years face several challenges of different nature:

- The implementation of the first geological disposal facilities by the more advanced programmes;
- The harmonisation of practices fostered by European initiatives such as WENRA safety reference level, EC Directive on radioactive waste, EC Directive on nuclear safety, Aarhus Convention for the access of public to information...;
- The development and update of the less advanced programmes to start a licensing process taking benefit of the experience gained by more advanced programmes;
- The availability of competencies, research infrastructures and programmes to accompany the implementation of the GD and contribute to optimizing the management of radioactive waste;
- The necessity of creating a multi-decennial research perspective, considering the more than 100 yr process between siting, licencing, operation and closure of any repository project in deep geological formations.

One major objective for WMOs is to be ready to start operation of the first geological disposal facility by 2025. For that reason, there is a need for maintaining a tight schedule for research programs in order to offer sufficient knowledge in due time for building the safety case that supports the construction license application of a repository. Due attention should be paid to the needs of knowledge related to features, processes and events that could occur during the operational phase of the geological disposal, and their consequences on either the operation and evolution after closure.

The state of development of the waste management programme is not homogeneous amongst Member States: whilst some of them deal with the license application, others consider ways to plan repository siting or to create an infrastructure to implement the decision making process. The less advanced programs should benefit from the more advanced programs if knowledge transfer is organised in a proper way. Besides technical/scientific knowledge, experience gained by some countries in setting up decision making processes is of interest, in particular, how to ensure the development and maintenance of necessary skills and the establishment of safety approaches to build a safety case.

As underlined by the Aarhus Convention, the sustainable presence and engagement of the public along the decision-making is expected to reinforce the quality of the decision-making process for managing radioactive waste. Thus, the civil society's acknowledgment that the scientific and technical elements carried out by the WMOs comply with the regulatory expectations is a central task. For that purpose, close interaction between experts from WMOs, TSOs, REs and civil society is necessary and will require innovative ways of collaborative work to foster the mutual understanding of key processes and uncertainties. More generally, these innovative ways should be part of forthcoming radioactive waste management governance schemes. Taking into account public engagement contributes to reinforcing reliable, democratic decision-making in the context of RWM at local, national and international levels.

Several initiatives at European level (ENSREG, WENRA, ETSON, Eurosafe...) promote achievement of harmonised practices and in particular a common safety culture amongst the actors involved in RWM, including members of the public. This again, is a key factor for reaching harmonised safety levels of the forthcoming GD facilities. Such common safety culture is based on knowledge and values that can be developed and shared throughout the implementation of common activities within the Joint Programming.

ii. What are our expectations and priorities?

WMOs, TSOs, REs and experts from the civil society have identified different kinds of activities and technical topics that could be part of a future JP. This preliminary work aimed at developing a set of scientific areas considered as the basic material to elaborate a work programme that would include activities of interest for the whole community. The expectations, priorities and types of activities (RD&D or horizontal activities) proposed by the 4 different communities are summarized in the sections below. These scientific/strategic issues will be then compiled together, grouped into common sets and prioritized on the basis of criteria defined jointly by the partners. As a matter of fact, the major concern of JOPRAD's partners is to avoid limiting the future work programme to the minimum cross-section between the scientific topics identified by the different entities. But on the contrary, the aim is to offer the possibility that the medium/long-term scientific and horizontal activities embraced by the work programme under elaboration are ambitious enough to justify the creation of a Joint Programme.

REs expectations and priorities:

In the frame of the discussions around the JOPRAD project, representatives of European research entities have met regularly and have developed a strategic research agenda with clearly identified priorities. Considering the long time frame of geological disposal and the fast evolution of scientific knowledge and of the standards of scientific quality, the vision of research entities goes very much beyond the implementation driven SRA of the waste management organizations; it covers periods of as much as 20 years.

Also, in contrast to other stakeholders, research entities do not have to adhere tightly to the agenda and constraints of waste management organisations (strongly striving towards implementation).

Joint programming will also allow for longer sustained cooperation on specific research themes on time scales which go beyond those typical for European projects (3-4 years). This

will result in a more focussed approach, exploiting the full potential of cooperation and partnership to tackle some of the more demanding technical, experimental and scientific difficulties encountered in R&D.

Research items were classified according to “Medium term period”: the 5 year JP and “longer period”: next 10 years and more, crossed with ranking of priority: high, important and low.

Some (non-exhaustive) high priority items are :

- The integration of scientific understanding in the safety case and in the assessment of its uncertainties
- Some crosscutting ill and well defined processes of high importance such as impact on radionuclide migration by colloids, organic matter, microorganism or the incorporation of radionuclides in solids, considering thermodynamics, speciation and strong sorption
- The question of upscaling and complex THMC couplings, including reactive transport
- Work on waste forms, source terms and characterisation techniques and integral HLW near-field experiments
- The long term THMCB performances of near field rock, EDZ, bentonites, seals and plugs
- Geotechnical studies on bentonite barrier properties as a function of interfaces, degree of resaturation and temperature
- Transformations at interfaces of various materials
- Production and fate of gases and the understanding of resaturation of void spaces
- Geopolymers and cement systems
- Monitoring science: operational phase, radiological, criticality, leakage, redox, sensors, long term stability, ...
- Input of social science studies: ethical framework, expectations of citizens...
- ...

Regarding these potential scientific areas for JP, one objective is to decrease the conservatism taken in safety assessment calculations. It is expected that increase in knowledge will allow for more reliable determination of “safety margins” in current and future safety assessment procedures. Conservative bounding case assumptions may become replaced in many (not all) cases by fundamental process understanding or precise data and their uncertainties. In that perspective, upscaling technics become an increasingly important challenge since chemical, mechanical, hydraulic, thermal and sometimes even radiation processes are strongly coupled on any space and time scale. This requires the organization of strongly transdisciplinary research and knowledge management systems.

WMOs expectations and priorities:

It must be acknowledged that a large set of scientific and technical knowledge has been acquired over more than 40 years of research on geological disposal which has allowed countries to progress towards licensing (Finland, Sweden and France).

RD&D serves several purposes: it provides input to system design and optimisation and makes essential contributions to siting of the repositories. It furthermore contributes to achieving a sufficient level of system understanding to allow an adequate evaluation of safety. The priorities of RD&D depend upon the stage of the programme’s lifecycle and change with progress of the programme. In the early phases the emphasis is on the development of basic

concepts, combined with an evaluation of safety and of technological feasibility in principle, taking into account the country-specific boundary conditions. This early phase is followed by system optimisation, with the main emphasis on post closure safety and correspondingly on (site-specific) geology and design concepts with the system of engineered barriers becoming more tailored to the specific geological conditions envisaged. In the later stages, when moving towards implementation, practical issues become increasingly important, such as construction procedures, operational safety, and optimisation of technology (including "industrialisation" of repository operation).

RD&D' effort at European level must continue throughout the lifecycle of RWM in order to promote optimization of management routes and of disposal solutions, and to support compliance with the waste directive obligations. RD&D will also continue to be compulsory to address evolving regulatory concerns. This knowledge must also be maintained and increased throughout the incremental development, operation and closure of disposal facilities.

Furthermore, there is a high risk of shortage, at the European level and at short to medium timescales, of the skilled, multidisciplinary human resources needed to develop, assess, licence and operate geological disposal facilities; this shortage may affect not only waste management organisations, but also authorities, research organisations, academia and supplier industries. Dedicated RD&D efforts and exchange activities will contribute to bridge this shortage.

Last but not least, stakeholders' concerns regarding the safety of geological disposal and the protection of the environment it provides must be addressed in a systematic way and the commitment of local communities that will host geological disposal facilities will have to be maintained over the years. RD&D plays a major role in addressing these two challenges.

In the early stage of the JOPRAD project, WMOs have defined potential activities for JP by addressing criteria as: Implemented-driven RD&D at short and medium terms (5 to 10 years), RD&D to maintain and increase competence/knowledge at long term and Prospective/innovative RD&D for long-term.

The WMOs developed a list of categories, shown in Table 1, to be used as a benchmark to determine the eligibility of the final list of topics to be included in a 'common area' for Joint Programming. Topics may be deemed suitable or unsuitable depending on their exact scope. Governance rules are guidelines to help decide on this and to identify common ground. At this early stage, the WMOs identified 6 categories of topics not eligible for JP related to: Compliance demonstration, Detailed technical development & design of repository (e.g aspects of DOPAS), Time & mission critical RD&D, Issue under discussion with regulation activities, Activities close in time to licencing, Monitoring of complementary technologies & impact on geological disposal. As a matter of fact, they are mainly driven by national context and specific safety concerns, and therefore could not be shared in a JP.

Table 1 Categories used to determine eligibility of WMO SRA topics in a 'common area' for Joint Programming

Fully eligible as technical activity	What might be acceptable by WMOs according to gov. rules ⁷	Unsuitable
A - Develop. & maintenance of competence & fundamental science	F - Large scale demonstrator (e.g. DOPAS, ESDRED, aspects of LUCOEX)	L - Compliance demonstration (BELBaR)
B - Increasing confidence in supporting concepts (e.g. Cebama, BELBaR, MIND)	G - Projects having an impact on social acceptance (e.g. aspects of MoDeRn)	M - Detailed technical development & design of repository (e.g. aspects of DOPAS, LUCOEX)
C - Early state RD&D	H - Benefit on gaining scientific & state of the art technical consensus (BELBaR)	N - Time & mission critical RD&D (BELBaR)
D - Very long-term studies (>10 years)	I - Development of common understanding of safety case structure and arguments	O - Issues under discussion with regulation activities
E - Pooling of information, knowledge management	J - Development of codes & verification through benchmarking	P - Activities close in time to licencing
	K - Novel disposal components technologies (low TRL)	Q - Monitoring of complementary technologies to geological disposal & impact on geological disposal

Civil society expectations and priorities:

A set of considerations for evaluating the governance of joint programming (JP) that will ensure safety and gather the conditions of a potential participation of civil society organisations (CSOs) representatives in it has been elaborated in the frame of task 3.5. This is based on the results of discussions with CSOs interacting with the JOPRAD project. Periodic meetings took place to inform representatives of CSOs, present them results and gather their views, comments and recommendations. In particular, the results of the SITEX-II and IGD-TP SRAs were assessed in order to improve and validate the findings and further develop them. The possible schemes of governance and the way to integrate the CS in the European Joint Programming were also debated.

CSOs expect to have a global picture that allows putting in perspective JP on GD in a broader framework of EC R&D on RWM. Since the development of GD projects interacts with global RWM strategies, GD issues cannot be completely separated from the global issue of the safest strategy for all types of waste. It implies a constant concern to articulate the

reflexions on a GD implementation with its implications on the global RWM strategy. It raises e.g. issues regarding coherence of the RWM strategy with waste inventory.

According to the above general reflexion on the interactions between “institutional actors” of RD&D and the CSOs, CSOs propose to build the future JP on the basis of:

- 1/ the definition of participation of experts from the civil society in research topics where technical aspects are predominant in order to foster the "knowledge sharing and interpretation" (KSI) between stakeholders ;
- 2/ the definition of multidisciplinary research topics involving technical and social sciences dimensions as well as necessitating multi-stakeholders engagement (WMOs, REs, TSOs and CSOs).

For 1/, CSOs has identified scientific and technological topics for which people (amateur or non-professional scientists) are directly involved in the process of generating scientific knowledge. Citizen’s sciences⁸ is understood as a means to generate scientific knowledge perceived by the broader community as meeting the requirements of trustworthiness and reliability. Citizens actively contribute to the activity by providing technical inputs, discussing the results and linking outside the joint programme with others CSOs and citizens. As an example, topics identified are: experimental works on corrosion, monitoring, concepts for closure, ageing and interactions between components...

For 2/, CSOs are of the opinion that it seems to be a misbelief of scientific and technological researchers/implementers that safety can be achieved purely by scientific/technological improvements. In particular, the management of all kinds of uncertainties requires interactions and common understanding between all the actors. All stakeholders and decision-makers should be aware of the complexity of the radioactive waste management issue induced by the close interconnection between scientific issues and societal concerns. To deal with this socio-technical dimension, CSOs identified in a first approach three topics: 1/ “Final operation licence”, including the possible need for a pilot installation/phase before full commissioning and addressing the participatory safety case review; 2/ “Conditions for closure”, addressing the progressive full demonstration test of seals, operational monitoring and governance of the implementation of the DGD and its closure strategy ; 3/ “Intergenerational governance of the GD operational phase”, including activities on the practical implementation of reversibility, the operational monitoring, the sustainable societal memory patterns and the participatory safety case review.

Horizontal activities, allowing the organization of information exchange are also expected to be included in the JP. In a first approach, three topics are identified: “Design optimization”, based on pre-licensing studies and operational experience, including the consideration of evolving boundary conditions (inventory, volumes...) ; “Shared safety culture” in order to share common grounds for appraising the level of safety afforded by DGD; “Siting process characterization & siting process” for countries where this preliminary step in the implementation of DGD remains of high concern regarding the interaction with citizens.

TSOs expectations and priorities:

⁸ also known as networked science, civic science, or crowd-sourced science, volunteer monitoring, sometimes including wording such as "public participation in scientific research", participatory monitoring and participatory action research,

In the framework of the SITEX-II⁹ project (2015-2017), a strategic research agenda (SRA) dedicated to the Expertise function has been developed. This SRA covers any scientific topic to be used by the Expertise function to assess whether geological disposal facilities are developed, constructed, operated and closed in a safe manner.

The current SRA is not an exhaustive list of all the potential topics that could enter into the scope. It covers topics for which a sufficient level of common interest has been expressed among its contributors and for which more research or exchanges have been identified.

This first selection of areas of main interest was split into activities related to RD&D projects (experimental and/or modelling works) or “horizontal” activities related to 3 inclusive modes of interaction: 1/ Exchanges of practices, establishment of common position paper, guidance where knowledge and practices are considered sufficiently mature, 2/ Establishing the state of the art, to identify where there is a need for new knowledge, or if sufficient knowledge has been gained for safety purpose, 3/ Transfer of knowledge where the practice of the expertise function is mature, ready for transfer of knowledge (through training and tutoring). The activities having the highest level of common interest were identified considering the relevance of the topic to the geological disposal concept currently considered in the partner’s country, the gap for each topic between the need and the current knowledge/expertise of each partner and the resources that can be allocated to the topic in the prospect of carrying out common actions.

In order to consolidate their relevance, each classified topic was further questioned: why is the topic important to safety, why is research needed, why is the topic a candidate for joint research, is it a candidate for JP?

It has to be acknowledged that RWM is not only a technical problem that could be solved solely by technical solutions as this is already raised by the CSOs above. The exchanges with CSOs in the framework of the SITEX II along the preparation of the SRA have led to the identification of socio-technical research topics associated with the implementation of Geological Disposal (see description above chapter 4.ii).

RD&D and horizontal activities related to pre- and post-closure safety, as well as the technical feasibility of geological disposal were identified. These topics are relevant to any waste type and spent fuel for which geological disposal is envisaged as a solution for its long-term management (e.g. Low, Intermediate and High Level radioactive waste). Topics proposed by the SITEX SRA and the JOPRAD TSO’s working group may be synthesised as follow:

- Interdisciplinary topics with scientific/technological and social sciences components; Topics concerned have been addressed in the previous section related to civil society expectations and priorities¹⁰.
- Lifecycle of a disposal programme and its safety case for horizontal activities: the development of guidance for reviewing the safety case; How to implement a process

⁹ http://sitexproject.eu/index_2.html

¹⁰ TSOs acknowledge the importance to address citizen and social sciences issues in research programmes dedicated to radioactive waste management. Therefore, they have an interest in contributing to some extent to research projects addressing this topic. Nonetheless, TSOs may not always have the necessary expertise, resources or mandate to act as the leading organisation or to perform research in such projects. In this case, TSOs may still contribute e.g. by providing a technical input or participating in end-user groups.

for site selection? The co-disposal of waste ; how to apply in practice the optimization principle? Implication of reversibility and retrievability principles for facility design...

- Safety-relevant operational aspects: R&D should be considered for monitoring aspects on the basis of the results of the on-going project MODERN2020 and for fire and explosion risks in geological disposal vaults. In this context, linking with other initiatives at NEA (Expert Group on operational Safety (EG-OS)) and IAEA (follow-up of GEOSAF2) should be considered;
- Radionuclide behaviour in the disturbed engineered barrier system and host rock;;
- Evolution of Engineered Barrier System (EBS) material properties: It is proposed to pursue R&D on the processes that influence the effectiveness of closure concepts ;
- Spatial extent and evolution of transient Thermo-Hydro-Mechanical-Bio-Chemical (THMBC) conditions in the near-field: Topics for R&D are focused on chemical transient and transfer of gas in continuation of the on-going CEBAMA, MIND or former FORGE projects ;
- Waste inventory and prediction of waste form degradation mechanisms. Several EC projects were already devoted to this field of research (e.g. MICADO, FIRST NUCLIDE, CEBAMA, NFPRO) but the pursue of the R&D efforts in several fields must be considered as for example the impact of radiation on the transport properties of a cementitious matrix or the impact of an alkaline environment (cement) on glass leaching. Besides the needs for R&D activities, horizontal activities are identified on the methodologies applied to define the radionuclide inventories (e.g. use of radionuclide vectors, uncertainties about databases of radionuclide properties), on the characterization of the waste forms and the definition of the Waste Acceptance Criteria.
- Pre-disposal radioactive waste and spent fuel management: pre-treatment, treatment, conditioning, as well as transport and conditions of storage of radioactive waste e.g. ageing of waste or unexpected delays in geological disposal programmes that may extend storage periods beyond what was originally anticipated in the national programme having an impact on the safety of geological disposal facilities are of interest for TSOs.

The TSOs came to the conclusion that there is generally no restriction on the topics that can be shared among all actors but only on the type of joint activities that can be undertaken. Thus, for TSOs, the topics described in the previous section are eligible for JP except the activity related to the development of methods to review the safety case which is the responsibility of the Expertise function and is not considered as eligible for JP. But when established, the method can be shared with WMOs and experts from the civil society through horizontal activities.

iii. Deployment of an Integrated Knowledge Management System

The Vision and the way to establish and implement an Integrated Knowledge Management System (IKMS) have been developed in the JOPRAD WP3/task3.4. The Programme to implement the IKMS is given, together with the Deployment Plan for the first five years of operation. Several types of activities are identified:

- Education for generating a competence base for present and future needs,
- Training in support of generating, developing and maintaining specific expertise and competence,
- Strategic Studies developing specific topics, including the needs for developing further Knowledge,
- Guidance on selected topics making the Knowledge accessible for specific purposes and applications,
- Mechanisms for transfer of Knowledge between different Programmes with respect to programmes of different competence levels, but also with respect to different implementation time schedules, and
- Dissemination and exchange of the Knowledge to the expert community and potentially other interested parties.

The expected outcome of the IKMS is thus to bring together these different activities so that not only the Knowledge is documented and updated in an enduring fashion, but also that the topics are reviewed and developed, and that the Knowledge is used in support of maintaining and developing Competence, as well as the Knowledge is easily accessible and useful for different interested parties.

A particular attention should be paid to the Mechanisms for transfer of Knowledge between different Programmes (More advanced programmes and Less advanced programmes), regarding the identification of topics mature and transposable enough related to pure scientific topics as well as to the governance of the RD&D itself. This comprises the role played by different categories of actors in the implementation of RD&D and the development of scientific skills. In that perspective, the different kinds of entities represented in JOPRAD should be able to contribute to this activity.

5. How JP will complement National Programmes in RD&D in the domain?

The actors of the JOPRAD have identified the assets potentially provided by joint programming activities in complementing their national program in RD&D.

i. What are the added values of working together?

JOPRAD's participants are of the opinion that a long-term stable structure and framework for the different actors with an interest and/or responsibility in the management of radioactive waste, through to disposal, is a real opportunity to improve the overall definition and implementation of the RD&D in an harmonised way throughout the European Union. In particular, four major strategic assets are identified:

- Fostering between Waste Management Organizations, Technical Support Organizations and Research Entities **a shared understanding** of the overall system behaviour and of RD&D needs for managing the radioactive waste in a responsible manner, through to disposal.

The JP will provide a common space where the stakeholders are able to share the phenomenological interpretation of research findings related to various processes in perspective with the safety functions of the geological disposal. The consideration of the role and influence of specific research findings on the overall system and processes of a disposal by the different actors will foster as far as possible **a common “integrated interpretation”** (integration refers both to the different actors and to the overall system) of the findings. It may allow a **better analysis of the needs** for further RD&D activities focused on areas where uncertainties or scientific gaps still need to be further addressed in order to improve confidence in achieving the safety demonstration. This approach should also foster a dialogue and a mutual understanding on the **interpretation of the international safety requirements** (IAEA, WENRA) and the substantiation of their fulfilment through scientific arguments.

- Recognizing the strong **social dimension** in the management of radwaste, that implies innovation in the management of RD&D and transverse activities for 1/ dealing with interdisciplinary topics embedding societal and technical issues and 2/ interacting with citizens during the implementation of the activities.

The strong social dimension in the management of radwaste and in particular in the development of the Geological Disposal has two major consequences on the implementation of research activities:

- It generates research needs that involve both technical and social aspects. They are embedded and necessitate **interdisciplinary research** involving both technical and social sciences as well as a multi-stakeholder engagement that is allowed by the pluralistic partnership (WMOs, TSOs, REs, CS organisations) that is foreseen for the JP. The management of uncertainties is for instance a complex issue which entails both providing best available (technical and social) knowledge as well as creating the conditions of trust all along the stages of GD implementation (and safety case review) among the several categories of players involved in order to support uncertain and multi-dimensional decision-making. The long implementation time-scales and thus the need for a stable decision-making basis require specific research for creating the conditions for interacting with the civil society on this long timeframe ;
- It creates demand from citizens having scientific background to be associated to the definition of the research and the interpretation of the findings, in particular with respect to the key safety issues of concern for the civil society. **The participation of experts from the civil society or citizens with scientific background** to scientific works provides several assets: it contributes, as for the other actors, to increase competency; it allows transparency on the implementation of the research; they are able to bridge between scientific specialists from WMOs, TSOs and REs with other stakeholders from CSOs in order to provide them with up to date scientific results and put these results into perspective of scientific or safety expectations or concerns expressed by these CSOs (and feed internal CSOs exchanges on the basis of consolidated

scientific matters). It can be expected that such interaction between experts from society and scientific specialists from the “institutional” organisations will contribute to enhance confidence in the decision-making process and mutual respect of the actors. Reversely, the experts from WMOs, TSOs and REs can benefit from the exchanges with experts from civil society in the sense that it can help them to better identify topics of concern for the civil society and how to present the results in such a way that they are more adapted to mutual understanding.

- Continuously analysing the need for, developing and sharing the **required knowledge**, and transforming mature knowledge into **commonly agreed upon guidance**.

The JP should provide a sustainable mean for **sharing the knowledge** developed by the different actors and contributing **to improve scientific skills/competencies** within the member states (MS) on the geological disposal of radwaste. The integration of national scientists in the international scientific community contributes to competence building, and facilitates the transfer of knowledge amongst national programs where needed. It should foster the **harmonization of competencies** in MS for managing the research and for developing the required knowledge for the implementation of a safe geological disposal. The elaboration of strategic studies and guidance on specific RD&D topics should reflect this effort to harmonization of approaches to the development of a safe radwaste management throughout a geological disposal.

- Sharing, developing and making **effective use** of human, technical and administrative competencies and **resources**.

The JP provides the possibility to **share resources** (e.g. experimental tools, facilities, staff), **results obtained** by the different national programs (existing knowledge) and the scientific priorities in order to use the efforts made by each Member State in such a way that, even if resources may differ strongly, national programs can benefit from scientific knowledge, skills and tools available in a common space at European level ; it offers also the possibility, at European level, **to foster excellence** by taking benefit from the (best) expertise of different teams in different scientific domains.

6. Challenging issues that should be carefully examined for the success of a JP

In this section key issues for success of building a JP are discussed, namely (i) the capability of the different actors to build a joint work programme, (ii) to ensure inclusiveness and interaction, (iii) to establish governance for a fair and equitable joint programming, (iv) to preserve independence of actors at national level, where needed, and finally (v) to allocate sufficient resources.

i. Elaborating the work programme

Establishing a Joint Programme in the next future is intimately linked to the capability to issue a work programme. On the basis of the above description of the expectations of the different actors, there is good perspective on the possibility to elaborate a work programme, as indicated by the similarity of many research items in the SRA of RE, SITEX-II et IGD-TP. In

order to categorize the topics to be included in the work programme, the following types of activities are further considered:

- **“Implementation driven”** topics responding to the short term needs for implementing a geological disposal programme ; this comprises in particular topics responding to needs for ensuring adequacy of the safety demonstration;
- **“Curiosity driven”** topics responding to potential needs/opportunities to address forward looking science (**long term science**) along the considerable implementation time for development and operation of the GD, as well as scientific knowledge linked to possible concept optimization;
- Horizontal activities addressing **“Transfer of knowledge”, “Good practices”, “State of the knowledge” and “Strategic studies”** managed through the IKMS described on previous section. In the framework of these horizontal activities, **think tank activities** involving the different categories of actors (WMOs, TSOs, REs and CS) would offer the possibility to enhance the governance of the JP, in connection with their own networks outside the JP (e.g. IGD-TP for WMOs or SITEX for TSOs), by preparing the assessment of the functioning of the JP and of the activities, and by preparing new activities if needed.

Further work must be done by JOPRAD in order to build the strategic research agenda on the basis of the prioritization that will be made using the above categories of topics. The main challenge for the elaboration of the work programme is to be able to move from the independent expectations of the different actors and topics eligible for joint programming to an **integrated programme of work** that will reflect the commonalities, the diversity and the complementarity of the different actors.

ii. To ensure inclusiveness and interactions

Interactions and inclusiveness are pillars of the potential JP. This relies on the **integration of the different categories of actors in the activities of the program**. The plurality of researchers and research organisations is a source of quality of scientific results. This implies that the JP should enable to host a sufficient number of organisations and scientists from the civil society that will ensure both high level science and equity amongst the different potential partners. Specific attention should be paid to the identification of potential partners sufficiently in advance of the creation of the joint programming in order to collect their views on the work programme and its possible management. This is the objective of the working groups led by the partners of JOPRAD which allowed liaising with WMOs, TSOs, REs and experts from the civil society outside the JOPRAD consortium.

The R&D topics and priorities have to cover the interests of the partners on an equity basis. Balance has to be found **between the different types of institutional actors** (WMOs, TSOs and REs), but also **between the different Member States**. The benefit for Member States with less advanced programmes lays both in the participation in R&D projects, but in particular in the area of knowledge transfer. Therefore, it is essential that these Member States get involved in the process of defining the Knowledge Management Programme. Activities defined in the JP should offer the possibility to the beneficiaries willing to participate to be associated to the implementation of the activity. The way the beneficiaries of the JP will be associated to the implementation of the activities should offer sufficient flexibility (e.g. by

experimental work, modelling work, knowledge management, review of deliverables, participation in meetings, etc...).

It is important to recognise that participation of CSOs and citizen experts is bound to the possibility to finance their participation at a level that allows their full commitment in the activities.

iii. To ensure fair governance

Regarding governance of the JP, the decision-making process has to be transparent with clear roles and rules of functioning. The issue of transparency is of utmost importance. It is an expectation for all phases of the JP governance process and includes transparent decision making with respect to how decisions are taken, who takes the decisions, and what the decisions are. In particular, the JP will have to present argumentation regarding how, why and by whom projects and activities are selected. There is also an expectation of extensive release of results, allowing the assessment of their impacts on current GD development. The JP using public money should not use commercial confidentiality as a mean to preclude access of the public to the results.

A specific challenge regards the participation of actors from less advanced programmes and CSOs in the governance of the JP. **The governance rules should provide them with the capacity to influence decision** (not only observing) and offer clear statement on how their concerns are duly taken into account. It would reinforce trust, credibility and legitimacy of decisions and create the conditions for a real improvement of the integration of all actors (including institutional experts and CSOs) in the management of RD&D at European level.

iv. To preserve the roles of the actors in the national decision-making process

According to Article 6 of the 2011/70/EURATOM directiveⁱⁱⁱ, Member States shall ensure that the competent regulatory authority is functionally separated from any other body or organisation concerned with the management of spent fuel and radioactive waste, in order to ensure effective independence from undue influence on its regulatory function. This requirement has several implications for the expertise function which is aimed at providing the technical and scientific basis for supporting the decisions made by the regulatory function. The particular situation linked to the presence of WMOs and TSOs (acting in support to the regulatory body) in the same joint program raised legitimately the question of the preservation of the independence of national roles between the « Expertise function » (performed by TSOs and in some Member States also by REs) and the « Implementing function » (performed by WMOs). TSOs, on the basis of SITEX work performed in 2012-2013 and within the JOPRAD working group, examined this question of the required independence and to which extent this may constitute an obstacle from the regulatory body side to establishing a JP with both WMOs.

First, regarding the scope of the JP, it was found that there is generally no restriction on the topics that can be shared among all actors but only on the type of joint activities that can be undertaken.

Second, TSOs identified two situations that must be considered:

- The independence in the national decision-making process context:
 - o TSOs may play various roles within their national framework. In addition to supporting the regulator, TSOs provide in some countries a technical support to the national WMO (e.g. by contributing to the preparation of specific parts of a safety case). In this case, arrangements should be made to maintain the independence of the different actors. Arrangements made at the national level to preserve independence need to be taken into consideration when defining the modes of governance of a JP bringing together TSOs, REs and WMOs. When building and reviewing the national safety case, WMOs and TSOs are free to use the results produced within the JP. The use and interpretation of these results in the context of the national geological disposal programme is the respective responsibility of WMOs and TSOs. For that purpose, TSOs may decide to implement activities aiming at challenging the content of the safety case;
 - o SITEX identified as well three elements contributing to the independence of the expertise function with respect to the implementer^{IV} :
 - The availability of competence, experience and knowledge notably provided by resources and skills independent from implementers in order to avoid conflicts of interests;
 - The transparency and proximity to the public, involving public release of its assessments and reports and interactions with citizens;
 - The impartiality when delivering a technical opinion (no conflict of interest).
- The independence in the framework of the JP : the requirements to ensure that TSOs involved in the JP can effectively perform activities without jeopardizing their capability rely on the following issues :
 - o Independence in joint R&D activities can be preserved as long as the work is focused on data acquisition, process understanding or benchmarking of tools and approaches, with no direct connection to national concepts ;
 - o R&D activities are implemented in a transparent way, e.g. activities and data are entirely available to other parties ;
 - o TSOs are able to provide internal competences to design and implement the activities and may be involved in the design, the implementation and the interpretation of the experiments/studies ;
 - o There is no restriction to share interpretation of results linked to a phenomenological understanding of processes ;
 - o If it is decided that one activity wouldn't be implemented even if it is considered as a key topic for TSOs regarding the confidence in safety, TSOs should have the capability to perform this research collaboratively outside the JP;
 - o The JP makes possible the creation of independent rooms for the different categories of actors (including TSOs) in order to discuss separately from the

consortium the progress of the JP, and elaborate common positions/expectations/proposals for the implementation of the programme... (including the update of SRAs) to be further debated with all the partners of the consortium;

- Pluralities of views or understanding of phenomena can be expressed, either in research activities or horizontal activities ;

v. The availability of resources that will allow to implement joint research

The allocation of sufficient resources on duration of several years (at least five years) is a key success factor of the establishment of a valuable JP. National programs manage already a large amount of resources of different kinds (experts, students, experimental tools, numerical computer codes, URL, demonstration tests...) and it is expected that the mandated actors (program owners and managers) will afford a part of these resources for the implementation of a JP.

7. Feasibility of the implementation and management of a future JP

i. Feedback of existing initiatives

Lessons from existing European initiatives in joint programming are drawn on the basis of:

- The OPERRA project (Open Project for the European Radiation Research Area) which is a programmatic tool (Coordination and Support Action) that was launched in June 2013 for four years with financial support from the European Commission. OPERRA aims to build up a legal and logistical coordination structure to administer future EU calls for projects in radiation protection.
- The ‘CONCERT-European Joint Programme (EJP) for the Integration of Radiation Protection Research’ which is an umbrella structure for the research initiatives jointly launched by the radiation protection research platforms MELODI, ALLIANCE, NERIS and EURADOS. CONCERT was launched in June 2015 under Horizon 2020 and aims at attracting and pooling national research efforts with European ones in order to make better use of public R&D resources and to tackle common European challenges in radiation protection more effectively by joint research efforts in key areas.

The lessons learned on these programmes concern:

- The organisation of two categories of calls for projects (work/time to prepare calls, selection of independent experts, cost, etc.) since OPERRA organised open calls and CONCERT organised internal calls to implement their activities;
- The governance of the JP and the role of the partners (program owners, program managers, linked or not linked third parties, mandated actors, etc.) – who do what ?

o OPERRA

In order to manage the calls, an independent “Go between Administrative Operator” (GAO) was contracted. For the organisation of two calls, the cost of the GAO was around 83 k€ The GAO was composed of a group of lawyers that acted as interface between OPERRA and independent experts in charge of managing the call for proposals process and its evaluation. The independent experts were nominated by the GAO to avoid a conflict of interests; they were chosen from a panel of UNSCEAR and ICRP experts given by the EC. Each expert reviewed 3 answers.

For the first call, 17 projects were eligible and finally, 3 were selected which enabled 20 new members to join the consortium. After the second call, 30 new members integrated the consortium. Finally, OPERRA had to work with 64 partners, which is huge to manage. The integration of these new members required a great deal of work and time to write and validate an amendment to the grant agreement. The cost of this task was totally financed by the work-package project management (EC funding: 207 k€).

On the basis of the rank of each project determined by the independent experts, the OPERRA Management Board takes a final decision on the projects that will be funded.

One important aspect to be highlighted from this approach is the need for transparency in the selection process: there should be clear rules on how to evaluate the proposals and avoid selecting evaluators that could have possible conflicts of interest. Furthermore, the call must be designed properly in order to have sufficient applicants per items.

- CONCERT is an EJP with open calls.

The EJP CONCERT officially started in June 2015; the first call was launched in summer 2016. The project calls are managed internally by a working group that will act as the tender manager (WP4 leader). The priorities for the call were based on pre-selected topics by each platform amongst their Strategic Research Agenda (SRA).

In the CONCERT Grant Agreement, signed between the EC and the coordinator of the EJP, beneficiaries and Linked Third Parties are identified.

The beneficiaries are “mandated actors” which means that they are entities financing and operating RD&D in the field of RWM. The mandate is given by the highest governmental body in charge of implementing the EC Waste Directive (generally a ministry or a regional authority, other possible cases can be discussed with the EC). The mandate is given only for the duration of the project and for a limited domain of activities. It stipulates that the “Activities” implemented by the mandated actors will correspond to the actual needs of a national programme and the associated RD&D programme.

Other legal entities, as associations, participate as beneficiaries, in particular entities created to coordinate or integrate transnational research efforts (MELODI, ALLIANCE, NERIS, and EURADOS). Such entities do not require a mandate to be a beneficiary.

The Linked Third Parties (LTP) are affiliated entities or third parties with a legal link to a beneficiary (pre-existing agreement, i.e. an established and a legal relationship which is broad and not specifically created for the Grant Agreement). The association members are automatically Linked Third Parties of the association; they don't need specific agreement.

The EC funding is given to the beneficiaries for their own participation in the project and for their linked third parties. The EC considers that the beneficiary is responsible for the actions undertaken by their linked third parties and for the money engaged by them in the project. There is no funding in advance for Linked Third Parties. The EC funding is given by the beneficiary when the work is done.

The difference between the cost of the actions and the EC funding must be financed by the beneficiary and the LTP (in-kind or cash).

The beneficiaries and their LTP are recipients of the project results.

The other Third Parties, without a link to a beneficiary are considered as “subcontractors”. In the Grant Agreement, the actions dedicated to subcontracting and the amount of money devoted to these actions must be clearly identified and accepted by the EC. After that, a beneficiary can contract with Third Parties in compliance with a call for tender. The beneficiary pays the non-linked Third Party for its contribution in the project but can be financed by the EC with respect to the actions identified in the Grant Agreement.

In CONCERT, the first call was launched in June 2016 and was organized by one of the beneficiaries, the French national research agency (ANR – France). A second call will be

launched in 2017. The EC has asked for open calls to guarantee that all the scientific community involved in this topic has the possibility to participate in the EJP.

In CONCERT, it was decided that after the call, new partners cannot be part of the consortium. The new partners will only sign a contract with the EJP coordinator and become subcontractors or non-linked Third Parties. This signifies that the EJP coordinator must be the guarantor of the new partners, and report to the EC the expenses of each new partner in view of the activities carried out. This organisation is different from other EJPs where it is necessary to have an amendment of the Consortium Agreement to embark new partners in the programme.

ii. Main available instruments proposed by the EC under Horizon2020: ERA-NET and European Joint Programme

The **ERA-NET Co-Fund** instrument under Horizon 2020 is a co-fund action designed to support public-public partnership including joint programming initiatives between Member States, the establishment of networking structures, design, implementation and coordination of joint activities by implementing a transnational call for proposal.

A **European Joint Programme (EJP)** is a co-fund action designed to support public-public partnership, coordinated national research and innovation programmes, including networking, training, demonstration and dissemination activities, support to third parties, etc.

The participants in both joint programming must be legal entities from different member states or associated countries owning or managing national research and innovation programmes.

o *comparison of identified co-fund actions*

ERA-NET co-fund	EJP
Participants in ERA-NET co-fund actions must be research funders: legal entities owning or managing public research and innovation programmes Minimum conditions for participation (three independent legal entities from three different Member States or associated countries) to be fulfilled by the entities participating in the joint transnational call for proposals.	At least, five independent legal entities from different Member States or associated countries owning or managing national research and innovation programmes
Duration 5 years	Duration of 5 years (possibility for two further years)
Stable reimbursement rate of 33%	EC contribution represents an average maximum of 70%, for ambitious overall budgets (20-50 M€). EC funding is

	generally around 50%. The management board (MB) may apply their own reimbursement rates within the EJP.
Implementation of a single co-funded call per Grant Agreement (GA) organised by national/regional funding agencies	Implementation of single or multiple calls and/or direct consortium activities by coordinator/MB
It is not necessary to have a high level of detail for the activities. The proposals/projects can deal with upstream topics (e.g. fundamental R&D topics)	A (pre-)agreed roadmap, or at least a goal/oriented approach with clear objectives. The programme activities are those planned to be carried out in full duration, but can be updated in each relevant twelve-month reporting period (Annual Work Plan).
The proposals/projects must be transnational projects (at least two independent entities from two different EU Member States or associated countries) and be selected, evaluated and ranked through specific procedures	The proposals/projects must follow the national research and innovative programmes of the countries involved.

iii. Why choosing EJP ?

From the above comparison, we can identify some assets of the EJP for a future joint programming on geological waste disposal:

- ✓ The EJP is the most suitable tool when it is possible to have a clear vision on the activities and to define them with a high level of detail;
- ✓ An EJP is well adapted to a publicly funded research community that already collaborates well together and intends to engage in complex and coherent *programmes* of joint activities beyond standard projects however, it requires a clear commitment by member states;
- ✓ In this case, for each activity, the project (tasks/participants/budget/deliverables) can be described in advance as it is for a technical project or a Coordination and Support Action providing a short to medium term vision of the resources to be used. Adjustments to the scope of the activities can be done every year;
- ✓ It is not compulsory to carry out external calls and contract GAOs if it can be proved that all the scientific community involved in geological waste disposal R&D are represented.
- ✓ An EJP is a EC tool that enables the funding of ambitious projects (minimum 20-50 M€)
- ✓ The EC contribution is comprised between 50-70% (ERANET 33%)
- ✓ The project coordinator manages the budget under the control of the General Assembly and its Executive board, whereas for the ERANET it is managed by national/regional funding agencies.

The EJP tool appears to be a suitable tool when the activities are defined and planned in advance, and when a research community has already collaborated together.

The aim of JOPRAD is to build a research community in RWM, in particular in the field of geological disposal, to embark together WMOs, TSOs and REs in the same JP. The results of JOPRAD should lead to a clear vision of the activities that could be shared by the different entities. Hence, from the feedback gathered from previous JPs, the EJP tool seems to be well adapted for a JP built on the JOPRAD outcomes.

From the feedback of CONCERT in terms of identifying the participants, we can note that:

- The beneficiaries must be “mandated actors” therefore, if they want to be beneficiaries of a future EJP, the entities involved in JOPRAD have to ask to their national or regional authority to be mandated.

The TSO’s group expressed the difficulties for certain entities (namely TSOs from Less Advanced Programs (LAPs)) to be mandated by their member states. For the moment, only two TSOs have received confirmation that they will be mandated for a future EJP. The other TSOs have encountered, either difficulties in identifying which authority or ministry is able to mandate them, and in some cases, (mainly for LAPs) are confronted with a situation where the national research programme is managed by the WMO and the entity in charge of the expertise function (TSO) has to answer a call for tender to contribute to research programmes for and with their respective WMO. This situation suggests that only a few TSOs will realistically be “mandated actors” in a future EJP, as for the other TSO’s, they will have to be linked to a beneficiary to participate.

- Associations can be beneficiary of an EJP at the same level as project managers; they don’t need to have mandate. The association members are consequently Linked Third Parties of the association (no legal contract is necessary between LTP and association).
- The Linked Third Parties must be identified and linked to a beneficiary before the beginning of the EJP. The beneficiaries and the LTP are identified in the Grant Agreement (GA) of the EJP.
- The Non Linked Third Parties (subcontractors) do not need to be identified in advance but the actions dedicated to NLTP must be described in the GA and the cost associated to these actions pre-defined.

8. Conclusion

In order to ensure inclusiveness of potential actors, especially from less advanced programs, for the implementation of JOPRAD, JOPRAD's partners have engaged during 12 months in intensive networking with external organisations designated by some of the member states to represent national actors of research in radioactive waste. Some of these external organisations are directly involved in IGD-TP or SITEX : their contribution allowed to account for the expectations of these two networks. Great efforts were also made to federate the research entities from academic field (universities, other laboratories...), and civil society organisations/citizen through dedicated working groups to collect their view and expectations for the future research to implemented in a JP, as well on their expectation for - and role in - the governance of the JP.

On the basis of these extended exchanges, JOPRAD's participants are of the opinion that a long-term stable structure and framework for the different actors with an interest and/or responsibility in the management of radioactive waste, through to disposal, is a real opportunity to improve the overall definition and implementation of the RD&D in an harmonised way throughout the European Union.

In particular, the JP would make possible to :

- Foster a shared understanding between WMOs, TSOs, REs and CSOs,
- Innovate in the management of RD&D and transverse activities by recognizing the strong socio-technical dimension in the management of radwaste,
- Continuously analyse the need for, develop and share the required knowledge, and transform mature knowledge into commonly agreed upon guidance,
- Share, develop and make effective use of human, technical and administrative competencies and resources.

Basis for the implementation of a system on JRC Public Access WEB Space integrating documentation on Knowledge, Guidance, Training, Strategic Studies for identification of further needs and Dissemination were also produced in order to allow the efficient implementation of transfer of knowledge.

Based on a comparison of possible European instruments for joint research, and on the experience gained with the implementation of two initiatives (the OPERRA project and the CONCERT European Joint Program (EJP)) in the field of radiation protection, JOPRAD came to the conclusion that the EJP tool appears to be the most suitable tool. A question remains to be further investigated during JOPRAD regarding the way to select the activities to be implemented during the EJP. Several options exist, as internal or external calls, or no call but only a predefined program of activities with some flexibility to launch new activities during the on-going of the EJP. The challenge is to minimize the burden for the management of the activities but ensuring in the same time inclusiveness of the overall research community.

Finally, a special vigilance is required regarding the key issues for success of building a JP, which are namely (i) the capability of the different actors to build a joint strategic research agenda and future work programme, (ii) to ensure inclusiveness and interaction, (iii) to establish governance for a fair and equitable joint programming, (iv) to preserve independence of actors at national level, where needed, and finally (v) to allocate sufficient resources.

References

ⁱ IGD-TP (2011), Strategic Research Agenda, Implementing Geological Disposal of Radioactive Waste Technology Platform, ISBN 978-91-979786-0-6.

ⁱⁱ IGD-TP (2012), Deployment Plan 2011-2016, Implementing Geological Disposal of Radioactive Waste Technology Platform, ISBN 978-91-979786-1-3.

ⁱⁱⁱ The Council of the European Union (2011). Council Directive 2011/70/EURATOM of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste.

^{iv} SITEX public report D6.1 available on the SITEX website (2013)