JOPRAD

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Deliverable D3.7 – Civil Society Views on the Content and Governance of a Joint Research Programme

Work Package 3, task 3.5

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Presentation of the JOPRAD Project

The goal of the JOPRAD project is to prepare a proposal for the setting up of "Joint Programming on Radioactive Waste Disposal". Joint Programming (JP) is intended to create and benefit from synergies between participating EU Member States' national R&D programmes in the field of geological disposal of spent fuel and other high-level and/or long-lived radioactive waste. The JP will embrace accompanying key activities (Education and Training, as well as Knowledge Management).

Implementation of the projected JP will engage "programme owners and programme managers", who are nationally mandated actors of research ("mandated actors"), and those who finance and carry out R&D on radioactive waste management, including geological disposal, in their respective countries. At the highest level, "the programme owners" are the ministries in charge of the setting up of the national programmes as mandated in the EU Radioactive Waste Directive[1].

The mandated actors addressed by the preparatory JOPRAD project fall into three categories: (i) Waste Management organisations (WMOs), (ii) Technical support organisations (TSOs) or national regulatory bodies, and (iii) nationally funded Research Entities involved in the R&D of radioactive waste management, under the responsibility of Member States (RE). JOPRAD involves representatives of these actors, as well as the participation of a Civil Society group to bring its views on the conditions and means for European Joint Programming on Radioactive Waste Disposal.

[1] 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: see https://ec.europa.eu/energy/en/topics/nuclear-energy/radioactive-waste-and-spent-fuel

Abstract

This report presents the work carried out under task 3.5 of the JOPRAD project, aiming at determining the views of civil society on the conditions, means and research content of a European Joint Programming (JP) on Radioactive Waste Management (RWM) including Geological Disposal (GD), and more specifically, the rules and procedures for the potential involvement of civil society (CS) in this Joint Programming.

The **first chapter** details task 3.5's objectives and methodology. It specifies the role and contribution of civil society representatives in the course of the JOPRAD project. In summary, the work of task 3.5 was to enable a civil society review of the R&D programme and governance options envisioned by JOPRAD for a potential Joint Programming (JP), and on the basis of that review to recommend how the views of civil society participants can be taken into account. Task 3.5 interacted on a regular basis with a group of European Civil Society Organisations (CSOs) engaged in RWM issues (see Appendix 1).

The **second chapter** describes the views and recommendations of the CS participants regarding the research content of a jointly programmed European R&D on RWM including GD. This chapter details the results of the assessment carried out by task 3.5 on the different Strategic Research Agendas (SRAs) that were generated by representatives of the mandated actors (WMOs, TSOs, REs) in an early stage of the JOPRAD project. This assessment checked the effective coverage of topics of relevance according to civil society, as well as the consistency and coherence of the later Programme Document combining the amended SRAs. This chapter also describes CS expectations for taking these relevant topics into account in the JP.

The **third chapter** presents Task 3.5 input on the selection of a governance framework for the Joint Programming, and in particular the means to associate CS in that future governance. CS participants reviewed several projected options with the help of a methodology set out in a "Guide for the assessment of the future JP Governance" (see Appendix 6), and suggested provisions to secure the participation of civil society in the final arrangements retained by mandated actors for European Joint Programming.

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List of abbreviations

CS:	civil society
CSO:	civil society organisation
DGR:	deep geological repository
DG RTD:	directorate general for research and innovation
EBS:	engineered barrier system
EC:	European Commission
EJP:	European Joint Programme
JP:	Joint Programme
GD:	geological disposal
IKMS:	Integrated Knowledge and Management System
ILW:	intermediate level waste
JRC:	joint research center
KSI:	knowledge sharing and interpretation
NGO:	non-governmental organisation
NTW:	Nuclear Transparency Watch (European network of NGOs)
R&D:	research and development
RE:	research entity
RWM:	radioactive waste management
SC:	safety case
SITEX[2]:	sustainable network for independent technical expertise of radioactive waste disposal
SRA:	strategic research agenda
TSO:	technical support organisation
WMO:	waste management organisation
WP:	work package

[2] The SITEX-II project (Interactions and Implementation) aimed at practical implementation of the activities defined by the former EURATOM FP7 SITEX project (2012–2013), using the interaction modes identified by that project. Overall SITEX and SITEX-II target an independent Expertise Function network in the field of deep geological disposal safety, in the beginning of its activities. After this first period, actions dedicated to pre-treatment, treatment, conditioning, as well as transport and storage of radioactive waste having an impact on the safety of geological disposal facilities could also be considered in the SRA network. Furthermore, activities related to management options other than geological disposal may be addressed by the SITEX network if relevant to several national programmes. This SITEX network is expected to ensure a sustainable capability for developing and coordinating, at the international level, joint and harmonized activities, related to the Expertise Function.

1- Introduction

1.1. Objectives and activities of task 3.5

As it is established in the Grant Agreement of the JOPRAD project, the main objective of task 3.5 is to "*propose and prepare the mechanisms for interacting with the civil society on the common R&D cross-cutting issues of Technical Support Organisations (TSO), Waste Management Organisations (WMO) and Research Entities (RE) and determine research topics relevant for society notably regarding social science*". In order to reach this objective, task 3.5 carried out two main activities:

- The identification of key research areas that civil society would like to see addressed by the joint research programmes. Based on this work of identification, a first step was to review the three Strategic Research Agendas (SRA), produced by the different types of actors involved in JOPRAD and in the future Joint Programming: the IGD-TP SRA for the WMOs, the SITEX-II SRA for the TSOs, and the SRA of the REs. A second step of this work was to review the emerging common Programme Document of JOPRAD and to make proposals, when necessary.
- The identification of rules and procedures for the potential involvement of civil society (CS) in this Joint Programme.

1.2. Methodology of task 3.5

Through the task 3.5, 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 a group of representatives of European Civil Society Organisations (CSOs) engaged in following radioactive waste management activities at EU or national level. This group has interacted with JOPRAD participants throughout the project in the frame of task 3.5. It gathers representatives of 35 organisations from 18 countries in Europe (see Appendix 1), reflecting a variety of situations at national level, sometimes very unfavourable for public participation.

This Civil Society group has been assembled under the auspices of the Working Group for Radioactive Waste Management of the Nuclear Transparency Watch (NTW) network that is co-ordinated by Johan Swahn from MKG (Swedish NGO Office for Nuclear Waste Management Review). The CSO participants in the network are not expected to represent NTW as one organisation but rather to provide a variety of European CSO viewpoints. Strengthening and maintaining a high level of nuclear safety in Europe is a common concern for all members of this group without prejudice to their respective position vis-à-vis nuclear energy. This group of CSOs was also involved in the SITEX-II project that developed[3] innovative processes enabling interactions between experts and civil society.

Task 3.5 interacted with the whole Civil Society group through a mailing list to broadcast information and collect comments. Task 3.5 also organised three meetings with more involved CS representatives in the group: 28th August 2015 in Paris, 23th February 2016 in Ljubljana and 29th June 2016 in Budapest. The first meeting gathered around 30 participants, the second and the third meetings around 20 participants. The attendance lists are available in Appendix 2. At the first meeting the JOPRAD project was presented to invited representatives

[3] The reflexion on the model of interactions with civil society was already initiated in the SITEX (2012-2013) project.

of NGOs and it was discussed the how they could potentially be involved in the project. The second meeting reviewed the progress of the JOPRAD Task 3.5 and discussed and improved the preliminary assessment of the SRAs. The third meeting discussed the potential schemes of governance and integration of Civil Society in an European Joint Programme (EJP). The EJP that has been chosen by the JOPRAD consortium as the most suitable option is one of the available governance options to implement a Joint Programme (see chapter three).

Task 3.5 methodology combined analysis and assessment of JOPRAD consortium proposals (SRAs of the different mandated actors, preliminary elements of a common programme, models of JP governance) with the development of specific recommendations on conditions and means to ensure a fair and fruitful contribution of civil society. Relying on the Civil Society group's conclusions Task 3.5 identified key research areas that it would like to see included into the activities of the joint programme. CSOs underlined the need to consider both technical and non-technical aspects of the decisions involved in the development of RWM and GD, therefore calling for the integration of not only scientific and technical but also social sciences R&D.

1.3. Role and contribution of civil society in JOPRAD

In JOPRAD the position of the CSOs is specific in the sense that they are not research actors but are involved in the perspective of the implementation of the Aarhus Convention[4]. The CS participation in the setting of the potential R&D joint programming on GD fits with the Aarhus rights to access to information and effective public participation. Involved CSOs in JOPRAD have expressed views on what matters to them and they will consider the extent to which their views will be duly taken into account. Still, it is accepted that the final responsibility for implementation of suggestions lies in the hands of JOPRAD, as well as in the hands of the European Commission.

The participating CSOs have a specific interest in the safety of RWM and, in this perspective, in the safety of GD (this is the very aim of the NTW RWM working group). It is understood that while focusing on geological disposal (GD), at least part of the Joint Programming will develop research in the perspective of reinforcing safety of RWM as whole. CSOs have underlined the need to consider in the research programming the impact (externalities) of some decisions involved in the development of GD on the safety and radiation protection of RWM as a whole.

Moreover, Civil Society representatives are not bound by any mandate to geological disposal or any other technical solution. The Civil Society viewpoint is not based on a technical framework and it therefore enables broader qualitative inputs to be taken into account. Participation of Civil Society in joint programming should not be limited to projects that are more specifically dealing with non-technical topics. It is underlined that Civil Society should also participate in more technical activities, interacting with WMOs, TSOs and Research Entities. It is however noted that a fruitful participation on technical topics should entail the involvement of knowledgeable experts that are close to and entrusted by civil society, that have the capacity to liaise with non-government organizations and the public in general to contribute to the Knowledge Sharing and to its Interpretation (KSI), developing a mutual understanding of how and to what extent a given research make sense and contributes to improving decisions (see chapter 3 for further development). It is also underlined that one condition of effective involvement of Civil Society is giving due account to its expressed views on what should be included in the Programme Document.

[4] The full text of the Aarhus Convention is available online: https://www.unece.org/env/pp/treatytext.html

2. Expectations of Civil Society regarding R&D issues and horizontal activities of a JP on GD

2.1. Introduction

An important part of the possible Joint Programme (JP) is obviously the definition of shared and prioritized R&D programme. The Programme Document developed by the WP4 of JOPRAD is based on combined contributions by the implementers or Waste management organisations (WMOs), the Technical support organisations (TSOs) and the Research entities (REs). It also includes an in-depth discussion of horizontal activities. The process was informed by substantive inputs from Civil Society (CS) on the crosscutting issues.

The CS analysis includes a review of the draft strategic research agenda (SRA) developed by TSOs under SITEX-II, as well as of the already finalized SRA by the WMOs of IGD-TP, and finally of the available inputs from the SRA under drafting at that time by the REs. Those documents[5] were presented and discussed during the JOPRAD meeting of 14 December 2015. The discussion notably compared those SRAs in light of key issues identified by the CSOs[6] and contributed to the compilation of the effective draft Programme Document. CSOs will build on this first assessment when reviewing a finalized version of the Programme Document that is expected to be delivered by JOPRAD WP4 in 2017. The results of their final assessment will be presented in a separate report[7].

CS also identified a need to include "social and citizen science aspects" in the JP in order to address the complexity of RWM. Citizen science is defined here as the direct involvement of the interested public in working together with scientists in the production of trustworthy and reliable scientific knowledge. While task 3.5 recommends including social science domains in the Programme Document alongside technical domains in order to elaborate “complex” (multidisciplinary) R&D projects in the future EJP, citizen science could be the methodology of involvement of CS representatives in these project. Furthermore, “Knowledge Sharing and Interpretation” (KSI) should also involve a direct CS contribution.

[5] These documents included:
- WMOs: «JOPRAD: WMO’s Priorities», IGD-TP, slides by Jacques Delay (ANDRA), JOPRAD meeting of 5 October 2015 in London (file “11 - 0 - JOPRAD WMO's priorities v2.pptx”);
- TSOs: «JOPRAD Task 3.2: Objectives, Current Status & Key Questions», slides by F. Lemy (Bel-V), SITEX II WP1 meeting of 18 November 2015, Millau (file “SITEX2_WP1_15_11_18_Task3_2_v0.ppt”);
- REs: «Research Entities in the Joint Programming on Radioactive Waste Disposal», slides by Berndt Grambow (CNRS), meeting of 13 March 2015 (file “2015 09 24 WP1 CM2 Item 11 - WP3 -Task 3.3.pptx”);
- Horizontal activities: «Integrated Knowledge Management System for Radioactive Waste Management / Geological Disposal in view of Joint Programming in R&D», Working Document for development of Horizontal Activities, not authored, not dated (file “Horizontal Activities Working Document 1.7_AvK GB_JD.docx”).

[6] These issues were described and explained in two working documents:
- *«SITEX II WP 4.1: Comment on the possibility of Civil Society input into the Work Package 1 process to develop “Possible R&D Topics” for a SITEX II Strategic Research Agenda, SRA»*, J. Swahn (MKG), Y. Marignac & G. Hériard-Dubreuil (Mutadis), Z. Koritár (Energiaklub EK), 12 November 2015.
- *«SITEX II Task 4.1: Civil Society Organisation review of European “strategic research agendas (SRAs)” for radioactive waste management and input from Civil Society into a European strategic research agenda»*, J. Swahn (MKG), Y. Marignac & G. Hériard-Dubreuil (Mutadis), Z. Koritár (Energiaklub EK), 17 September 2015.

[7] This second report will be the deliverable D5.3 of the JOPRAD project on EJP stakeholder’s involvement to be finalized at the end of October 2017.

2.2. Identification of key issues for Civil Society Organisations

The CSOs developed comments regarding the progress towards Joint Programming on two separate levels:

- WMOs, TSOs and REs each express specific conditions to achieving joint R&D, depending on their own responsibilities and constraints. This explicitly or implicitly points to a shared need to elaborate on the boundary conditions of joint R&D activities – which in turn encouraged CSOs to bring their own views on that matter;
- WMOs, TSOs and REs each proposed R&D topics in different levels of detail. The CSOs first focused their analysis on the identification of possible gaps or overlaps, then slowly moved towards the way to the introduction and articulation of other research topics they felt incompletely addressed in the SRAs. This analysis will constitute a basis for assessment of the Programme Document when it will be finalized as mentioned above.

2.2.1. Preliminary considerations on the boundary conditions

Upon reviewing the draft or final SRAs available from WMOs, TSOs and REs at the beginning of the JOPRAD project, the CSOs noted that each of the three concerned groups of entities had felt the need, to a greater or lesser extent, to define the boundary conditions of its involvement in joint R&D activities. Bounds were placed on the topics that these entities would cover, in light of e.g. their respective responsibilities, or the nature of the implied collaboration.

It was not relevant at this stage for CSOs to elaborate the boundary conditions of their own involvement in joint R&D activities. This is mostly because the CSOs involved in the project are not in a position of conducting or contributing as researcher to R&D. However, **CSOs emphasized from the beginning that a fruitful participation of Civil Society entails the involvement of knowledgeable experts that are close to civil society and vested with trust by it and who have the capacity to liaise with Non-Government Organizations and the Public.**

CSOs expressed some strong concerns with boundary conditions found in the draft documents of the WMOs, TSOs and REs, and notably what they consider as a "risk of a capture of the regulator" by the implementer, or more precisely of the TSOs by the WMOs. They clearly expect TSOs to develop not only R&D that is needed to examine the safety cases as presented by the WMOs, but also independent R&D in the whole field of safety assessment. CSOs expect TSOs to seriously follow up on any issue raised or identified in the course of their own safety research, whether or not the WMOs attribute importance to these issues.

The whole analysis is available in Appendix 3.

2.2.2. Complexity of RWM and comprehensiveness of R&D

In order to be able to consider the SRAs developed by the WMOs, TSOs and REs and the subsequent elaboration of a Programme Document, the CSOs felt the need in the beginning of the process to develop their own analysis of the issues they would regard as the most critical.

As a starting point, the CSOs emphasize that all stakeholders and decision-makers should be aware of the complexity of the radioactive waste management issue. This is a system

comprising not only scientific and technological questions, problems and tasks, but largely social/societal concerns as well. Such elements are interconnected, and addressing scientific or technological aspects in isolation from the social/societal context (or conversely) might lead to incompatible or incomplete results. CSOs identified signs of a mistaken belief by scientific and technological researchers/implementers that safety can be achieved purely by scientific/technological improvements. Uncertainties exist, especially because of the long time span and also because of the hybrid socio-technical nature of the complex system, and these uncertainties should be managed also by means other than technology.

The CSOs were concerned to read in some working documents statements such as: "the objective is to demonstrate that long-term safety can be met in practice by available construction technologies". In their view, a complex problem such as RWM cannot be addressed by the sole means of technology. Rather the research question should read: "the objective is to demonstrate *whether* long-term safety can be met in practice by available construction technologies"

The current official RWM strategies, explicitly or at least implicitly, suggest that the best way to reach a safe solution is to elaborate an optimal solution (the geological disposal) and to demonstrate its safety through a safety case review procedure. However, a strong level of uncertainty is inherent to the long-term dimension of RWM and would suggest the need to consider other epistemological strategies. For instance, the "substantive rationality" characterizing current RWM strategies (find now the optimal solution and decide now for the future) could fruitfully be exchanged for "procedural rationality" (incremental knowledge development and decision management). It should be mentioned here that substantive rationality strategies reduce the chances of reaching a "satisficing" option (rather than an optimal option), should the process eventually reject the considered optimal option.

In light of this need for comprehensiveness, and this concern for addressing the complexity of the projects considered, the CSOs developed their own list of key topics, issues and themes to be addressed as part of a consistent strategy. It is important to note that this list was never intended to become the basis for a kind of CSOs' SRA. The approach was not to categorize issues and to establish priorities, but rather to describe a series of items that should, in the view of the CSOs, be included in a joint agenda, whichever way they might be articulated and ranked. In that sense, the list was mostly meant to feed the analysis of proposed SRAs through benchmarking their content against these issues of concern for the CSOs. These numerous issues were organised in seven distinct fields, as follows:

- Quality of data
- Techno-scientific issues of importance for safety-case review
- Siting (safety case related)
- Issues regarding methods for disposal
- Fundamental principles for evaluation of safety case
- Issues regarding societal development related to RWM (justification of RWM strategies and governance, evaluation of societal impact of different RWM scenarios, retrievability, monitoring, long-term surveillance, transfer of information, institutional procedures)
- Social science research and interaction with humanities and arts.

It is interesting to note that this structure is for the most part "bottom-up", going from the details outwards to more general issues. It should be noted that a strategic research agenda should ideally be set up to be "top down", i.e., starting with more general issues and then developing the details.

These issues found to be of special interest from a civil society perspective are detailed in the following sub-sections.

2.2.3. Quality of data

- **Consistent and complete inventory analysis**

It is essential that the descriptions of inventories of radioactive waste be consistent and complete, and that they account for the uncertainty regarding the final waste that could arise from future voluntary or forced changes in radioactive waste management strategies or from possible future changes in energy production strategy.

The inventory is of essential importance in at least two concrete domains of application. The first one is the final allotment of various categories of waste to the different final management solutions. Some categories, which were planned to be dealt with through another path, might end up as part of the inventory of geological disposal projects if the path sought for turns out to fail. Also, the planned allotment of legacy waste might rely on a priori estimates of their physical, chemical and radiological characteristics that could be challenged by actual monitoring, possibly adding volumes and even new categories to the planned inventory of geological repositories.

The second domain concerns strategies aiming for the reuse of some nuclear materials, the main example being the reuse of plutonium obtained after reprocessing of spent fuel in the manufacture of fresh MOX fuel. There is obviously a risk that part of the inventory of those nuclear materials that are planned to be reused, and therefore not considered as waste, turns out not to be reused (either for regulatory, technical, industrial or economic reasons). This could particularly concern, where reprocessing has been or still is implemented, some irradiated fuel, and some separated plutonium and reprocessed uranium under various forms.

This calls for efforts in research at various levels. To start with, some analysis is needed to discuss the overall relevance of the allotment strategies, including plans for reuse of materials, in terms of overall balance of risks, consistency, robustness and flexibility. Then, the uncertainties on the volumes and categories potentially part of the inventory of geological repositories should be assessed, and the sensitivity of the repository design and of its safety case to the possible range of volumes and categories should be discussed. Finally, research should cover the need to adapt the design and extend the safety case to these potential conditions: this implies, for instance, to conduct specific research on the safe disposal of separated plutonium where there is a risk that some separated plutonium remain unused.

2.2.4. Techno-scientific issues of importance for safety-case review

- **Corrosion issues**

General corrosion of encapsulation materials or other metallic materials in a repository will influence the safety case.

The corrosion of copper in anoxic conditions is a very important variable for the safety case of the KBS system used by Sweden and Finland, and potentially by several other EU member states. There appear to be scientific uncertainties regarding how copper behaves under real repository conditions compared to theoretical and mass balance calculations.

The corrosion of steel containers is also important. Corrosion processes can produce gas that can become problematic in a repository. There are indications that some countries could consider using steel instead of copper in the KBS method, a substitution also of significance for the safety case.

Corrosion processes must be assessed in a range of conditions covering with sufficient margins the various situations found in the repository and its close environment as required in the safety case. Moreover, the assessment must be extended to the various components of final waste that could interact with the encapsulation materials, including characterization of legacy waste as well as uncertainties related to the risk of failure of quality and control processes.

- **Clay issues**

Clays are used in different repository systems as a buffer or filler during deposition of waste packages. In the KBS method the clay has a very important function for the safety case, as it should form a tight enclosure of the canister. It is thus important to understand clay-metal interactions.

- **Microbiological issues in conjunction with corrosion or clay issues**

Microbes influence many mechanisms in a repository environment. If it is important that the repository is anoxic, then understanding the rate at which microbes consume oxygen is essential for safety assessment, as the behaviour of canister materials and clays will rely very much on the microbiological environment.

- **Geological and hydrological knowledge**

The understanding of how to model the geology and hydrology of different types of host rocks is important for the evaluation of the safety case. There is a need to develop modelling independently from the implementers.

- **Glaciation issues and other natural stresses**

The understanding of how permafrost, earthquakes and other stresses on a repository environment is important for the evaluation of the safety case. Independent research and modelling from that of the implementers is needed.

- **Security issues (physical protection and safeguards)**

Issues regarding physical protection and safeguards against non-proliferation need to be studied, in both pre- and post-closure perspectives. Although these issues are usually dealt with separately from safety, environmental and radiological protection issues, there is obviously a need to establish a linkage between them. One reason, which is common to all nuclear facilities, is that security measures (such as fences, armed forces, etc.) might not be adequate to prevent malevolent attacks, therefore calling for safety equipment (such as cooling devices, containment barriers, etc.) to assure a required level of protection against the consequences of successful attacks.

This will be even truer as time goes by, because technical progress creates increasingly diverse, diffuse and remote means of malevolent attacks (such as drones, computer viruses, etc.) that become increasingly difficult to detect and intercept. This furthermore applies to geological repositories, where active protection against those attacks could only be sought while active monitoring and operation are maintained.

Research on vulnerabilities and hazards of transports of radioactive waste to central storage/disposal sites is similarly important.

A research agenda should include some identification of credible malevolent attacks to be considered during different relevant timespans and the way to reinforce the design of safety features of the planned repositories against those threats.

2.2.5. Issues regarding siting

- **Selection of an area**

Siting in areas where regional ground-water flows at depth may provide long break-through times after corruption of repository barriers. When siting a repository it may be advantageous to locate it inland in a recharge area where regional groundwater flows can give long break-through times from a leaking repository. This issue has not been considered sufficiently in siting activities. An example is the Swedish siting process where the implementer decided to only explore coastal sites, even when the regulator had recommended also considering inland siting.

- **Geological stability**

The following issues regard geological stability. They should be investigated, where the aim is to find out whether environmental processes will have significant impact on the repository:

- Investigating neotectonic activities is of great importance, as they might influence fracturing in host rock (which is responsible for permeability), as well as elevation of areas, resulting in more intense erosion, or the changing of morphology and groundwater flow systems (recharge and discharge areas).

- Investigating local faulting systems with regard to susceptibility to seismic activity.

- Effects of climate change should be analysed, as it will be of crucial importance: marine transgression, changes in meteorological conditions (influencing groundwater flows), changes in the biosphere (with the change of microbiological activities in groundwater).

- Complex processes, in general but especially in view of changes over time around the planned repository, will be important to understand. Properties (of host rock, groundwater, waste, etc.) and processes (geological, hydrogeological, climatic, anthropogenic, etc.) can widely vary; modelling of their interactions should be conducted, in order to provide estimations for the long term.

2.2.6. Issues regarding methods for disposal

- **General discussion of how to approach the choice of disposal methods**

An interesting project when it comes to an open discussion of how to approach the choice of disposal method is the German ENTRIA project[8]. The project has a broad interdisciplinary approach and has divided the discussion of choice of disposal into three different types:

- Final Disposal in Deep Geological Formations Without any Arrangements for Retrieval
- Disposal in Deep Geological Formations With Arrangements for Monitoring and Retrieval
- Surface Storage.

This can be seen as an approach to choice of disposal method that is less inclined to a “lock-in” situation than processes that have traditionally been used in many countries.

[8] http://www.entria.de/projekte.html?&L=1

- **Repository systems that can be converted from retrievable "intermediate storage" to "final repositories"**

It is very much worth discussing the possibility of constructing a good safety case for a final repository that allows radioactive waste to be retrieved for a certain period before final closure. One aspect of this discussion is the difficulty to reconcile the degree of flexibility needed as long as operational and monitoring capacity is maintained on the site, with the intrinsic stability needed once this capacity is lost – which is bound to happen at some point in the future. A clear path would be needed from one state to the next.

There is therefore a need to further discuss the strategy attached to the management of a geological disposal and the decision-making process allowing its eventual transformation into a final disposal site.

- **Very deep boreholes**

There is increasing interest internationally in the use of very deep boreholes for final disposition of high-level radioactive waste. There is an on-going pilot program in the United States[9]. As the safety case for very deep boreholes may prove to be exceedingly robust and the method may be less expensive than present European repository systems it may be well worthwhile to examine the method more closely.

- **Surface storage with "rolling stewardship"**

There is the possibility that no method for final disposal of high-level radioactive waste is found to be acceptably safe. In this situation long-term surface storage may be considered the only way forward. If this is the case the possibility of "rolling stewardship" has been proposed and could be evaluated further.[10] Rolling stewardship entails keeping the waste in a surface or sub-surface facility indefinitely with access to observation possibilities. The challenge is to pass the responsibility and knowledge to future generations. Even if a geological disposal is used for final disposal of high-level radioactive waste, the idea of rolling stewardship" could be interesting as a way of trying to ensure that information about the repository is moved into the future.

- **Transmutation of radioactive waste in a non-nuclear future**

Whether nuclear industry is only a short parenthesis in energy history or is there for longer, we must consider a situation in the future where there is no nuclear power production but only radioactive waste.

Transmutation is today only considered in the perspective of continuing production of nuclear energy. The possibility that at least some of the long lived radionuclides could be turn into short lived radionuclides or stable elements relies on the assumption that nuclear energy will be used long enough to develop reactors or more complex systems implementing this transmutation process. The first limitation to this plan is the fact that we have so far no evidence, besides some experiments on tiny targets of selected radionuclides, of any real potential for a drastic change of scale, needed to transmute large quantities of mixed radionuclides with a positive balance across the nuclear fleet. But then comes the second limitation that transmutation becomes even more out of scope if nuclear energy is no longer used.

[9] http://www.nwtrb.gov/meetings/2015/oct/mackinnon-om.pdf
http://prod.sandia.gov/techlib/access-control.cgi/2015/154424r.pdf
[10] http://www.ccnr.org/CCNR_Undertaking_final.pdf

The possibility to reduce the inventory of some of the most problematic radionuclides in waste by transmutation, if it exists, has to be considered, especially if the long-term safety cases of repository systems are found to be difficult to show to be safe enough. However, research in this area should primarily focus on the way this possibility really articulates with the design and implementation plans of geological repositories. This means for instance to discuss the degree to which a credible level of transmutation could be obtained in the deployment of future reactors, the compatibility of this implementation with the actual status of the waste prepared, conditioned and disposed of according to the stage of advancement of the repository[11], and the balance of risks involved. Research could also question in a very open way the possibility for transmutation by other means in a post-nuclear world.

2.2.7. Issues regarding fundamental evaluation criteria for a safety case

- **The use of concepts like the precautionary principle, best available method or technology, or best available site**

It would be useful if there were some discussion at European level of how concepts like the precautionary principle, best available method or technology, or best available site can be used in safety case analysis.

Modelling is needed to support risk assessment. Modelling failure scenarios, such as failure of one or more barriers (natural or engineered), can help prepare for uncertainties.

2.2.8. Issues regarding societal development

- **Justification of RWM strategies and governance (general balance of risks for population, site and time)**

There are a number of issues to balance when taking decisions on how to proceed with different RWM strategies, especially when considering open or closed nuclear fuel cycles. Risks to a population over time under different strategies, as well as different siting strategies, are important issues that need close attention.

The final disposal of some radioactive waste in a geological disposal is only a part of the final outcome of an overall RWM strategy. As soon as geological disposal is decided to be the preferred option for the management of some waste, there is an interaction between the overall design of the strategy and the general concept of the repository. The decisions regarding the categories of waste to be disposed of in the repository have implications regarding both whether or not to develop other options (such as subsurface disposal of specific categories), and the size and safety features of the repository. These decisions must therefore be justified from both perspectives, based on an overall assessment of the risks. For instance, some options taken in RWM to reduce the inventory (in terms of volumes or categories) of the final repository and therefore its risks, lead to higher risks in the interim period that need to be balanced.[12]

[11] For instance, the reprocessing option leads to conditioning the final waste to be disposed of, long before its actual disposal in a future geological disposal, in the form of vitrified waste that strongly reduces the possibility to implement any transmutation of some of its content in a foreseeable future.

[12] The worst illustration of that kind of bias might be when the reprocessing industry uses the argument of reducing the long term radiotoxicity in the geological disposal thanks to the separation of plutonium from the final waste, while this separation actually leads to much more handling, transport, storage and use of this material, and therefore much more risk of exposure of workers, populations and the environment to its extremely high radiotoxicity. Another commonplace example is the comparison of potential releases arising from the

Such choices also affect the timeframe of implementation, raising issues regarding the management of risks in the interim period that are also interlinked with the project of geological disposal and its development. Typically, the longer it takes to implement this repository, the higher are the stakes of safely storing the corresponding waste in the interim period. Also, the technical options chosen for this storage (like wet or dry storage of spent fuel) might influence the final characteristics of the waste and therefore impact the safety case of the final repository. Again, this kind of interaction needs to be fully assessed in order to justify, from the perspective of an overall reduction of risks, the consistency between the overall RWM strategy and the design of the repository.

The common Programme Document should therefore address this consistency issue. First, some methodological developments should allow better assessment of the overall balance of risks in this interaction between RWM and repository options, so that justification could be discussed on a fair basis. Then, specific issues regarding the technical continuity between the reduction of risks during the interim period and the reduction of risks attached to the repository should be better identified so that specific research could be conducted where it is needed.

- **Cross-evaluation of the societal impact of different scenarios and strategies of RWM decision making**

In order to better address the complexity of RWM decision-making processes and more specifically the social/societal dimensions that are attached to the whole long term picture of RWM, several social sciences perspectives should be adopted to cross-evaluate decision-making pathways and their respective capacity to fulfil the needs of both societal and scientific-technical modes of building confidence and social trust.

As explained above, the past and current scientific and technical focus of RWM strategies has underestimated the complexity of RWM issues and given limited account to the societal dimensions (social, political, ethical) of decision-making processes. **Civil society finds itself largely outside the process of drafting and of implementing the RWM options, while implementers and public authorities struggle to involve society at the latest stage of decision-making when most options are predetermined, and, in particular, when the foreseen outcome of the scientific and technical elaboration is essentially set, precluding therefore the embedding of social and technical issues (see also section 2.3 of this report).**

From the very first stage of the JOPRAD process, some of the participating CSOs underlined that: “to set a priori the outcome of the decision process (by designating the geological disposal as the optimal option and ultimate goal of the process) is a factor of destruction of social trust and therefore compromises the chances of safely implementing RWM policies”.

It is therefore suggested to develop research on cross-evaluation of diversity of scenarios and mix of technical options such as Final Disposal in Deep Geological Formations Without any Arrangements for Retrieval, Disposal in Deep Geological Formations with Arrangements for Monitoring and Retrieval, Surface Storage, Repository systems that can be converted from retrievable “intermediate storage” to “final repositories”, Surface storage with “rolling stewardship”, Transmutation of radioactive waste in a non-nuclear future, Very deep boreholes, etc.

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disposal of vitrified waste versus spent fuel in a geological disposal, when it does not take into account the huge actual radioactive releases that occur at the reprocessing stage.

In order to avoid misunderstanding, it should be underlined that the purpose of the considered research is not to evaluate the technical options in themselves, but to consider the relative contribution of different decision-making pathways (involving several technical options at different successive stages of the decision making) to the integration of technical and societal issues.

In particular, it is suggested to consider the potential of each scenario for socio-technical hybridization, for enabling the various concerned communities (experts, regulators, implementers, local communities, CSOs) and the public to build together inter-generational "commons" in framing and making successive steps of long term RWM, in precluding the political externalization of society that is attached to technocratic decision-making, the social construction of satisficing options, the development of a democratic culture and democratization of expertise.

- **Retrievability (pros and cons)**

The issue of whether to ensure retrievability of radioactive waste is a complicated issue worth proper handling. This issue is a research topic on its own from the point of view of governance and ethics, but also related to most of the technical and societal points listed in this sub-section.

One important part of the discussion is that retrievability allows changes but also makes it easier for future generations to intentionally or non-intentionally cause security problems or environmental harm. Another important part of the retrievability discussion is the level of reversibility which is actually sought, from the simple capacity to take some of the waste back from the repository to a broader concept involving some flexibility of the design and the management options, so as to delay as much as possible irreversible decisions.

The level and timespan of retrievability and its consistency with the overall RWM strategy and with the aim of bringing the geological disposal to the best possible level of safety are an important field of research that should be strengthened in the strategic agenda.

- **Monitoring (possibilities, pros and cons)**

The issue of whether monitoring of a radioactive waste repository for environmental reasons is possible, and the advantages or disadvantages of monitoring, are worth further consideration. It should be taken into account that developing reliable monitoring systems can contribute to societal confidence in geological disposal.

- **Long-term surveillance for safeguards/physical protection**

The issue of how to keep safeguards/physical protection in the long term after closure is worth considering. It should be taken into account that developing reliable long-term surveillance systems can contribute to societal confidence in geological disposal.

- **Transfer of information (possibilities, pros and cons)**

The issue of how it would be possible to transfer information about a radioactive waste repository into the future is a challenge that needs to be investigated.

- **Legal, institutional and organizational procedures**

Working out accurate legal, institutional and organizational procedures is almost equally important than technical and scientific research. It can include aspects on planning, siting, construction, operation as well as issues mentioned in the previous points (4.6.1-4.6.5), which are essential if the aim is to strengthen confidence in geological disposal.

This preliminary analysis on issues regarding societal development is further developed in a later step of task 3.5 (see section 2.3 “addressing RWM complexity).

2.2.9. Social science research and interaction with humanities and arts

- **Social science research**

The following issues could be of interest for social science research:

- Transparency and public participation including new participatory processes
- Legal aspects including issues of responsibility
- Risk analysis, communication, and perception
- Aspects of intergenerational ethics
- The anthropological, sociological and social psychological impacts of repository host communities and associated affected communities along transportation routes; and of communities hosting large-scale radioactive remediation such as former uranium mining sites and facilities under long-term decommissioning.

- **Humanities and arts**

Regarding interaction with the humanities and arts, the InSOTEC[13] and OECD NEA RK&M[14] projects have demonstrated the need for the arts and humanities to be involved in the process of siting, monitoring and marking of radioactive waste disposal sites for future generations. Development of nuclear and radiation culture (films, art and installations) is an interesting way of embedding knowledge of RWM into cultural archives, traditions and practices in ways that are resilient[15]. The Nuclear Culture project, UK, is working with contemporary art institutions and RWM agencies across Europe to include artists and a wider public in this discourse.[16]

In a further step of the task 3.5 analyses, the identification of social science research topics to be included in a Joint Programme have been completed (see section 2.3 “addressing the RWM complexity).

2.3. Addressing the complexity of RWM

2.3.1. Addressing the complexity of RWM, identifying social sciences needs

Task 3.5 further developed the considerations on issues regarding societal development and social research topics presented above.

Geological disposals are integrated (complex, holistic) sociotechnical systems that aim to achieve safe disposal of radioactive waste on the long term. They are made of various different parts that are brought together in order to make it possible to take sound decisions that involve difficult technical challenges as well as political, ethical and financial choices and trade-offs. Radioactive waste management has a composite nature and involves a combination of natural resources, technological artefacts, scientific knowledge and expertise together with social, political and cultural resources. It entails an irreducible dimension of uncertainty that is associated with the (very) long-term dimension that characterizes the potential impact of

[13] http://www.insotec.eu/
[14] https://www.oecd-nea.org/rwm/rkm/
[15] See for example: http://www.artscatalyst.org/perpetual-uncertainty-0
[16] http://nuclear.artscatalyst.org/

radioactive waste. Complexity means here the existence of several dimensions of a problem that cannot be addressed and dealt with separately.

Addressing the complexity of RWM issues and GD implementation, task 3.5 developed a detailed description of 5 different research topics addressing social and political dimensions of the development of geological disposal:

- **Research topic 1 - Uncertainty, Epistemology, Social Trust along RWM and GD Implementation**

Background:

The inherent uncertainties as well as the inter-generational dimension of long-term implementation of geological disposals make it necessary to understand how social trust building processes may unfold along the stages of a phased decision making, for the successive generations of stakeholders at local, national and international levels. It should be investigated whether it is possible for each generation to inherit, update and carry forward previous radioactive waste management strategies, achievements, and remaining questions and uncertainties, while maintaining social cohesion and solidarity.

Research needs and drivers:

A first question here is to characterize the nature of the several kinds of uncertainties that are expected to come into play in the course of the development and implementation of geological disposals: technical uncertainties (uncertainties that can be solved with more science, irreducible uncertainties), non-technical uncertainties (such as social, political and economic uncertainties), etc.

The second question then is to determine the possible processes (collective intelligence, social trust and confidence building) that are available for successive generations to deal with or to reduce those uncertainties, in the course of the safety case review and considering operational safety. The collective intelligence of the waste management strategy means here, taking advantage of contributions by a plurality of persons in an intra-generational and inter-generational perspective (distributed rationality in space and time). This research topic is considering epistemological strategies such as “procedural rationality” involving incremental knowledge building and decision management as well as “distributed rationality” mobilizing societal capacities of synchronic and diachronic distributed intelligence. This involves evaluating the current patterns of social trust for the different categories of stakeholders (including the public) in order to bring a fresh understanding of the conditions and means for renewed trustworthy epistemological patterns.

Those questions should be investigated for the successive phases of a long-term decision making process (pre-disposal, licensing, construction operation, closure and post-closure). The research will notably identify the expected role of the civil society along the successive phases of safety case review that characterizes the implementation of GD.

The research should determine the epistemological quality of the decision-making process, meaning here its capacity to take advantage of the complexity of contexts involving new information, new techniques and the vision of a plurality of actors (including the new successive generations of people along and beyond the development of geological disposals).

Research objectives:

To identify the conditions and means for dealing with the several natures of uncertainties and complex issues that are expected to be met in the course of staged implementation of

geological disposal while identifying the conditions and means for intra and inter-generational social trust and confidence in the decision-making process and safety review.

- **Research topic 2 - Socio-Technical Hybridization of GD implementation strategies**

Background:

The sustainability of long term governance of geological disposal is linked with the diversity of the categories of stakeholders effectively involved (across successive generations) and their capacity to form and maintain common goals and to give meaning to new information and potential disruptive events, throughout the implementation of geological disposal. This diversity is itself linked with the existence of a comprehensive understanding of geological disposals as hybrids taking on board a diversity of social and technical components that matter for the stakeholders.

Research needs and drivers:

A driving question here concerns how long-term radioactive waste management processes can be made to enable the fabric of hybrids embedding technical and social perspectives and to match a diversity of values in the framing of problems. This involves the question of "framing problems into socio-technical networks" in order to allow the building of a "common world" in the context of geological disposals, on the long term perspective. Another aspect is the question of favouring the aggregation of new components of society as active stakeholders and potential contributors to collective intelligence and creativity, as required by the complexity of this issue. Particular attention here should be given to the capacity of waste management strategies to favour inter-generational mobilization in the context of geological disposal, opening thereby the framing of issues to successive updating and enrichment, with and beyond the technical dimensions. A concrete object here is how meaningful, competent and willing societal engagement can be assured throughout the successive stages of implementation of long-term strategies. What are the issues to be addressed by the successive generations? On the basis of what information? Will it really matter for those successive generations and why? Are they expected to effectively contribute to decisions? Will actual alternatives be available at each successive step of the strategy?

Interactions with the humanities and arts should be considered here in the perspective opened by previous research on "nuclear culture", examining the opportunities for engaging contemporary art institutions across Europe and to include artists and a wider public. Research into visual culture on radioactive waste and radiation is important to embed knowledge of radioactive waste into cultural archives, traditions, practices and societal memory.

Research objectives:

To enlarge the societal basis of geological disposal governance and to embed radioactive waste management into a comprehensive perspective by the mean of "framing problems into socio-technical networks".

- **Research topic 3 - Safety culture in the context of GD**

Background:

The safety of geological disposal is linked not only with natural or technical factors, but also with the way complexity is managed by human systems. A key challenge here is to prevent

the specific obsolescence associated with long term compartmentalization (in silo fragmentation – Luhmann) of organisations that compromises their capacity to cope with changes, crisis, ruptures, and evolutions of the world likely to occur in the long period implied by radioactive waste management. Safety culture is a means for coordinating the various actors engaged around a common goal of safety. *"The discussion extends to Safety Culture in all concerned, because the highest level of safety is achieved only when everyone is dedicated to the common goal." (IAEA INSAG 4).* A particular attention is to be given to safety culture during the (long term) operational phase of geological disposal that relies on active safety management. Rather than being directed toward "public acceptance," efforts can be oriented toward inclusive dialog steered equally by all parties.

Research needs and /drivers:

A central question here is to investigate the extent to which safety systems may avoid becoming vulnerable in the long term as a result of specialisation and compartmentalization, where technocratic barriers to cross-boundary conversation are well known and well documented. The research should investigate how to expand the geological disposal conversation by cultivating greater participation by non-specialists. This include experimenting with novel public venues, expanding long-term engagements through advisory bodies, along safety case review and incorporating affected communities more fully into the design of public consultation (cf. INSAG, 2006). This also includes the historical review of the understanding of civil society interactions with RWM, within various kinds of spontaneous or institutional processes, from the early eighties to more recent contexts of societal engagement as, for instance, laid out in the terms of the 1998 Aarhus Convention.

Attention should be given to geographic and cultural contexts (e.g., seismic characteristics, weather hazards; governmental transparency and public participation) to inform technological choices and regulatory processes. The research should complement the prevailing emphasis on quantitative safety metrics, and related assumptions regarding the completeness and accuracy of quantitative risk models, with broader qualitative appraisals of safety as understood by a broader range of parties. This research on safety culture should also address potential impact of economic concerns on safety, two issues often separated rhetorically but deeply intertwined in fact. In addition, research should investigate how nuclear engineering education & training may benefit from greater inclusion of humanities, social science, and policy science perspectives, to help inform the work of engineers and regulatory staff. Support for sustained, collaborative programs linking these disciplines can play a valuable role.

Research objectives:

While maintaining safety as common goal in the long term, research on safety culture is expected to develop concepts and processes in order to maintain safety culture across concerned communities (and the public) and successive human generations in the context of geological disposal, thus contributing to the prevention of long term obsolescence of RWM safety systems.

- **Research topic 4 - Ontological and Axiological Commitments of Geological Disposal Stakeholders**

Background:

The long-term management of radioactive waste by the mean of a geological disposal is not an ordinary activity for human beings. The geological dimension entails the non-obvious

question of “mankind-impacting deep geology“, from an ontological (for it is related to the question of what means being human), symbolic, and cultural perspective. It involves new kinds of duties and liabilities that transcend a single human generation. The definite allocation of geological resources to a disposal facility entails some unfamiliar changes in the perception and meaning of the (local/global) natural ecosystem. Even the idea of passive safety and closure of a geological facility necessitates ontological and cultural resources that need to be worked out. This is expected to take place in a kind of renewed narrative elaborating a societal meaning of this trans-generational activity.

Research needs and drivers:

This research field should investigate foreground agreements in the interactions between geological disposal promoters and civil society, as regards the vision of the past and the future. The implementation of geological disposal entails the implicit adoption of a goal of a “terminus option” entailing a switch from active safety to passive safety. The research will investigate those agreements (or disagreements) starting from just formal declarations, and the extent to which they require some deeper substantive ontological and axiological commitments of the actors that would allow the construction of a common vision. It will identify the main paradigms or frames of reference of the radioactive waste stakeholders and societal actors that must be re-constructed by an analysis of their background assumptions and implicit visions of the world and mankind.

Research objectives:

Beyond the usual devices of democratic governance, this research is expected to investigate the potential need, scope, use and role for “ontological diplomacy” processes (Latour) for the actors to come up with an agreement and avoid background ontological conflicts on the meaning of this activity.

- **Research topic 5 – Background Democratic Culture of Geological Disposal Implementation**

Background:

The long-term implementation of geological disposal takes place in a political and institutional context assigning a specific role to respectively the representative institutions (the representative democracy, the state, the safety authority and its experts), the implementer and the public. Like most activities involving risk, geological disposals are ruled by national regulatory frameworks establishing a set of normative standards that determine safety objectives, describe the key aspects and steps of the decision making processes that will run along the successive stages of their development. In modern democratic countries, however, the existence of such a framework is not enough to enable social trust and societal confidence in the management of complex and challenging activities. More advanced democratic schemes and processes are needed to ground decision-making in broad and sustainable societal support.

Research needs and drivers:

Research should review the political status of geological disposal and the processes of its politicization according to different political and socio-technical theories and concepts. At the heart of the pattern of democracy lies the question of the understanding of what is a “public issue” as opposed to a “private issue”. In this research area, the status of geological disposals

(as a “private” or “public” activity) will be given a particular attention while reviewing past experiences of interaction with the public of most advanced RWM programmes.

This research would investigate the observed “social inquiries” processes (Dewey) led by members of the public in order to “politicize“ the RWM technological process. The role of the experts and the function of expertise processes are also to be considered in this perspective and the observed evolution of the function, status and understanding of the concept of “rationality”.

Examining the context of technological development (here geological disposal), there is a need for analysing the observed social contingencies of the geological disposal development, and to determine the extent to which the situation has led to the embedding of geological disposal in a larger societal perspective. And the extent to which the situation has open the forming of “commons” (Orström) in the context of radioactive waste development.

Research objectives:

How might modern societies take up radioactive waste management and geological disposal as a democratic issue, with its requirement for a societal commitment at national and local level and the need to pass this commitment along to successive generations (at least during the period of geological disposal operation), and to achieve the conditions for intergenerational cohesion and solidarity vis-à-vis this activity.

2.3.2. Addressing the complexity of RWM, towards complex (multidisciplinary) projects

The above research domain gathers several social and political dimensions that have been identified as unavoidable aspects of the development and implementation of geological disposals and come into play with technical dimensions in order to effectively address the complexity of RWM.

Social and political research activities are not intended to be stand-alone activities separated from the technical aspects of geological disposal. On the contrary, they should be conducted jointly with the other technical and non-technical studies in order to properly address the complex (multidisciplinary) nature of this activity.

The contribution of social sciences and civil society advice could be represented by the following scheme:

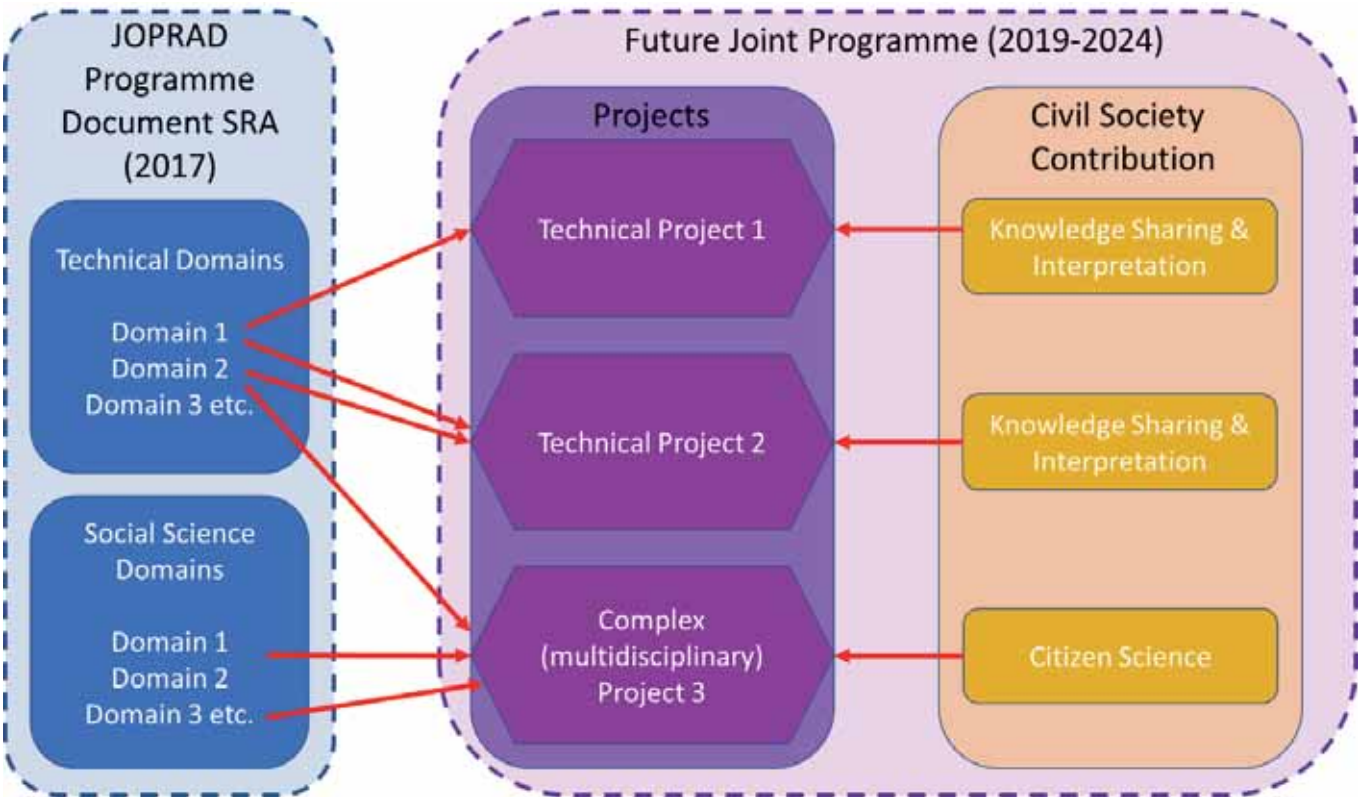

Figure 3- Implementation of CS contribution and Social science topics in the future joint programming

- **Developing "complex/multidisciplinary" research projects** (project 3 in Fig. 3) makes it necessary to gather technical and non-technical dimensions ("**Social Sciences**", such as sociology, anthropology, political sciences, economics, philosophy). It also involves specific research methodologies such as **"Citizen Sciences"** (meaning here involving directly people interested in working together with scientists in the production of trustworthy and reliable scientific knowledge). The JOPRAD Programme document will provide technical and social sciences research domains to feed the projects to be carried by the future Joint Programming.
- **Regarding more technical research projects** (Project 1 & 2 in Fig 3), it is foreseen that civil society will bring a contribution consisting of "**Knowledge Sharing and Interpretation" (KSI)** that will involve interactions between the partners of the project and an enlarged CSOs group. Those interactions will be organised by knowledgeable CS experts involved in the technical project, thus enabling the CS group to share, interpret and evaluate the results along the project (at framing, implementation and evaluation stages). In effect, future technical R&D projects on Geological Disposal conducted in the frame of the JP will play a determining role in the coming steps of GD implementation: validation or not of hypotheses that will open or close the door to subsequent concrete development. It represents therefore a genuine interest for the CS.

2.3.3. Towards complex/multidisciplinary research projects in the EJP

After the identification of these several social and political topics that could be included in complex projects, a cross-identification matrix was elaborated to see how these research

topics could be connected with the first selection of technical topics emerging from the different SRAs produced by JOPRAD WP4. This matrix is presented in Appendix 4 of this report.

Based on this matrix, a meeting of task 3.5 held on 4th July 2016 gathering JOPRAD TSO experts and CS experts of was organized in Paris in order to elaborate pre-proposals for "complex" (multidisciplinary) projects in the perspective of a future EJP. A list of 6 projects was identified. A distinction was made between R&D projects as such and projects that could be included in the frame of the networking activities foreseen in the Joint Programming (see chapter 3 for further description of the different activities). The six projects are the following:

- **Complex (multidisciplinary) R&D projects:**
  - A - "**Final operation licence**"
  - B – "**Intergenerational governance of the GD operational phase**"
  - C – "**Conditions for closure**"
- **Research Framing Topics (for horizontal Networking activities)**
  - D – "**Design optimisation**"
  - E – "**Shared safety culture**"
  - F – "**Siting process**"

These proposals for projects were then presented and discussed during the JOPRAD WP4 meeting in London, on 21st July 2016. An exploratory development of the technical description of a selection of those complex/multidisciplinary research projects was produced. Five draft descriptions of these projects (namely A, C, D, E, F) are presented in Appendix 5. The draft description of the B project is still under preparation.

2.4. CSO assessment of draft SRA of WMOs, TSOs and REs

As mentioned in section 2.1, the elements presented below are not the results of the assessment of the common document that is still under elaboration. Instead they relate to the draft SRAs produced by the TSO and RE, and the provisory WMO SRA.

The preliminary identification of priority issues of concern (section 2.2) was a necessary step for the CSOs towards the second important objective of WP3.5, which is to identify key research areas that CS would like to see included in the research programmes. It should be noted again that, as they pointed out during their first meeting, the perspective of CSOs cannot be reduced to providing input for R&D on GD without consideration of the consistency of the overall RWM strategy. Although JOPRAD (and the foreseen EJP) is not about reviewing and discussing this overall strategy of RWM, this standpoint contributes to the broadening of the perspective that CSOs see as crucial, and leads to identifying specific R&D areas that CSOs see are needed to respond to this consistency principle.

It should also be emphasized that, while JP is partly about prioritising, CS participants are reluctant to establish strong priorities in R&D, mostly for two interrelated reasons:

- CS calls overall for strong systemic consistency, which could be compromised by identifying certain topics or issues as secondary; there is a feeling that lower-ranked topics or issues could be expediently left by the wayside;

- CS views that problems, eventually leading to a failed safety case, may arise from an expected difficulty in a prioritised area, but also could arise from an unexpected little detail unfolding in a neglected area.

Put another way, the overall priority of CSOs regarding R&D issues is not that one or the other is covered, but that comprehensiveness and consistency are guaranteed.

CSOs were able to provide JOPRAD with an assessment of how the draft or provisory SRAs appear to cover the issues pointed to as important by the CSOs. Their findings, as they summarized them for JOPRAD in January 2016, are as follows.

First, some technical issues were found to be explicitly covered or understood by CSOs to be implicitly covered by some areas of the SRAs of IGD-TP, SITEX-II or REs. This includes, referring to the list established by CSOs:

- Characterisation of specific historic and potentially incoming waste (mostly ILW),
- Corrosion issues (long term behaviour of containers, interactions),
- Characterisation of phenomena related to waste possibly challenging safety conditions (e.g. gas generation from metallic containers),
- Microbiological processes (oxic / anoxic conditions),
- Reinforced assumptions regarding long-term conditions (climate change, geological events…),
- Operational security and safeguard issues.

Furthermore, the CSOs found out that some technical or methodological issues, although they were not covered at review stage, could possibly be covered by extension of some areas of IGD-TP, SITEX-II or REs SRAs. This includes:

- A more comprehensive approach to the possible waste inventory (in particular plutonium waste disposition issues),
- Strengthening and sensitivity analysis of geological, mechanical and hydrological modelling,
- Interaction between RWM strategy and operational development of the disposal,
- Monitoring, including participation of CS,
- Retrievability and reversibility (from an operational perspective),
- Long-term storage vs disposal (from an operational perspective of decay and optimisation),
- Long term security and safeguard issues.

However, it was also found that, on the contrary, some technical or methodological issues raised by CSOs did not appear to be taken up in the IGD-TP, SITEX-II or REs draft SRAs. These significant issues that were not to be found, whatsoever, in the SRAs included:

- Overall balance of risks attached to a disposal strategy in the framework of an overall RWM strategy,
- Methodological development regarding choice of site, geological structure,
- Comparison of various disposal concepts (GD, deep boreholes…) and designs (horizontal galleries, vertical pits…), respective merits of centralized vs. decentralized approaches,

- Methodological development regarding the comparison of different storage and disposal combinations,
- Methodological development regarding the practical meaning of guidelines such as “precautionary principle” or “best available”.

As explained above, this analysis will serve as a basis to discuss and assess the common Programme Document that will emerge from JOPRAD in a further step of the CSOs work involved in JOPRAD. Regarding the on-going elaboration process for this Programme Document, it is noted that the JOPRAD community did elaborate a common vision[17] for the JP that takes into account some CS recommendations such as the need for transparency and the need to develop R&D projects without compromising the independence of the actors. The CSOs will verify that these statements are duly taken into account in the elaboration of the governance rules and implementation of the JP.

Although the horizontal activities are fully acknowledged to be of great importance by the CSOs, the process of elaboration and the issues discussed within the preparation of the horizontal activities and Integrated Knowledge and Management System (IKMS) were not extensively reviewed and discussed. The description of the expected deployment of the IKMS presented in the JOPRAD deliverable report D.3.2 presents interesting elements for CSOs, including the recognition of the “strong social dimension of RWM”, the “need for interdisciplinary research”, the importance of taking into account the “key safety issues of concern for civil society” and the importance of “the participation of experts from civil society or citizens with scientific background”. CS involved in JOPRAD will conduct further analysis of the IKMS.

[17] See JOPRAD deliverable report D.3.2, op cit.

3. Expectations of Civil Society regarding governance of JP

This chapter presents the results of the CSOs analysis regarding governance of Joint Programming (JP) on Geological Disposal (GD). Section 3.1 firstly settles identified general principles to guide CS involvement in the future JP. Section 3.2 presents the governance proposal of the JOPRAD consortium that selected the European Joint Programming (EJP) option. Section 3.3 details the provisions for task 3.5 proposal and CS expectations regarding the governance scheme of an EJP.

3.1. Principles of CS involvement regarding nuclear safety

The CSO group firstly identified a set of principles guiding the involvement of civil society in European projects, including JP. The involvement of civil society (CS) in European research projects aims at improving safety and ensuring protection of people and environment. R&D on radioactive waste management (RWM) and geological disposal (GD) are considered as a part of the safety process. It is why CS participants are contributing to this safety review process that implies multi-stakeholder interactions, as it is suggested by the following figure coming from final report[18] of the SITEX project (2012-2013):

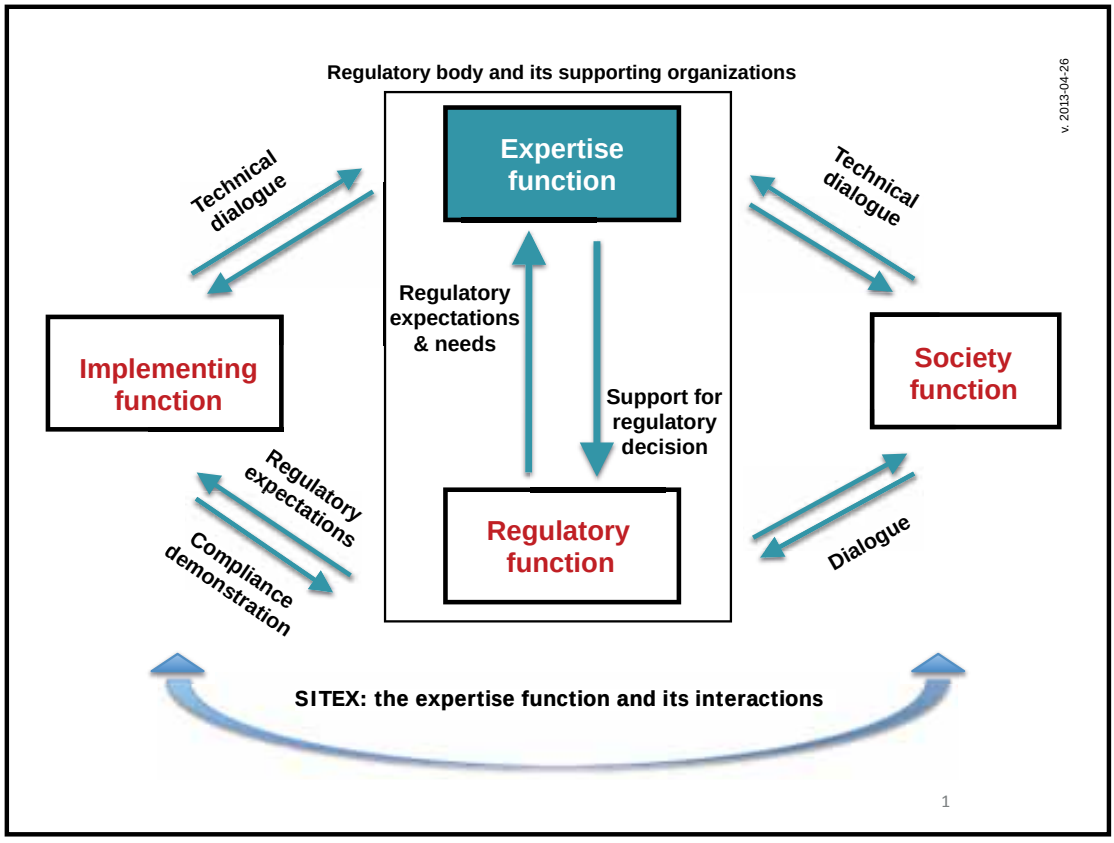

Figure 4- The expertise function and its interactions

The first responsibility regarding safety of nuclear facilities lies in the hands of the implementing function (carried out by the operators) that designs a safety case. The regulatory function (safety authorities, regulators) supported by the expertise function (technical support organisations, universities, research institutes, other external organisations[19]) ensures a second

[18] Deliverable 6.1, final SITEX report, **Conditions for establishing a sustainable expertise network**, May 2014, p 7. The report is available here: http://sitexproject.eu/index_1.html#deliverables.
[19] See SITEX Deliverable 61, p 6, reference above.

level of safety by assessing the safety case prepared by the operators. One of the important CS concerns is to ensure that each actor effectively plays its role vis-à-vis safety. The societal function (carrying out by civil society organisations and the public) also exerts vigilance and gives additional inputs (CS expertise and expectations) that constitute a complementary contribution to safety in the multi-level (in-depth) safety system.

As mentioned in introduction of this report, civil society also adopts a holistic perspective including GD in the broader framework of RWM safety: it considers that GD projects can't be separated from the overall RWM strategies which they interact with; CS is not solely concerned by the safety of GD, but attributes importance to the consistency of risk management in the whole RWM strategy. Moreover, CS representatives are not bound by any mandate to GD or any other technical solution. The CS reflexion cannot be reduced to a technical framework and it is therefore key for CS involvement to create space for enabling broader qualitative inputs to be taken into account. Furthermore, as it is stated in the InSOTEC report[20], "the "one solution" that facilitates the "perfect and reflective way of approaching long-term radioactive waste management of course does not exist." It is the reason why CS considers RWM as a complex problem and GD not only as a technical object but also a socio-technical hybrid. Implementation of a GD implies safety issues that cover a broader spectrum of concerns than technical R&D issues regarding the GD itself.

The commitment of CS representatives to 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 CS participation in setting the potential R&D joint programming on GD fits with the principles of public access to information and participation. According to the Aarhus Convention, an effective interaction with CS also implies that the CS contribution is duly acknowledged.

Based on these principles, task 3.5 developed an approach to assess the available options of governance for the JP. A guide for this assessment was finalized and released to the JOPRAD consortium in November 2015. The guide contains a grid of analysis and a set of evaluation criteria that are detailed in Appendix 6. These will be applied in the final stage of JOPRAD for the CS review of the final JOPRAD conclusions and proposal regarding the setting of the JP.

3.2. Governance of the EJP suggested by JOPRAD consortium

WP2 of JOPRAD performed an assessment[21] of currently available Joint Programming Frameworks. As a result of this work, the "European Joint Programme (EJP)" scheme was selected by WP2 as the "most suitable option[22]" for the JOPRAD consortium. The management of the EJP activities proposed by JOPRAD is based on the following scheme:

[20] InSOTEC final report, "InSOTEC Project: Final report summarising the main S&T results, key messages and potential impact and use and dissemination of foreground", September 2014, p22-23. The report is available here: http://www.insotec.eu/publications/final-report

[21] See deliverable D2.3 of the JOPRAD project, Summary of lessons learned in other JP initiatives.

[22] See the section "Why choosing EJP?" of the Deliverable D3.2 of the JOPRAD project "Conditions for implementing a JP" written by IRSN, p27-28. It detailed the different reasons of the JOPRAD consortium choice.

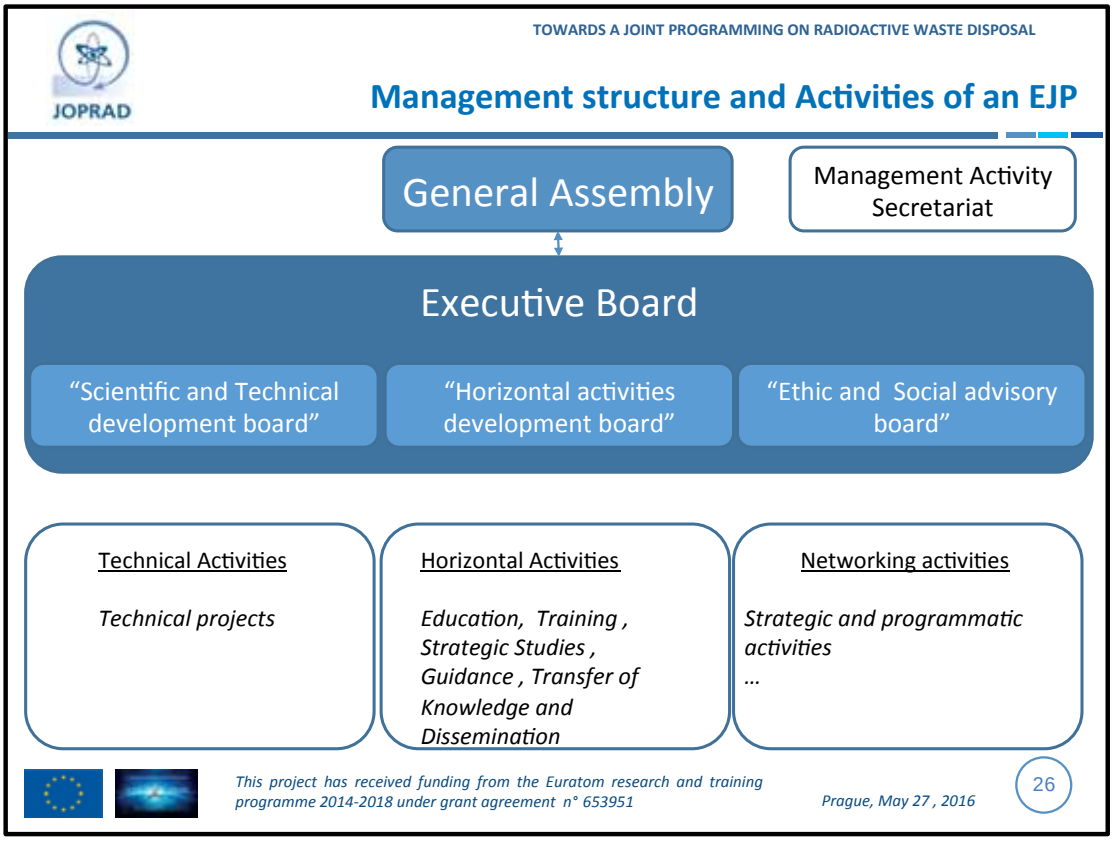

Figure 8- Management Structure for EJP, Mid-Term Workshop of JOPRAD

The EJP will be composed of:

A General Assembly (GA)

- composed of the beneficiaries of the EJP
- approve the Annual Work Plan and the evolution of the EJP, including the entry of new EJP participants.
- elects the Chair of the Executive Board (voting rights are currently being studied by the WP5 of JOPRAD).

An Executive Board (EB)

- composed of the Chair, chairs and members of the three (technical, horizontal & Ethics and social advisory) sub-boards, representatives of JRC, of DG-RTD, and the coordinator of the EJP.
- manage, organise and evaluate the activities, select new participants, manage the relations with other technical platforms and forums (SNETP, NEA, etc.) and propose the activities to be included in the Annual Work Plan, to the General Assembly.
- subdivided in three boards:
    - The Technical board
        - composed of WMOs, TSOs and REs (as "Mandated actors" involved in the technical activities), of some members of « Ethics and Social advisory board » (as observers) and of the coordinator of the EJP.

        - elect its chair and its representatives at the EB, evaluate the technical activities, prepare the assessment (Scientific and technical aspects) report of the activities to the EB, evaluate the request for amendment of Activities to be submitted to the EB, propose new participants, prepare its contribution to the Annual work plan, propose evolution towards new activities and following programmes.
    - The Horizontal board
        - composed of "mandated actors" involved in horizontal activities, some members of « Ethics and Social advisory board » as observers, representatives of JRC, potentially representatives of ENEN and the coordinator of the EJP.
        - same role for the horizontal activities as the Technical Board for the technical ones.
    - The Ethic and Social Advisory (ESA) board
        - composed of
            - the coordinator of the EJP,
            - the coordinator of the Civil Society network (conducting "Strategic and programmatic activities of Civil Society actors" as Secretariat of the board,
            - interested "Mandated actors" (WMOs, TSOs and REs),
            - Civil Society organisations.
        - The number and selection of the representatives as well as financial support for their participation have to be discussed in the WP5 of JOPRAD.
        - The chair of the ESA board will be a member of the EB.
        - The ESA board:
            - elect its chair and its representatives at the EB,
            - evaluate the on-going activities by preparing the assessment report (position of the Civil Society) of the activities to be presented to the EB, prepare the contribution to the Annual work plan, propose evolution of governance for the on-going and following EJP.

A Secretariat

- coordinate the EJP and manage the secretariat activities
- ensure day-to day administrative, financial and legal management.
- is represented in the three sub-boards of the EB
- organise the GA and EB meetings
- ensure internal and external communication.

3.3. Proposal for CS involvement in the EJP governance

Taking into account the preference of JOPRAD for an EJP framework, Task 3.5 has elaborated and discussed with the JOPRAD participants the following provisions for setting the conditions of a meaningful and fair participation of CS into the foreseen EJP. Those provisions have been presented, as a part of the JOPRAD framework for the JP, during the Mid-Term Workshop of JOPRAD, held in Prague on 7-8 September 2016.

A draft proposal was first discussed with the CS group during the third 3.5 meeting on 29th June in Budapest and updated after the Mid-Term Workshop. The comments of the CSOs and the evolution of the JOPRAD proposal led to the elaboration by task 3.5 of a second proposal of governance that is presented below in Figure 7:

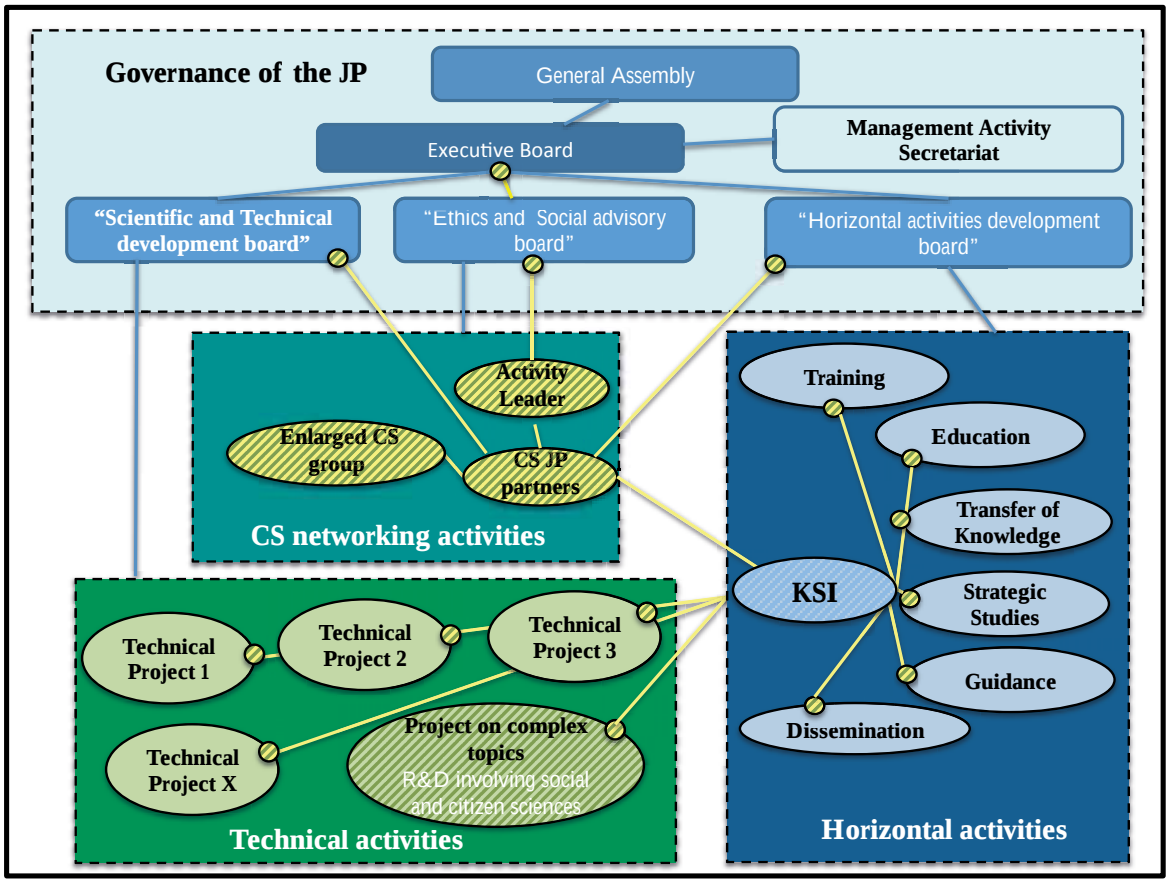

Figure 7- modalities of participation and involvement of CS in an EJP

3.3.1. Two categories of CS representatives

In order to create the conditions for a meaningful participation, it is proposed to articulate the engagement of European CSOs with the participation, as partners in the EJP, of knowledgeable non-institutional experts (small expertise groups and research organisations) that have links with the Civil Society.

Two categories of CS participants are foreseen in this perspective:

- A wide group of European CSO representatives, participating on a regular basis to network activities as well as to citizen sciences processes on the complex/multidisciplinary projects, where necessary. The participants of this group are not beneficiaries of the EJP, but their expenses are covered by the networking activities.
- A small group of knowledgeable CS experts (with a technical background, or social sciences and citizen's sciences, beneficiaries of the EJP as linked third parties to a European association involved in the JP consortium (presumably the SITEX Association).

This principle of this "double-level" CS engagement have been tested in the SITEX II and JOPRAD projects and has proved to be very effective for enabling informed and fair interactions with Civil Society.

3.3.2. Four types of activities of the JOPRAD proposal for the EJP

As explained above, the governance scheme presented in this report is based on the JOPRAD proposal for an EJP that define three main categories of activities:

- **Technical Activities** are equivalent to technical research projects developed in Horizon2020 but the current projects do not include horizontal and networking activities associated to the technical ones.
- **Horizontal Activities** covers the deployment of a Integrated Knowledge Management System (IKMS) covering activities such as Education, Training, Strategic Studies, Guidance, Transfer of Knowledge and Dissemination.
- **Networking Activities** cover strategic and programmatic activities of *permanent or ad hoc*- groups (think tanks) gathering the same category of participants in the EJP (respectively TSOs, WMOs, REs, Civil Society, representatives of Less Advanced Programmes of RWM.
- **Governance activities** gather the management and organisational activities, and the coordination and secretariat of the EJP.

3.3.3. Three main potential contributions for CS representatives

Regarding the specific role of CSOs, the task 3.5 governance proposal is based on the identification of three main functions for Civil Society representatives that could be involved in the EJP:

- **A contribution to governance of the Joint Programming** that will involve CS partners beneficiaries of the JP and a wider CSOs group following the CS networking

activities. The contribution of CS is represented in Figure 7 by the yellow circles included in the top blue box gathering the governance activities.

- **A function of Knowledge Sharing and Interpretation** in the technical research that involves interactions between the small group of CS experts with the wide group of CSOs representatives. The KSI function in Figure 7 involves interactions between the technical and horizontal activities as well as with CS networking activities.
- **A citizen science contribution to "complex" (multidisciplinary) projects** that will involve social scientists, CS experts (small group) and the wide group of European CSO representatives.

Linked with the above scheme, the following expectations have been identified in order to support a meaningful participation of the Civil Society:

3.4.4. Regarding the governance of the EJP

- CS access to the three types of activities of the JP: Technical, Horizontal and Networking.
- CS represented in the Executive board and the three sub-executive boards, namely the Scientific and Technical Development Board, the Horizontal Activities Development boards and the Ethical and Advisory board.

3.4.5. Regarding the Ethical and advisory board

- a CS Expert beneficiary as chair of the Ethical and Advisory board

3.4.6. Regarding the funding

- Work and expenses of CS Experts beneficiaries involved into JP activities as linked third parties in the consortium,
- Meeting (travel and subsistence) costs of the CS participants (wider group) to the EJP activities reimbursed under a 100% scheme**.**

Appendix 1 - List of members of Civil Society Organisations' network

- AUSTRIA
  - ✓ Austrian Institute of Ecology (AIE)
  - ✓ Global 2000 – Friends of the Earth Austria
- BOSNIA AND HERZEGOVINA
  - ✓ Center for Environment, Bosnia and Herzegovina
- BULGARIA
  - ✓ Environmental Association ZaZemiata
- CZECH REPUBLIC
  - ✓ South Bohemian Mothers Association
  - ✓ Calla
- DENMARK
  - ✓ NOAH
  - ✓ Sustainable-Energy, Denmark
  - ✓ Danish Network of Local NGOs in Radioactive Waste Communities
- GERMANY
  - ✓ BUND, Germany
  - ✓ Bürgerinitiative Umweltschutz Lüchow-Dannenberg, Germany
- FRANCE
  - ✓ Association Nationale des Comités et Commissions Locales d'Information (ANCCLI)
  - ✓ CLIS de Bure (expression of interest)
- FINLAND
  - ✓ Finnish Association for Nature Conservation
  - ✓ Technology for Life, Finland
- HUNGARY
  - ✓ Energia-Klub
  - ✓ Green Circle of Pécs
- NETHERLANDS
  - ✓ Laka Foundation, Netherlands
  - ✓ WISE, Netherlands
- POLAND
  - ✓ Common Earth, Poland
- ROMANIA

- ✓ TERRA Milenium III

- SLOVAKIA
  - ✓ CEPTA - Centre for Sustainable Alternatives, Slovakia
- SLOVENIA
  - ✓ Focus, Association for Sustainable Development, Slovenia
  - ✓ Regional Environmental Centre office in Slovenia
- SPAIN
  - ✓ Grup de Cientifics i Tecnics per un Futur No Nuclear
- SWEDEN
  - ✓ Milkas, Sweden
  - ✓ MKG, Swedish NGO Office for Nuclear Waste Review
- UKRAINE
  - ✓ National Ecological Center, Ukraine
- UNITED KINGDOM
  - ✓ CORE (Cumbrian's Opposed to a Radioactive Environment)
  - ✓ Cumbria Trust
  - ✓ Friends of the Earth Nuclear Network, UK
  - ✓ Nuclear Free Local Authorities, NFLA
  - ✓ Nuclear Consulting Group
  - ✓ Nuclear Waste Advisory Associates, UK
  - ✓ West Cumbria & North Lakes FoE

Appendix 2 - List of participants in the task 3.5 meetings

Participants in Task 3.5 meeting n°1

JOPRAD meeting
28th August 2015
List of participants

Name	**Forname**	**Country**	**Organisation**
Anvegard	Christine	Sweden	MKG
Autret	Jean-Claude	France	ANCCLI (French Federation of local Commission of Information)
Baude	Stephane	France	Mutadis
de Rijk	Peer	Netherlands	Wise
Dewoghelaere	Julien	France	Mutadis
Dorfmann	Paul	UK	Nuclear Consulting group
Harembski	Marcin	Poland	Common Earth
Heriard-Dubreuil	Gilles	France	Mutadis, NTW
Hooje	Niels Henrik	Denmark	Friends of the Earth Denmark
Kalisova	Olga	Czech Republic	Calla
Kearney	Philip	Ireland	NTW
Kobor	József	Hungary	Green Circle City of Pécs
Koritar	Zsuzsanna	Hungary	Energya Klub
Lemy	Frank	Belgium	BelV
Lorenz	Patricia	Europe	Friends of the Earth
Lowry	David	UK	Nuclear Waste Advisory Associate
Marignac	Yves	France	Mutadis
Marzio	Myriam	France	Mutadis
Meijers	Daniel	Netherlands	Laka Foundation
Mihok	Peter	Slovakia	CEPTA
Natunen	Jari	Finland	Technology of Life
Romanov	Magdalena	Sweden	MKG
Serres	Christophe	France	IRSN
Stirb	Lucian	Romania	Terra Milleniul
Swahn	Johan	Sweden	MKG
Verbytska	Tetiana	Ukraine	National Ecological Center
Verhoeven	Marie-Alix	France	NTW
Wales	Colin	United Kingdom	Cumbria Trust
Zeleznik	Nadja	Slovenia	Regional Environmental Center Slovenia

Participants in Task 3.5 meeting n°2

JOPRAD meeting
23rd February 2016

List of participants

Name	**Forname**	**Country**	**Organisation**
Autret	Jean-Claude	France	ANCCLI
Dewoghelaere	Julien	France	Mutadis
Harembski	Marcin	Poland	Common Earth
Haverkamp	Jan	Europe	Greenpeace
Heriard-Dubreuil	Gilles	France	Mutadis, NTW
Kobor	József	Hungary	Green Circle of Pécs
Koritar	Zsuzsanna	Hungary	Energya Klub
Lorenz	Patricia	Europe	Friends of the Earth
Marignac	Yves	France	Mutadis
Mihok	Peter	Slovakia	CEPTA
Natunen	Jari	Finland	Technology for Life
Serres	Christophe	France	IRSN
Studen	Tatjana	Slovenia	Regional Environmental Center Slovenia
Swahn	Johan	Sweden	MKG
Wales	Colin	England	Cumbria Trust
Zeleznik	Nadja	Slovenia	Regional Environmental Center Slovenia

Participants of Task 3.5 meeting n°3

JOPRAD meeting task 3.5 n°3
29th June 2016

List of participants

Location: **Hotel Benczúr, H- 1068 Budapest, Benczúr u. 35.**

Name	**Forname**	**Country**	**Organisation**
Autret	Jean-Claude	France	ANCCLI
Delory	Linda	NTW	NTW
Dewoghelaere	Julien	France	Mutadis
Haverkamp	Jan	Europe	Greenpeace
Heriard-Dubreuil	Gilles	France	Mutadis, NTW
Kalisova	Olga	Czech Republic	Calla
Kobor	József	Hungary	Green Circle of Pécs
Koritar	Zsuzsanna	Hungary	Energyaklub
Lowry	David	United Kingdom	Nuclear Waste Advisory Associates
Marignac	Yves	France	Mutadis
Mays	Claire	France	Symlog
Mihok	Peter	Slovakia	CEPTA
Miksova	Jitka	Czech Republic	CV-Rez
Salat	Elisabeth	France	IRSN
Serres	Christophe	France	IRSN
Studen	Tatjana	Slovenia	Regional Environmental Center Slovenia
Swahn	Johan	Sweden	MKG
Verhoeven	Marie-Alix	NTW	NTW
Wales	Colin	United Kingdom	Cumbria Trust
Zeleznik	Nadja	Slovenia	Regional Environmental Center Slovenia

Appendix 3 - Observations on boundary conditions expressed by different actors

The analysis was conducted at the start of the JOPRAD project, based on available draft documents of WMOs, TSOs and RE. It should not be regarded as a definite position since those documents have been completed since that time. This analysis is provided here as an example of the methodology implemented by the CSOs in order to review the proposed documents along the project. WP3.5 will further review the fulfilment of the expectations and views of Civil Society regarding the content of the work program, on the one hand, as well as on the conditions and means regarding its potential involvement in the governance of the Joint Programming, on the other hand.

While reviewing, in the first stage of the project, the working material available from WMOs, TSOs and REs, the CSOs took note that, although to various extents, each of the three concerned groups of entities has felt the need to define the boundary conditions of their involvement in joint R&D activities with entities of the other groups. These boundary conditions could relate both to some limitations on the issues covered, due for instance to the respective responsibilities of entities, or to the nature of the collaboration involved.

The boundary conditions of the involvement of CSOs into potential joint R&D activities is also a topic that will necessitate due considerations (see chapter 3 of this document). It is underlined that there are links between the principle of Civil Society engagement and the research content of the EJP. Should the content of the research programme document not address the issues of concern identified by the Civil Society, it would result in impeding its potential involvement.

It is also underlined that most CSOs potentially involved are not in a position of conducting or contributing as researchers to R&D themselves. CSOs however emphasized from the beginning that involving into research activities, as research partners, knowledgeable experts or independent entities that are vested with trust by Civil Society "*experts we can trust*", like e.g. independent environmental expertise or small independent research organizations, could greatly contribute to and facilitate the wider involvement of Civil Society.

In addition, the analysis conducted by CSOs also brings, at the frontier between governance issues and the discussion of R&D priorities, some comments that are food for thought when discussing the respective boundary conditions of WMOs, TSOs and REs.

The balance between joint R&D areas and independent R&D strategies

In their first round of discussion, at the beginning of the project, the CSOs expressed a strong concern with the risk of a "capture of the regulator", or more precisely of the TSOs by the WMOs. They clearly expect TSOs not only to develop R&D that is needed to examine the safety cases of the WMOs, but also to independently develop R&D in the whole field of safety assessment and seriously follow up on any issue raised or identified, independently of how the WMOs may view their importance.

If this principle is likely to be agreed by all parties, its implementation has to be demonstrated in practice. Participating CSOs remain cautious about this. In fact, when reviewing the IGD-TP SRA, they felt that selecting research topics is never a neutral activity. For obvious reasons, potential reluctance of operators might occur vis-à-vis certain research topics, should they, for instance:

- explore areas where results might be challenging regarding their own safety case,
- open new options (methods, technologies) that may prove better but imply modifications of their plans,

- demonstrate new or heavier risks of failure of the considered options, making necessary to prepare alternative options (plan B);

It was also noted that the scope of R&D considered by TSOs apparently tend to remain relatively close to the approach of WMOs, mostly focusing on the need to control the soundness of the safety assessment they build, rather than addressing the need to broaden their perspective.

In the view of CSOs, it is therefore important that the identification of joint R&D areas does not reinforce this “risk of capture”. The same risk can also apply to REs as they develop R&D supporting the progress and needs of WMOs and/or TSOs. However, REs could on the contrary contribute to that openness and broadening of perspective (which the COSs would expect them to do).

Regarding the scope and breadth of joint R&D areas, it is interesting to note that WMOs, TSOs and REs have so far developed the same vision based on the intersection between three circles, but then introduced very different approaches to define their levels of intersections. The CSOs emphasized that the elaboration of a joint "Programme Document” should rather be based on a shared understanding of these intersections, and therefore suggested that WMOs, TSOs and REs work to get their visions to converge.

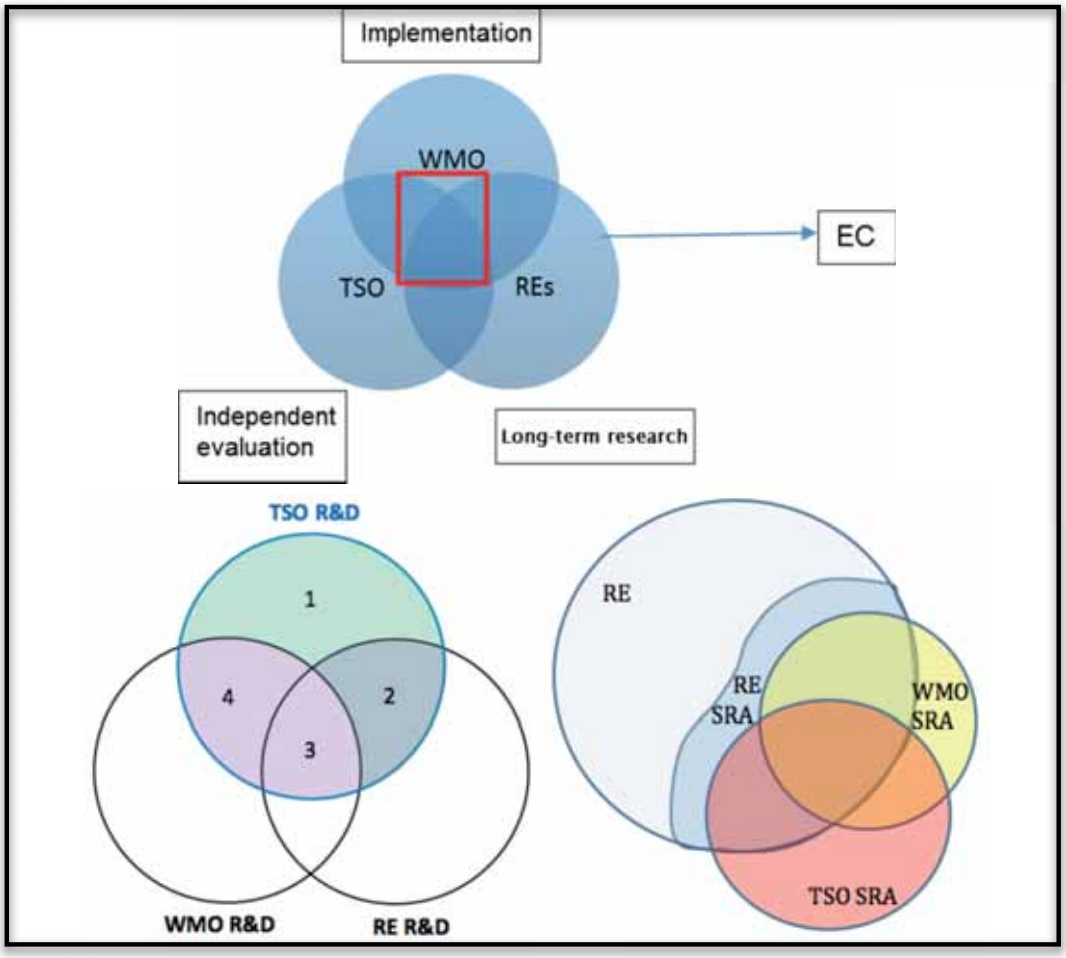

Figure 1- the different views of the WMO, TSO and RE regarding Joint Programming

The view of WMOs

WMOs seemed to adopt a direct operational approach where they simply define the respective areas of research of WMOs, TSOs and REs as “implementation”, “independent evaluation” and “long-term research”, then categorize their R&D items to separate them between those “fully eligible as technical activities”, those “that might be acceptable by WMOs according to governance rules”, and those “unsuitable”.

The CSOs note that, contrary to TSOs and REs, WMOs didn‘t elaborate about their common R&D areas with TSOs and with REs as two different perimeters, of which the joint R&D areas would eventually be the intersection. CSOs suggested that it would be useful, as part of the effort to develop a shared vision and prevent the “risk of capture”, that WMOs provide some information about what they understand as being common areas between them and TSOs, and between them and REs.

The CSOs welcome the approach consisting in distinguishing between R&D activities that are fully eligible, potentially eligible or unsuitable as joint areas. The WMOs, however, don’t refer to specific R&D issues but rather to general objectives that are seek through the whole scope of R&D activities.

Although this approach seems very relevant to CSOs, it also leads to some questions and suggestions:

- CSOs could not find more precise information regarding the criteria that define the three categories used by WMOs. It would have been useful to make explicit the logics beyond the notions of eligibility, acceptability and unsuitability in order to be unambiguously understood by the other groups;
- the WMOs seemed to work with a list of their R&D objectives (from A to Q), separate from a list of R&D areas (including 42 topics in their initial list – in which 9 were already amalgamated topics – then reduced to 20 to 22 topics after initial prioritisation analysis). The WMOs supposedly share a vision of the articulation between objectives and topics (whether it is explicitly developed in a correspondence table or remains implicit). Again, it would have been useful, for the sake of shared understanding with other groups, that they provide some information about this correspondence.

Also, the CSOs were somehow surprised by the categorization established by WMOs, for instance when it comes to consider that topics such as “development & validation of codes through benchmarking” could possibly be common areas, when the CSOs rather think they should absolutely be.

Providing such additional information could be shared, the CSOs encouraged TSOs and REs to develop the same kind of approach: the development by each of the groups of criteria of eligibility to JP and objectives of R&D relevant to this eligibility or not would certainly help for the shared understanding of what R&D area need or need not to be joint areas and why.

The view of TSOs

Although they seek as well to develop their own criteria for the acceptability and conditions of joint R&D, TSOs adopted an approach different from that of WMOs, based much more on principles to respect than on operational categories.

One important first step in the approach by TSOs was to identify and discuss the added value that could be expected from JP of some R&D from their perspective. Besides the obvious optimisation by sharing of available resources or the better focus on safety priorities, they identify other less directly practical added value. This includes the benefit for their own

competence of being part of a broader scientific community, which responds to the concern expressed by CSOs that they develop a broader vision, beyond the issues raised by the implementers' cases. However, the CSOs emphasized that this needs to be reflected in the JP by the embedding of broader issues. They encouraged WMOs and REs to either react to this view proposed by TSOs on the added value of JP or to develop their own vision so that the shared interest in JP can be better understood.

Like WMOs, TSOs considered the different needs that R&D is expected to fulfil as an important entry to discuss the R&D areas that could be part of JP. However, CSOs note that TSOs referred there to a list of 7 different needs, which is more than twice less than the 16 referred to by WMOs. In addition, the correspondence between the needs identified by TSOs and the objectives set by WMOs is hardly straightforward. It would be very useful that TSOs and WMOs provide further information for a better-crossed understanding of their lists.

Finally, TSOs discussed the boundary condition of joint R&D activities and the conditions for implementing this boundary condition. They clearly defined independency as the "key boundary condition" from their perspective, which CSOs naturally welcome. However, they note that this essentially refers to the separation of the "expertise function" and the "implementing function". It is too limitative, in the view of CSOs, that TSOs aggregate REs as possible contributors to the first instead of fully identifying a complementary function for them.

The view of REs

The vision of REs also started with a schematic vision on the separation and roles of actors, in which they define the interest of Research organisms as the generation of high quality knowledge. This is to combine with the interest of regulators (and therefore TSOs) for safety and security and the interest of WMOs for best technical solutions to discuss the options and drive the research, together with other players: the radioactive waste producers on one hand, the institutions driving general and local public interest on the other hand.

The CSOs welcome REs standpoint that their research objectives go beyond the implementation or safety oriented needs of WMOs and TSOs. This matches, in a way, their concern that the global R&D agenda should not be too much focusing on the needs of implementation and therefore "captured" by WMOs. However, there is still a need to develop information about what this broader perspective engulfs, and how it articulates with the narrower perspective of implementation and safety oriented needs.

This was not possible at the time when CSOs discussed these matters, as REs had yet to establish their own SRA. This appeared to be a more difficult task than for WMOs and TSOs for some reasons that REs pointed to as "problems to be managed". This mostly goes with the fact that they are much more diverse entities than WMOs and TSOs, often not focusing solely on RWM and GD research but developing as part of other programmes some R&D that finds some use in that field (and therefore lacking an overall view of RWM and safety issues), working in various contexts with various backgrounds on their countries' RWM programmes and objectives, etc. While not downplaying the difficulties that this implies, the CSOs emphasize that this diversity is a resource to provide the broader possible perspective that REs commit to. They are therefore concerned that JP should not lead to reducing this diversity but rather to make a better use of it.

It is interesting to note that, in relation with this difficulty, the proposed approach by REs was to "start with SRAs of WMO/TSO and Euradwaste'13 conclusions as starting point, identify areas of common interest, and formulate essential additional research items". While the second part of this approach was definitely seen by CSOs to be key to bring the expected

broadening of perspective, the first part appeared in contrast with the approaches developed by WMOs and TSOs, which had so far focused on drawing from their own SRAs the issues, objectives or areas that they propose to pour into EJP.

Wider expectations regarding Joint Programming

The CSOs, which participate in the network gathered in the JOPRAD project, have a specific interest in the safety of RWM and, in this perspective, in the safety of GD. It is understood that while concerning GD, at least part of the Joint Programming will develop research in the perspective of reinforcing safety as whole (pre-disposal for instance). CSOs have underlined the need to consider in the research programming the impact of (technical and non-technical) decisions associated with the development of GD on the safety and radiation protection of the global RWM strategy that includes GD as a part of it. Although they acknowledged the value of keeping the scope of a JP focused, they underline that the broader concerns they raise need to be addressed, if not there, then in another explicitly relevant research framework.

The contradiction between narrowing priorities and broadening approaches

Whatever is the answer to that, what is true is that the overall R&D strategy should not be only about implementing GD but bear a broader view of GD as (potential) part of a safe global RWM strategy. It is therefore the view of CSOs that this situation should anyway reflect in JP. The CSOs found themselves very concerned, as the process of elaboration of the SRAs went on, that this risked not being the case.

Altogether, the non-technical and scientific issues that are related to the expected review of the safety cases for radioactive waste repository systems that radioactive waste management organisations/implementers can be expected to be present in safety assessment reports provided in applications for licenses. The technical review of those safety cases must be strong, and it is therefore right that the strategic research programme developed by the nuclear and radiation safety regulators and their TSOs strongly focuses on fulfilling this need. Nevertheless, this kind of control is only a part of the capacity that CS would expect regulators and TSOs to build. Repositories must be developed as part of a comprehensive RWM plan that is a technical implementation of a global RWM strategy. This perspective brings some issues of a broader kind, such as final inventory, alternatives, timeline, balance between local and global risks, etc. that also point to research and development needs.

To be complete, a future broader strategic research agenda would therefore benefit from a wider focus on the research areas to be included. According to CSOs, this requires that the issues, which would be addressed by a JP, are not purely and only technical ones. The need to address social and societal issues and the multi-dimensional nature of the GD projects calls for the development of what CSOs propose to define as "complex" projects, involving altogether technical issues, and what was called social sciences and citizen sciences.

The general approach of CSOs on SRAs and JP

Due to the above, it is important to understand that the perspective of CSOs cannot be reduced to providing input for R&D on GD without consideration for the overall RWM strategy. Therefore, it is hard for CSOs to get down to a logic where priorities are discussed and defined with consideration for GD only.

Moreover, the overall priority of CSOs regarding R&D issues is not that one or the other is covered. What is important for CSOs is that comprehensiveness and consistency of the R&D

approach are guaranteed. This is why CSOs have been very reluctant to start a process of establishing their own priorities.

The CSOs nevertheless worked to identify – without prioritizing - a series of issues and topics that they would consider as key to ensure the consistency and comprehensiveness they are looking for, still in a perspective focused on GD. Then the CSOs went through the process of assessing, as they were already final or still developing, the respective (draft) SRAs of IGD-TP, SITEX-II and REs, to find out what share of their own proposals was explicitly or possibly reflected in these SRAs. This analysis was completed with an overview of selection process of joint R&D issues

The difference between prioritization and strategy

The CSOs developed some concern through this overview with the way the joint elaboration of a programming by WMOs, TSOs and REs sets itself between prioritization and strategy. What they understood while reviewing work-in-progress was that each of these players SRA is rightly built through a mix of top-down strategic mapping and bottom-up identification of technical issues of specific interests. But the selection process is then a bottom-up one of prioritization and relevance to share (each based on criteria). To put it in a more practical way, if each group of entities brings its own issues for JP and the discussion is simply about selecting common proposals, the result risks to be poorer than if there is more exchange between the groups on the basis of their SRAs as to what could be common. According to CSOs, whatever the quality of criteria and the rating process – a rather challenging issue –, this raises a significant risk of losing strategic top-down vision through the process.

Moreover, CSOs are concerned with the need for a shared vision of the selection process to be developed at all stages, and the memory of this shared vision maintained. They discussed the fact that each set of entities used its own categories of areas / topics, and defined its own process to select prioritised and relevant R&D issues for JP, based on its own criteria. The CSOs could see that this was developed without sharing criteria of priority, relevance and the vision of “boundary conditions” between WMOs, TSOs and REs, while such exchange would have been needed upfront, and all along. Regarding this concern, the CSOs concluded that the development of a more inclusive selection and review process was expected to allow for further consideration of CS issues that are currently not in the scope.

Appendix 4 - Cross-identification Matrix- Social Sciences Research Topics/ Technical topics merging from the different JOPRAD SRAs

Complex Research Topics Involving citizen science, multidisciplinary social sciences, hard sciences, and multi-stakeholders engagement	Uncertainty, epistemology, social trust along RWM and GD implement.	Aggregating a diversity of people, unfold capacities of collective intelligence along RWM and geological disposal implementation	Socio-technical hybridization of geological disposal implementation strategies	Safety culture in the context of geological disposal	Ontological and axiological commitments of geological disposal stakeholders	Background democratic culture of geological disposal implementation	Drivers/rationale • reducing uncertainty, • improved definition of safety margins, • confidence in decision making, • optimisation, • Knowledge transfert suitability Priority setting (high-medium-low)	RESEARCH PARTNERS
Safety case review								
• Participatory safety case review along GD life cycle								
• Developing a shared safety culture in the GD context								
• Safety case communication and treatment of uncertainties								
Conceptualization								
• Framing Terms of Reference of a GD Pilot Phase								
• Conditions and means for sustainable long term funding of GD								
Siting								
• Site characterization & Siting process								
Reference design								
Construction								
• Evolving programme boundaries								
Operation								
• Intergenerational Governance of the GD operational phase (including local and national governance)								

Complex Research Topics • Involving citizen science, multidisciplinary social sciences, hard sciences, and multi-stakeholders engagement	Uncertainty, epistemology, social trust along RWM and GD implement.	Aggregating a diversity of people, unfold capacities of collective intelligence along RWM and geological disposal implementation	Socio-technical hybridization of geological disposal implementation strategies	Safety culture in the context of geological disposal	Ontological and axiological commitments of geological disposal stakeholders	Background democratic culture of geological disposal implementation	Drivers/rationale • reducing uncertainty, • improved definition of safety margins, • confidence in decision making, • optimisation, • Knowledge transfert suitability Priority setting (high-medium-low)	RESEARCH PARTNERS
• Practical implementation of reversibility, Retrievability effect of repository architecture, rock stability								
• Design optimisation based on operational experience								
• Impact of societal evolutions on disposal implementation								
Closure								
• Setting conditions for Closure (moving from active to passive safety)								
Post-closure								
• Post-closure management and institutional surveillance								
• Operational monitoring, Relation monitoring / decision making								
• Development of a sustainable societal memory patterns								
• GD Long term governance (after closure)								

Appendix 5 - Towards Complex-Multidisciplinary research projects in the EJP

Theme A - Final operation licence (before full commissioning)

DRAFT – July 18th 2016

Task Number	*Numbering scheme TBD*	Origin	TSO
Topics	• Safety case • Integrated themes		
Sub-topic	• Best practice in presenting and reviewing GDF safety case – H • 7#5 Evolution of the safety case content with the lifecycle of the disposal programme (TSO) • 2.1.5 Safety case communication and treatment of uncertainties (inc. societal aspects • Operational Safety • Demonstration/feasibility		
Title			
Gradual demonstration of the technical feasibility and safety before the commissioning of a geological disposal facility.			
Background			
In the initial conceptualisation phase of a geological disposal programme general and theoretical options regarding the construction and the safe operation and closure of a disposal facility are investigated. During this phase, a first assessment of the technical feasibility and safety of these options is performed, generally based on a collection of general and theoretical arguments. As the programme moves towards the design and then the construction and operation phases, a reference design is chosen and the demonstration of its technical feasibility and safety is gradually further substantiated and documented in the safety case. To this end, pilot plants and a qualification programme could be for example developed. The review of the safety case during the lifecycle of the disposal programme is thus expected to entail several successive steps. In some countries, even the operation licence could be a step by step procedure that will gradually move from an authorization for a partial to a full commissioning of the disposal facility. This gradual demonstration of the technical feasibility and safety of the geological disposal concept is essential for the confidence building among all stakeholders and thus necessitates a strong engagement of the several concerned components of Society, including in the last steps before full commissioning.			
Research Need			
To build up a pluralistic expertise regarding the gradual demonstration of the technical feasibility and safety, for the full commissioning of the disposal facility.			
Research Objectives			
- to develop a structured socio-technical understanding of the possible successive decision-making steps to confirm the design and operation modes of a geological disposal facility in view of the full commissioning license. - to identify the nodes of decision making and associated stakes vis-à-vis safety, reversibility, need for regulatory & legal framework, social trust, governance, pluralistic expertise. - to set up criteria for the decision-making process during the last steps prior to and for full commissioning according to the preference of the different categories of stakeholders. - on this basis, to develop a new and improved methodology to plan the last steps prior to and for the full commissioning of the facility.			
Scope			
The development of methods to structure the phases of a geological disposal programme with regards			

to the engagement of each category of stakeholders (implementers, safety authorities, institutional and non-institutional experts, civil society) prior to and for full commissioning of the facility necessitates an improved understanding of the various technical and non technical aspects required by the translation of the "theoretical" design into the life size real situation. It also entails the understanding of the stakes involved for the last decision-making steps, according to each category of stakeholders.

Depending on the concept and the developed programmes at the national levels, tests (e.g. mock-up) are planned in above-surface laboratories or in Underground Research Laboratories. In situ tests under real conditions in so called pilot plants could be needed for fully demonstrating the technical feasibility and safety of construction methods and equipment (e.g. mining methods used for the large excavation works regarding the damaged to the host rock and their stability, equipment for surveillance, technical demonstration of the capacity to seal with the required level of containment …). Regarding the operational processes, the very specific features of geological disposal facilities currently developed in EU (underground works, tight areas, operation time-and space-scales, co-activity…) challenges the transposition of some of the knowledge developed for the safe operation of already existing (aboveground) nuclear facilities. This yields to a need for the qualification of processes essential for managing risks (e.g. ventilation system, waste package handling specific to underground disposal…) including anticipating accidental situations.

Among the challenge to be met is the practical implementation of reversibility during the operation phase that is now part of the terms of reference of geological disposal in several EU countries.

The successful achievement of these phases prior to the commissioning of the facility necessitates to meet the conditions for a meaningful and secured engagement of the civil society.

SRL or HML at task start	TBC	SRL or HML at task end	TBC	Target SRL/HML	TBC

Horizontal Activities

Incorporate reports and knowledge from past projects (XXXXXXXXXX). Expand text with any other elements that relates to scope considered horizontal activity.

Civil Society Aspects

The proposed research is a so called- "complex topic" involving technical research as well as social science together with methods of citizen science such as co-framing of the stakes associated with each successive decision-making stages, setting the legal ground of the decision making structure and engagement framework, development of a common safety culture between the several categories of stakeholders (operator, regulator, institutional and non institutional experts, civil society at national and local levels) involved in the safety case review process, development of a democratic culture.

Theme C - Conditions for closure

DRAFT – January 5th 2017

Determining the influence of THMC processes on the effective closure (e.g. performance on the long term of plugs? and seals made at a real scale);
Examining the criteria on which a partial or full closure could be decided: technical (e.g. surveillance strategy and methods) and socio-political criteria used to assess the assets and drawbacks of the possible strategies for closure (partial, full, gradual approach);
Identifying the conditions required to implement the closure on the basis of the analysis of the above criteria, in terms of pluralist expertise and governance scheme involving the various stakeholders in the decision making process.

Task Number	*Numbering scheme TBD*	Origin	TSO
Topics	• Understanding of near-field systems • Process modelling • Gaseous pathways • Radionuclide aqueous pathways • Operational monitoring • Decision-making processes and governance		
Sub-topic	• THMCG Models (Performance of Plugs and Seals) • Bentonite Properties (or Heterogeneous behaviour of bentonite components – BEACON) • Bentonite and cementitious systems (Gas geochemistry and Microbes, EDZ/ EBS Gas Migration, Bentonite evolution, Metallic & Cementitious Chemical Pertubations) • Gas formation and migration • Monitoring strategies • Technical and Socio-political criteria for partial or full closure		
Title			
Conditions for closure			
Background			
Geological Disposal (GD) is designed to be passively safe after closure. Moving from active to passive safety is a paramount step in the GD's lifecycle and should be carefully prepared as it makes the process less reversible and will impact the long-term post-closure passive safety. Nonetheless, the final closure operations can only begin when the repository operator and other pertinent national authorities have a sufficient level of confidence that the repository system will satisfactorily perform its intended function of long-term isolation of the waste. The purpose of closing a GD is to try to restore, as far as possible, the initial natural conditions of the host rock before any excavation operations and to limit the movement of water inside the GD. The overall strategy for closure should rely on an analysis of the assets and drawbacks of preferring e.g. a partial or gradual closure during waste emplacement operations, or a full closure at the end of waste emplacement. The closure will involve activities such as backfilling and sealing of drifts and shafts. These operations will likely occur over several decades and may entail that large and small scale drifts would be sealed in parallel with			

waste emplacement operations. Technical criteria used to support the decision for closure will be linked to data and measurements related to the behaviour of the different components of the GD, and on sufficient confidence on the performance of the concept used for closure gained through data and measurement of demonstration tests. Besides purely technical and safety criteria, societal aspect will be part of the strategy for closure. As a matter of fact, this strategy may also be influenced by the interaction with the public and the governance of disposal activities.
Thus, there is a need to further study the conditions for implementing various closure strategies, in which both technical and social aspects (e.g. the pluralist expertise of the safety case documenting the operational phase monitoring) will undoubtedly play a key role, together with other socio-political issues regarding the ongoing radioactive waste management context.

Research Need

There is a need for a greater understanding on how bentonite as an engineered barrier evolves through time in stable and altered conditions, when it is placed in drifts or shafts and juxtaposed to different host rocks. This requires different challenging aspects that include scientific bases (e.g. experimental and modelling of the thermal-mechanical-biological-chemistry evolution, understanding and pinpointing the evolution of the main parameters that will ensure that the bentonite fulfils its safety functions), engineering aspects (e.g. how the bentonite barrier is manufactured and installed), near-field and far field-monitoring (e.g. to confirm certain performance assessments of the engineered barrier and to monitor any excessive radiation or releases of radioactive material) and societal issues (e.g. engaging public stakeholders in the monitoring strategies and decision making processes).
There is also need to build a relevant post-closure baseline data from the DGR but also from the surface facility area that could provide a basis to develop criteria or indicators for closure monitoring and performance assessments.

Research Objectives

- Determining the influence of THMCB processes on the effective closure (e.g. long term performance of seals)
- Continue to solve technical issues in repository monitoring, which are related with data transmission technologies, long term power supplies, new sensors, geophysics, reliability and qualification of components
- Examining the technical and socio-political criteria on which a partial or full closure could be decided
- Identifying the conditions to implement the closure on the basis of the analysis of the above criteria, in terms of pluralist expertise and governance scheme involving the various stakeholders in the decision making process.

Scope

- Demonstrate the effectiveness of the closure system could be shown by demonstrating and understanding the natural evolution of a site, by in situ testing, by data analysis and modelling and by the use of suitable natural analogues.
- Influence of closure strategy on the safety of the operational phase should be documented through the monitoring of specific criteria
- Post-closure performance of a GD should be considered in the initial design and in subsequent updates to the safety case. Prior to regulatory approval for closure, the safety case should be updated to provide sufficient evidence that the closure system will be effective and that the safety of the GD after closure will be in accordance with

regulatory requirements.

Following the closure of a waste disposal facility, continuing control, including environmental monitoring, may be needed. Depending on national legislation, requirements may be contained within a post-closure licence held by the operator or responsibilities may be taken by a relevant national authority prior to agreement to closure.

SRL or HML at task start	TBC	SRL or HML at task end	TBC	Target SRL/HML	TBC

Horizontal Activities

Incorporate reports and knowledge from past projects (XXXXXXXXXX). Expand text with any other elements that relates to scope considered horizontal activity.

Civil Society Aspects

The proposed research is a so called- “multi-disciplinary topic” involving technical research as well as social science together with methods of citizen science such as co-framing of the stakes associated with each succesive decision-making stages, setting the legal ground of the decision making structure and engagement framework, development of a common safety culture between the several categories of stakeholders (operator, regulator, institutional and non institutional experts, civil society at national and local levels) involved in the safety case review process, development of a democratic culture.

Theme D- "Design optimisation"

DRAFT February 1st 2017

Task Number	*Numbering scheme TBD*	Origin	TSO
Topics	• Design optimisation		
Sub-topic	• 7#4 Application of the optimization principle (TSOs) • 4.1 Adaptation and optimisation of disposal concept before and during the operational phase (WMO) • 3.7 Development of alternative HLW/SF container materials (WMO) • Research-Framing Topic Proposed for horizontal Think Tank Activities (Joint-TSO-CS WP4 Mtg3 London) • 10#2 Strategies and programmes for back-end of nuclear fuel cycle (TSO) • 2#4 Co-disposal of waste: interactions between different types of waste (TSO)		
Title			
Design optimisation			
Background			

The NEA considers that "*where optimization becomes a matter for the regulatory authority, the focus should not be on specific outcomes for a particular situation but rather on processes, procedures and judgements*".

Feedback on optimization choices: it would be necessary to acquire from the WMOs, feedback on the optimizations that they have already done (or proposed) during their projects on GD.

Some example of design optimisation:

Ex1: sealing each gallery at the closure step? A technical-economic optimization decision led the implementer to choose a concept based on a single plug for the central well and filling for the disposal cells. This proposal will be examined by the nuclear authority to ensure that the safety of the disposal after closure is not degraded.

Ex2: longer disposal cells are now presented in order to reduce construction costs (less to build) and to ensure the ability to remove waste packages if necessary.

Ex3: reduce the space between the disposal cells; this optimization proposal requires studies on long-term behaviour and, in particular, the absence of chemical disturbances between the disposal cells containing different types of waste (rock alteration and its confinement properties)

Ex4: blind or open disposal cells on both sides? The design of the Cigéo MAVL disposal cell evolved from a "blind" concept to an "open" concept in order to allow ventilation of the disposal cells in operational phase; in this case the optimization is driven by safety.

Research Need
It is important to define what optimization means and why it is necessary to optimize ? - is it to improve safety? - Is it to make the disposal easier to operate? - is it to reduce costs? - to take into account new constraints: regulatory, new types of waste,... Who drives the optimization? Most of the time, WMO do it on its own initiative, but it can be incitated by its Safety Authority. In some case, we can also take into account the concept of "adaptability" to say that the disposal may accept evolutions, such as new types of waste or spend fuel. Thus, one research theme could be "how to design a disposal which can accept optimizations and/or evolutions"; What does this imply during the conception phase? Of course, this theme encompasses technical subjects, but can also raise the question of what does this imply in terms of licensing and decisions during the life of the disposal. How to take decisions? How to take into account the safety of the disposal and be sure that the safety is guaranteed even if the optimization leads to an important evolution when compared to its original design (what are the limitations of the optimization?) How to choose between the technical, economic and safety constraints? How to make them acceptable with regards to national authorities and civil society? Extracts from civil society contribution to SITEX SRA: There is a lack of effort to examine the fundamental principles of how to approach the review of a safety case. Issues such as the robustness of the technical barriers, the use of the precautionary principle, the use of the best available method and technology, and the choice of the best available site would be useful to study on a European regulatory level. (…) It would be useful if there was some discussion at a European level on how concepts such as precautionary principle, best available method or technology or best available site can be used in safety case analysis.
Research Objectives
- Examining how, in practice, GD alternative options will be evaluated. Optimization of the performance of the disposal system concerning isolation, containment capacities, as well as robustness (sites, design options, construction methods and operational vs after closure period); qualitative and quantitative arguments including the reasons why particular options were accepted/rejected. - Organising and tracing the dialogue between implementer, regulator and other stakeholders. In particular, how to record the decisions taken and the role that optimization had played in making them, considering the management of uncertainties (participatory safety case review) - Examining flexibility in the design to accommodate variation of volume and inventory (boundary conditions)

Scope
- Sharing experience feedback on the optimization of current projects; this is limited to the three European countries that have GD projects under development. The 3 WMOs must agree to share their experiences in terms of optimization choices (success and failure) and accept that all or part of it, is brought to the knowledge of the LAPs. This research theme could be very helpful as it would work on the optimization criteria and how they were used. - Operational feedback from disposal sites (excluding GD): examine how the experience feedback from the operational surface waste disposals can be useful in terms of optimization of operational phase of a GD; Can examples of optimization (design, operation, closure) be useful for GDs? - Feedback from the WIPP accident: how this feedback can help to optimize a GD during study or design (eg safety culture, reversibility...) This theme "optimization" can be the opportunity to exchange on the topic: how each country implements GD. Each country will make choices on disposal design that will be based on a technical optimization but also on societal concerns expressed at different stages; Interest in sharing feedback on how this optimization is built and how the logic of optimization techno-societal can be used. Discussion with civil society on optimization choices: how to match together technical options, political and economic choices? The implication of WMOs is fundamental in this project because optimization is essentially led by the implementers, but it's also a politically sensitive subject; so it's important to well share the objectives.

SRL or HML at task start	TBC	SRL or HML at task end	TBC	Target SRL/HML	TBC

Horizontal Activities
Share feedback

Civil Society Aspects
The proposed research is a so called- "multi-diciplinaries topic" involving technical research as well as social science together with methods of citizen science such as co-framing of the stakes associated with each succesive decision-making stages, setting the legal ground of the decision making structure and engagement framework, development of a common safety culture between the several categories of stakeholders (operator, regulator, institutional and non institutional experts, civil society at national and local levels) involved in the safety case review process, development of a democratic culture.

Theme E– "Safety culture in the context of Geological -Disposal"

DRAFT- January 5th 2017

Task Number	*Numbering scheme TBD*	Origin	TSO
Topics	• Shared safety culture • Safety and risks in complex socio-technical systems		
Sub-topic	• Safety culture in the context of geological disposal (TSO) • Research-Framing Topic Proposed for horizontal Think Tank Activities • Implications of complexity and interdisciplinarity for safety case review methods		
Title			
Safety culture in the context of geological disposal			
Background			

Radioactive Waste Management has a composite nature (scientific knowledge, gaps of knowledge, irreducible uncertainty, ontological and ethical aspects, inter and intra generational dimensions, difficult trade-offs and value driven decisions). It is made of various different parts that are brought together in order to make it possible to take decisions. Geological disposals in particular are complex sociotechnical systems that aim to achieve safe disposal of radioactive waste through a combination of natural resources, technological artefacts, scientific knowledge and technical expertise with social, political and cultural concepts and processes. Complexity means here the existence of several dimensions of a problem that cannot be addressed and dealt with separately.

The safe or unsafe character of such complex systems is linked not only with natural or technical factors, but also with the way complexity is managed by organisations and societies. The management of complexity entails the building of meaningful representations of the world that selects only some elements among this complexity. In order to manage increasingly complex systems, modern societies rely on two interlinked mechanisms of trust and specialisation. Trust is enabling societies to operate the division of tasks and the development of organisations. The management of increasingly complex systems goes together with distributing tasks along specialised sub-systems (Luhman). The analysis of accidents in the nuclear and non-nuclear field (Le Coze), underline the development of systems's obsolescence associated to such dynamics of compartmentalisation and "in silo" fragmentation (Kinsella), which compromise the capacity of the system as whole to adapt to changes, crisis, ruptures, and evolutions of the world that are likely to occur along the long term perspective of radioactive waste management.

Safety culture is a means for coordinating the various actors engaged in the management of a hazardous faciltiy or activity around a "common goal" of safety. *"The discussion extends to Safety Culture in all concerned, because the highest level of safety is achieved only when everyone is dedicated to the common goal." (IAEA INSAG 4).* While maintaining safety as common goal in the long term, safety culture is enabling transboundary conversations (Kinsella) among the compartmentalized sub-systems. It is therefore a means for prevention long term obsolescence of RWM safety systems. A particular attention should be given to safety culture during the (long term) operational phase of geological disposal that rely on active safety management.

Safety culture can be considered as balancing the tendancy of the radioactive waste management subsystems to overspecialise and fail to identify potentially emerging factors of risks by providing a feedback loop in which the different subsystems take into considerations not only the conformity of their activity but also their actual cross-influence on the overall safety system.

The SITEX II and ECCSSafe European research projects have pointed out the existence of two type

of safety cultures in the field of geological disposals: an "operational safety culture" (seriousness of safety management and control) specific to an organisation (e.g. operator, TSO, regulator) and a "societal safety culture" shared across the various actors engaged in the actual management system (set of values, references, through which the different actors can have assess together the degree of assurance that the safety objective is reached). The implementation of safety culture in the long term of RWM (aiming at the prevention of obsolescence) entails the development of meaningful cross-boundary conversations between operational safety culture and societal safety culture across the successive generations of stakeholders.

Research Need

Research Objectives

- Understanding how current research on sociotechnical systems – in particular in the field of industrial safety – can improve the methodology for safety case review of geological disposals by incorporating social, organisational and management dimensions together with technical dimensions.
- Defining and characterising safety culture at the level of actual management system (including networks and social interactions between specialised and non-specialised actors) rather than focussing on mandated organisations (waste management organisations, regulators and TSOs) only, setting differentiated roles and duties as well as creating opportunities for cross-cutting interactions in order to avoid long term obsolescence and vulnerability of organised systems.
- Understanding the factors which help or impede the actual management system to adapt to emerging risks issues and properties in a long-term, inter-generational perspective.

Scope

- Examination of recent sociotechnical models of safety and their consequences for safety case review methods as regards addressing socio-technical interactions
- Empirical research based on case studies and return of experience of actual cases in the field of radioactive waste management and in other industrial fields
- Development of criteria of long-term robustness and adaptability for the socio-technical management of a geological disposal, notably through PEP exercises
- Further developing the works on safety culture initiated in SITEX II WP4.2 based on recent sociotechnical models of safety, empirical materials (case studies and return of experience) and discussion with civil society actors

SRL or HML at task start	TBC	SRL or HML at task end	TBC	Target SRL/HML	TBC

Horizontal Activities

???

Civil Society Aspects

The proposed research is a so called- "complex/multidisciplinary topic" involving technical research as well as social science together with methods of citizen science such as co-framing of the stakes associated with each succesive decision-making stages, setting the legal ground of the decision making structure and engagement framework, development of a common safety culture between the several categories of stakeholders (operator, regulator, institutional and non institutional experts, civil society at national and local levels) involved in the safety case review process, as well as the development of a democratic culture.

Theme F - "Site characterization & siting process"

DRAFT (V3) – January 5th 2017

Task Number	*Numbering scheme TBD*	Origin	TSO
Topics	• Site Characterisation and Siting Processes		
Sub-topic	• Research-Framing Topic Proposed for horizontal Think Tank Activities (Joint-TSO-CS WP4 Mtg3 London):		
Title			
Siting process & site characterization			
Background			

The siting process of a geological disposal project is obviously a crucial step in the implementation of a radioactive waste management strategy, both from the perspective of the overall safety and that of the public participation to the decisions. The global objective of the siting process should be the selection of the best available site. This would imply that what this means, theoretically and in practice, is clearly defined and fully and equally understood by all the involved players.

The reality proves to be different. The site selection is a complex issue that involves both a technical process to assess the technical suitability of possible sites and characterize them, and a political dimension that has to deal with some social and economic aspects. In other words, the decision-making process brings together a theoretical concept of radioactive waste management, and the related geological structure, with the reality of a territory where a population is living. The siting phase also implies to build a local justification for activities that mostly relate to a regional, national or even international RWM agenda. From that perspective, the siting process will combine the specific need to address the consistency of the choice regarding the overall objective of a safe RWM strategy with the need to deal with the usual problems of implementing large infrastructures of any kind in modern democracies.

Most site selection processes developed in EU countries have experienced severe problems while trying to identify suitable sites, especially with finding the balance between technical geological selection criteria (where the suitability of the site should be determined by the geology) and social, political or cultural criteria (where the appraisal of the suitability of the site is determined by the attitude of the local actors vis-à-vis the possibility of hosting a site). This situation has contributed to undermine the credibility of the review of safety along the site characterization, while, in some countries it has become unclear that real long-term safety criteria were met in the site characterization. The perceived risk there is that the process tends to subsitute a "good enough" approach to the "best available" one.

In parallel, site selection processes that have been implemented have in some cases raised issues regarding the fairness towards concerned local communities, whether it relates to the way they are incentivized or constrained to make a positive decision, or their access to information and due participation in the decision making process. This has also contributed to undermine the credibility of the siting process. The perceived risk there is for instance either that a community gets "trapped" into accepting the project in a particularly suitable site, or that the safety case is "distorted" to demonstrate the suitability of a site which the acceptance of the community led to select.

Although the siting process is a national concern, the criteria used as well as the national and local decision making processes developed for the site selection are somehow still a matter for debate in the countries where the siting decision has been made. The same issues are already or will likely be discussed in the countries where this process is still ongoing or has not even started. It is therefore relevant, while being fully respectful of the siting process framework in each of the Member States, to develop a better understanding through the sharing of experiences and concerns.

Research Need

There is a need to better understand the way technical criteria that should apply to the siting process to contribute to a good safety case on one hand, and societal criteria that are needed to engage a community in a territorial project as a result of a site selection on the other hand, tend to articulate in real-life decision making processes, and how this articulation could be dealt with in a way that would both tend to the implementation of the best available solution and the fairness of the process regarding the rights of the concerned community.

This requires first, through a review of geological, hydreological and other concerns, to better characterize and make more explicit the technical criteria that drive the search of suitable sites, the boundary conditions that could be set to suitability, and the guiding principles that could relate to the concept of "best available" site from a technical point of view. This analysis should be combined with an analysis of the processes through which a territory gets selected for a siting project and the concerned community is engaged in the decision making. Most importantly, the combined analysis should allow to identify, based on the discussion of the relevant return of experience and the reflexion on possible evolutions, some good practices and potential guidelines.

This research, building up on the experience of the most advanced programmes, could foster a better shared understanding of their processes and their respective rationale, both helping to a better informed continuation of their programmes, and contributing to address the questions and concerns arising as to the siting process in the countries with less advanced programmes.

The proposed approach would also consider some organisational issues regarding the development of the site selection process, including the framework of the process, the conditions for stakeholders' involvement, and more specifically the expectations towards the expertise function about the criteria for site selection.

Research Objectives

The overarching objective of research on siting processes is to better characterize, understand and explain the criteria involved and the way they are acknowledged, explicated, assessed, interlinked and balanced in decision making processes towards the choice of a site. This more precisely points to a double objective:

- in a past and present perspective, the analysis of processes that have been experienced or that are still implemented in the most advanced countries, in a way that allows for (a) a better and better shared understanding of the criteria that led or lead to the siting decision, their weight and balance, and (b) drawing good and bad lessons from these experiences;
- in a future perspective, the capitalization of this return of experience to establish indicative guidelines that could be useful for decision making processes to come in the less advanced countries.

In other words, the objective of the research is to draw shared principles from the existing return of experience in MAP countries on the real conditions of site characterization and siting processes, and to examine the conditions for a transfer of this experience to LAP countries.

Scope

The proposed research is a complex topic involving technical as well as social science issues, altogether with requiring public participation. The research should address the technical aspects of site characterization and siting, the societal aspects of engaging with a concerned territory and the related community into such a project, and the way these technical and societal aspects interlink in the national decision making process. Also, the scope of research should cover both levels of guiding principles and practical experiences.

- The technical criteria used for site selection, the methodology used for site characterization

and for the assessment of site performances compared to upfront criteria, and the possible elaboration of principles guiding decision (between the search for the absolutely best possible site and the temptation to accept a site that is "good enough").

- The lessons to be learnt from the historical study of the temporal and discursive relationships between site characterizations and siting processes (and, when possible, the assessment of process outcomes). This could be based on case studies such as:
  - the original Andra assessments of the 1970s-80, the Mission Bataille, and the Mission Granite in France,
  - the successive processes in the UK and the treatment of national geological characterisations as forerunners or results of process,
  - examples in many other countries, in related and unrelated fields.
- Several research projects of social science have been developed in order to investigate alternative approaches and processes to siting giving room to citizen engagement at different levels of decision-making. Although no definite outcomes have been reached for the time being in this field, a transverse analysis of the issues covered would contribute to the elaboration of common principles.
- Philosophical and social anthropological studies could contribute to better understand the relationships between "sense of place" and socio-technical processes, also including the "geological imaginary" (cultural, social and intimate representations of the underground).
- Regulatory aspects, in the sense of the framing of decision processes and the principles applied, needs to be analysed too. This includes analysis of moves in legislative and other authoritative bodies, degrees to which they respect the spirit as well as the letter of the law or of other siting process agreements (Choice of Dessel at the close of the Belgian Local Partnership process; legislation on reversibility in France, etc.)

SRL or HML at task start	TBC	SRL or HML at task end	TBC	Target SRL/HML	TBC

Horizontal Activities

Incorporate reports and knowledge from past projects (XXXXXXXXXX). Expand text with any other elements that relates to scope considered horizontal activity.

Civil Society Aspects

The proposed research is a so-called "complex topic" involving technical research as well as social science together with methods of citizen science such as co-framing of the stakes associated with each successive decision-making stages, setting the legal ground of the decision making structure and engagement framework, development of a common safety culture between the several categories of stakeholders (operator, regulator, institutional and non institutional experts, civil society at national and local levels) involved in the safety case review process, development of a democratic culture.

Appendix 6 - Guide for the assessment of the future JP governance

Based on the governance principles presented in section 3.1 of this report and on the results of the task 3.5 meetings with civil society organisations (CSOs), notably the first meeting held in Paris on 28th August 2015, task 3.5 elaborated a draft document. The purpose of this document was to settle identified general principles that guide potential CS involvement in the future JP, to define what should be the main modalities of its potential involvement and to determine a grid of analysis providing concrete questions to be used for assessing the JP governance that can result from JOPRAD. The document was released to the JOPRAD consortium in November 2015 for consultation and further input. The final elements of this draft document are presented below.

A - The three identified levels of JP governance

During the Kick-off meeting of JOPRAD held on 11th June 2015, three options were presented as possible results of the project: the achievement of an European Joint Programming (EJP), the implementation of a structure based on ERA-NET model and the prolongation of the current European R&D programming[23]. It is understood that the last option would be considered by some participants as a failure of the JOPRAD project, but still it has to be considered at least as a comparative reference (to ensure that the future joint programming is a better option than the current situation). It is also a matter of solving the issue of what would happen if JOPRAD does not succeed.

To carry the required comparative assessment of the three types of governance, task 3.5 identifies three levels of governance that need to be investigated:

The first level of JP governance is the Institutional governance (I-gov) aiming at defining the European Strategic Research Agendas (SRA) of the mandated actors and the programme document defining the roadmap of the future European research on GD (prioritization of R&D topics). It is also in the frame of I-gov that the different JP institutions and their functioning rules are set. It is also at this level that the role of the different actors and the framing of their interactions are defined.

The second level of JP governance is the Operational governance (O-gov) that set the procedure for projects selection, R&D calls[24], preparation or update in the annual work plan of the programme document. It is also at this level that the actors defined in the frame of the I-gov will be invited to answer the potential R&D calls and be allowed to participate (and funded) to the projects.

The third level of JP governance is the phase of Evaluation (Eval) that integrates two interconnected dimensions: assessment of results and evaluation of the procedures and governance. The results of this evaluation phase should produce inputs for the institutional governance (integration of new R&D topics in the programme document, change of the rules according to the feedback of the previous R&D calls or previous projects assessment). It implies to have a reflexion on how and with witch periodicity will the results and procedure be assessed.

[23] As underlined by Bruno Schmitz (Head of Unit Fission Energy)

[24] After the work carried out by WP2 and WP3 of JOPRAD and the assessment of different existing Joint Programming, the JOPRAD consortium selected a JP scheme without calls. But the purpose here is to have a reflection integrating all the existing possibilities.

The figure below represents the interactions existing between the different levels. It is a feedback loop system:

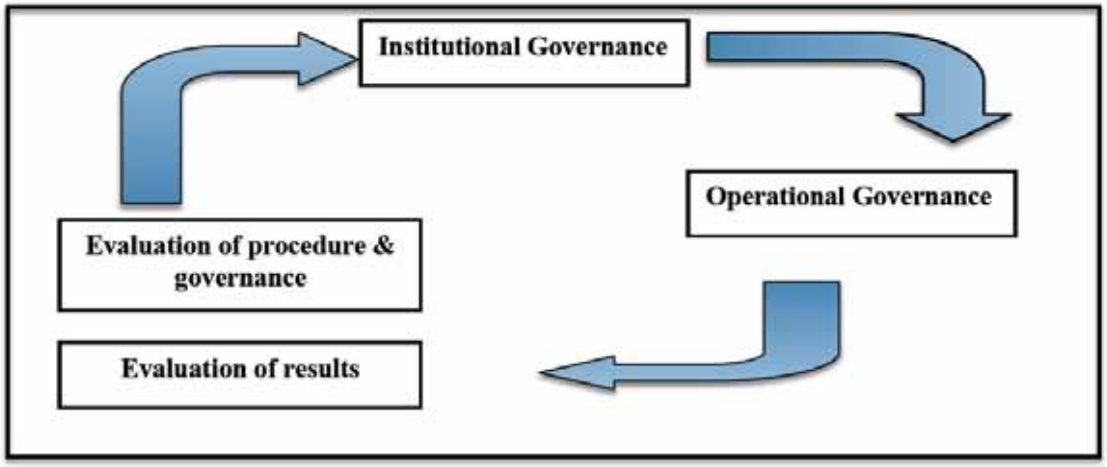

Figure 1- interactions between the three levels of JP governance

B - General principles guiding potential CS involvement in the future JP - CS assessment criteria

CS involvement is a key element of an in-depth safety process integrating multi-level expertise of different actors: operators, regulators with the support of their technical experts, CS experts. CS commitment makes sense only if the good functioning of the in-depth safety system (described in the section 3.1 of this report) has been verified first at all levels. It is a pre-requisite of the CS participation. CS representatives can have the feeling of a honest functioning when they are reasonably convinced that the regulators assess the operators' work in an efficient way. It is the reason why CS expects that the regulators and their technical supports work independently from the operators and CS wants to ensure the conditions are met to do so.

This general concern of CS is reflected by a set of considerations regarding JP governance in the context of European R&D on RWM (and more specifically on GD). They are presented below through a set of concrete questions and statements and constitute CS assessment criteria.

B-1 Honest functioning of the in-depth safety implementation in R&D processes

- **Independence of public experts**

  - What are the conditions for the experts that will assess the safety case to remain independent and keep their capacity to conduct R&D within the JP on specific topics without necessarily involving cooperation with or approval of implementers and other research organizations?
  - How will the independence of the experts be guaranteed in joint programming by the rules of governance?

- **Appropriate conditions for CS involvement in a JP**

It includes a procedural dimension: the decision-making process has to be transparent with clear roles and rules of functioning. It implies different considerations at the three identified levels of JP governance:

At JP institutional governance level (I-gov):

The R&D issues extracted from national contexts and from European networks and platforms of mandated actors have to be the results of processes which are themselves complying with the consultation rules of the European Commission and with the principles of the Aarhus Convention.

Regarding the interactions between CS and a potential JP institution, CS representatives should be part of the different boards that will constitute the decision-making bodies of the future JP. It necessitates defining an agreement procedure of selection of the CS members that will participate. They should be independent experts, entrusted by CS and with capabilities to assess the R&D issues in the programme document (and the future updates). The CS members should be consulted and they could assess the decision-making process of the JP. The assessment work is resources demanding: it necessitates dedicated resources (person months, travel & subsistence) to enable the CS representatives to operate efficiently in the future JP for this purpose.

At operational governance level (O-gov):

Regarding the potential preparation of calls or updates realized in the programme document (according to the JP model that will be implemented), the JP will have to present argumentation regarding how the calls/programme's updates are prepared and the basis on which the topics of calls/programme's updates are chosen.

Regarding the selection procedure of projects, the JP will have to present argumentation regarding how, why and by whom the projects are selected.

CS representatives could give their opinions on R&D calls/programme's updates and project selection by participating in the decision-making bodies (see the section "at institutional level" above). They could also directly participate in the selection of R&D projects; this means CS experts would participate in the discussion regarding the selection of the R&D topics included in the calls/ programme's update.

This implies a capacity to influence decision (not only observing). It would improve the quality of selection and reinforce trust, credibility and legitimacy of decisions.

CS experts should have answers from the JP institutions regarding justifications of the final decision, showing how the CS position has been duly taken into account.

At evaluation level (Eval):

The JP should include an assessment of results and procedures in order to improve the governance. CS representatives could contribute to results and procedures' assessments. A honest functioning implies also a high level of transparency regarding results and procedure (see the section Transparency below)

B- 2 Quality of R&D process

- **Plurality of researchers and research organisations**

Plurality of researchers and research organisations is a source of quality of scientific results. CS representatives consider that a R&D call[25] process or Research consortium limited to a small number of actors risks to lower the quality of research. Specific attention will be given to the risks of capture of the R&D process, in this perspective.

The same consideration applies for the potential transversal and cross-cutting activities (task 3.4 of JOPRAD). They have to be prepared by a plurality of research organisations and they have to be designed to embed a real plurality of researchers.

- **Transparency**

The issue of transparency is of utmost importance for CS. It is an expectation for all phases of the JP governance process and includes early access to information of R&D results and justification of the decisions.

There is also an expectation of early and extensive release of results, allowing the assessment of their impacts on current GD safety case review. The JP using public money should not use commercial confidentiality as a mean to preclude access of the public to the results.

B-3 Governance concerns linked to GD R&D issues

- **Integration of GD issues in a global European R&D perspective on RWM**

CS expects 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 interact 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 issues regarding coherence of the RWM strategy waste inventory and also regarding risk transfers over time and space.

Regarding the coherence issue:

If the JP governance on GD has to be integrated in a coherent way in the European R&D strategy on RWM, the JP institutions are not responsible alone for ensuring a complete coherence. There are other institutions, places or processes to discuss this issue.

CS must have representatives in such places, which should ensure their participation at the appropriate level. It is why participation of civil society in JOPRAD and joint programming necessitates also the possibility of a participation in other structures or processes dealing with larger issues.

Regarding the risk transfer over time and space:

Different technical paths could lead to Geological Disposal. (Different schedule, inventories, modalities, etc.). It implies different concerns:

- R&D should address every step of the different paths because decisions of a previous step have consequences on the other step (and conversely, decisions regarding future steps bring constraints for interim steps).

[25] As indicated above, the section here envisioned all the possibilities to have a overall picture, even if the JOPRAD consortium finally selected a JP without calls.

- It is important to take into consideration the objective of reducing the risks all along the path and to develop appropriate R&D to do so.
- R&D is needed on how to characterize a path, on what should be the criteria to take into account, on how to value the criteria.
- It is also important to introduce an appropriate level of reversibility in the different possible paths of GD implementation.

- **Necessity of a flexible process**

The development of a GD safety case as safe as possible is a long process that will have to be able to evolve according to new different questions that will arise, according to the evolution of the social context, according to the feedback of existing facilities. Regarding governance, it means that a balance has to be found between a long-term perspective and a capacity to integrate new elements all along the process (including new CS concerns that could be raised by the future generations). For the governance of the JP, it implies several reflexions:

- The programme document of JOPRAD will present a programme of work for a longer duration than the five years of the first joint programming. CS encourages this perspective to improve transparency.
- How will the JP governance integrate this long-term vision? (Periodic re-assessment of the R&D priorities, etc.)
- Will JP partners (and CS) have the possibilities to introduce new topics in the successive R&D calls/programme' updates?

- **Balance in setting R&D priorities**

The R&D topics and priorities included in the common JP SRA have to cover the R&D interests of the partners on an equity basis. Balance has to be found:

- Between the different types of mandated actors (Operators, Experts, Research Entities),
- Between the different countries: Small countries could benefit from joint programming but it depends on their capacities to influence the selection of topics. Regarding funding, JP on GD is part of European public resources. All Members States contribute to the European budget, including Members that have no GD plans and that are studying alternatives options. It is important to have a view on what part of global EU R&D budget on RWM will represent the joint programming on GD and to be sure that there is possibility to launch programmes on topics that do not enter in JOPRAD frame but that are of public interest in the EU.
- Between the different national GD programmes: There are obviously less and more advanced programmes. European R&D governance should not only be based on more advanced national programmes but different national situations have to be taken into account. JP should develop R&D calls allowing for the development of research projects adapted to different national contexts.

C - Synthetic Scheme

Figure 2 (see below) is a tentative conceptual tool aiming at helping the reflexion by identifying key elements for the three levels of JP governance. It is a synthetic diagram presenting function and actors that could have a role in JP governance.

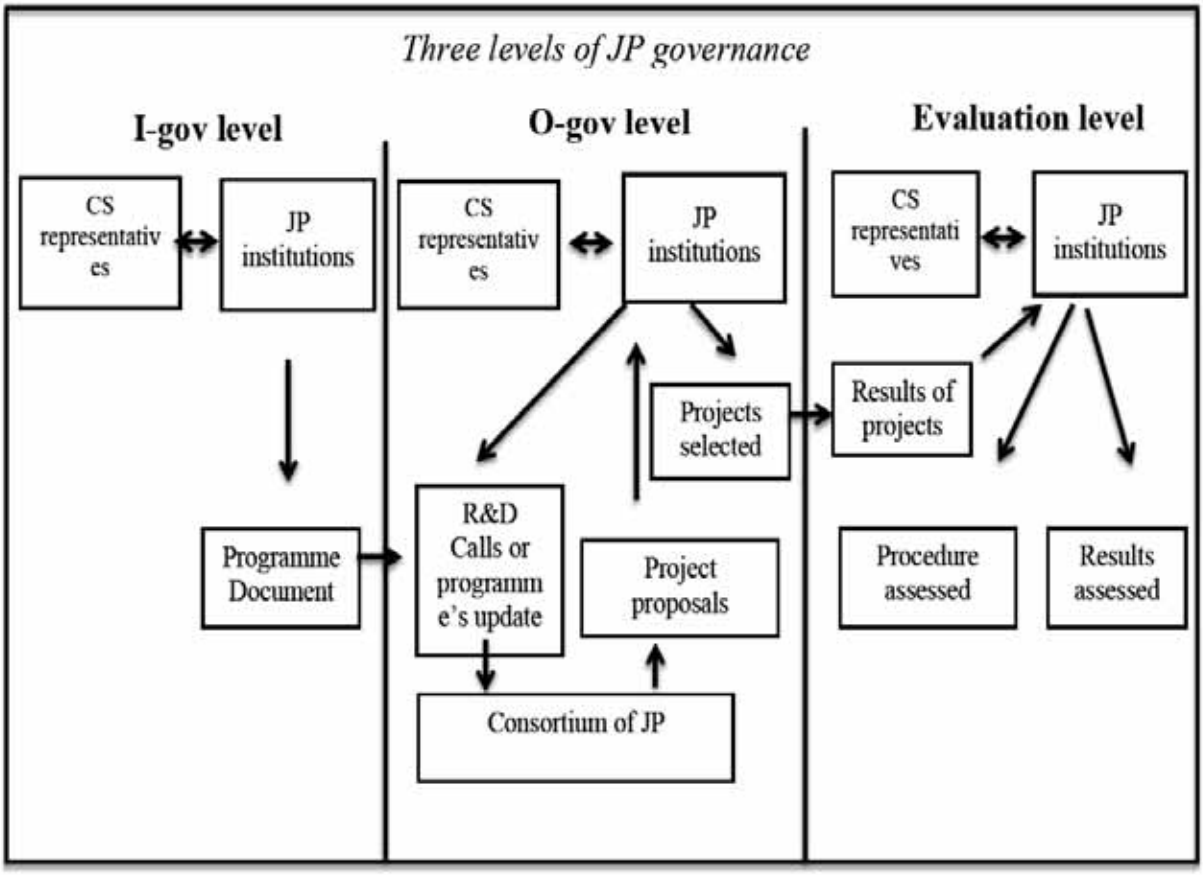

Figure 2- Key elements of the three schematic levels of governance

D- Practical questions for CS investigations, draft grids of analysis

According to the overall considerations defined above, task 3.5 developed a set of concrete questions for each of the three levels of JP governance that constitute a grid of JP analysis. The grids of analysis are structured to assess and compare the different possible options that could result from JOPRAD. These questions have been elaborated by identifying potential problematic issues or on the contrary potential favourable conditions of the different available options for a JP. The work was performed before the selection by the JOPRAD consortium of the EJP as the most suitable option.

D-1 Issues related to Institutional Governance- (I-gov) (R&D programmes definition, rules for JP governance)

Firstly, there is a set of concrete questions related to decision process:

- What will be the different steps of the JP decision-making process?
- The programme document has to be finalized by JOPRAD. Who will decide at the end of JOPRAD what topics will be included or not? Only mandated actors within JOPRAD? What would be the role of the European Commission?
- If a JP is implemented, who will take the decisions regarding the definition of the R&D programmes? A selected group of mandated actors? Other actors? What will be the role of national governments?
- Will non-involved actors (new operators, new TSOs, new academics, other entities) have the possibility to enter the JP? How? At what conditions? When?

There is then a set of issues related to the process for setting the priorities and making the trade-off among the topics:

- What rules for ensuring fair balance between the R&D topics to be included in the JP programme document?
- What balance between the SRA of the different mandated actors?
- What balance between the different interests of national programmes?
- Will those rules be made explicit? How?
- How will the views of the CS regarding priorities among identified issues be considered? How will the other topics suggested by CS (e.g.: social science, overall RWM consistency) be taken into account? What are the foreseen procedures?

There is thirdly issues regarding the sharing of information along the preparation of the programme document:

- What rules will apply regarding the sharing of information for the first JOPRAD programme document? Later on in the JP procedure?
- Who will access the related documents? When?

There is another set of concrete questions related to funding:

- Who will finance the joint programming? To what extent? What will be the rules?

- How will the European Commission allocate the European resources in GD JP ? To what extent will this integrate a global perspective on RWM research? What will remain for other R&D issues regarding RWM?

Finally, there is issues related to CS Participation in this Institutional level of governance (I-gov):

- Will CS members be part of the decision-making bodies? With what objective? (Discussing priorities, suggesting R&D areas)
- What would be the role of the CS representatives? What information would it access? When? What would be the procedure for its engagement? What would be the guarantees for its contribution to be duly taken into account?
- Who would be the CS representatives? What would be the procedure for selecting them?
- What would be the dedicated resources allowing for the CS representatives?
- What would be the process of consultation of the national CSOs by the mandated actors of the JP in the perspective of the implementation of the Aarhus Convention? In addition, what are the processes in the JP to convey the priorities of the national CSOs?

The synthetic grid of analysis for I- gov is presented below. It compiles the different set of questions and connects them to CS assessment criteria presented above (part B of this section). Elements of answers are given for the different options of governance (EJP, ERANET, No JP) and also for the current elaboration of the programme document.

Synthetic grid of analysis for I-gov level

CS expectations/ criteria of governance	Areas of investigations regarding I Gov (SRA, programme document)	JOPRAD programme document	EJP	ERANET	No JP
- Honest functioning of the in-depth safety implementation in R&D processes	**Who will decide? What? When?** What will be the different steps of the JP decision-making process?	WP5 consortium agreement	I-Gov& O-gov in JOPRAD Like a R&D project	JOPRAD: definition of themes of research (project define in calls)	Probably R&D project
	The programme document has to be finalized by JOPRAD. Who will decide at the end of JOPRAD what topics will be included or not? Only mandated actors within JOPRAD? What would be the role of the European Commission?	Mandated actors/	Mandated actors in JOPRAD/ EC will launch a global call	Mandated actors more broader spectrum	Mandated actors Probably
	If a JP is implemented, who will take the decisions regarding the definition of the R&D programmes? A selected group of mandated actors? Other actors? What will be the role of national governments?	/	WP4 defined, JOPRAD extended partners/ global validation by MS during WS meeting	Selected Mandated actors (like in Concert) Role of validation at the end of JOPRAD	JOPRAD partners Probably None role of National gvts

	Will non-involved actors (new operators, new TSOs, new academics, other entities) have the possibility to enter the JP? How? At what conditions? When?	/	NO	YES	??
Governance concerns linked to GD R&D issues	**What process for setting the priorities and making the trade- off among the topics?**	Separated Selection of topics by RE, TSO and WMO Pb of coherence	During JOPRAD WP4, question of trade-off between the different SRA	Framework established in WP4 / trade-off possible after the JOPRAD project	??
	What rules for ensuring fair balance between the R&D topics to be included in the JP programme document? Balance between the SRA of the different mandated actors?	Long term research privileged/ operational topics	Negociation inside WP4	Pb of heavy administrative process	
	Balance between the different interests of national programmes?	Pbmatic inside the SRAs of each group of mandated actors	Place of R&D for only one type of mandated actors?	Large framework defined in WP4 More room opened after JOPRAD	
	Will those rules be made explicit? How?	Rules explained in JOPRAD document	Rules explained in JOPRAD document	Rules could be defined in JOPRAD document, implemented	

	How will the views of the CS regarding priorities among identified issues be considered? How will the other topics suggested by CS (e.g.: social science, overall RWM consistency) be taken into account? What are the foreseen procedures?	CS proposals (task 3.5à, trade off- during WP4	CS proposals (task3.5), trade off- during WP4	after CS proposals (task3.5), trade off- during WP4 and after JOPRAD	
- Quality of R&D process	**What rules will apply regarding the sharing of information along the preparation of the programme document?** For the first JOPRAD programme document? Later on in the JP procedure? Who will access the related documents? When?	Presentation to stakeholders during Mid-term workshop	Mid-term WS, and updated document: not defined yet Will the programme document be public? A priori yes	Idem- Rules to define the different steps of sharing the information regarding the contents of the calls	??
- Governance concerns linked to GD R&D issues	**Funding** Who will finance the programmes? On What Extent? What will be the financing rules? Part of GD research in the R&D European Budget How will the European Commission allocate the European resources in GD JP ? To what extent will this integrate a global	/	EU for 70% mandated actors for the rest What for the linked third parties? A priori all the budget allocated to RWM R&D	EU for 33%, mandated actors for the rest What for the linked third parties? A priori all the budget allocated to	

	perspective on RWM research? What will remain for other R&D issues regarding RWM?			RWM R&D	
Honest functioning of the in-depth safety implementation in R&D processes	**CS participation** Will CS representatives be part of the decision-making bodies? With what objective? (Discussing priorities, suggesting R&D areas) What would be the role of the CS representatives? What information would it access? When? What would be the procedure for its engagement? What would be the guarantees for its contribution to be duly taken into account?		Role of CS representatives defined in WP5/proposal in section 3.3 of this document	Role of CS representatives defined in WP5 Different steps to elaborate inside the ERANET network	
	Who would be the CS representatives? What would be the procedure for selecting them?		Work to do WP5	Work to do WP5	
	What would be the dedicated resources allowing for the CS representatives to provide an actual input?		Defined allocated resources inside JOPRAD project	Idem	
	What would be the process of consultation of the national CSOs by the mandated actors of the JP in the perspective of the implementation of the Aarhus Convention? In addition, what are the processes in the JP to convey the priorities of the national CSOs?		Defined Through WP5	Defined through WP5	

D-2 Issues related to Operational Governance- (O-gov) (preparation of R&D calls/programme's updates, selection of projects)

Firstly there is an issue related to preparation of R&D calls or programme's updates according to the different available JP options:

- What shared information regarding the preparation of calls/programme's updates and selection of topics?

There is then a set of questions focusing on the plurality of research's organisations involved in the Joint programming:

- Who will be invited to answer the calls of the JP/ to be part of the consortium? Will the invitation be restricted to mandated actors involved in JOPRAD?
- What will be the funding rules for each category of participants? (Mandated actors, JP consortium members, others?)

A third set of concrete issues is related to the selection of projects:

- What will be the project selection procedure?
- What will be the rules regarding how, why and by whom the projects are selected?

Finally, there is questions related to CS Participation at this level of governance:

- What would be the role of CS representatives at this level of JP governance? (Discuss preparation of R&D calls/programmes updates and contribution in the selection of projects?)
- Would it be a participation of CS representatives in the JP Selection procedure? What would be the influence of CS representatives on the decision-making process?

The synthetic grid of analysis for O- gov is presented below. It compiles the different set of questions and connects them to CS assessment criteria presented above (part B of this section). Elements of answers are given for the different options of governance (EJP, ERANET, No JP) and also for the current elaboration of the programme document.

Synthetic grid of analysis for O-gov level

CS expectations/ criteria of governance	Areas of investigations regarding O-gov (Preparation of R&D calls, selection of projects)	EJP	ERANET	No JP
- Quality of R&D process	**Preparation of R&D calls or programme' s update?** What shared information regarding the calls/programme's udpate and selection of topics?	WP4 and no after, no calls but possibility of programme's update	Global Scheme in WP4 will determine the information shared regarding the calls	
- Quality of R&D process - Governance concerns linked to GD R&D issues	**Access to the R&D calls, plurality of research organisations** Who will be invited to answers the R&D calls? What will be the funding rules for each category of participants?	Mandated actors selected in JOPRAD Defining rules for linked third parties Indroducing differenciation for CSO?	More open process after the end of JOPRAD, depending of the calls Defining rules for linked third parties Indroducing differenciation for CSO?	
- Quality of R&D process	**Selection of projects** What project's selection procedure?	Projects defined in WP4, selection inside	Rules of Selection to be determined in JOPRAD	

	What rules regarding how and why the projects are selected?	JOPRAD No precise rules yet determined	To be determined in WP5	
- Honest functioning of the in-depth safety implementation in R&D processes	**CS participation** what role of CS representatives? (Discuss preparation of R&D calls/programme's updates and contribution in the selection of projects?) CS participation in the JP selection procedure? What influence?	Same role as before Role of task 3.5, to be seen in WP4	Role to be precised in WP5 First elements inside JOPRAD project, define role in WP5	

D-3 Evaluation (Eval) (results, procedures & governance)

A first set of questions is related to access to R&D results:

- Who will have access to the R&D results? When?
- What results will be public? All of them? If not, on what basis are the results published or not?

A second set of issues is focused on the assessment of results and procedures:

- Who will assess the results and the procedures?
- What procedure will be set?
- With what regularity will the assessments be done?
- How and through which procedures could institutional governance and operational governance be adapted to take into account the outcomes of this assessment?

A third set of issues is related to CS participation:

- What would be the CS representatives' role at this level of JP governance? (Contribution of assessment of R&D results, assessment of governance & procedures of the JP, production of inputs for updated programme document?)

The synthetic grid of analysis for Evaluation level is presented below. It compiles the different set of questions and connects them to CS assessment criteria presented above (part B of this section). Elements of answers are given for the different options of governance (EJP, ERANET, No JP) and also for the current elaboration of the programme document.

Synthetic grid of analysis for Eval level

CS expectations/ criteria of governance	Areas of investigations regarding Eval level (Results and Procedure)	EJP	ERANET	No JP
- Quality of R&D process	**Access to R&D results** Who will have access to the R&D results? When?	Determined in WP5	Determined in WP5	
	What results will be public? All of them? If not, on what basis are the results published or not?	Question of industrial secrecy and knowledge transfer not free	Idem	
- Governance concerns linked to GD R&D issues	**Assessment of results and procedures** Who? What procedure? What regularity?	Like R&D project, few room for adaptation	Big administrative machine, difficult to change	
	How and through which procedure could institutional and operational governance be adapted?	Evaluation each year	Probably evaluation each year	
- Honest functioning of the in-depth safety implementation in R&D processes	**CS participation** What role of CS representatives? (Contribution of assessment of R&D results, assessment of governance & procedures of the JP, production of inputs for updated programme document?)	WP5 determined and suggestion of 3.5 (see section 3.3)	WP5 determined and suggestion of 3.5 (see section 3.3)	