



**Deliverable 11.2:**

**List of selected demonstration cases, criteria for final selection, proposal and estimation of effort and resources**

Work Package 11 State-of-Knowledge

The project leading to this application has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 847593.



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## Document information

Project Acronym	<b>EURAD</b>
Project Title	<b>European Joint Programme on Radioactive Waste Management</b>
Project Type	<b>European Joint Programme (EJP)</b>
EC grant agreement No.	<b>847593</b>
Project starting / end date	<b>1<sup>st</sup> June 2019 – 30 May 2024</b>
Work Package No.	<b>11</b>
Work Package Title	<b>State-of-Knowledge</b>
Work Package Acronym	<b>SoK</b>
Deliverable No.	<b>11.2</b>
Deliverable Title	<b>List of selected demonstration cases, criteria for final selection, proposal and estimation of effort and resources</b>
Lead Beneficiary	<b>BGE</b>
Contractual Delivery Date	<b>01/03/2020</b>
Actual Delivery Date	<b>17/03/2020</b>
Type	<b>Report</b>
Dissemination level	<b>Public</b>
Authors	<b>Astrid Göbel (BGE), Tobias Knuuti (BGE)</b>

## To be cited as:

**BGE mbH** (2020): List of selected demonstration cases, criteria for final selection, proposal and estimation of effort and resources. Final version as of 17/03/2020 of deliverable D11.2 of the HORIZON 2020 project EURAD. EC Grant agreement no: 847593.

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## Acknowledgement

This document is a deliverable of the European Joint Programme on Radioactive Waste Management (EURAD). EURAD has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 847593.

<b>Status of deliverable</b>		
	By	Date
Delivered (Lead Beneficiary)	BGE	13/03/2020
Verified (WP Leader)	BGE	17/03/2020
Reviewed (Reviewers)	PMO / Bureau	18/03/2020 (PMO) 19/03/2020 (Bureau)
Approved (PMO)	PMO / Bureau	18/03/2020 (PMO) 19/03/2020 (Bureau)
Submitted to EC (Coordinator)	Coordinator	24/03/2020

## Executive Summary

Safe management and disposal of radioactive waste relies predominantly on knowledge. This is reflected in a strong commitment of EURAD to enhance knowledge management (KM) and transfer between organisations, member states and generations. To this end, the current state-of-knowledge (SoK) on relevant topics will be compiled in user friendly documents and made accessible to benefit member states' RWM programmes. Furthermore, gaps in knowledge codification will be identified, to help prioritise future KM needs. All of this shall be done in a systematic and comprehensible approach. Since the production of SoK documents is of immediate interest, the development of this approach is to be done in an agile, "learning-by-doing" manner. This means that from the start there will be a strong focus on SoK documents generation, whilst developing and refining the production process in parallel. To accomplish this, it was decided that 2-3 demonstration cases will be implemented in a systematic manner. The topics for these demonstration cases were selected from the EURAD Roadmap/WBS according to comprehensible criteria. The rationale and application of these criteria will be discussed in this report. As a result, two demonstration cases were chosen, namely: 1) HLW and SF containers, and 2) Spent Nuclear Fuel. The demonstration cases will be launched in April 2020 and finalised by September 2020 (6 month). For each case, 2-3 experts will be involved. Identification and involvement of experts will be done by the WP11 team and the Bureau. Experts will be provided with a document that provides guidelines and suggestions for their work (draft "Authors Guidance and Template") and will be supported by the WP11 team. The process will be continuously and closely monitored, feedback assessed and the process adjusted accordingly. Final results will be reported in November 2020 and an updated version of the "Authors Guidance and Template" will be presented in September 2020.

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## Glossary

The following are common terms used in the context of the EURAD Roadmap and linked to EURAD Knowledge Management.

### Communities of practice (CoP)

A voluntary group of peer practitioners who share lessons learned, methods, and best practices in a given discipline or for specialized work. The term also refers to a network of people who work on similar processes or in similar disciplines, and who come together to develop and share their knowledge in that field for the benefit of both themselves and their and other organization(s).

### Domain

An area of activity, interest, or knowledge, especially one that a particular person, organization etc deals with. Also referred to as 'Topic' or 'Knowledge Area'.

### EURAD

The European Joint Programme on Radioactive Waste Management (EURAD). Also referred to as the 'Joint Programme'.

### Expert

Someone widely recognized as a reliable source of knowledge, technique or skill whose faculty for judging or deciding rightly, justly, or wisely is accorded authority and status by their peers or the public in a specific well-distinguished domain.

### Knowledge

Knowledge: A mix of experiences, values, contextual information and expert insight for acquiring, understanding and interpreting information. Together with attitudes and skills, it forms a capacity for effective actions.

### Knowledge base

1. The knowledge available to an organization
2. The knowledge available in a specific knowledge domain
3. A technology used to store complex structured and unstructured information used by a computer system.

### Knowledge Management

Knowledge Management coordinates and integrates systemic practices and activities which enable and promote effective knowledge processes and ensure adequate knowledge assets as needed to achieve organizational goals.

### Roadmap

A generic RWM framework to organise different typical scientific and technical domains/ sub-domains in a logical manner against different phases of a RWM programme.

### State-of-Knowledge (SoK)

Experts' view of the most relevant knowledge and associated uncertainties in a specific domain/sub-domain applied in the context of a radioactive waste management programme. Activities consisting of developing a systematic approach of establishing the state-of-knowledge in the field of RWM research.

### State of The Art (SoTA)

Scientific facts underpinning the knowledge base.

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## **Strategic Research Agenda (SRA)**

Describes the scientific and technical domains (and sub-domains) and knowledge management needs of common interest between EURAD participant organisations.

### **Themes**

Themes are large groupings of related Knowledge Domains typical in Radioactive Waste Management. They are the highest level of the EURAD Roadmap work breakdown structure.

### **Work Package**

A work package is a group of related tasks established within EURAD. Because they look like projects themselves, they are often thought of as sub-projects within the Joint Programme.

### **Work Breakdown Structure (WBS)**

The EURAD work breakdown structure is a functional-oriented breakdown of knowledge essential for radioactive waste management. It originally comprised Themes (Level 1) and Domains (Level 2) during the EURAD establishment of its first SRA. It has subsequently been extended with Sub-Domains (Level 3) for organising Competency Matrices and SoK.

## 1. Introduction

Knowledge is crucial for the safe management and disposal of radioactive waste. EURAD will generate and manage knowledge to support EU Member States with their implementation of the Waste Directive (EC 2011/70/EURATOM), taking into account the different stages of member states' national programmes. By mapping the existing global state-of-knowledge (SoK) relevant to RWM, EURAD will identify gaps in knowledge codification and consequent KM needs. Gaps identified for SoK documents will be evaluated with regards to suitability for addressing within EURAD and prioritised within the future EURAD KM programme (or if should be covered elsewhere, e.g. IAEA or NEA). EURAD has the potential to complete critical KM tasks, and provide European added value, by accessing organisational and expert tacit knowledge and codifying it to support transfer between programmes, member states and generations. For both, a systematic approach of establishing the current state-of-knowledge and its transfer to the end users in the field of Radioactive Waste Management (RWM) research is needed.

In EURAD the SoK for a given topic is defined to consist of two elements:

- (i) short documents for themes/domains/sub-domains that describe the state-of-knowledge by experts and that also contain a few signposts to important reports ("Experts' view")  
and
- (ii) a more detailed mapping of and signposting to important reports that can be easily found and retrieved by end user ("Further information")

The domain/sub-domain of a SoK document is clearly oriented in the EURAD Roadmap/WBS. In short, the purpose of a EURAD SoK is to provide a comprehensive overview about a defined domain/sub-domain in one document ("Experts' view") and additionally signpost to existing, accessible, high quality digital knowledge and related active communities of practice (CoPs) for further information. It is strongly orientated towards end-users in the context of RWM.

To generate the SoK documents, a feasible approach is needed that defines what to do and how. More precisely, it should be clear which scope the documents should have, what timeframe is intended for one individual domain/sub-domain, which persons should be involved in which roles, and so on. By design, the approach is to be developed in an agile, "learning-by-doing" way. This means, that right from the beginning there is a strong focus on generating SoK documents that are useful to the end-user, namely the member states' individual WMOs, TSOs and REs, now and in future generations. It is explicitly not the idea to first "waste time" on developing a suitable approach in theory, which will then be put to practical work after a few years. EURAD RD&D heavily depends on generating SoK documents as quickly as possible to benefit national RWM programmes and to prioritize the next RD&D needs within EURAD. To do this, already in the initial phase of the SoK Work Package (WP), a practical "Pilot case" was conducted that produced a first Experts' view document on the sub-domain "Spent Nuclear Fuel" and provided valuable insight into the SoK approach. This Pilot case was designed as a quick first exercise. As a next important step, so called "demonstration cases" are to be conducted in which Experts' view documents will be created. Here, the initial ideas on the approach will be put to test,

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assessed critically and the approach will be refined according to the feedback gathered during and after the demonstration cases. However, it should be stressed that the demonstration cases shall and will also deliver high-quality, highly-relevant SoK documents that are of immediate interested and benefit for end-users. The idea of the demonstration cases is not to be a mere exercise that yields no relevant results outside of the SoK WP. Considering this, the choice of suitable domains/sub-domains for the demonstration cases is of great importance and shall be done by applying comprehensible criteria. These criteria will be discussed in the following.

## 2. Criteria for selection

During year 1 of the EURAD programme it was decided that 2 demonstration cases should be implemented. They were to be selected from the different domains/sub-domains of the EURAD Roadmap/WBS. This selection was done in consideration of following criteria:

- **Both sub-domains should be from a relatively mature area.** The intention of the Experts' view SoK document is to give a comprehensive overview about the most relevant knowledge and associated uncertainties in a specific domain/sub-domain in the context of RWM. In light of this, it makes sense to choose sub-domains for the demonstration cases for which an advanced and well established knowledgebase exists. This should allow the experts to draw on scientifically sound sources, not having to focus on assessing the validity of information and gathering scarce sources, but rather on compiling the most relevant knowledge and putting it into an end-user friendly context.
- **Both sub-domains should be of wide and current interest to member state programmes with high R&D priority (according to EURAD SRA).** By this, a number of positive effects can be achieved. For one, the generated SoK documents will be of instant interest for many programme members and their national RWM programmes. Ideally, this would immediately support current RD&D activities and the planning of future projects. Secondly, achieving this positive effect for the broader EURAD community already with the demonstration cases should automatically raise awareness and acceptance for future SoK activities, paving the road for a successful and lively SoK culture within EURAD.
- **For each of the 2 sub-domains a number of highly recognized experts should be available.** Since the SoK generation itself, and especially the demonstration cases, rely heavily on the active participation of experts from the given fields, it is crucial to have access to a number of motivated experts. It should be taken into account that:
  - i) 2-3 experts should be involved in the generation of one "Experts' view" document,
  - ii) the timeframe for the demonstration cases is set (April 2020 to September 2020),
  - iii) experts themselves tend to have extremely busy schedules,

- iv) for the demonstration cases, which are intentionally designed as an agile “learning-by-doing” approach, the process itself may not be as streamlined as possible yet and active participation and feedback of the experts on the process itself is highly welcomed and hoped for, subsequently increasing the workload for the experts.

With this in mind, getting enough highly recognised and motivated experts involved in the demonstration cases is not a given. Therefore, the field of possible experts for a specific sub-domain should be large enough to increase the chance of inspiring enough experts to participate (2-3 per case). This issue has to be considered in the selection of the sub-domains for the demonstration cases.

- **The 2 sub-domains should not be from the same field, meaning: science-, engineering- or application-oriented.** As the different domains/sub-domains of the EURAD Roadmap/WBS tend to have a different emphasis with regard to being more science-, engineering- or application-oriented, choosing 2 demonstration cases with the same orientation should be avoided (e.g. 2 “engineering-oriented” topics like “Clay-based Backfills” and “Salt-based Backfills”). By doing this, the lessons learned from the demonstration cases are anticipated to reveal a broader scope of potential challenges and provide valuable insights into the feasibility of the EURAD SoK approach for the different themes of the Roadmap. Issues specific to the science-, engineering- or application-orientation of a given sub-domain shall be uncovered.
- **Sub-domains from theme 2 of the EURAD Roadmap/WBS (pre-disposal) should be avoided.** The link between this theme and the future pre-disposal programme (PREDIS) and its SRA still needs to be developed for the Roadmap. Therefore, performing a SoK demonstration case in this theme at this point seems premature and unnecessarily complicated.

Further criteria as the existence of training materials, of international guidance and ongoing RD&D projects were only roughly discussed with respect to parallel works on WP12 and WP13 and recognizing the strong demand not to lose too much time but starting and learning by doing. It should be noted, that the criteria for the selection of demonstration cases are not necessarily the same criteria that apply for the selection and prioritisation of future SoK sub-domains. For example, the latter should consider factors like the loss of critical knowledge due to the retirement of experts, the urgency of a given topic for the progression of RWM programmes and others. Although the demonstration cases will generate high-quality and relevant SoK documents, the selection of the sub-domains is influenced by the feasibility of the demonstration cases, as stated in the criteria mentioned above.

The criteria for the selection of sub-domains for SoK generation were compiled in a “selection matrix” and distributed to the different WPs of EURAD. The WPs kindly provided valuable feedback, which greatly helped to verify the suitability of said criteria for the selection for the demonstration cases and importantly also for the sub-domain selection for future SoK documents.

### 3. Selected demonstration cases

For the demonstration cases two sub-domains were selected under consideration of the criteria discussed in chapter 2. These sub-domains are:

- Spent Nuclear Fuel
- HLW and SF containers

The rationale behind the selection of these sub-domains will be discussed in the following.

#### 3.1 Case 1: HLW and SF containers

The sub-domain “HLW and SF containers” is defined as a sub-domain (level 3) of the EURAD Roadmap/WBS under the domain “Waste packages (for disposal)” (level 2) within theme 3 “Engineered barrier systems (EBS) properties, function and long-term performance” (level 1). As such, it has a clear reference to the EURAD Roadmap/WBS, which will make it easy for end-users to put the generated SoK into a broader context.

It can be considered to be a very broad and mature sub-domain, with advanced knowledge and open source publications at hand. Access and availability of knowledge should therefore not be a problem for experts. On the contrary, it could be argued that some issues may arise from the sub-domain being too broad, which could make it challenging to give a comprehensive overview. Focussing on the most relevant aspects and disregarding others will be an interesting issue and should be carefully observed from the “process-side” of the demonstration case, especially by the SoK WP11 team. Lessons learned in this context could be of great value for further SoK generation and the respective approaches. It will also be worth to keep in mind that this sub-domain can be approached from different angles and to see how the experts choose to handle this.

Another point in support of this sub-domain is its high interest to all RWM programmes, meaning that sooner or later every member of EURAD has to (or had to) cover this sub-domain. This is in contrast to, for example, sub-domains concerning different host-rock properties, if a member state has decided to focus their efforts on only one host-rock type (e.g. the Finnish programme with its crystalline host-rock). With this high interest, this demonstration case could be expected to be well received, by contributing experts as well as end-users. Available knowledge for the sub-domain will be contextualised relative to “Safety”, the “Engineering Feasibility” and the “Science and Technology underpinning these two aspects”.

Almost as a consequence of the earlier points (mature topic and of high interest), a sufficient number of highly recognised experts should be available for this sub-domain, which is a further strong argument for selecting it as a demonstration case.

Regarding its orientation (science-, engineering- or application-oriented), “HLW and SF canisters” can be classified as “engineering/design” oriented. This should be kept in mind for the second demonstration case, as two sub-domains with the same orientation should be avoided (see chapter 2).

Taking all these points together, the sub-domain “HLW and SF containers” is considered to be well suited as a demonstration case and was therefore selected as such.

### 3.2 Case 2: Spent Nuclear Fuel

The sub-domain “Spent Nuclear Fuel” is defined as a sub-domain (level 3) of the EURAD Roadmap/WBS under the domain “Wasteform (source term and behaviour) and Inventory for Disposal” (level 2) within theme 3 “Engineered barrier systems (EBS) properties, function and long-term performance” (level 1). Similarly to Case 1 (“HLW and SF containers”), it therefore has a clear reference to the EURAD Roadmap/WBS. This will allow end-users to put the SoK generated in this demonstration case into context with other sub-domains.

Many of the arguments in favour of Case 1 (“HLW and SF containers”) also apply for this sub-domain, as well as the aforementioned challenges (like focusing on the relevant aspects and compiling a comprehensive overview in face of a vast amount of knowledge). It is a mature and broad sub-domain, and of high interest for EURAD members, since most of them have to deal with High-Level Waste and Spent Nuclear Fuel at some point. Therefore, they are anticipated to be interested in the different aspects of the sub-domain, namely the “Safety”, the “Engineering Feasibility” and the “Science and Technology underpinning these two aspects”, which should and could be covered by the SoK Experts’ view document.

Due to the nature of the sub-domain (mature and of high interest), the availability of experts is expected to be high enough to get highly recognised experts involved in this demonstration case.

In contrast to the engineering focus of “HLW and SF containers” (Case 1), the sub-domain “Spent Nuclear Fuel” has a scientific focus, which fits the criterion of selecting sub-domains with different focuses. Another difference is the existence of SoK Experts’ view document, which was compiled as a so called “Pilot case” during the initial phase of the EURAD SoK Work Package. This Pilot case was conducted as a first “real life” learning experience with a more limited timeframe as the demonstration cases discussed here. Nevertheless, as a valuable achievement a high-quality Experts’ view document was generated that was very well received and arguably had a positive impact on the general perception of the EURAD SoK approach. This positive attitude could be capitalised on by continuing with this sub-domain as a demonstration case. Furthermore, the existing SoK document could be used as a basis for this demonstration case and be a good exercise on how to “update” SoK documents. As this will (or should) inevitably happen as time progresses and the state-of-knowledge on a given sub-domain develops, it would be of interest to take this into account within the demonstration case.

In summary, the sub-domain “Spent Nuclear Fuel” is deemed highly suitable and interesting for a demonstration case and was therefore selected as such.

### 3.3 Fall back case “Plugs and Seals”

In the process of discussion and selection of the sub-domains for the demonstration cases a number of other topics were considered, one of them being “Plugs and Seals”. In the EURAD Roadmap/WBS this can be found as a sub-domain (level 3) in the domain “Buffers, Backfills, Plugs and Seals” (level 2) within theme 3 “Engineered barrier systems (EBS) properties, function and long-term performance” (level 1). This sub-domain was considered as suitable demonstration case due to some interesting

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aspects, i.e. being of high relevance for safety assessment in RWM. Hence, it was selected as a “fall back case”. If one of the selected demonstration cases should turn out to be unfeasible for some reason, “Plugs and Seals” will be implemented as a demonstration case.

### 3.4 Other sub-domains considered

Another considered sub-domain was “Natural Analogues”, a sub-domain (level 3) in the domain “Integration of safety-related information” within theme 7 “Performance assessment, safety case development and safety analyses” (level 1). As for “Plugs and Seals”, there are a number of arguments in favour of this sub-domain, like its mature and broad knowledge base and availability of experts. Yet, within EURAD there was a lot of discussion with regards to the exact scope of “Natural Analogues” and its feasibility as a demonstration case. On one hand natural analogues have to be investigated very topic specific on the other hand the approach would have to be from a rather methodological angle. In consideration of the feedback from the 2<sup>nd</sup> GA this sub-domain was not selected as a demonstration case.

## 4. Work plan and estimated efforts and resources

The selected demonstration cases will be implemented after formal approval by the Bureau. For a detailed description of the timeline, phases and resources see below. In short, the implementation will be done as follows:

- for the production of the Experts' view documents a total duration of 6 month is scheduled, with initial expert engagements to request a maximum of 80 hours.
- work shall begin in April 2020, and therefore be finished by the end of September 2020 (6 month)
- the production is planned to be conducted in different phases
- a total of 3 (minimum 2) experts should participate in the generation of each SoK document
- experts will be identified and contacted by the WP11 team and the Bureau
- for the generation of the SoK documents the essential top tips from the “Authors Guidance and Template” (draft is in work) document will be shared by WP11 with the experts as an orientation, giving suggestions and information about the process
- the WP11 team will provide continuous support to the experts, as well as continuously monitor the progress and collect feedback to further improve the process, resulting amongst other things in a updated version of the “Authors Guidance and Template” document by the end of September 2020 (Deliverable D11.8 of WP11)
- Feedback gathered during the demonstration cases as well as final results will be assessed and presented in a final report in November 2020 by the WP (Deliverable D11.3 of WP11)

The production of the SoK documents is planned to occur in 4 different phases. It is realised, that the participating experts typically have a very busy schedule and workload. The intention of the phases is therefore to give a timeframe in which the experts can organise their work according to their needs and preferences as well as to coordinate the co-operation between the experts and the WP11 team.

## 4.1 Phases of SoK document production

Early April 2020:

**Initiation:** Kick-off meeting with experts (video) in order to view requirements, define scope and concrete objectives, agree on methods and terms of cooperation (WP11 team with experts, PMO representative invited).

April to end of June 2020:

**Drafting:** Experts co-author first draft (maximum ~3 months for production). WP11 team will provide continuous support for the experts on a regular basis and whenever requested by the experts.

July to end of August 2020:

**Peer Review:** Bureau will make review comments and questions on the SoK documents available to the experts (maximum ~ 2 months for review).

September 2020:

**Production:** Experts will finalise and approve publication-ready SoK (maximum ~1 month).

After the experts have finished their part (September 2020), WP11 team and PMO will work on:

**Socialisation:** WP11 team will support appropriate socialisation of the developed SoK document to ensure it is well disseminated across the RWM community. We envisage there to be a strong role by the experts in doing this, especially proactive socialisation among authors' expert networks.

**Lessons learned:** WP11 team will review the process and results, prepare a report and adjust the process according to the "lessons learned" to provide an optimised approach for following SoK activities. Critical assessment and flexible adjustment of the process will also take place during the process.

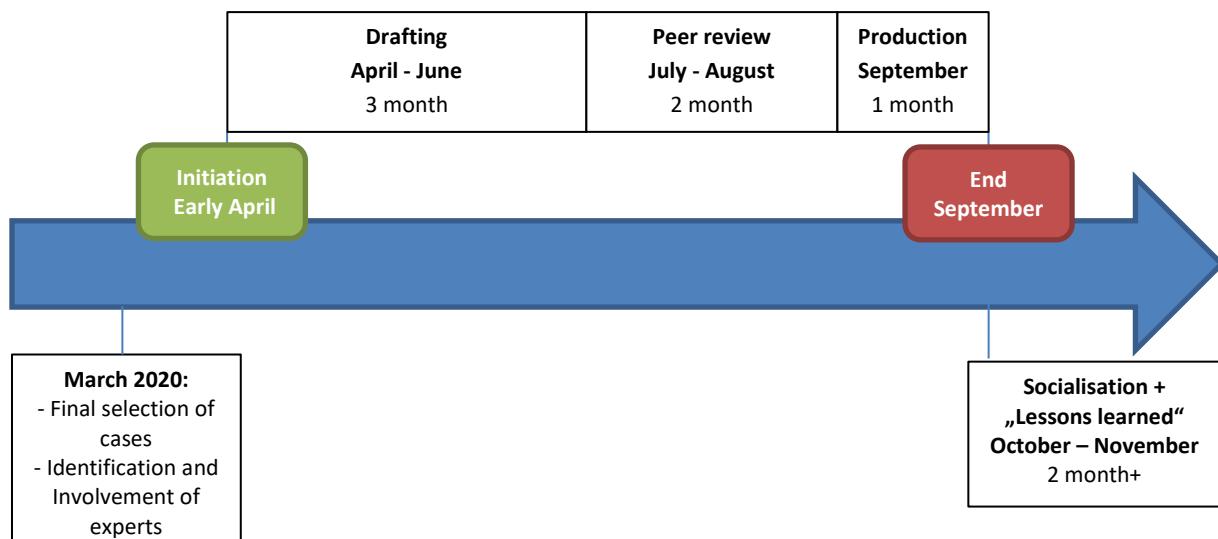


Figure 1 – Timeline for SoK document production

## 4.2 Estimated efforts and resources

Item	Workload per case	Workload for 2 cases	Costs per case (3 experts)	Costs for 2 cases (3 experts)
Workload per expert per case	1 pm	-	-	-
Honorarium per expert per case (2.000 – 3.000€)	-	-	6.000 – 9.000€	12.000 - 18.000€
Coordination by WP11	2 pm	4 pm	-	-
Organisation of a physical meeting (including travel cost for experts), per case by WP11/PMO	1 pm	2 pm	4.500 €	9.000 €
Reports & presentations, writing and presenting by WP11	1 pm	2 pm	-	-
Editorial draft review on consistency, comprehensibility, compliance by WP11/Bureau	0.75 pm	1.5 pm	-	-
Transfer and updating procedures by WP11	0.75 pm	1.5 pm	-	-
Total cost per case	-	-	10.500 – 13.500€	-
Total Workload per case for WP11/PMO	5.5 pm	-	-	-

Table 1 – Estimated efforts and resources for SoK document production