



Deliverable 13.1: List of training needs from Research, Development and Demonstration and Strategic Studies Work Packages

Work Package 13

This project has received funding from the European Union's Horizon 2020 research and innovation programme 2014-2018 under grant agreement N°847593.



Document information

Project Acronym	EURAD
Project Title	European Joint Programme on Radioactive Waste Management
Project Type	European Joint Programme (EJP)
EC grant agreement No.	847593
Project starting / end date	1st June 2019 – 30 May 2024
Work Package No.	13
Work Package Title	Training and Mobility
Work Package Acronym	Training and Mobility
Deliverable No.	13.1
Deliverable Title	List of training needs from Research, Development and Demonstration and Strategic Studies Work Packages
Lead Beneficiary	SCK CEN
Contractual Delivery Date	August 2019
Actual Delivery Date	April 2021
Type	Report
Dissemination level	PU
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To be cited as:

Belmans N., Coeck M., (2020): Title. List of training needs from Research, Development and Demonstration and Strategic Studies Work Packages Final version as of 12.04.2021 of deliverable D13.1 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.

Status of deliverable		
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Submitted to EC (Coordinator)	Coordinator	12/04/2021

Executive Summary

In March 2020, WP13 launched a 'Survey on training initiatives' in order to get a clear overview of the training needs as well as the existing training courses in the field of Radioactive Waste Management (RWM) within the EURAD community. The survey was sent to all EURAD Beneficiaries.

The 80 respondents have indicated a total of 363 training needs, of which 262 are indicated as 'difficult to find', in the field of RWM were identified. A lot of topics are covered by the existing courses, however, analysis of the training needs indicated that there are still a lot of gaps for many of the EURAD partners.

In this report, the results of the 'Survey on training initiatives' are summarized. These results will be linked to the Goal Breakdown Structure (GBS) of the EURAD Roadmap. This way, the Roadmap can serve as an easily accessible tool to check which training needs there are and need to be addressed. In the end, the Roadmap, together with this report, provide an easily accessible overview of identified training gaps for end-users

Table of content

Executive Summary	4
Table of content	5
List of figures	6
List of Tables	7
Glossary.....	8
1. Introduction	9
2. Survey on training initiatives.....	10
3. Training needs from the RD&D and Strategic Studies WPs	11
3.1 Overview of the identified training needs	12
3.2 High priority topics	14
3.3 Urgency of identified training needs	15
3.4 Training needs based on the organization type	17
3.4.1 Research Entities.....	17
3.4.2 Waste Management Organizations	18
3.4.3 Technical Support Organizations	19
3.4.4 Waste producers.....	21
3.5 Most requested and highest priority topics	21
4. Proposed training topics	21
5. Conclusion	22
Appendix A. Survey on training initiatives.....	24

List of figures

<i>Figure 1 Overview of the priority given to all training topics by the EURAD community.....</i>	<i>13</i>
<i>Figure 2. Overview of the topics that were identified as having 'high' or 'very high' priority by the EURAD community.</i>	<i>15</i>
<i>Figure 3. Overview of all topics that were identified as being urgent.</i>	<i>16</i>
<i>Figure 4. Overview of the urgent and high priority topics.</i>	<i>17</i>
<i>Figure 5. Overview of the high priority topics which were identified by the Research Entities within EURAD.</i>	<i>18</i>
<i>Figure 6. Overview of the high priority topics which were identified by the Waste Management Organizations.....</i>	<i>19</i>
<i>Figure 7. Overview of the high and very high priority topics which were identified by the Technical Support Organizations.</i>	<i>20</i>

List of Tables

<i>Table 1. Overview of the priority given to training topics by the EURAD community.....</i>	<i>13</i>
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Glossary

EURAD	European Joint Programme on Radioactive Waste Management
GBS	Goal Breakdown Structure
RD&D	Research, Development and Demonstration
RE	Research Entities
RWM	Radioactive Waste Management
TSO	Technical Support Organization
WAC	Waste Acceptance Criteria
WMO	Waste Management Organization
WP	Work Package

1. Introduction

The main goal of European Joint Programme on Radioactive Waste Management (EURAD) Work Package (WP) 13 is to establish the 'School of Radioactive Waste Management (RWM)'. The School of RWM acts as the executive body for all training and mobility actions that are organized within EURAD. For training courses, a diverse portfolio of tailored basic and specialized courses will be established. This portfolio will contain a list of existing initiatives (e.g. IAEA and NEA courses), but will also contain new training courses to bridge identified gaps.

The content of this portfolio will be linked to the EURAD Roadmap. In doing so, the School of RWM contributes to the strategic knowledge management objectives of EURAD, namely: (i) preservation of generated knowledge (in- and outside of EURAD), (ii) transfer of knowledge towards Member States and between generations and (iii) dissemination of knowledge (by organizing training courses based on identified training needs within RWM).

The new training courses will be developed by WP13 in close collaboration with the Research, Development and Demonstration (RD&D) and Strategic Studies WPs as well as external training providers. These new courses will be organized based on the current training needs identified from within the EURAD community. It is the main objective of WP13 Task 1 to identify these training needs from the RD&D and Strategic Studies WPs. This report provides an overview of those training needs as identified by the EURAD community through a survey that was held by WP13 between March 8, 2020 and May 31, 2020.

2. Survey on training initiatives

In March 2020, WP13 launched a ‘Survey on training initiatives’ in order to get a clear overview of the training needs as well as the existing training courses in the field of RWM within the EURAD community (see Appendix A). The survey was sent to all EURAD Beneficiaries.

The survey consisted of three parts:

- Cataloguing existing training providers in the field of RWM (focussing on post-graduate professional development) – these are active/existing/planned courses available now/soon (both within EURAD and external to EURAD)
- Cataloguing historic training materials (focussing on past EC projects) and making them accessible to the RWM community
- Understanding training needs across RWM, especially needs that are not met by the above mentioned parts (i.e. gaps) and that could be developed by EURAD

The former two will serve as input for a mapping of existing training courses which needs to be done in Task 2 of WP 13 (Deliverable 13.2). The latter is used to identify current training needs in RWM.

In this report, the results on the training needs identified by the WP13 ‘Survey on training initiatives’ will be summarized. These results will be linked to the Goal Breakdown Structure (GBS) of the EURAD Roadmap. This way, the Roadmap can serve as an easily accessible tool to check which training needs there are and need to be addressed. In the end, the Roadmap, together with this report, provide an easily accessible overview of identified training gaps for end-users.

3. Training needs from the RD&D and Strategic Studies WPs

A major aim of the Survey on training initiatives (see section 2. Survey on training initiatives) was to identify current training needs from the RWM community, more specifically the RD&D and Strategic Studies WPs within EURAD. In the survey, a non-exhaustive list of topics was described using the currently available Roadmap Classification Terminology (EURAD Roadmap GBS version of October 2020; <https://service.projectplace.com/pp/pp.cgi/r1741312540>). In this terminology, the following format is used X.Y.Z., in which X is the main Roadmap theme, Y is the sub-theme and Z is the domain. Using this terminology, the following topics were covered by the survey:

- 1.1 Programme planning + 1.2 Programme organization
- 2.1.1 Waste Generation
- 2.1.2 Processing
- 2.1.3 Storage
- 2.1.4 Transport
- 2.2.2 Waste Acceptance Criteria (WAC)
- 3. Engineered Barrier Systems
- 3.1.1 Spent Nuclear Fuel
- 4. Geoscience
- 5.1 Design
- 6. Siting and Licensing
- 7.1 Safety Strategy
- 7.2.1 Safety case production
- 7.3.1 Performance assessment and system models
- 7.3.2 Treatment of uncertainty
- 3.1 Confirm wasteform compositions, properties and behaviour under storage and disposal conditions, including impact on the disposal environment (wasteform)
- 5. Facility Operation
- 5. Facility Closure
- Others (to be defined by respondents, making this list non-exhaustive)

As indicated by this list, not all roadmap domains were covered by the questionnaire since these were not yet defined at the launch of the survey. However, the most relevant topics were included. For each of these topics respondents were asked to indicate whether (i) courses on the topic are difficult to find, (ii) which priority they give to courses on the topic, (iii) within which term a course on the topic should be available, and (iv) to specify the topic if necessary. Respondents were also given the opportunity to add topics to the predefined list.

In total 363 training needs were identified by the 80 organizations that have completed the survey. The results will be described in detail in the next sections. The original results and the data described in this deliverable are stored on the EURAD Knowledge Management WPs Workspace on Projectplace (<https://service.projectplace.com/pp/pp.cgi/r1190799423>) Here, the training needs will be viewed from several perspectives, namely (i) an overall view of the needs, (ii) based on the priority that is given to the topics, (iii) based on the urgency, (iv) based on the type of organization which completed the survey, and (v) finally a synthesis will be made of the most requested and highest priority topics.

3.1 Overview of the identified training needs

In total 363 training needs were identified by the EURAD community, 262 of which were indicated as being 'hard to find'. Besides the topics that were listed in the survey (see above), ten additional topics were also added to the list by the respondents. These are indicated by the prefix 'custom'. In this section, all training needs will be shown in a comprehensive table (Table 1) and figure (Figure 1). These provide a clear overview of all training needs and their priorities as indicated by the respondents.

Topics	Very high	High	Neutral	Low	Very low
1.1 Programme planning + 1.2 Programme organization	4		5	6	3
2.1.1 Waste generation	6	3	5	1	4
2.1.2 Processing	4	2	8	1	3
2.1.3 Storage	4	1	9	2	3
2.1.4 Transport	6		4	5	3
2.2.2 Waste Acceptance Criteria	6	3	5	5	2
3. Engineered Barrier Systems	7	2	7	2	3
3.1 Confirm wastefrom compositions, properties and behaviour under storage and disposal conditions, including impact on the disposal environment (wastefrom)	6	5	9	2	2
3.1.1 Spent Nuclear Fuel	4	3	9	4	2
4. Geoscience	5	3	5	2	3
5.1 Design	4	2	3	5	2
6. Siting and licensing	4	2	7	1	3
7.1 Safety strategy	11	6	6	1	
7.2.1 Safety case production	10	3	6	1	3
7.3.1 Performance assessment and system models	6	4	9	1	1
7.3.2 Treatment of uncertainty	6	7	7	1	
Custom: coupled processess			1		
Custom: integrated overview course		1			
Custom: management of non-radiological properties of radioactive waste		1			
Custom: Modelling of radionuclide migration in barrier materials		1			
Custom: models included in the CROM code as well as its applications	1				
Custom: Organisation of the pre-licensing phase		1			
Custom: Role of colloids and organics on radionuclide migration		1			
Custom: Specific training course on Inspection of WMO		1			

EURAD Deliverable 13.1 – List of training needs from Research, Development and Demonstration and Strategic Studies Work Packages

Custom: Specific training course on Modelling		1			
Custom: Thermodynamic databases		1			
Facility closure	2	3	3	6	2
Facility operation	2	3	2	6	3

Table 1. Overview of the priority given to training topics by the EURAD community.

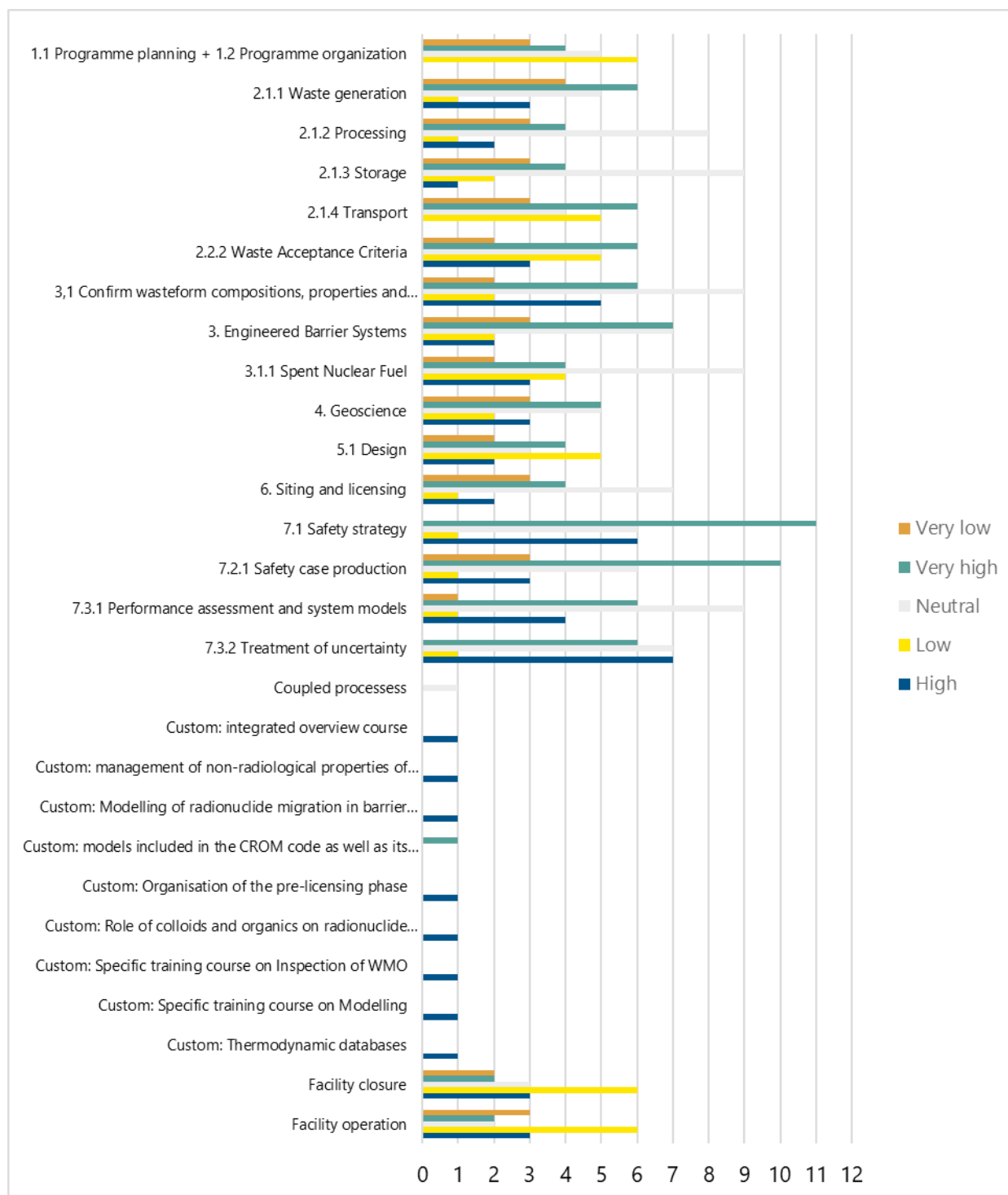


Figure 1 Overview of the priority given to all training topics by the EURAD community.

As indicated in Table 1 and Figure 1, some topics (e.g. 7.1 Safety strategy) stand out. However, the priority given to the different topics varies a lot. For the majority of the topics, the priority varies from 'very low' to 'very high'. This indicates that the priorities that are given are dependent on the type of organization that completed the survey (see '3.4 Training needs based on the organization type'), but also on the state of the radioactive waste disposal programme of the countries those organizations come from. Several organizations also indicated their own 'custom' topics that they deemed priorities. Here we see that topics on 'modelling' are also identified as (very) high priority. 'Modelling' was not included as a training topic in the survey, but the results indicate that it is also a topic that is prioritized by several EURAD partners. Therefore, the training needs are as expected, highly dependent on the state of the radioactive waste disposal programme and thus vary between different Member States. It is worth noting that although the priority is clearly highlighted here, the urgency is not. This will be discussed in section '3.3 Urgency of identified training needs'.

3.2 High priority topics

In this section, the high priority topics will be highlighted. These are topics that were indicated as 'high' or 'very high' priority. Based on these parameters, 158 out of the 363 identified a topic as a high priority topic. The following topics were identified as high priority topics by the EURAD community (Figure 2). As indicated in Figure 2, the topics related to safety were given the highest priority by the EURAD community. The list from below shows an overview of the highest priorities in descending order of priority:

- 7.1 Safety Strategy
- 7.2.1 Safety case production
- 7.3.2 Treatment of uncertainty
- 3.1 Confirm wasteform compositions, properties and behaviour under storage and disposal conditions, including impact on the disposal environment (wasteform)7.3.1 Performance assessment and system models
- 3. Engineered Barrier Systems
- 2.2.2 Waste Acceptance Criteria
- 2.1.1 Waste Generation

As with the general overview (3.1 Overview of the identified training needs), there is a wide variety of topics that is identified as a high priority topic. This also indicates that these are highly dependent on the state of the national radioactive waste disposal programme. However, it provides a good overview for WP13 on where the priorities lie, which will help deciding which training courses need to be designed (or which existing ones need to be highlighting). Furthermore it is indicative of where the training gaps are situated. It is noteworthy that these high priority topics, as listed here, are not taking into account the urgency. This will be discussed in the next section.

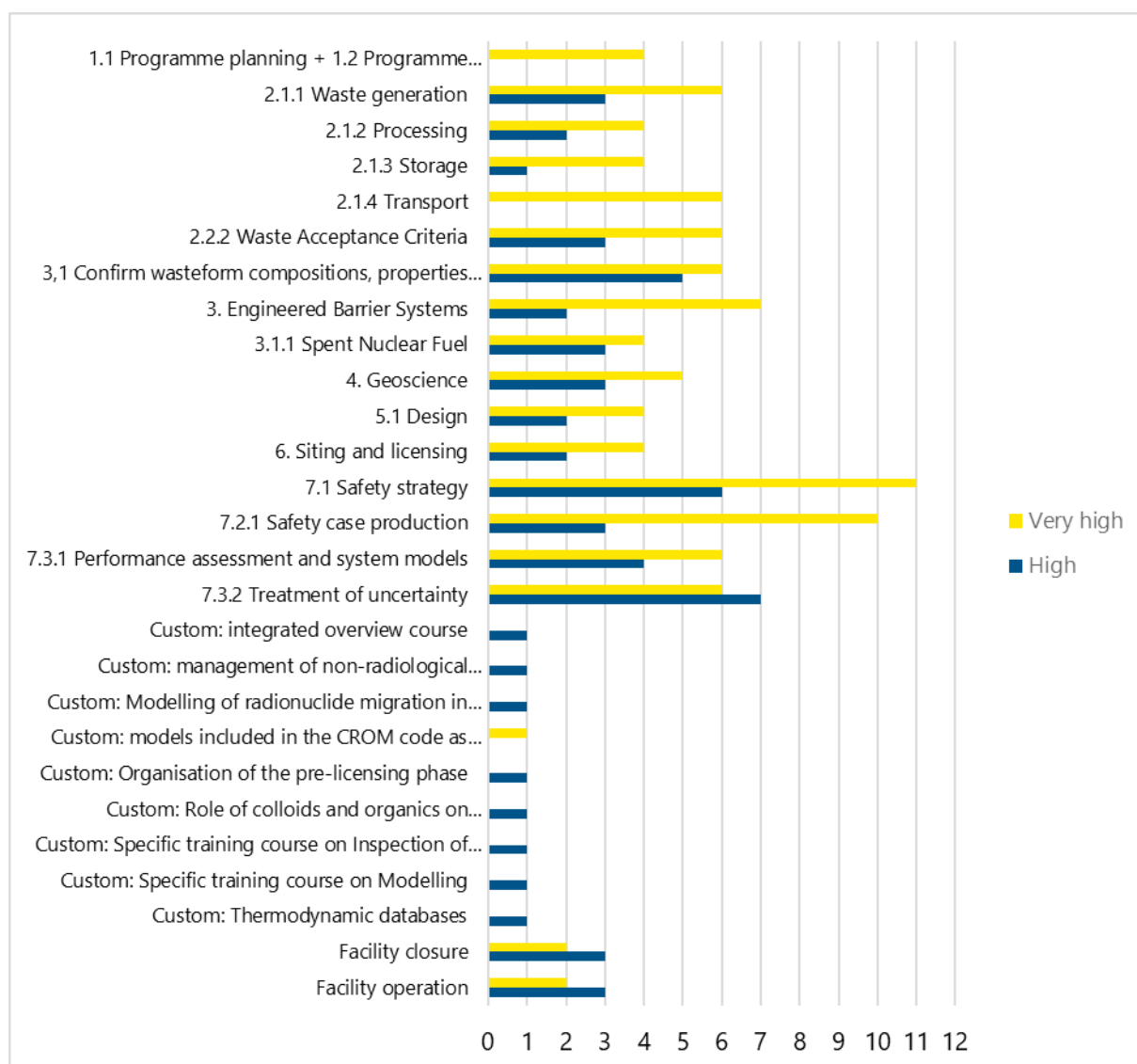


Figure 2. Overview of the topics that were identified as having 'high' or 'very high' priority by the EURAD community.

3.3 Urgency of identified training needs

Respondents were asked to indicate within which timeframe courses on certain topics should be available. They had four options to choose from: (i) within one year, (ii) within two years, (iii) within five years or (iv) later than five years from now. Topics that were required by the EURAD community within two years, were defined as 'urgent topics'. This decision is based on the fact that the survey was launched in March 2020 and the first results were in by July 2020. As a large part of the first year since the launch of the survey had already passed, the first two years following the launch of the survey were chosen as the timeframe for these urgent topics.

The overview of the urgent topics (Figure 3) shows that the most urgent topics are those related to safety and uncertainty. These are closely followed by '2.2.2. WAC', '2.1.1. Waste generation' and '2.1.2. Processing'. These follow a similar trend to that seen for the high priority topics (Figure 2). Therefore, Figure 4 shows an overview of both the high priority and the urgent topics, in contrast to Figure 3, which shows all levels of priority.

In the next section, the training needs will be described based on the type of organization.

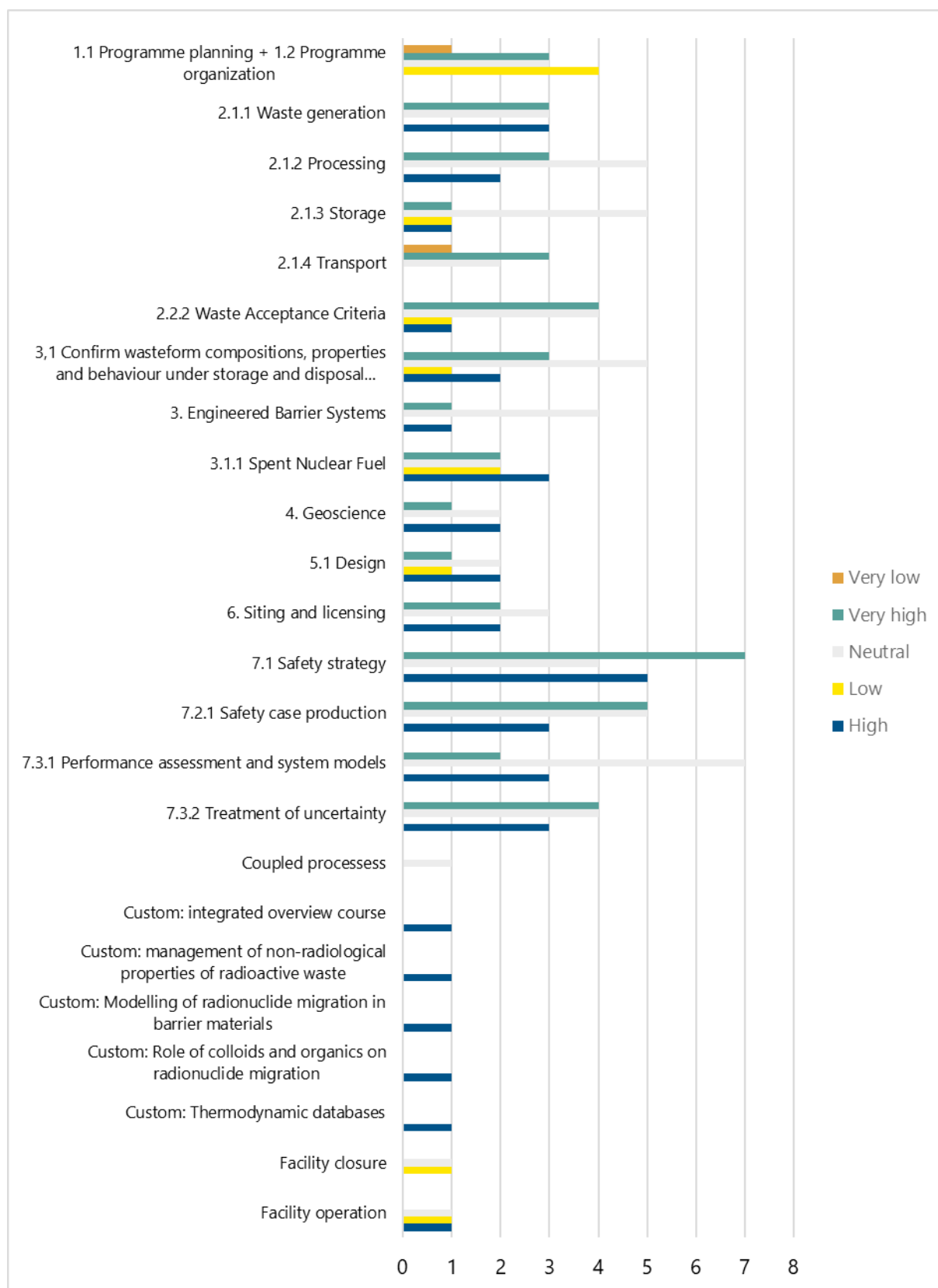


Figure 3. Overview of all topics that were identified as being urgent.

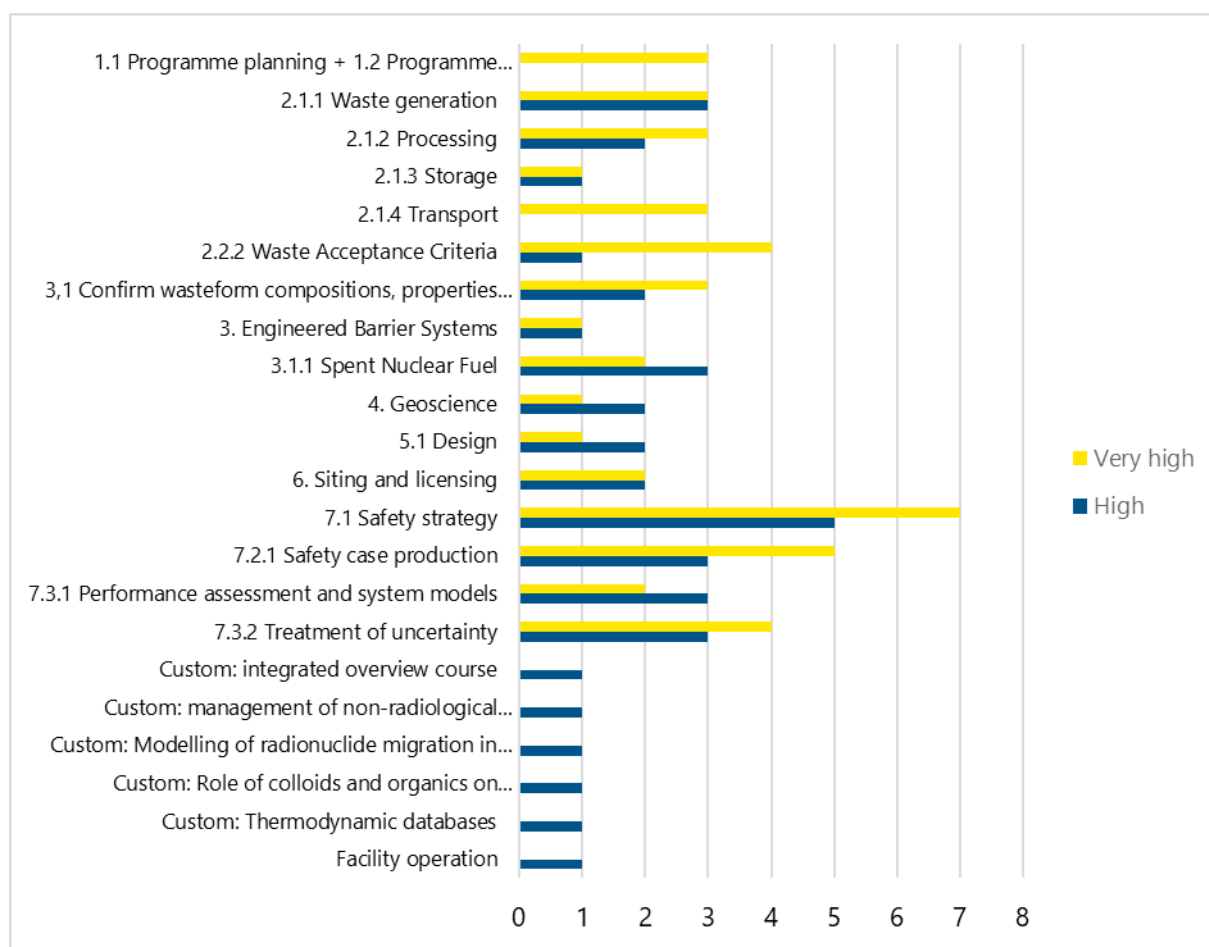


Figure 4. Overview of the urgent and high priority topics.

3.4 Training needs based on the organization type

The results from the survey are also determined by the state of the national radioactive waste disposal programmes. However, they can also differ between which type of organization provided the feedback. In EURAD, the following organization types are distinguished:

- Research Entities (RE)
- Waste Management Organizations (WMO)
- Technical Support Organizations (TSO)
- Waste producers

In the end, 80 organizations completed the survey: 41 REs, 14 TSOs, 24 WMOs and one waste producer. In this section, only the high priority topics that were identified by the different types of organisation will be discussed.

3.4.1 Research Entities

Out of the 80 organizations that have completed the survey, 41 identified themselves as RE. There is a balance between the number of 'high' and 'very high' priority topics (see Figure 5). The highest priority topics according to REs are:

- 7.1 Safety strategy

EURAD Deliverable 13.1 – List of training needs from Research, Development and Demonstration and Strategic Studies Work Packages

- 3.1 Confirm wastefrom compositions, properties and behaviour under storage and disposal conditions, including impact on the disposal environment (wastefrom)
- 7.3.2 Treatment of uncertainty
- 2.1.1 Waste generation
- 7.2.1 Safety case production

These are similar to the overall results, however this could be due to the fact that the highest number of respondents were REs. This list does not change when looking at urgency (i.e. need to be addressed within two years).

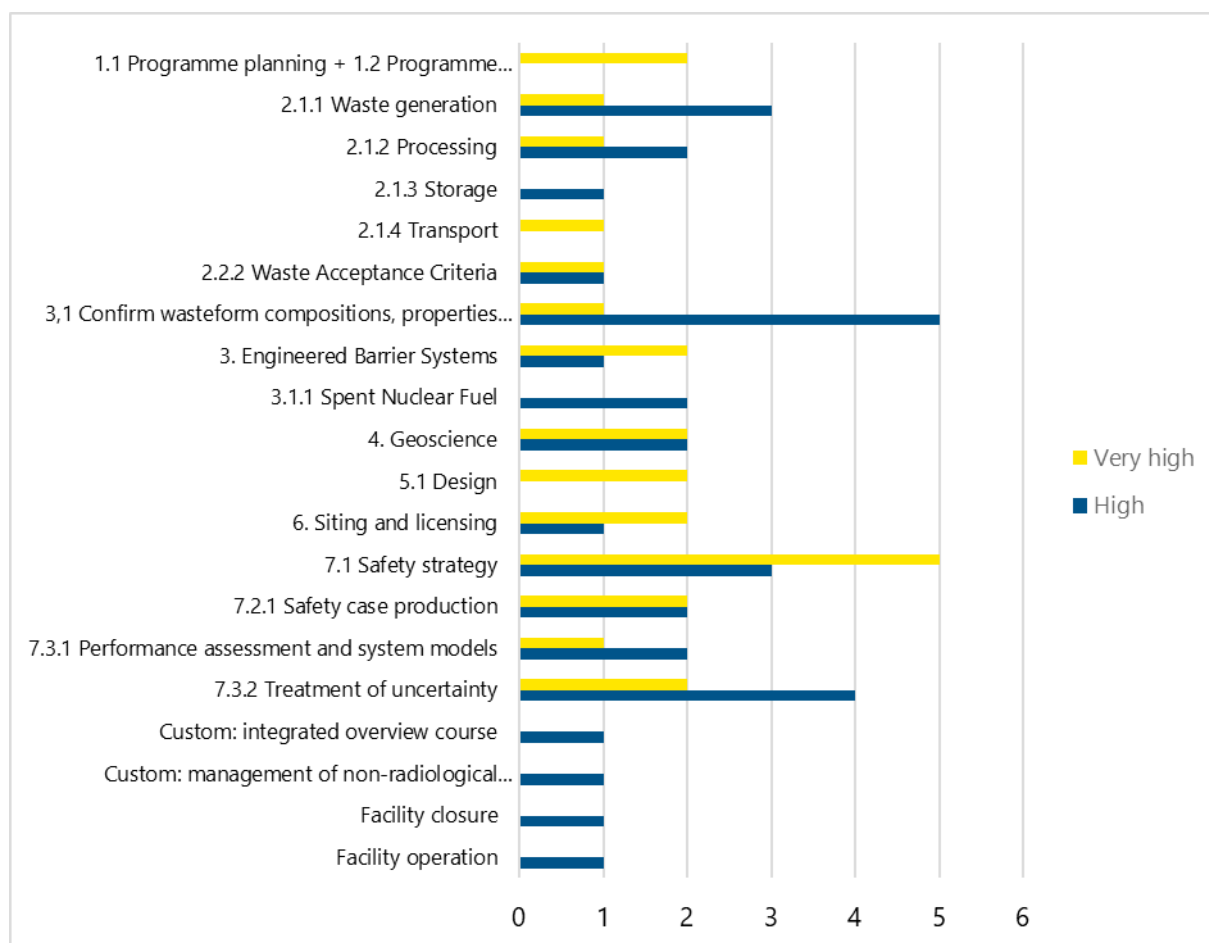


Figure 5. Overview of the high priority topics which were identified by the Research Entities within EURAD.

3.4.2 Waste Management Organizations

A total of 24 WMOs have responded to the Survey on training initiatives. The WMOs prioritize topics related to the management of radioactive waste as well as those related to safety, uncertainty and facility closure (see Figure 6). This was to be expected given the role WMOs play in RWM. Contrary to the priorities identified by the REs, most training needs identified by WMOs are indicated as being 'very high' priority rather than 'high' priority.

EURAD Deliverable 13.1 – List of training needs from Research, Development and Demonstration and Strategic Studies Work Packages

The results described above do not take into account the urgency for addressing these training needs. When taking urgency into account, the following are identified as being the most urgent high priority topics (in no particular order):

- 2.1.2 Processing
- 2.2.2 WAC
- 7.2.1 Safety case production
- 7.3.2 Treatment of uncertainty

These results are somewhat deviant from the overall results. However, this is to be expected given the role WMOs fulfil. In comparison with REs, there is a greater focus on topics which are directly linked to managing radioactive waste. However, topics such as '2.1.1 Waste generation' and '2.1.2 Processing' were also of relatively high priority to the REs. Thus there is an overlap between the training needs between these two types of organization.

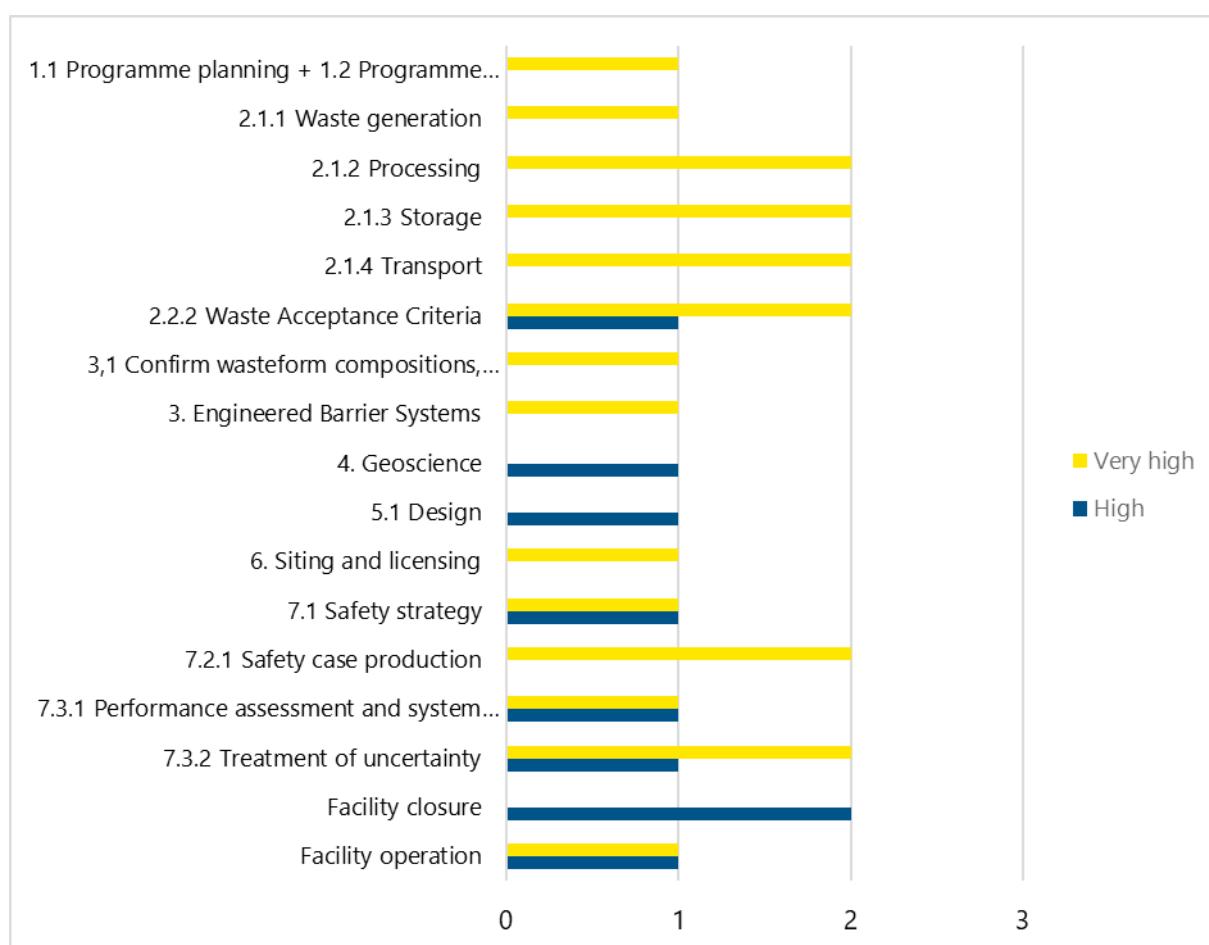


Figure 6. Overview of the high priority topics which were identified by the Waste Management Organizations.

3.4.3 Technical Support Organizations

Fourteen TSOs have completed the Survey on training initiatives. Which is considerably less than the number of REs and WMOs (41 and 24, respectively). Therefore, it is interesting to look at them separately, as they are at risk of getting lost in the overall results. Similarly to the WMOs, the TSOs

EURAD Deliverable 13.1 – List of training needs from Research, Development and Demonstration and Strategic Studies Work Packages

indicated most training needs as having ‘very high’ priority, rather than ‘high’ priority. Despite only fourteen TSOs having completed the survey, they have identified more high priority topics than the REs and WMOs:

- Research Entities: 58
- Waste Management Organizations: 29
- Technical Support Organizations: 68

Thus per number of participating organizations, the TSOs have by far indicated the most high priority topics out of all responding organizations. These topics range from topics related to basic RWM, over engineered barrier systems and spent nuclear fuel to safety topics and source term understanding for disposal (see Figure 7). Noteworthy is that the TSOs have also added the highest number of ‘custom’ topics which they believe to also have a high priority.

Overall, the topics the TSOs identified as high priority topics correlate well to overall results (see Figure 2).

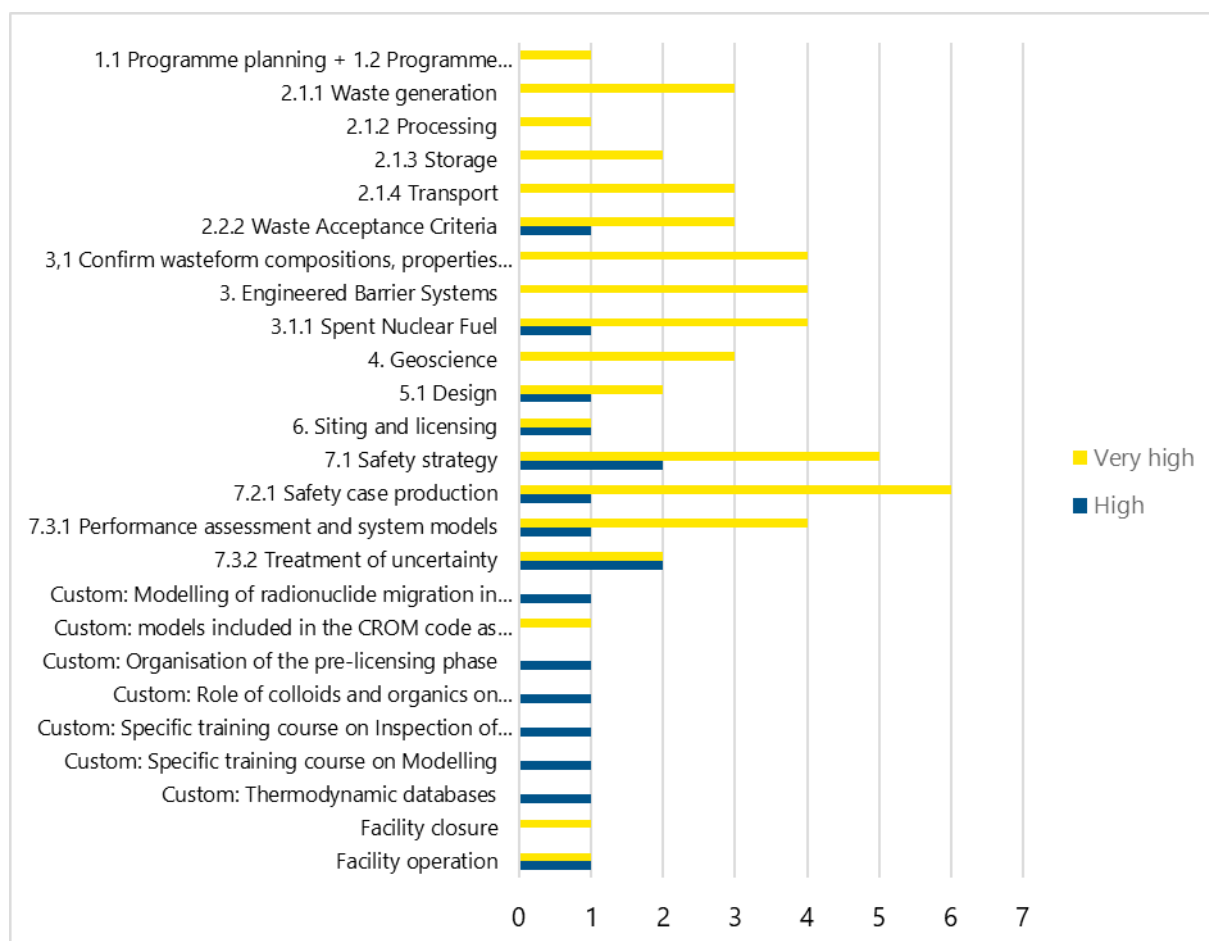


Figure 7. Overview of the high and very high priority topics which were identified by the Technical Support Organizations.

3.4.4 Waste producers

Only one waste producer (i.e. ENUSA) completed the survey. No training needs were identified by ENUSA. ENUSA only completed the part of the survey related to training courses that they organize. They indicated that they do not host any training courses in the field of RWM.

3.5 Most requested and highest priority topics

Based on the input of all EURAD partners, as well as by looking at the specific needs from REs, WMOs and TSOs the most requested and highest priority topics could be identified. This was done by taking the topics that were indicated to be urgent (i.e. to be organized within 2 years) and which were identified as high or very high priority. The topics that scored high on these criteria were identified as most urgent and highest priority. The five most urgent and highest priority topics are (in descending order of urgency and priority):

1. 7.1 Safety strategy
2. 7.2.1 Safety case production
3. 7.3.1 Treatment of uncertainty
4. 2.2.2 Waste acceptance criteria
5. 3.1 Confirm wasteform compositions, properties and behaviour under storage and disposal conditions, including impact on the disposal environment (wasteform)

These are followed by '2.1.1 Waste generation', '2.1.2 Processing', '2.1.3 Storage', '2.1.4 Transport', '3 Engineered Barrier Systems' and '3.1.1 Spent Nuclear Fuel'.

This list can be used to set up and prioritize training courses in year 2 of EURAD that tackle these training needs. WP13, through the School of RWM, and the PMO will organize these courses in collaboration with partners from the RD&D and Strategic Studies WPs. Fortunately, several EURAD partners have also proposed training topics to which they are willing to contribute/organize (see section '4 Proposed training topics').

4. Proposed training topics

In this section, training topics that were proposed by EURAD partners are listed. In the survey, respondents were asked for which topics they would like to be involved in organizing a training course. They had the option to choose between four levels of contribution: (i) lead organizer, (ii) organizing partner, (iii) involvement in organization and (iv) as an attendee. This is useful information for WP13 and the PMO as it helps them identify organizing partners for specific training courses that will be planned within EURAD. Topics which are related to the most urgent and highest priority training needs (see section '3.5 Most requested and highest priority topics') are indicated in bold.

Following topics were proposed:

- **Spent fuel characterization (by EC-JRC Geel; as organizing partner)**
- Fuel characterization after irradiation (by CIEMAT; as lead organizer)
- **Spent Nuclear Fuel disposal (by VUJE; as attendee only)**
- Fuel thermo-mechanical behaviour in dry storage (by CIEMAT; as lead organizer)
- **Spent Fuel management (by ARAO; as attendee only)**
- Difficult to measure and long-lived radionuclides (by ARAO; involvement was not indicated)
- Treatment process and techniques for problematic waste streams (by ARAO; involvement was not indicated)
- Overview of international RWM frameworks (by BGR; as attendee only)

- Radionuclide migration, Thermodynamic modelling, thermodynamic databases and Organics and colloids (by CIEMAT; as organizing partner)
- Physi-Chemi-Geochemistry characterization of the barrier and RN migration, adsorption within barrier, colloids performance, Modeling structures through DFT calculations (by CIEMAT; as lead organizer)
- **Safety assessment (by UJV ; as attendee only)**
- **Safety case and performance analysis (by VTT; as lead organizer)**
- Management of non-radiological properties of radioactive waste (by Galson Sciences Ltd.; as attendee only)
- Modeling of coupled THMC processes in the near field of geological repository (by LEI; as attendee only)
- Shielding modeling, re-criticality (by CIEMAT; as lead organizer)
- Modeling of fuel thermo-mechanical behaviour (by CIEMAT; as lead organizer)
- Chemical processes modelling under geological disposal conditions (by LEI; as attendee only)
- Site evaluation and selection, criteria development (by SURAO; as attendee only)
- Research in repository chemical interactions (by Universidad Autónoma de Madrid; wants to be involved in organization)
- Characterization and clearance of radioactive materials from regulatory control (by SSTC NRS; as organizing partner)
- **Safety issues of management of disused sealed radiation sources (by SSTC NRS; as organizing partner)**
- **Dry storage of Spent Nuclear Fuel (by SSTC NRS; as organizing partner)**
- Multi-barrier system for long-term storage and disposal of radioactive waste in near-surface disposal facilities (by SSTC NRS; as organizing partner)
- **Development of safety case and safety analyses reports for processing, storage and disposal of radioactive waste in near-surface disposal facilities (by SSTC NRS; as organizing partner)**
- **Treatment of uncertainties during management of "legacy" radioactive waste (by SSTC NRS; as organizing partner)**
- **Packages for safe transport of radioactive waste and Spent Nuclear Fuel (by SSTC NRS; as organizing partner)**

The topics proposed by the EURAD partners cover most of the topics in the survey. As indicated in the list above, there are several partners that want to be involved in the organization of training courses that are directly linked to the most urgent training needs (e.g. safety). However, a lot of EURAD partners proposed topics, but they do not want to be actively involved in the organization thereof. This list together with the list of training needs provides useful information which allows specific training courses to be organized within EURAD.

5. Conclusion

In the 'Survey on training initiatives' the 80 respondents have indicated a total of 363 training needs, of which 262 are indicated as 'difficult to find', in the field of RWM were identified. A lot of topics are covered

EURAD Deliverable 13.1 – List of training needs from Research, Development and Demonstration and Strategic Studies Work Packages

by the existing courses, however, analysis of the training needs indicated that there are still a lot of gaps for many of the EURAD partners. This information will be compared to deliverables D13.2 ('Mapping of available course materials') and D13.3 ('Alignment of the available course material with the Roadmap'). Together with these documents, the critical gaps can be easily identified. Furthermore, these deliverables could offer a solution to certain gaps that were identified by some EURAD beneficiaries by pointing them to courses they did not have access to before.

The five most urgent and highest priority topics are: '7.1 Safety Strategy', '7.2.1 Safety case production', '7.3.1 Treatment of uncertainty', '2.2.2 Waste Acceptance Criteria' and 'Source term understanding for disposal'. This was indicated by the REs, WMOs and TSOs almost unanimously (no training needs were identified by waste producers), indicating that these are indeed high priority training needs. It is worth noting that some courses already exist within EURAD dealing with some of these high priority topic (e.g. the vocational course on 'Regulatory review and assessment of the safety case for disposal facilities Module 1 – Safety case context, safety strategy, site characterization and the facility description' organized by SITEX.Network). Despite some of these courses existing (or covering (part of) the training needs), the EURAD partners still indicate that most of these courses are hard to find for them. This indicates that there are needs that can be tackled by EURAD. Therefore, WP13 aims to increase the availability to training courses in the field of RWM by gathering information on these courses in one place which is maintained and curated by WP13, namely the website of the School of RWM (<https://euradschool.eu/>). This website has a section dedicated to training courses in which training courses of both EURAD and external partners are signposted. Here, EURAD partners and other users can find an overview of relevant courses.

Fortunately, several EURAD partners indicated that they are willing to contribute to the organization of several training courses on specific topics. Some of them are willing to contribute to courses tackling the high priority training needs (e.g. safety). This is useful information for WP13 and the PMO and can help decide which courses will be organized and who can assist in the organization.

In conclusion, there still exist a lot of training needs in the RWM community as evidenced by the results of the survey. These needs are of importance to all main actors in RWM: REs, WMOs and TSOs. In addition to the survey and this deliverable, WP13 will create an overview of available courses (deliverable D13.2). Combined with this deliverable, the real gaps can be identified. These gaps will then be filled by organizing specific courses, based on the end-user's needs, in cooperation with the Research, Development & Demonstration and Strategic Studies work packages, as well as with external partners (e.g. OECD-NEA, PREDIS). All this information, will be gathered on the website of the School of RWM, making it a hub for all training related to RWM, and will be mapped to the EURAD roadmap to increase the ease-of-use for the end-users.

Appendix A. Survey on training initiatives



EURAD WP13 Survey
on training initiatives.doc

Appendix B. List of organizations that completed the survey

- ARAO
- BAM
- Bel V
- BGE
- BGR
- CEA
- Centre for Energy Research
- Centre of Experimental Geotechnics, Faculty of Civil Engineering, Czech Technical University in Prague
- CIEMAT
- CIMNE
- COVRA
- Czech Technical University in Prague
- Czech Technical University in Prague, Faculty of Nuclear Sciences and Physical Engineering, Dept. Nucl. Chem.
- Danish Decommissioning
- EC-JRC Geel
- ENRESA
- Enusa
- EnviroCase Ltd.
- ESV EURIDICE
- Euridice
- Galson Sciences Ltd (GSL)
- HZDR
- Ignalina NPP
- Institute of Nuclear Chemistry and Technology
- JSI
- KIPT
- KIT-INE
- LEI
- NAGRA
- NCSR D
- Nuclear Engineering Seibersdorf GmbH
- ONDRAF/NIRAS
- RATEN
- SCK CEN
- SITEX.Network
- SKB

EURAD Deliverable 13.1 – List of training needs from Research, Development and Demonstration and Strategic Studies Work Packages

- SSTC NRS
- STUBA
- SÚRAO
- SURO
- Technical University of Sofia
- TU Delft
- TUL
- UJV Rež, a. s.
- Universidad Autónoma de Madrid
- University of A Coruña
- University of Jyväskylä
- University of Liège
- UPC: Polytechnic University of Catalunya
- Uppsala Universitet
- VTT
- VUJE