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**Development of a training module for generalist experts in geological disposal**

Authored by: P. Poškas, D. Justinavičius, A. Narkūnienė, (LEI), P. Metcalf (ENSTTI), M. Tichauer, M. Rocher (IRSN), V. Detilleux (Bel V), J.-P. Wouters, F. Bernier (FANC), G. Heriard Dubreuil, J. Dewoghelaëre (Mutadis), A. Mrskova (Decom), J. Miksova (CV REZ)

Edited by: A. Narkūnienė, M. Rocher

12/10/2017:

Checked by: A. Narkūnienė  
Work Package 3 Leader

12/10/2017:

Approved by: D. Pellegrini,  
Coordinator

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## SITEX-II OUTLINES

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### **Sustainable network for Independent Technical Expertise of Radioactive Waste Disposal – Interactions and Implementation (SITEX-II)**

The SITEX-II Project (Coordination and Support Action) was initiated in 2015 within the EC's Horizon 2020 programme to further develop the Sustainable Independent Expertise Function Network in the field of deep geological disposal safety. This 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. SITEX-II brings together representatives from 18 organisations including regulatory authorities, technical support organisations, research organisations and specialists in risk governance and interaction with general public, including NGOs and an education institute. It is 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. SITEX-II, coordinated by IRSN, is implemented through 6 Work Packages (WP).

**WP1 - Programming R&D** (lead by Bel V). The general objective of WP1 is to further define the Expertise Function's R&D programme necessary to ensure independent scientific and technical capabilities for reviewing a safety case for geological disposal. In this perspective WP1 will develop a Strategic Research Agenda (SRA) and define the Terms of Reference (ToR) for its implementation accounting for the preparatory work to be carried out in the framework of the JOPRAD project for construction of a Joint Programming of research for geological disposal.

**WP2 - Developing a joint review framework** (lead by FANC). The key objective of WP2 is to further develop and document in position papers and technical guides a common understanding of the interpretation and proper implementation of safety requirements in the safety case for the six phases of facility development (conceptualization, siting, reference design, construction, operational, post-closure).

**WP3 - Training and tutoring for reviewing the safety case** (lead by LEI). WP3 aims to provide a practical demonstration of training services that may be provided by the foreseen SITEX network. A pilot training module will focus on the development of training modules at a generalist level, with emphasis on the technical review of the safety case, based on national experiences, practices and prospective views. The training modules will integrate the outcomes from WP1, WP2 and WP4 and support harmonisation of the technical review processes across Europe.

**WP4 - Interactions with Civil Society** (lead by Mutadis). WP4 is devoted to the elaboration of the conditions and means for developing interactions with Civil Society (CS) in the framework of the foreseen SITEX network, in view of transparency of the decision-making process. The future SITEX network is expected to support development of these interactions at different levels of governance and at different steps of the decision-making process. Three thematic tasks, namely R&D, safety culture/review and governance will be addressed by institutional experts and representatives of CS within SITEX-II as well as externally through workshops with other CS organisations.

**WP5 - Integration and dissemination of project results** (lead by CV REZ). The overall objective of WP5 is to produce a synthesis of the results achieved within all the WPs of SITEX-II together with an Action Plan that will set out the content and practical modalities of the future Expertise Function network. WP5 will also foster the interactions of SITEX-II with external entities and projects, as well as the dissemination of SITEX-II results so as to allow possible considerations from outside the project in the process of developing the future SITEX network.

**WP6 - Management and coordination** (lead by IRSN).

*Contact:* D. Pellegrini (IRSN), SITEX-II Coordinator  
[delphine.pellegrini@irsn.fr](mailto:delphine.pellegrini@irsn.fr)

*Further details on the SITEX-II project and its outcomes are available at [www.sitexproject.eu](http://www.sitexproject.eu)*

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## ABSTRACT

This report is the second deliverable prepared by the SITEX-II project group for Work Package 3 *Training and tutoring for reviewing the Safety Case*. The report provides the overview of the process of training module development. It covers the compilation of training agenda, event description, and description of training content. Besides, the proposal for sustainable SITEX training in the future is introduced.

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## 1 Introduction

To review a Safety Case for a deep geological repository, experts with wide ranges of competencies are required. During the SITEX 7FP project (2012–2013), five different types of experts being involved in the technical review process were identified (generalist experts, environmental experts, numerical modellers, risk experts, experts in long-term safety) and their necessary knowledge and skills were compiled into “experts’ profiles”. According to the Terms of Reference of the SITEX network [SITEX, 2014a], Training and Tutoring will be one of the services provided by the Network. A plan for competence development in expertise of radioactive waste disposal safety was developed [SITEX, 2014b] and includes setting up a training programme.

Work Package 3 (WP3) of SITEX-II aims at demonstrating the implementation of a training service, including both technical and management aspects, by developing and testing a training module (common core module) devoted all proposed expert profiles and generalist experts in particular involved in the Safety Case review process.

The tasks under the activities in WP3 have been fulfilled by cooperation among technical safety organisations, research organisations, nuclear regulatory authorities, and the European Nuclear Safety Training and Tutoring Institute (ENSTTI).

Task 3.2 of Work Package 3 of SITEX-II project has been devoted for the development of a common core training module on Regulatory review of the Safety Case of geological disposal.

This deliverable presents the overview of activities of the development process and summary of the main outcomes such as the pilot training session agenda and associated list of lecturers and profiles of lecturers. The training module related material, such as lectures and exercises, and the lessons learnt from the pilot training module are issued as two separate deliverables (D3.3 and D3.4).

## 2 Approach for development of training module and pilot training session

The activities of Task 3.2 started with consideration of the outcomes of the SITEX project and the outcomes of Task 3.1 where the issue of importance of training sustainability was raised.

In the previous SITEX project (2011–2013), observations were made that SITEX network training programme would focus on the use of interactive teaching methods to involve trainees as much as possible in the learning process. While developing the training module, several proposals came from ENSTTI, LEI, and IRSN. These proposals develop almost similar topics; the main difference is the duration of the module (see Annex 6.1). Following the discussions on training sustainability, it was proposed by ENSTTI to develop a training module made of series of events of different nature.

The training programme being proposed should take into consideration the potentially limited number of trainees, the range of technical specialisations involved in the safety of geological disposal and the need to ensure sustainability. The programme will be presented over a nominal two year period and will involve a number of training modules of a generalist nature presented during the first twelve-month period followed by a programme of training modules the following

year focussed more on individual specialisation. The proposals for the second year of the cycle assume that the SITEX network will be in place and will integrate with the activities of the network. Should the programme be adopted on an ongoing basis, this two yearly cycle would be repeated, or could be extended over a three-year period if the number of participants is not sufficient to justify the two yearly cycle, and the overall sustainability will depend on the continuing existence of the SITEX network and the willingness of the SITEX Partners to make available personnel to present the training and assist with site visits and tutoring / mentoring of trainees.

The first year of the training programme would involve three events/activities:

1. A 2-week module with lectures including visits to research laboratories.
2. Visits to disposal facility sites and URLs together with structured discussion session with facility staff.
3. Participants undertaking a review of existing Safety Case and presentation of the outcome at a training seminar.

During the second year two training seminars on topical issues in regulatory review and independent Expertise Function research programmes would be presented in combination with activities of Expertise Function network. The topics would be decided based on the area of specialisation of the trainee.

More detailed proposal for the future SITEX training will be given at the end of the project and will integrate the feedback from the pilot training session. It will be issued in the deliverable D3.4 “Lessons learned from the pilot training session”.

## **2.1 DEVELOPMENT OF PILOT TRAINING SESSION**

After discussions and consultation within WP3, considering the duration of the project, it was decided that even if a 2 year long-term training module would be the target for future sessions, the pilot training session in SITEX-II has to be limited to one working week (5 days) for organisational reasons. This choice is also the result of the query presented below in chapter 3.2. Thus, a version of module was chosen on the basis of these proposals for the pilot training session by:

- shortening the practical exercises,
- not including any lecture related to introduction and “revisions” such as general considerations on waste management and on the concept of Safety Case,
- not including visits to disposal facility sites and URLs during this training.

The developed module is dedicated to all experts engaged in the review process of the Safety Case of geological disposal (called “module A” in the former SITEX project, see [SITEX, 2014b]). This module covers several thematic areas, such as:

- Definition of the Expertise function (on Day 1);
- Content of the Safety Case, detail of different parts and phases of development, evolution of Safety Case and its review (Day 2, Day 3);

- Different steps of the technical review and exchanges with other stakeholders, challenges (Day 3, Day 4).

While developing the training agenda for this module, the topics of SRA, identified as having common interest for knowledge transfer, was considered. Part of them has been covered within the frame of the SITEX common core training module being developed within WP3.

The recommendations for the experts new to the technical review or geological disposal were compiled as links to the material to be learned (or refresh of knowledge if needed) by training participants (trainees) themselves before coming to the SITEX training. This material is developed by the International Atomic Energy Agency (IAEA) and is available online at free of charge.

## **2.2 BOUNDARY CONDITIONS**

During the project SITEX (2012–2013), it was observed that the SITEX network Training Programme will rely on existing training programmes organised by the European Nuclear Safety Training and Tutoring Institute (ENSTTI) or similar and will propose a complementary step to achieve the complete professional development of experts in the geological disposal licensing process for new entrants in a safety organisation. Such a complete expert programme (Fig. 1) could be comprised of the “Basic Training Programme”, the “Advanced Training Programme”, and the “SITEX Training Programme”.

Training courses corresponding to the “Basic Training Programme” and the “Advanced Training Programme” (in blue in Figure 1) have already been proposed by various national and international institutions (IAEA, NEA, ENSTTI, etc.)



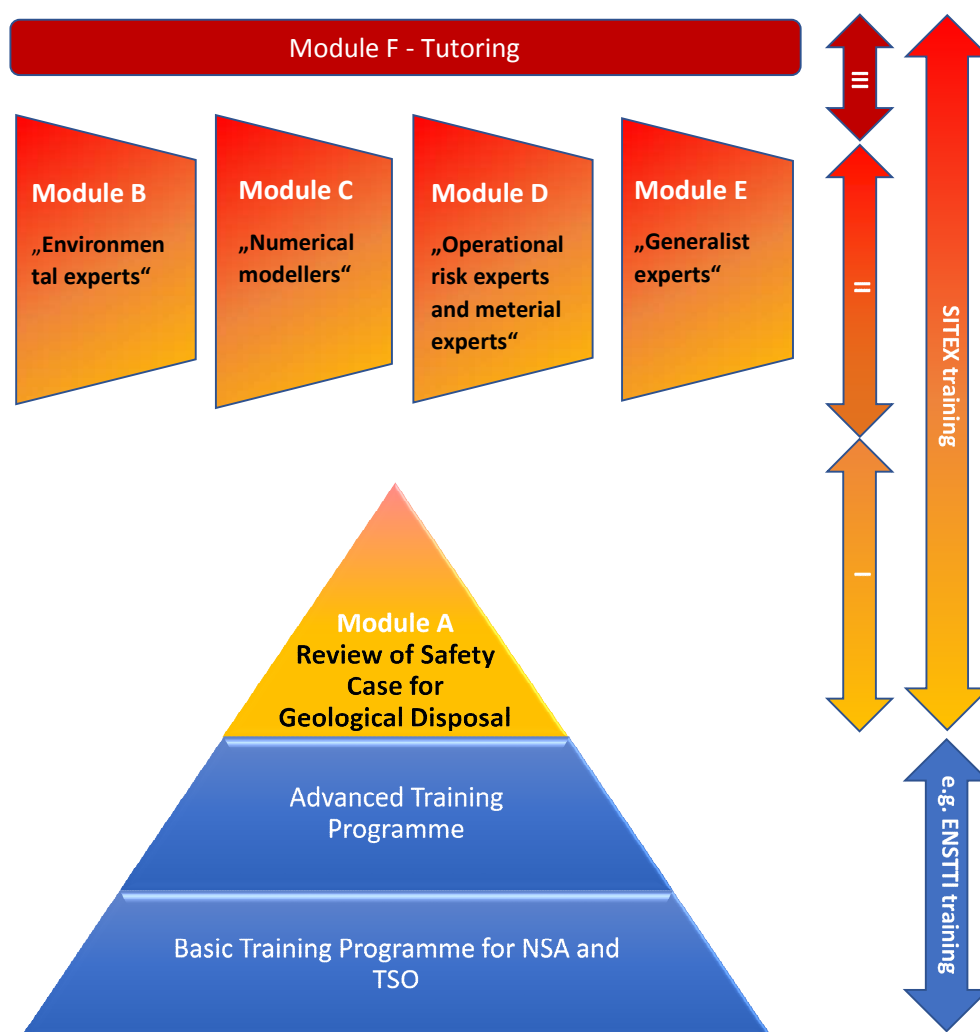


Fig. 1. SITEX training within the overall expert's training process [adapted from SITEX, 2014b]

Uneven background of the participants has been mentioned while analysing the current practise of experts training [SITEX-II, 2016a]; thus, recommendations have been provided to get some basic knowledge prior to taking part in the pilot session of the SITEX training (link to the material developed by IAEA and available online at no charge) (see section 3.5).

## 2.3 RESULTS OF QUERY

A short query has been developed and circulated among SITEX-II project organisations to collect opinion of SITEX-II project partners on the duration of the pilot training session and to assess the capacity of the lecturers and participants for the pilot training session. The results are summarised in Fig. 2.



Query on SITEX-II pilot training format												
Total	Option 1	BelV	FANC	PSI	GI-BAS	REC	IRSN	CNCS	Decom	CV-REZ	LEI	Energiaklub
12	lecturers	2	1	0	0	1	2	2	1	2	1	0
14	trainees	2	2	0	1	0	2	2	1	1	3	0
					?							
Total	Option 2	BelV	FANC	PSI	GI-BAS	REC	IRSN	CNCS	Decom	CV-REZ	LEI	Energiaklub
11	lecturers	2	1	0	0	1	2	2		2	1	0
10	trainees	2	2	0	1		2	2		1	0	0
					?							

Note: at least 1 lecturer assumed

Note: 1-2 trainees indicated

Note: 1-2 trainees indicated

Note: 2-3 trainees indicated

Note: at least 1 lecturer assumed

Note: 2-3 trainees indicated

Note: 1(2) trainees indicated

Fig. 2. Summary of the query results on the pilot session format and potential number of lecturers and participants (trainees)

“Option 1” corresponds to the one-week pilot training session in Lithuania; “Option 2” corresponds to a two-week training session in Paris followed by the facility visits. As it could be seen in Fig. 2, there is a potential of SITEX-II organisations to delegate the lecturers and trainees.

## 2.4 TOPICS OF SRA FOR KNOWLEDGE TRANSFER

While developing the Strategic Research Agenda (SRA) for SITEX network, some topics of common interest have been identified as the topics for knowledge sharing and transfer (i.e., from more advanced programmes to less advanced programmes). These topics are listed in the Table 1 with the indication which experts could take interest in it. Five different types of experts being involved in the technical review process have been identified (generalist experts, environmental experts, numerical modellers, risk experts, experts in long-term safety) as presented in [SITEX-II, 2016a]. The interest in these topics was considered during the development of the first SITEX training module.

Table 1. Topics of SITEX Strategic Research Agenda identified as having common interest for knowledge transfer

Topics identified for knowledge transfer while developing of SITEX SRA [SITEX-II, 2016b]	Within interests of experts	Notes
<b>Main Topic 1 (Waste inventory and source term) issues and activities of common interest</b>		
#3 Understanding of the release processes and speciation of the radionuclides for different types of waste	Numerical modellers, experts in long-term safety	Topic for the modules of more specialized experts
#4 Waste acceptance criteria	Generalist experts, risk experts, experts in long-term safety	Topic for dedicated training
<b>Main Topic 5 (Safety relevant operational aspects) issues and activities of common interest</b>		
#2 Assessment of the risk of fire and explosion	Risk experts	Topic for specialised training

Topics identified for knowledge transfer while developing of SITEX SRA [SITEX-II, 2016b]	Within interests of experts	Notes
<b>Main Topic 6 (Managing uncertainties and the safety assessment) issues and activities of common interest</b>		
#3 General methodologies for the safety assessment	Generalist experts, environmental experts, numerical modellers, risk experts, experts in long-term safety	To be covered in SITEX common core training module on technical review of Safety Case of geological disposal (Day 2 of pilot session)
#4 Safety assessment models	Numerical modellers, risk experts, experts in long-term safety	Topic for the modules of more specialized experts
<b>Main Topic 7 (Lifecycle of a disposal facility and the Safety Case) issues and activities of common interest</b>		
#1 Methods to review the Safety Case	Generalist experts	To be covered in SITEX common core training module on technical review of Safety Case of geological disposal (Day 3 of pilot session)
#3 Evolution of the Safety Case content with the lifecycle of the disposal programme	Generalist experts	To be covered in SITEX common core training on technical review of Safety Case of geological disposal (Day 3 of pilot session)
#4 Organisation of the pre-licensing phase	Generalist experts	Topic for dedicated training

## 3 Pilot training session

First of all the short description of training module was developed and accompanied with training syllabus developed later. More detailed description of each lecture is provided in the syllabus together with detailed information on lecturers' names, CVs and pilot training session date, location and time table.

### 3.1 SHORT DESCRIPTION

**TITLE:**

SITEX TRAINING MODULE "A" (COMMON CORE MODULE)

SITEX TRAINING COURSE ON REGULATORY REVIEW OF THE SAFETY CASE FOR GEOLOGICAL DISPOSAL

**ABSTRACT:**

This is a 5-day training course aiming at strengthening the general expertise of professionals involved in the review process of a Safety Case for geological disposal. It is being presented within the context of the EC-H2020-SITEX-II project (Sustainable network for Independent Technical Expertise of Radioactive Waste Disposal – Interactions and Implementation) as a pilot training event within a broader framework of training professionals in the safety of geological disposal of radioactive waste. The course, developed by SITEX-II partners in collaboration with ENSTTI, introduces the general concept of geological disposal, the current challenges that geological disposal projects are facing, the regulatory review process of a Safety Case, as well as the interactions of the expertise function (notably fulfilled by technical support organisations) and the Civil Society experts with this process. It presents the regulatory expectations of what should be presented in a Safety Case for the various stages of a geological disposal program (e.g. expectations about the siting stage, the design stage, construction and operation stages, the radiological impact and the management system of the operator/developers). The systematic and methodological approach to regulatory review and assessment of the safety will be presented together with the interacting processes between the implementing (fulfilled by waste management organisations), regulatory and expertise functions. The interactions with the Civil Society experts during this review process will also be covered. Finally, the establishments and implementation of research programmes by the expertise function will be presented in the course. The module is made up of presentations, exercises and key issue discussion sessions and is presented by internationally recognized experts from European nuclear regulatory authorities, organizations with an expertise function and the Civil Society. This training module allows an examination of knowledge gained within training course. The participants will receive the Certificate of attendance.

**WHO SHOULD ATTEND**

The training course is intended for professionals from nuclear regulatory authorities and technical support organisations involved in regulatory processes related to the development and operation of geological disposal facilities, particularly review and assessment activities related to the Safety Case. The course would also be of value to researchers involved with the safety of geological

disposal, future facility operators and other persons involved with national radioactive waste management policies.

**Requested/recommended knowledge:**

Participants will require a basic knowledge of radioactive waste management, incl. radioactive waste disposal, nuclear and radiation safety and nuclear regulatory processes. The target audience is technical/scientific specialists. Newcomers can gather the prior requested level of knowledge from available material online (e.g. from the IAEA eLearning material; Links and instructions to it can be provided in advance upon request).

**LEARNING OUTCOMES**

The expected learning outcomes of this training module are strengthened expertise of trainees in the regulatory review and assessment processes related to the Safety Case for geological disposal, knowledge of the main regulatory expectations for the Safety Case, technical and scientific expertise requirements, understanding of the review and assessment process and the interactions with other processes and supporting research.

**COURSE PROGRAMME**

In addition to the general introduction, the module will consist of 5 days of training, which will cover the following topics:

- The geological disposal concept;
- The regulatory expectations of the Safety Case and supporting assessment;
- The regulatory review and assessment process;
- Interacting processes with the Safety Case evaluation and licensing process;
- Research in support of the Safety Case evaluation.

A practical exercise will take place during the week in which participants will work in groups to address issues related to the subject matter being presented.

Each day will have a summary session to enable general feedback and discussion of the topics covered during the day.

A round table discussion session will take place at the end of the module to address issues identified by participants.

At the end of the week an evaluation of the course will be undertaken by the participants.

At this time, the participants' impressions of the course will be gathered and the fulfilment of the participant's knowledge needs will be reviewed.

**EXAMINATION AND CERTIFICATE**

The course will be concluded with a multiple choice test covering the material presented. The participants will receive the Certificate of attendance.

## **TEACHING METHODS**

A combination of lectures and practical exercises will be completed by summary discussions.

To ensure basic knowledge the trainees will be asked to complete the IAEA eLearning course in advance on Waste management, with special emphasis on waste disposal.

Electronic files of the lectures will be provided to the trainees at the beginning of the course.

The trainees and lecturers will be requested to fill in an evaluation form to assess the training received and its overall adequacy and relevance.

A final test will be given to assess the trainees' learning based on a multiple-choice test.

## **PRICE AND REGISTRATION**

The pilot training session is free of charge for the participants of organisations of SITEX-II project (excluding travels). The travel and living expenses of training participants are not covered by SITEX-II project. For participants outside SITEX-II project, a fee could be requested.

It was agreed that the maximum number of participants is limited to 20. Online registration via ENSTTI website was established.

## **3.2 AGENDA OF PILOT TRAINING SESSION**

The proposals for the topics to be discussed during the pilot training session are presented in Annex 6.1. The discussions lead to the final agenda as presented in Table 2.

Table 2. Timetable of the **SITEX** training course on “Regulatory review of the Safety Case for geological disposal”, 12-16 June 2017, Kaunas, Lithuania

	9:00-10:30		10:45-12:30	13:30-15:30	15:45-17:00	17:00-17:15
<b>A – Monday</b>	<b>A.0 “Introduction”</b> “Asta Narkūnienė”, “LEI”		<b>A.3 “Geological disposal programs”</b> “Jitka Miksova/ Lumir Nachmilner”, “CV-Rez”	<b>A.4 “Geological disposal concepts and challenges”</b> “Jitka Miksova/ Lumir Nachmilner”, “CV-Rez”	<b>A.5 “Overall regulatory process and technical and scientific expertise requirements”</b> “Phil Metcalf”, “IRSN”	<b>Discussion</b>
	<b>A.1 “Overview of Lithuanian nuclear and waste management programs”</b> “Asta Narkūnienė”, “LEI”	<b>A.2 “Overview of the Ukrainian national RW management program and recent developments”</b> “Oleksii Tokarevskyi”, “SSTC NRS”				
<b>B – Tuesday</b>	<b>B.1 “Regulatory expectations of the Safety Case – Part 1”</b> “Frederic Bernier/Jean-Pierre Wouters”, “FANC”		Exercise “Frederic Bernier/Jean-Pierre Wouters”, “FANC”	<b>B.2 “Regulatory expectations of the Safety Case – Part 2”</b> “Frederic Bernier/Jean-Pierre Wouters”, “FANC”	Exercise “Frederic Bernier/Jean-Pierre Wouters”, “FANC”	<b>Discussion</b>
<b>C – Wednesday</b>	<b>C.1 “Regulatory review and assessment process and its challenges”</b> “Michael Tichauer; Muriel Rocher”, “IRSN”		<b>C.2 “Regulatory review, moving from conceptualisation to implementation”</b> “Jean-Pierre Wouters/Frederic Bernier”, “FANC”	Exercise - “Application of the review grids” “Frederic Bernier”, “FANC in cooperation with IRSN”		<b>Discussion</b>

	9:00-10:30		10:45-12:30		13:30-15:30	15:45-17:00	17:00-17:15
<b>D – Thursday</b>	<b>9:00-10:30, 10:45-11:45</b>  <b>D.1 “Design and conduct of supporting research programmes”</b>  <i>“Valery Detilleux”, “Bel V”</i>		<b>11:45-12:30</b>  <b>D.2 “Summary of current programmes and future Joint Programming”</b>  <i>“Valery Detilleux”, “Bel V”</i>		<b>D.3 “Stakeholder engagement and introduction to PEP”</b>  <i>“Adela Mrskova”, “Julien Dewoghélaëre”, “Decom, Mutadis”</i>	<b>D.4 “Test”</b>  <i>“Phil Metcalf”, “ENSTTI”</i>	<b>PEP exercise</b>  <i>Adela Mrskova”, “Julien Dewoghélaëre”</i>  <b>**Social event**</b>  19:00-22:00
<b>E – Friday</b>	<b>9:00-10:00</b>  <b>E.1 “Recent experience with regulatory review of French Safety case for radwaste disposal in clay formation”</b>  <i>“Muriel Rocher”, “IRSN”</i>	<b>10:00-11:00</b>  <b>E.2 “Recent experiences and topical issues with regulatory review of the Finnish Safety Case for geological disposal”</b>  <i>Jaakko Leino”, “STUK”</i>	<b>11:15-12:30</b>  <b>E.3 “Test evaluation and roundtable”</b>  <i>“Phil Metcalf”, “ENSTTI”</i>	<b>12:30-13:00</b>  <b>E.4 “Course evaluation and closure”</b> <i>“Asta Narkūnienė”, “LEI”</i>	<b>13:00-14:00</b>  <b>Lunch</b>		



### 3.3 SYLLABUS

Content of the SITEX common core training module: “Regulatory review of the Safety Case for geological disposal” is briefly presented below.

#### **Day 1 – “Introduction to geological disposal and safety demonstration”**

##### **A0. “Introduction” – “Asta Narkūnienė”, “LEI”**

**Key words.** *“Welcome, H2020, SITEX-II, training course, logistics and administration”*

##### **Synopsis.**

The presentation will cover introduction of training course, its objectives, administration and logistics, brief overview of SITEX-II project, introduction of participants and lecturers.

##### **A1. “Overview of Lithuanian nuclear and waste management programs” – “Asta Narkūnienė”, “LEI”**

**Key words.** *“Radioactive waste, national program, overview, Lithuania”*

##### **Synopsis.**

The presentation will cover radioactive waste management and disposal program in Lithuania. The source of radioactive waste and spent fuel will be introduced and the implemented solutions of their management and final disposal will be overviewed. The current status of SNF and radioactive waste disposal program will be introduced.

##### **A2. “Overview of the Ukrainian national RW management program and recent developments” – “Oleksii Tokarevskyi”, “SSTC NRS”**

**Key words.** *“Radioactive Waste, Radioactive Waste Management, Facilities, Storage, Disposal, Waste Acceptance Criteria”*

##### **Synopsis.**

The objective of the lecture is to give the overview of current situation with RW management in Ukraine. This lecture provides information on national RW management program, as well as legal and regulatory framework, description of RW classification in Ukraine. Also the lecture gives the overview of existing RW treatment, storage and disposal facilities in Ukraine. Approaches to geological disposal are also addressed.

The lecture covers the following topics:

- Legal and regulatory basis for RW management in Ukraine
- National RW management program
- RW classification and upcoming changes
- RW management facilities in Ukraine
  - treatment

- storage
- disposal
- Approaches to geological disposal in Ukraine

### **A3. “Geological disposal programs” – “Jitka Miksova, Lumir Nachmilner”, “CV REZ”**

**Key words.** *“Radioactive waste, waste disposal programme, strategy and policy, disposal facility lifecycle, stakeholders, licensing process, QMS”*

#### **Synopsis.**

An introduction of the main principles of waste disposal programme will be given, its key elements will be briefly described, factors influenced successful programme running and an importance of strategy and policy will be discussed. The different stakeholders, their role and mutual relationship in decision making process with respect to the disposal programme stage will be presented. A lifecycle of a disposal facility and relevant licensing process will be described. An associated project management, incl. QMS will be shown. The function of generic and site specific laboratories will be discussed; example/s of national disposal programmes will be chosen and presented. The benefits of international cooperation and necessity of disposal programme peer reviews will be explained.

### **A4. “Geological disposal concepts and challenges” – “Jitka Miksova, Lumir Nachmilner”, “CV REZ”**

**Key words.** *“Radioactive waste, disposal concepts, disposal safety aspects, underground research laboratories, status of facilities”*

#### **Synopsis.**

The presentation will introduce existing concepts of disposal facilities with emphasis on geological disposal of ILW and HLW. Disposal facility of radioactive waste should provide a sufficient protection of both people and the environment in very long term period, in particular during an operational phase and also after its closure. With respect to this fact, a technical solution of disposal facility has to take into consideration all safety relevant aspects to fulfil safety requirements, these aspects will be discussed. A diversity of disposal options and main disposal facility components in different host rock environment will be presented. A safety demonstration of disposal solution demanded within licensing process shows the needs for continuing research and leads to the construction underground research laboratories, examples will be chosen. An overview of status of geological disposal facilities development in different countries will be presented and completed with examples.

### **A5. “Overall regulatory process and technical and scientific expertise requirements” – “Phil Metcalf”, “IRSN”**

**Key words.** *“Geological disposal, licensing, nuclear regulatory authority”*

#### **Synopsis.**

The nuclear regulatory process involves the establishment of safety requirements in the form of laws, regulations and regulatory guidance; the evaluation by the regulatory authority of the Safety Case presented to demonstrate compliance with these safety requirements; the establishment of conditions of authorisation for the design, construction and operation of facilities and the development and implementation of compliance assurance programmes. The presentation discusses the application of these processes in the licensing of a geological disposal facility from site selection through to closure and beyond. It also addresses the resources required by the regulatory authority to undertake this work.

## **Day 2 – “Regulatory expectations of the Safety Case and safety assessment”**

### **B1 & B2. “Regulatory expectations of the Safety Case:” – “Frederic Bernier/Jean-Pierre Wouters”, “FANC”**

**Key words.** *“Safety Case, safety principles, regulatory expectations, safety assessment, monitoring, uncertainties”*

#### **Synopsis.**

The lecture will be dedicated to a set of regulatory expectations relating to safety issues providing the basis for the review by the regulatory body of the Safety Case. Fundamental safety requirements for geological disposal rest on the following principles: defense in depth, demonstrability and the radiation protection principles elaborated by the International Commission on Radiological Protection (ICRP). These principles governing the development and implementation of geological disposal will be presented as well as expectations regarding following topics:

1. Safety context
2. Safety strategy
3. Radiation protection principles
4. Safety assessment
5. Management of uncertainties
6. Monitoring
7. Integration of safety arguments
8. Management system

## **Day 3 – “Regulatory review and assessment of the Safety Case”**

### **C1. “Regulatory review and assessment process and its challenges” – “Michael Tichauer/Muriel Rocher”, “IRSN”**

**Key words.** *“review team, technical review, successive steps, technical dialog,”*

#### **Synopsis.**

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How to prepare a technical review? What should be done when the implementer's Safety Case arrives on your desk? This lecture will focus on these practical aspects of the regulatory review process, often very limited in time and gathering a large panel of topics, which therefore should be optimised. Regarding the preparation, fulfilling a relevant technical review requires specific basic organisational aspects such as insuring the availability of a large panel of competences provided by resources and skills independent from implementers (notably regarding safety, radiological protection, scientific and technical knowledge...). This lecture will develop these managerial aspects of the review team. Regarding the assessment of the implementer's report itself, the successive steps of the technical review, from pre-review to completion phase, will be presented with examples. A focus will be done on technical dialogs with implementer and on possible interactions with Civil Society during this process.

## **C2. "Regulatory review, moving from conceptualisation to implementation" – "Jean-Pierre Wouters/Frédéric Bernier", "FANC with support of IRSN"**

**Key words.** *"Safety case, phases, review, analysis grids"*

### **Synopsis.**

Diverse types of decisions are expected to be made owing to the stepwise nature of a disposal programme:: conceptualization, siting, reference design, construction, operational, and post-closure. In nearly all programmes, regulatory approvals are expected at least from the point of repository construction and, in some countries, regulatory approvals will also be needed in earlier phases e.g. during the conceptualization and siting phases.

Regardless of these national specificities, well-defined decision points are associated with each programme phase such as host rock and/or site selection, and decisions to grant a license to construct, to operate or to close the facility. This implies that the Safety Case supporting a decision to move from one phase to the next needs to be updated to remain "fit for the purpose". The lecture sets out what regulatory authorities may expect from the Safety Case at each of these phase of the development of the disposal. The presentation will cover the different stages of the review process and present review grids as a tool to assess the Safety Case.

Exercise - "Application of the review grids"

## **Day 4 – "Interacting and supporting activities"**

### **D1. "Design and conduct of supporting research programmes" – "Valery Detilleux", "Bel V"**

**Key words.** *"Research, development, programme"*

### **Synopsis.**

The lesson will first introduce why organizations with an expertise function should perform or support R&D to achieve their missions. Then, the concept of geological disposal facility envisaged by the WMO in Belgium will be presented. Finally, key needs in R&D of the expertise function will be discussed, based on the example of the research needs identified by the Belgian regulatory body. For each research need, a brief topic description will be provided, as well as a discussion on

its importance for safety, with the objective of increasing or strengthening the awareness of generalist experts to those topics.

## **D2. “Summary of current programmes and future Joint Programming” – “Valery Detilleux”, “Bel V”**

**Key words.** *“Joint Programming, EJP”*

### **Synopsis.**

The Strategic Research Agenda (SRA) of the expertise function, developed at the international level within the H2020-SITEX-II project, will be presented. For each main topic of this SRA, a brief technical overview of the relevant issues will be given. Finally, an introduction to the possible Joint Programming (JP) of research at the European level (investigated within the H2020-JOPRAD project) will be given. The view of the expertise function on this JP will be given, as well as the identified conditions for preserving its independency from other actors.

## **D3. “Stakeholder engagement and introduction to Pathways Evaluation Process” – “Adela Mrskova”, “Decom”, “Julien Dewoghélaère”, “Mutadis”**

**Key words.** *“stakeholders, participation”*

### **Synopsis.**

Lesson provides introduction to stakeholder engagement process in various stages of deep geological repository lifetime, with focus on civil society aspects. Participants will be given basic information on stakeholder engagement, an overview of stakeholder identification according to particular case and general participation process characteristics and principles. Potential of stakeholder engagement in the Safety Case and its review will be discussed. Trainees will be given various examples of stakeholder engagement in radioactive waste disposal processes.

Further, as an example, civil society involvement in SITEX network will be presented. Pathways Evaluation Process (PEP) exercise will be introduced as an example of tool for facilitate discussion among various stakeholders. PEP approach has been conceptualized as an exercise of participative and comparative assessment of alternative scenarios on long-term management of radioactive waste. It is based on two concepts- pathway (strategies retracing the steps of a possible evolution from the current situation of RWM as a whole to a final state) and safe terminus (situation where the safety of all considered categories of waste do not anymore entail an active human contribution). The lesson will present the rules and the materials (boards and cards) of the PEP in order to practice it later during the social event (D5).

## **D4. “Test” – “Phil Metcalf”, “ENSTTI”**

**Key words.** *“test, knowledge gained, evaluation”*

### **Synopsis.**

Testing the gained knowledges will be performed through multiple-choice test.

## **D5. “PEP exercise ” – “Adela Mrskova “, “Decom”, “Julien Dewoghélaëre”, “Mutadis”**

**Key words.** Interaction, stakeholders, Pathways Evaluation Process, exercise

Pathways Evaluation Process (PEP) exercise was developed to support better understanding among stakeholders and to facilitate the merging of a common background on safety culture by understanding the different positions regarding safety issues of RWM. The main aim of PEP is to allow a pluralistic discussion on the way to secure, on long-term, safety of humans and the natural environment through different options. PEP allows discussing how social issues impact technical ones. Participants will during the social event test this serious game and address complexity of RWM, considered here as a socio-technical issue, not only a technical one. During discussions in small groups, each participant will test the robustness of pathways by selecting testing conditions to challenge them and evaluation Criteria to assess them.

### **Day 5 – “Summary and evaluation”**

## **E1. “Recent experience with regulatory review of French Safety Case for radwaste disposal in clay formation” – “Muriel Rocher”, “IRSN”**

**Key words.** “Cigéo, clayey host rock, Safety options, pre-licencing”

### **Synopsis.**

This lecture aims at introducing the review of the Cigéo Safety case, performed by IRSN in 2016-2017, and the main outcomes of the safety evaluation that was presented to the regulatory body. Cigéo is the French project of deep geological disposal in the Callovo-Oxfordian clayey formation. The Cigéo Safety Options File marks the last major step of consolidation in terms of repository design options and of safety requirements before licensing application planned by Andra by end of 2018. The examination of this Safety Options File by IRSN, as requested by the French regulatory body, addresses the maturity of the project and focuses on the relevance, in terms of safety and radiation protection, of the selected options and the potential need for major design changes should be made.

## **E2. “Recent experiences and topical issues with regulatory review of the Finnish Safety Case for geological disposal” – “Jaakko Leino”, “STUK”**

**Key words.** “Safety case, regulatory review, regulatory experiences, deep geological disposal”

### **Synopsis.**

Finland is one of the first countries in the world in developing a disposal solution for spent nuclear fuel (SNF). The Construction License Application (CLA) for the Olkiluoto SNF encapsulation and disposal facility was submitted by Posiva, the implementer, to the authorities at the end of 2012 and the Government granted construction license in November 2015. The post-closure Safety Case submitted as part of the CLA was reviewed during 2013-2015. The CLA covered both operational safety (PSAR) and post-closure safety. This lecture aims to introduce experiences gathered during the review process of the post-closure Safety Case. During the review process some practices proved to be good but the process revealed also some needs for improvements for the next



licensing phase. This lecture also aims to introduce the remaining open issues for Operating License Application (OLA).

### **E3. “Test evaluation and roundtable” – “Phil Metcalf”, “ENSTTI”**

**Key words.** “Knowledge gained, test, results, discussion”

#### **Synopsis.**

The evaluation of participants’ knowledge tests will be organized together and followed by roundtable discussion to clarify important issues if not understood properly. Discussion on the results of PEP exercise will be organized also.

### **E4. “Course evaluation and closure” – “Asta Narkūnienė”, “LEI”**

**Key words.** “Course closure, final discussion”

#### **Synopsis.**

The training course will be overviewed and summarized, course evaluation procedure will be organized and main observations will be recorded.

## **3.4 LECTURERS**

The lecturers invited to this pilot training course were from the WP3 organisations; two lecturers from organisation of SITEX-II project Associated Group. In general lecturers were delegated by technical support organisations, research organisations, regulatory body, Civil Society organisation and ENSTTI.

### **3.4.1 List of lecturers**

The list of lecturers giving the lectures and coordinating exercises during the pilot training session is presented in Table 3.

Table 3. List of lecturers giving the lectures and coordinating exercises during pilot training session

<b>Lecture / Workshop / Excursion</b>	<b>Lecturer / Company</b>
A1. “Overview of Lithuanian nuclear and waste management programs”	“A. Narkūnienė” / “LEI”
A2. “Overview of the Ukrainian national RW management program and recent developments”	“O. Tokarevskyi” / “SSTC NRS”
A3. “Geological disposal programs”	“J. Miksova/L. Nachmilner” / “CV REZ”
A4. “Geological disposal concepts and challenges”	“J. Miksova/L. Nachmilner” / “CV REZ”



<b>Lecture / Workshop / Excursion</b>	<b>Lecturer / Company</b>
A5. "Overall regulatory process and technical and scientific expertise requirements"	"P. Metcalf" / "IRSN"
B1. "Regulatory expectations of the Safety Case – Part 1"	"F. Bernier/J.-P. Wouters" / "FANC"
Exercise	"F. Bernier/J.-P. Wouters" / "FANC"
B2. "Regulatory expectations of the Safety Case – Part 2"	"F. Bernier/J.-P. Wouters" / "FANC"
Exercise	"F. Bernier/J.-P. Wouters" / "FANC"
C1. "Regulatory review and assessment process and its challenges"	"M. Tichauer/M. Rocher" / "IRSN"
C2. "Regulatory review, moving from conceptualisation to implementation"	"J.-P. Wouters/F. Bernier", "FANC with support of IRSN"
Exercise "Application of the review grids"	"F. Bernier", "FANC in cooperation with IRSN"
D1. "Design and conduct of supporting research programmes"	"V. Detilleux" / "Bel V"
D2. "Summary of current programmes and future Joint Programming"	"V. Detilleux" / "Bel V"
D3. "Stakeholder engagement and introduction to Pathways Evaluation Process"	"A. Mrskova" / "Decom" "J. Dewoghélaëre" / "Mutadis"
D4. Test	"P. Metcalf" / "ENSTTI"
D5. "PEP exercise"	"A. Mrskova" / "Decom" "J. Dewoghélaëre" / "Mutadis"
E1. "Recent experience with regulatory review of French Safety Case for radwaste disposal in clay formation"	"M. Rocher" / "IRSN"
E2. "Recent experiences and topical issues with regulatory review of the Finnish Safety Case for geological disposal"	"J. Leino" / "STUK"
E3. Test evaluation and roundtable	"P. Metcalf" / "ENSTTI"
E4. Course evaluation and closure	"A. Narkūnienė" / "LEI"

### 3.4.2 Short career summary of the lecturers

Short career summary of lecturers of this SITEX training module is presented below. Lecturers' profiles (CVs) are provided in Annex 6.2.

#### **"O. Tokarevskiy", "SSTC NRS"**

Oleksii Tokarevskiy, SSTC (Head of Laboratory) works as a Head of Laboratory for Safe Radioactive Waste Management. He has more than 15-year experience in field of radioactive waste management and decommissioning: development of radioactive waste management techniques; participation in creation of treatment and disposal facilities for Chernobyl NPP waste (complex Vector), development of feasibility studies; carrying out expert reviews of various documentation in field of radioactive waste management and decommissioning; development of regulatory documents; scientific and expert support of the regulatory body of Ukraine (SNRIU).

#### **"J. Miksova", "CV REZ"**

Jitka Miksova holds her master degree in applied geophysics, hydrogeology and economy geology at Charles University in Prague. She started her professional carrier more over then 30 years ago as a field geological prospector. Then, she supported national Nuclear Regulator in the field of radiation protection, in particular from natural sources. Since 90s, she has been involved in national waste disposal programme as a member of expert group at Czech Geological Survey focusing on siting issue, GIS development and scientific data and information management. In 2004 she joined the national waste management organization (SURA) working at Geological Repository Development Department as a project manager dealing with both national and international research projects, mainly focusing on geological barriers research and siting, GIS and Is implementation and KM. Currently, she is working for Research Centre Rez as an scientific researcher – expert in the Nuclear Fuel Cycle Department responsible for radioactive waste disposal activities. She is providing services to the national regulator (SUJB) in Safety Case review preparation, mainly in geological repository development, she is active as a lecturer, member of two ETSO experts Groups – KM, RWM&D. During her professional carried she has been participating in the IAEA activities - experts missions targeted at L/ILW, consultancy and technical meetings, training courses organization.

#### **"L. Nachmilner", "CV REZ"**

Lumir Nachmilner has more than 40 years in radioactive management, R&D experience in waste conditioning, formulating waste acceptance criteria, the development of near surface and deep geological repositories He has also managerial experience at national and international levels (EC, NEA projects, IAEA member staff); extensive tutoring activities throughout the world (organising and lecturing at some 20 international training events and workshops).

#### **"P. Metcalf", "IRSN"**

Phil Metcalf holds a part time appointment with IRSN (France) and ENSTTI. He has degrees in nuclear and applied physics (Bachelor) and radiation safety (Master) and worked for the South African National Nuclear Regulator for 28 years where he was deputy general manager. He was

head of the IAEA radioactive waste and spent fuel safety unit for 10 years. He chaired various IAEA committees including the Waste Safety Standards Committee and the Radiation Protection Training and Education Committee. He has been involved in the development of international safety standards for radiation protection, radioactive waste and spent fuel safety and legal and regulatory infrastructure and in over 100 technical assistance missions for the IAEA. He lectures on IAEA training courses in various countries and regions around the world and has lectured at the Universities of Milan and Munich (technical) and EC summer schools on radioactive waste and decommissioning safety. He is a past president of the International Radiation Protection Association and the South African Radiation Protection Society. He is the ENSTTI Key Expert for the INSC Training & Tutoring project since 2012.

#### **“F. Bernier”, “FANC”**

Frédéric Bernier received his degree in mining engineering at Free University of Brussels. In 1992, he joined the SCK•CEN as project engineer. His work was concerned with research on geo-mechanical aspects in waste disposal in deep argillaceous geological formation. From 2002-2007 he was the Scientific Manager of the E.I.G. EURIDICE. He is currently responsible for geological radioactive waste disposal at FANC, the Belgian federal agency for nuclear control. He has a large experience in EC projects and is member of the WENRA Working Group on Waste and Decommissioning (WGWD).

#### **“J.-P. Wouters”, “FANC”**

Jean-Pierre Wouters is an Inspector Expert Class I at the Federal Agency for Nuclear Control – FANC, the Belgian nuclear regulator located in Brussels. He has a degree of Nuclear Science Engineer and Prevention Counsellor and works since 1986 in the nuclear domain. He is an expert in radiation monitoring and protection. He worked as design engineer during 16 years for the engineering bureau TRACTEBEL ENERGY ENGINEERING and participated during this time in many projects related to radiation monitoring and protection (ALARA) like steam generator replacements in the Belgian NPP units, shielding calculations for new building or extension, installations of monitoring systems in NPP's, ... He was also involved in the fuel management as team leader for the fuel handling team in all Belgian NPP units. At the FANC since 13 years, he is an inspector expert in the management and disposal of radioactive waste. He is the former project leader for the disposal projects in Belgium and participated to the development of the national regulation about radioactive waste disposal. He is also involved in international conferences, meetings or workgroups (IAEA, EU-FP7, NEA,...). He is a member of the Belgian Society for Radiation Protection.

#### **“M. Rocher”, “IRSN”**

Dr. Muriel Rocher holds a PhD in Tectonics from Paris VI University, Department Earth Science and Gaz de France. She performed research and teaching in universities (bachelor's degree). Since 2004, she has been carrying out research projects on geological and hydrogeological issues and safety assessments on radioactive waste repositories (near-surface facilities and deep underground projects) to, including siting and seismic hazard. Since 2010, she has been the IRSN person in charge for the on-site follow-up of the R&D performed by Andra in the Meuse/Haute-

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Marne underground research laboratory and took responsibility as deputy head of the IRSN assessment team for the safety of waste disposal as well as mining and polluted sites. Recently, she led the regulatory review of the Cigéo “Safety Option Dossier” submitted by Andra before the request for the construction license application. In addition, she was involved in the technical review of Andra’s project for disposal of low-level long lived waste as well as in the development of the national guiding principles for siting of such disposal facilities.

#### **“M. Tichauer”, “IRSN”**

Michael Tichauer holds an engineering degree of the Ecole des Mines de Nantes and has been working in the assessment of nuclear facilities for over a decade at the French Institute of Radiation Protection and Nuclear Safety. He participated in different national assessment in the area of nuclear laboratories, decommissioning, radioactive waste safety and led the team in charge of the safety evaluation of radioactive waste disposal facilities, encompassing both near surface and deep geological repositories. He has been involved in post-accident management as well. At the international level, he participated in the assessment of various disposal facilities (international peer reviews, technical support to foreign authorities...) and acted as chairman of the IAEA GEOSAF 2 project for the harmonization of the Safety Case of geological disposal facilities. He is now head of Environmental measurements in emergency situations, radiological characterization and intervention at IRSN.

#### **“V. Detilleux”, “Bel V”**

Dr. Valéry Detilleux holds a PhD in physical chemistry from the Université catholique de Louvain (Belgium). He works at Bel V in the Branch “Radiation Protection & Waste”. He is involved in the review of safety assessments for radioactive waste treatment, conditioning and disposal facilities (Belgian projects for near surface and geological repositories) and participates in R&D projects aiming at strengthening Bel V expertise in modelling radionuclide migration in porous media. He was involved in the former EC-SITEX project and participates in international working groups (e.g. IAEA GEOSAF II, IAEA PRISM).

#### **“A. Mrskova”, “Decom”**

Adela Mrskova has 20 years of experience working in nuclear energy sector in various topics. She started her carrier as research worker at VUJE, a.s. (Nuclear Power Plant Research Institute) in 1996. From 2006 to 2009 she worked for JRC Ispra at Whole Body Counter Laboratory. From 2010 she is employed by DECOM, a.s., where she manages and coordinates projects in the field of nuclear waste management and disposal and cooperates on decommissioning projects.

She has technical expertise in radioactive waste management and disposal, decommissioning of nuclear power plants, licensing documentation, nuclear emergency preparedness and response, accident management modelling and safety assessment, radiation protection, regional energy policy and strategy, public information and involvement. She has been involved in various international projects in the field of nuclear waste management, particularly those combining technical and societal aspects.

**“J. Dewoghélaëre”, “Mutadis”**

Mr. Julien Dewoghélaëre has a graduate degree in Politics Sciences (Sciences Po Bordeaux, 2003). He has been working since 2011 in MUTADIS on research projects and network activities on the governance of hazardous activities, particularly on nuclear related matters. He has been involved in the development of the European network of Civil Society Organisations, Nuclear Transparency Watch. He was also involved in the SITEX project (2012-2013).

**“J. Leino”/ “STUK”**

M.Sc. Jaakko Leino is currently the Head of the Nuclear Waste Safety Assessment Section at Finnish Radiation and Nuclear Safety Authority’s (STUK) department of Nuclear Waste and Material Regulation.

His section is responsible for oversight of post-closure safety and review of post-closure safety assessment of nuclear waste disposal facilities. The section also reviews repository design, performance of the engineered barrier system and material issues. He has participated to regulatory oversight of Posiva and followed closely the development of the post-closure Safety Case, the repository design and engineered barrier system since 2010 and was responsible for the review of post-closure Safety Case in Posiva’s construction license application and is thus very familiar with the KBS-3 concept. Currently, his main focus is on the oversight of the development and preparation of the post-closure Safety Case for the operating license application. He is also responsible for the development of the regulatory oversight and review of nuclear waste facilities’ safety assessments. His education is Master of Science in material chemistry and metallurgy. He has have been working at STUK since 2010, the last four years as Section Head.

He is involved in NEA’s Integration Group for the Safety Case (IGSC) and other international groups and projects. He is also involved in IAEA’s development work for safety standards as a member state representative in the area of the safety of radioactive waste (WASSC).



### 3.5 RECOMMENDATIONS FOR THE PARTICIPANTS NEW TO THE GEOLOGICAL DISPOSAL

List of recommended lectures to be taken by the participants in advance (developed by IAEA and openly available <http://elearning.iaea.org/m2/course/index.php?categoryid=60>) is presented in (Fig. 3).

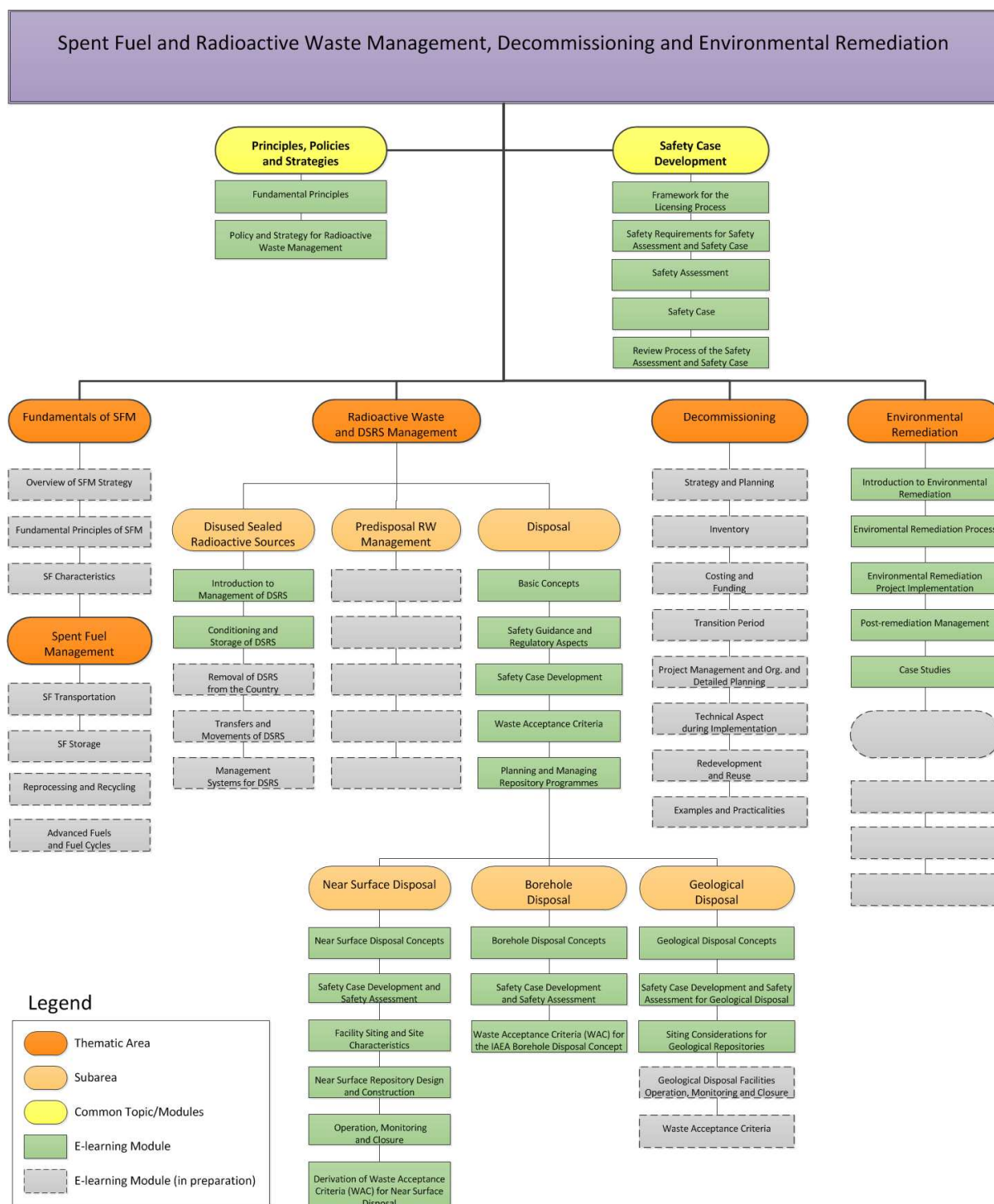


Fig. 3. IAEA eLearning modules

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### 3.5.1 For the participants with experience in radioactive waste management

Recommended list of modules to be taken by participants themselves in advance (before SITEX training):

#### **Topical area – Fundamentals of RW Disposal (14 lectures)**

Module: D1: Basic Concepts of Disposal (4)

- D 1.1 Introduction
- D 1.2 Waste Classification
- D 1.3 Multibarrier Disposal System
- D 1.4 Waste Forms and Waste Packages

Module: D2: Safety Guidance and Regulatory Aspects of Disposal (4)

- D 2.1 Introduction to Licensing of Radioactive Waste Management Facilities
- D 2.2 Introduction to Regulatory Review of Safety Assessments for Waste Management Facilities
- D 2.3 Introduction to Regulatory Inspections of Waste Management Facilities
- D 2.4 Regulatory Control of Discharges and Strategies for Monitoring

Module: D3: Safety Case Development for Disposal (3)

- D 3.1 Introduction to Safety Assessment and Safety Cases
- D 3.2 Development of the Safety Case
- D 3.3 Methodologies for Safety Assessments

Module: D4: Waste Acceptance Criteria (2)

- D 4.1 WAC Overview
- D 4.2 Verifying Compliance with Waste Acceptance Criteria

Module: D5: Planning and Managing Repository Programmes (1)

- D 5.1 Strategies and Approaches for Selection of Radioactive Waste Disposal Sites

#### **Topical area – Geological Disposal (4 lectures)**

Module: GD 1: Geological Disposal Concepts (1)

- GD 1.1 Geological Disposal Concepts

Module: GD 2: Safety Case Development and Safety Assessment for Geological Disposal (1)

- GD 2. Safety Case Development and Safety Assessment for Geological Disposal

Module: GD 3: Siting Considerations for Geological Repositories (2)

- GD 3.1 Geological Facility Siting and Site Characterization
- GD 3.2 Geological Environments for Deep Repositories

### 3.5.2 For new comers

Recommended list of modules to be taken by participants themselves in advance (before SITEX training):

#### **Topical area – Principles, Policy and Strategy (6 lectures)**

Module: PPS 1: Fundamental Principles (2)

- PPS 1.1 Nuclear Energy Principles and Radioactive Waste Management Objectives
- PPS 1.2 Fundamental Safety Principles

Module: PPS 2: Policy and Strategy for Radioactive Waste Management (4)

- PPS 2.1 Introduction to Policy and Strategy
- PPS 2.2 Legal, Institutional and Regulatory Framework

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PPS 2.3 Exclusion, Exemption and Clearance

PPS 2.4 Hans Forsström – Lecture

**Topical area – Safety Case Development (11 lectures)**

Module: SCD 1: Framework for the Licensing Process for RWM Operations (2)

SCD 1.1 Governmental Responsibilities with Safety

SCD 1.2 Responsibilities and Functions of the Regulatory Body and the Operator

Module: SCD 2: Safety Requirements for Safety Assessment and Safety Case (2)

SCD 2.1 General Safety Requirements for Safety Assessment

SCD 2.2 Specific Requirements for Safety Assessment and Safety Case

Module: SCD 3: Safety Assessment (2)

SCD 3.1 Safety Assessment Part 1

SCD 3.2 Safety Assessment Part 2

Module: SCD 4: Safety Case (3)

SCD 4.1 Role and Development of the Safety Case Components of the Safety Case

SCD 4.2 Specific Issues to be considered in the Safety Case

SCD 4.3 Documentation and Use of the Safety Case

Module: SCD 5: Review Process of the Safety Assessment and Safety Case (2)

SCD 5.1 Management of the Review Process of the Safety Assessment and Safety Case

SCD 5.2 Conducting and Reporting the Technical Review of the Safety Case and Safety Assessment

**Topical area – Fundamentals of RW Disposal (14 lectures)**

Module: D1: Basic Concepts of Disposal (4)

D 1.1 Introduction

D 1.2 Waste Classification

D 1.3 Multibarrier Disposal System

D 1.4 Waste Forms and Waste Packages

Module: D2: Safety Guidance and Regulatory Aspects of Disposal (4)

D 2.1 Introduction to Licensing of Radioactive Waste Management Facilities

D 2.2 Introduction to Regulatory Review of Safety Assessments for Waste Management Facilities

D 2.3 Introduction to Regulatory Inspections of Waste Management Facilities

D 2.4 Regulatory Control of Discharges and Strategies for Monitoring

Module: D3: Safety Case Development for Disposal (3)

D 3.1 Introduction to Safety Assessment and Safety Cases

D 3.2 Development of the Safety Case

D 3.3 Methodologies for Safety Assessments

Module: D4: Waste Acceptance Criteria (2)

D 4.1 WAC Overview

D 4.2 Verifying Compliance with Waste Acceptance Criteria

Module: D5: Planning and Managing Repository Programmes (1)

D 5.1 Strategies and Approaches for Selection of Radioactive Waste Disposal Sites

**Topical area – Geological Disposal (4 lectures)**

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Module: GD 1: Geological Disposal Concepts (1)

GD 1.1 Geological Disposal Concepts

Module: GD 2: Safety Case Development and Safety Assessment for Geological Disposal (1)

GD 2. Safety Case Development and Safety Assessment for Geological Disposal

Module: GD 3: Siting Considerations for Geological Repositories (2)

GD 3.1 Geological Facility Siting and Site Characterization

GD 3.2 Geological Environments for Deep Repositories

### 3.6 PARTICIPANTS OF SITEX PILOT TRAINING SESSION

The affiliation and contact information of the participants of SITEX pilot training session as trainees is provided in Table 4. The profiles of trainees are provided as their CVs in the Annex 6.3.

Table 4. Participants of SITEX pilot training session

No	First name	Last name	Country	Organization	Email
1	Kim-Marisa	Mayer	Germany	GRS	<a href="mailto:kim-marisa.mayer@grs.de">kim-marisa.mayer@grs.de</a>
2	Gintautas	Poskas	Lithuania	Lithuanian Energy Institute	<a href="mailto:gintautas.poskas@lei.lt">gintautas.poskas@lei.lt</a>
3	Asta	Narkuniene	Lithuania	Lithuanian Energy Institute	<a href="mailto:asta.narkuniene@lei.lt">asta.narkuniene@lei.lt</a>
4	Darius	Justinavicius	Lithuania	Lithuanian Energy Institute	<a href="mailto:darius.justinavicius@lei.lt">darius.justinavicius@lei.lt</a>
5	Maryna	Surkova	Ukraine	FANC	<a href="mailto:Maryna.Surkova@FANC.FGOV.BE">Maryna.Surkova@FANC.FGOV.BE</a>
6	Guillaume	Pochet	Belgium	FANC	<a href="mailto:guillaume.pochet@fanc.fgov.be">guillaume.pochet@fanc.fgov.be</a>
7	Žybartas	Patašius	Lithuania	State nuclear power safety inspectorate (VATESI)	<a href="mailto:zybartas.patasius@vatesi.lt">zybartas.patasius@vatesi.lt</a>
8	Aurélie	GALZY	France	Bel V	<a href="mailto:aurelie.galzy@belv.be">aurelie.galzy@belv.be</a>
9	Colin	Campbell	United Kingdom	Environment Agency	<a href="mailto:colin.campbell@environment-agency.gov.uk">colin.campbell@environment-agency.gov.uk</a>
10	Christopher	Glaister	United Kingdom	Environment Agency	<a href="mailto:chris.glaister@environment-agency.gov.uk">chris.glaister@environment-agency.gov.uk</a>
11	Madlena	Georgieva	Bulgaria	GI-BAS	<a href="mailto:mgeorgieva@geology.bas.bg">mgeorgieva@geology.bas.bg</a>
12	Kateryna	Fuzik	Ukraine	SSTC NRS	<a href="mailto:kv_fuzik@sstc.com.ua">kv_fuzik@sstc.com.ua</a>
13	Oleksii	Tokarevskyi	Ukraine	SSTC NRS	<a href="mailto:ov_tokarevsky@sstc.com.ua">ov_tokarevsky@sstc.com.ua</a>
14	Angelika	Krischer	Germany	Gesellschaft für Anlagen- und Reaktorsicherheit (GRS) gGmbH	<a href="mailto:angelika.krischer@grs.de">angelika.krischer@grs.de</a>

(D-N°:3.2) – Development of a training module for generalist experts in geological disposal

Dissemination level: PU

Date of issue of this report: 15/10/2017

No	First name	Last name	Country	Organization	Email
15	Tim	Marshall	United Kingdom	Office for Nuclear Regulation	<a href="mailto:tim.marshall@onr.gov.uk">tim.marshall@onr.gov.uk</a>
16	Christina	Bückers	Germany	Bundesamt für kerntechnische Entsorgungssicherheit	<a href="mailto:christina.bueckers@bfe.bund.de">christina.bueckers@bfe.bund.de</a>
17	Maxence	Lorencki	France	IRSN	<a href="mailto:maxence.lorencki@irsn.fr">maxence.lorencki@irsn.fr</a>
18	Premysl	Moucka	Czech Republic	CV Rez	<a href="mailto:premysl.moucka@cvrez.cz">premysl.moucka@cvrez.cz</a>

## 4 Conclusions

The effective collaboration within WP3 led the training module material to be ready for testing at pilot training session. This experience forms a valuable basis for further developing the Training and Tutoring services to be provided by the future SITEX network.

## 5 References

- SITEX, 2014a. Terms of Reference (TOR) of the SITEX network. *EC 7FP Euratom SITEX project deliverable N°: 6.2*
- SITEX. 2014b. A plan for competence development in expertise of radwaste disposal safety. *EC 7FP Euratom SITEX project deliverable N°: 4.2*.
- SITEX-II. 2016a. Synthesis of existing practices for training and tutoring of experts in geological disposal safety. *EC H2020 Euratom SITEX-II project deliverable N°: 3.1*.
- SITEX-II, 2016b. Strategic Research Agenda of the Expertise function in the field of geological disposal of radioactive waste. *EC H2020 Euratom SITEX-II project deliverable N°: 1.1*.

## 6 Annexes

### 6.1 PROPOSALS FOR AGENDA OF PILOT TRAINING SESSION

#### 6.1.1 ENSTTI proposal

Day	Topics
Day 1	<b>Radioactive waste management (1 day)</b> Introduction to the steps of radioactive waste management Management of high-level waste
Day 2	<b>Safety Basis and the legal and regulatory framework (1,5 days)</b> International nuclear safety regime International safety standards Safety convention waste and spent fuel safety European waste safety directive Legal and regulatory basis for geological disposal
Day 3	<b>Disposal concepts (1 day)</b> Geological disposal facility design concepts
Day 4	<b>The safety case (1 day)</b> Introduction Regulatory expectations of the safety case Safety case context Safety strategy in design Site characterisation and Facility description
Day 5	<b>Safety assessment (1,5 days)</b>
Day 6	
Day 7	<b>Design optimisation and management of uncertainty (1 day)</b> Iteration and design optimisation Uncertainty management
Day 8	<b>Interacting processes (0,5 day)</b> Regulatory interaction Stakeholder engagement Management system application  <b>Development of limits, controls and conditions (0,5 day)</b> Integration of safety arguments
Day 9	<b>Supporting research (1 day)</b> Basis for research activities and summary of current programmes Independent Expertise Function review Laboratory visits
Day 10	<b>Regulatory review ( 1 day)</b>

## 6.1.2 LEI proposal

Day	Topics
Day 1	<b>Introduction to licensing process</b> <b>Founding principles for the expertise function</b> Definition of independent expertise Legal and regulatory framework Managerial aspects Independence of the expertise function Transparency of the expertise function and relation with civil society Competence of experts
Day 2	<b>Implementation of the technical review process for deep geological repositories</b> Management of the technical review of geological disposal Available technical review guidance Methodology for harmonized technical review (main review phase, review grids, review report content, etc.)
Day 3	<b>Topic 4. Regulatory expectations of the safety case</b> <b>Topic 5. Analysis (practical exercise) of selected Safety Case with special attention to SC components, application of review grids (1 day)</b> Safety case context Safety strategy in design Site characterisation and Facility description <b>Safety assessment</b> Radiological impact assessment Engineering and site assessment Operational safety assessment Management system assessment
Day 4	<b>Design optimisation and management of uncertainty (0.5 day)</b> Iteration and design optimisation Uncertainty management <b>Supporting research (0.5 day)</b> Basis for research activities and summary of current programmes Independent Expertise Function review
Day 5	<b>Exchanges with various representatives (implementer, safety authority, public...) (0.5 day)</b> Regulatory interaction Stakeholder engagement Management system application <b>Evaluation of training outcomes, common discussion (0.5 day)</b>

### 6.1.3 IRSN proposal

Day	Topics
Day 1	<b>The safety case ( 0.5 day):</b> Introduction Regulatory expectations of the safety case Safety case context Safety strategy in design Site characterisation and Facility description  <b>Disposal concepts ( 0.5 day):</b> Geological disposal facility design concepts
Day 2	<b>Safety assessment (1 day):</b> Regulatory review Radiological impact assessment Engineering and site assessment Operational safety assessment Management system assessment
Day 3	<b>Interacting processes ( 1 day):</b> Regulatory interaction Stakeholder engagement Management system application
Day 4	<b>Supporting research (1 day):</b> Basis for research activities and summary of current programmes Independent Expertise Function review
Day 5	<b>Analysis (practical exercise) of selected Safety Case with special attention to SC components, application of review grids ( 0.5 day)</b>  <b>Evaluation of training outcomes, common discussion ( 0.5 day)</b>

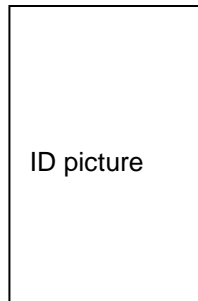
## 6.2 CVS OF TRAINEES

To respect the trainees' privacy, it has been chosen not to include their CVs in this report. However, the file compiling the CVs is available, in case of need for future training sessions, in the restricted area of SITEX-II website.

## 6.3 CVS OF LECTURERS



## LECTURER CV



Family name: TOKAREVSKYI

First name: OLEKSII

Date of birth: 01/04/1975

Nationality: UKRAINE

### Education:

Institution (Date from – Date to)	Degree(s) or Diploma(s) obtained
Kiev National University by Taras Shevchenko, 09.1991 - 06.1996	Diploma in radiophysics and electronics

### Language skills: Indicate competence on a scale of 1 (excellent) to 5 (basic):

Language	Reading	Speaking	Writing
English	1	1	1
Spanish	2	3	2
Russian	native	native	native
Ukrainian	native	native	native

Present position (company, position, technical field, etc.):

SSTC NRS (Ukraine), Head of Laboratory for Safe Radioactive Waste Management,  
Decommissioning Department

Key qualifications:

Expert in field of radioactive waste management, regulatory reviews of documentation for radioactive waste management and decommissioning.

Professional experience:

Date	Company - Location	Position	Description
12/2011 to present time	State Scientific-Technical Centre for Nuclear and Radioactive Safety (SSTC NRS), Kiev, Ukraine	Head of Laboratory for Safe Radioactive Waste Management (since October 2016), Senior Researcher (until October 2016)	Elaboration of national documents for regulation of nuclear and radiation safety in field of radioactive waste management; regulatory reviews of documentation in field of radioactive waste management and decommissioning; coordination of activities of the laboratory
03/2008 – 08/2011	Ukrainian State Corporation Radon, Kiev, Ukraine	Deputy Project Manager	Coordination of work within the Project for creation of the Centralized Facility for Long-Term Storage of Disused Sealed Radiation Sources (SRS), preparation and agreement of technical and financing proposal for signing the Contract, participation in preparation of tendering documentation and carrying out tendering procedures, risk analysis, organization of proper cooperation with the designer, including that in crisis situations. Participation in support of expert examination of design documentation, reporting in the framework of the Project.

02/1999 – 06/2011	State Specialized Enterprise – Center for Treatment and Disposal of Mixed Hazardous Waste "Technocentre", Kiev – Chernobyl, Ukraine	Deputy Head of the Department for Pre-Design Activities, Senior Researcher, Researcher	Coordination of activities of the department. Carrying out scientific and research activities in field of RW management. Preparation and development of feasibility studies. Analysis of worldwide experience in RW management.
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Other relevant information (e.g. previous training, tutoring, etc):

**Lecturer in the framework of EU projects:**

- MC.03.01/11-Lot 1 (ENSTTI) "Education and instruction for specialists of regulatory authority and their technical support organizations (TSO): Nuclear safety regulation, licensing, carrying out inspections and application of sanctions" (16 – 20 May 2016, Kaunas, Lithuania);
- MC3.01/11 (ENSTTI) "Legislative and regulatory framework of decommissioning of nuclear facilities" (08 – 11 December 2014, Kaunas, Lithuania).

**Publications:**

1. **Tokarevskyi O.**, Kondratiev S., Alekseeva Z., Rybalka N. "Safety and Optimization Aspects of Radioactive Waste Long-Term Storage at the Vector Site", Nuclear and Radiation Safety, 2015, No. 4 (68), pp. 24-30.
2. Mykolaichuk O., Kilochytska T., Rybalka N., Alekseeva Z., Kondratyev S., **Tokarevskyi O.** "Application of Radiation Safety Principles and Criteria in the Process of Safety Reassessment for Disposal of Radioactive Waste in Near-Surface Facilities of USC "Radon"/ Nuclear and Radiation Safety, 2013, No.3 (59), pp. 27-32.
3. **Tokarevskyi O.**, Rybalka N., Alekseeva Z., Kondratiev S. "Safety Issues in Construction of Facilities for Long-Term Storage of Radioactive Waste at "Vector" Site" / Forum EUROSAFE-2013.

Mykolaichuk O., Alekseeva Z., Kondratyev S., Nikolaiev E., **Tokarevskyi O.** "Ukrainian Approach on Guidelines for Assessment of Radiological Impacts for Sites with Multiple Existing and/or New Storage/Disposal Facilities and Decision-Making Criteria" Forum EUROSAFE-2012.

## LECTURER CV



Family name: Mršková

First name: Adela

Date of birth: 07/02/1972

Nationality: Slovak

### Education:

Institution (Date from – Date to)	Degree(s) or Diploma(s) obtained
Slovak University of technology, Bratislava (Slovakia)  01/10/1990–20/12/1995	Diploma in the field of Electro-material Engineering

### Language skills: Indicate competence on a scale of 1 (excellent) to 5 (basic):

Language	Reading	Speaking	Writing
English	1	1	1
Czech	1	1	1
Italian	2	2	3
Russian	3	3	4

Present position (company, position, technical field, etc.):

DECOM, a.s., senior expert, nuclear energy, waste management and decommissioning

Key qualifications:

Project management in the field of waste disposal and stakeholders engagement.

Compilation of licensing documentation for decommissioning of nuclear facilities, waste management and disposal.

Professional experience:

Date	Company - Location	Position	Description
16/09/2010–Present	<b>DECOM, a.s. – Trnava, Slovakia</b>	<b>Senior expert</b>	Projects coordination and management in the field of nuclear waste management, disposal, nuclear facilities decommissioning and stakeholders engagement.
01/09/2006– 31/08/2009	JRC Ispra – Italy	Contractual agent	Laboratory management - Management of Whole Body Counter laboratory, gamaspectrometry analysis and database management
01/03/1996– 31/08/2006	<b>VUJE, a.s. – Trnava, Slovakia</b>	research and development worker	Research and development projects in the field of radiation safety of nuclear facilities, accident management and risk assessment.

Other relevant information (e.g. previous training, tutoring, etc): XXX

## LECTURER CV



Family name: Bernier

First name: Frédéric

Date of birth: 30/07/1966

Nationality: Belgian

### Education:

Institution (Date from – Date to)	Degree(s) or Diploma(s) obtained
The Free University of Brussels  (1984-1990)	Master in mining engineering

Language skills: Indicate competence on a scale of 1 (excellent) to 5 (basic):

Language	Reading	Speaking	Writing
<b>French</b>	1	1	1
<b>English</b>	1	2	2
<b>Dutch</b>	1	2	2



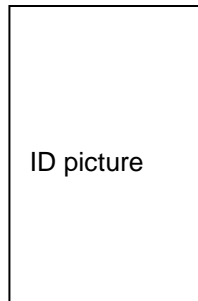
Present position (company, position, technical field, etc.): Project Manager – Geological Disposal

Key qualifications: Engineering, Nuclear Waste, Management

Professional experience:

Date	Company - Location	Position	Description
1990-1991	The Royal Belgian Institute for Space Aeronomy	Non-military voluntary service	Analysis of data from Space-lab 1
1992-2001	Belgian Nuclear Research Centre  (SCK)	Researcher	Research on geo- mechanical aspects in waste disposal in deep argillaceous geological formation
2001-2007	European Underground Research Infrastructure for Disposal of nuclear waste in Clay Environment (EURIDICE)	Scientific Manager	Management of the scientific issues of the underground laboratory HADES
2007-now	Belgian Federal Agency for Nuclear Control (FANC)	Project manager – Geological Manager	Responsible for geological radioactive waste disposal

## LECTURER CV



Family name: Leino

First name: Jaakko

Date of birth: dd/mm/yyyy

Nationality: Finnish

### Education:

Institution (Date from – Date to)	Degree(s) or Diploma(s) obtained
<b>Helsinki University of Technology</b>	<b>M.Sc</b>

### Language skills: Indicate competence on a scale of 1 (excellent) to 5 (basic):

Language	Reading	Speaking	Writing
<b>English</b>	<b>4</b>	<b>4</b>	<b>3</b>
<b>Finnish</b>	<b>5</b>	<b>5</b>	<b>5</b>
<b>Swedish</b>	<b>3</b>	<b>2</b>	<b>2</b>

Present position (company, position, technical field, etc.):

The Head of the Nuclear Waste Safety Assessment Section at Finnish Radiation and Nuclear Safety Authority's (STUK) department of Nuclear Waste and Material Regulation. The section is responsible for oversight of post-closure safety and review of post-closure safety assessment of nuclear waste disposal facilities. The section also reviews repository design, performance of the engineered barrier system and material issues.

Key qualifications:

Professional experience:

Date	Company - Location	Position	Description

Other relevant information (e.g. previous training, tutoring, etc): XXX

## LECTURER CV



Family name: Wouters

First name: Jean-Pierre

Date of birth: 30/03/1962

Nationality: Belgian

### Education:

Institution (Date from – Date to)	Degree(s) or Diploma(s) obtained
I.S.I.B. Brussels (Belgium), 1980-1982	Bachelor Engineer
I.S.I.B. Brussels (Belgium), 1982-1984	Nuclear Science Engineer
CNAC (Belgium), 2006	Prevention Counsellor

### Language skills: Indicate competence on a scale of 1 (excellent) to 5 (basic):

Language	Reading	Speaking	Writing
<b>French</b>	<b>1</b>	<b>1</b>	<b>1</b>
<b>Dutch</b>	<b>1</b>	<b>1</b>	<b>1</b>
<b>English</b>	<b>2</b>	<b>2</b>	<b>2</b>

Present position (company, position, technical field, etc.):

**FANC - Federal Agency for Nuclear Control** (Belgian regulator)

- Inspector expert class I - Radioactive Waste Management / disposal
- former project leader for radioactive waste disposal projects in Belgium (categories A and B&C);
- prevention counsellor

Key qualifications:

**Waste management and disposal projects:**

- Project management, strategy and people management;
- Licensing process and procedures;
- Development of the regulatory context
- Safety Assessment
- Management system
- participation to EU projects

**ALARA and radiation protection - shielding studies:**

- On site measurements, development of data acquisition programs
- Exposure prognosis, exposure calculations & 3D simulations (interfaces with CAD)
- Exposure & ALARA follow-up during the works (development of specific program for dosimetry follow-up)
- Shielding calculations (buildings and equipment)
- Development and improvement of calculation codes
- Radiation monitoring systems (design specification, tender, installation, commissioning, ...)
- Shielding, detector response, calibrations
- Training, starting-up and operational assistance

**Fuel handling team leader for all Belgian NPP's (Doel and Tihange units)**

**Post-accidental situations:**

- studies inn NPP related to the post TMI actions (Doel and Tihange sites)
- Source term and shielding calculations
- Post accidental accessibility + training of operators
- Dose calculations (equipment qualifications)
- Influence on radiation monitors in post accidental situation.

Professional experience:

Date	Company - Location	Position	Description
2004 - today	<b>FANC Brussels</b>	<b>Inspector expert class I</b>	<b>Radioactive waste management and disposal</b>  Project leader, inspector – expert, regulatory framework, participation in Belgian disposal projects (i.e. cat A & cat B&C), in EU FP7 projects (i.e. SITEX...), in NEA projects (i.e. R&R – reversibility & retrievability, ...)
1991 - 2003	<b>TRACTEBEL ENERGY ENGINEERING Brussels</b>	<b>Design Engineer - Expert Radiation protection &amp; monitoring</b>	<b>ALARA studies &amp; on site follow-up SGR - Steam Generator Replacement projects at NPP's Doel units 2, 3 &amp; 4 and Tihange units 1, 2 &amp; 3</b>
1999 - 2003	<b>TRACTEBEL ENERGY ENGINEERING</b>	<b>Team Leader fuel handling team</b>	<b>Team leader for the fuel handling teams at all Doel and Tihange NPP's.</b>

	<b>Brussels</b>	<b>(for ELECTRABEL)</b>	
<b>1999 - 2003</b>	<b>TRACTEBEL ENERGY ENGINEERING Brussels</b>	<b>Design Engineer (for BELGOPROCESS)</b>	<b>Qualification documents for industrial processes at the waste treatment and conditioning unit BELGOPROCESS</b>
<b>1997 - 2002</b>	<b>TRACTEBEL ENERGY ENGINEERING Brussels</b>	<b>Design Engineer (for ONDRAF &amp; BELGOPROCESS)</b>	<b>HRA-Solarium Project: studies for the new waste treatment and conditioning unit, measurements, waste Inventory &amp; analysis, dose rate &amp; shielding calculations.</b>  <b>PAMELA building: shielding calculations</b>
<b>1999 - 2002</b>	<b>TRACTEBEL ENERGY ENGINEERING Brussels</b>	<b>Design Engineer (for consortium FRAMATOME – ENERGOATOM)</b>	<b>Chernobyl Spent Fuel Interim Storage Facility (ISF2): radiation Monitoring, basic and detailed design – Procurement</b>
<b>1990 - 2003</b>	<b>TRACTEBEL ENERGY ENGINEERING Brussels</b>	<b>Design Engineer - Expert Radiation protection &amp; monitoring</b>	<b>Radiation protection : calculations, shielding, detector response, calibrations, on site measurements, development and improvement of calculation codes (decay, buildup,...), development of data acquisition programs, use of calculation codes (<math>\mu</math>-shield, <math>\mu</math>-skyshine, raddecay, QAD-CGGP, ...</b>
<b>1990 - 1995</b>	<b>TRACTEBEL ENERGY ENGINEERING Brussels</b>	<b>Engineer - Expert Radiation protection &amp; monitoring (for ELECTRABEL)</b>	<b>Post TMI actions (Doel and Tihange units) : studies, source term calculations, shielding calculations, post accidental accessibility, shielding of post accidental sampling systems, dose calculations for equipment qualification, training of operators in post accidental situation, influence of such situation on radiation monitors.</b>  <b>WAB building (Waste treatment Building at Doel site): Installation of area monitors &amp; scanning gas monitor</b>  <b>Tihange 1 NPP : installation of a new stack monitor</b>  <b>Design specification, tender and contract documents, evaluation, project and construction management, training, starting-up and operational assistance</b>
<b>1988 - 1989</b>	<b>MONTIN sa Brussels</b>	<b>Nuclear Engineer (for TRACTEBEL)</b>	<b>Tihange 1 NPP: Replacement of radiation detection monitors, design specification, tender and contract documents, evaluation, project and construction management, training, starting-up and operational assistance</b>



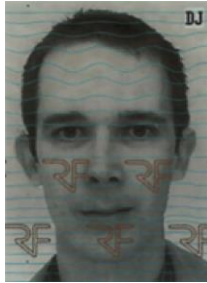
1988 - 1989	MONTIN sa Brussels	Nuclear Engineer (for TRACTEBEL, for ONDRAF- NIRAS)	B 36 (building 36 site 1) new storage building for HLW: studies, calculation & definition of radiation protection needs and shielding requirements.
1987 - 1988	C.O.M.N. Brussels	Engineer medical applications at St Jean Hospital - Nuclear Medicine Department.	Responsible for preparation of nuclides solutions, examination with gamma- cameras, images processing & basic maintenance.
1986- 1986	NENIMIJ BELGIUM Antwerp	Sales Engineer & representative for Belgium & Luxemburg	Products for nuclear applications, chemical industry & electronics

Other relevant information (e.g. previous training, tutoring, etc):

**Recent trainings & certificates:**

12/06/2012 Autocad LT – Brussels - Tase  
30/09/2014 Calculation code  $\mu$ -shield - Manchester - Grove engineering  
08/03/2016 SCK-CEN certificate: training course on radiation protection  
01/06/2016 SCK-CEN certificate: training course on radioactive waste disposal  
30/06/2017 United Nations certificate: basic security in the field  
06/07/2017 United Nations certificate: advanced security in the field

## LECTURER CV



Family name: DEWOGHELAERE

First name: Julien

Date of birth: 15/03/1980

Nationality: French

### Education:

Institution (Date from – Date to)	Degree(s) or Diploma(s) obtained
Sciences Po Bordeaux, 2000-2003	Sciences Po degree, 2003
SPIRIT 2003-2004	Science Politics master degree, 2004

Language skills: Indicate competence on a scale of 1 (excellent) to 5 (basic):

Language	Reading	Speaking	Writing
<b>French</b>	<b>1</b>	<b>1</b>	<b>1</b>
<b>English</b>	<b>2</b>	<b>3</b>	<b>2</b>
<b>German</b>	<b>5</b>	<b>5</b>	<b>5</b>

Present position (company, position, technical field, etc.):

Project Manager in Mutadis in charge of different projects linked to nuclear governance and public information and participation.

Key qualifications:

Science Politics knowledge on public participation

Animation of networks, conferences, meetings

Organisations of events

Professional experience:

Date	Company - Location	Position	Description
2011	Vivagora- NGO in Paris	Project Manager	Work on public information and participation process in the field of nanotechnology
2011-until now	Mutadis	Project Manager	Work on public information and participation process mainly in the field of nuclear governance

Other relevant information (e.g. previous training, tutoring, etc): XXX

## LECTURER CV



Family name: Nachmilner

First name: Lumir

Date of birth: 21/01/1950

Nationality: Czech

### Education:

Institution (Date from – Date to)	Degree(s) or Diploma(s) obtained
<b>Institute of Chemical technology, Prague, Czech Republic (1969-1974)</b>	<b>MSc.</b>
<b>Institute of Chemical Technology, Prague, Czech Republic (1981-1985)</b>	<b>PhD</b>

### Language skills: Indicate competence on a scale of 1 (excellent) to 5 (basic):

Language	Reading	Speaking	Writing
<b>English</b>	<b>1</b>	<b>2</b>	<b>2</b>
<b>Russian</b>	<b>1</b>	<b>2</b>	<b>3</b>

Present position (company, position, technical field, etc.):

Freelance Consultant in Radioactive Waste Management and Nuclear Fuel Cycle technologies, Czech Republic

Key qualifications:

RW processing technologies. RW near-surface and geological disposal, waste acceptance system, SNF management, DSRS management, RWM corporate system, RWM formal and technical infrastructures, policy and strategies, RWM QMS, planning

Professional experience:

Date	Company - Location	Position	Description
1974-1997	NRI Rez, Czech Republic	Director, Division of Nuclear Fuel Cycle Technologies	RD&D in RWM, near surface and geological disposal, waste acceptance, planning, budgeting, project management, strategic studies
1997 - 2003	RAWRA, Prague, Czech Republic	Head, DGR Development Section	Managing, planning, budgeting, contracting, supervision of DGR projects, representing Czech Republic in EC, NEA, IAEA
2003 - 2012	IAEA Vienna	Leader, Disposal Group of Waste Technology Section	Running technical and technical cooperation projects, publishing IAEA documents (13), launching and managing DISPONET network, organizing & participating in peer review missions, organizing and lecturing in training courses and workshops
2012 -	Czech Republic	Freelance Consultant	EC, IAEA, NEA and national contracts regarding RWM, DGR development, DSRS management

Other relevant information (e.g. previous training, tutoring, etc): Organising and tutoring in about 20 training courses and workshops worldwide (RWM technologies and infrastructure)

## LECTURER CV



Family name: Miksova

First name: Jitka

Date of birth: 14/03/2017

Nationality: Czech

### Education:

Institution (Date from – Date to)	Degree(s) or Diploma(s) obtained
<b>Faculty of Natural Science (1979-1984)</b>  <b>Charles University in Prague</b>	<b>MSc.</b>  <b>Applied Geophysics</b>

Language skills: Indicate competence on a scale of 1 (excellent) to 5 (basic):

Language	Reading	Speaking	Writing
<b>English</b>	<b>1</b>	<b>1</b>	<b>1</b>
<b>French</b>	<b>1</b>	<b>2</b>	<b>2</b>
<b>Russian</b>	<b>2</b>	<b>2</b>	<b>2</b>

### Present position:

Scientific researcher- expert in the Research Centre Rez, Nuclear Fuel Cycle Department, Radioactive Waste Management and,

National Radiation Protection Institute, Department of National Supervision Support over Nuclear Safety, Legislative support in the field of nuclear safety.

### Key qualifications:

Radioactive waste management, national supervision support on nuclear safety, policy and strategy, siting, geological disposal, knowledge management, Geographical Information Systems, radiation protection from

natural sources, geophysics, project management.

Professional experience:

Date	Company - Location	Position	Description
1986-1993	Geofyzika Ltd.	Senior Geophysicist	Regional geophysical investigation, research activities, physical properties of rock, data processing.
1994-1996	GMS Ltd.	Head of Data Processing Centre	Geophysical investigation for needs of engineering and economic geology, data processing, IS.
1996-2004	Czech Geological Survey	Senior Scientist in Nuclear Waste Disposal Project and Radiation protection project.	<p>Performance of state geological services, state mineral deposits prognoses evaluation.</p> <p>Contribution to the radiation protection, RWM, siting, GIS, IS; new methodologies development.</p> <p>Project management, international cooperation.</p>
2004-2014	Radioactive Waste Repository Authority	Manager for Technical Development in Department of Geological Repository Development	<p>Supervision and management of both international and national research projects, e.g. far field, natural analogues, LTD, siting, etc.; IS and GIS implementation; lecturing, expert missions.</p> <p>Strategical planning in the field of RW disposal; legislative support, international cooperation, participation in international activities, e.g. IGD TP Joint Activities (monitoring, KM), NEA (Forum on</p>



			stakeholders confidence, Records keeping), IAEA (TMs and CMs), Natural Analogues Working Group and EC projects (Funmig, Crock, MoDeRn, etc.)
2014-now	Research Centre Rez	Scientific Researcher - Expert	Research for nuclear safety and waste disposal, technical support of regulatory authority (siting, safety case evaluation); leader of research group on geological disposal), research projects management. Participation in H2020 projects JOPRAD and SITEX-II.
2017- now	National Radiation Protection Institute		National supervision support on nuclear safety, legislative issues.

Other relevant information:

In the field of RWM - organising and lecturing in trainings and for scientific visits (in cooperation with the IAEA and national safety authority), tutoring in ENSTTI.

In the field of Radiation protection and GIS - lecturing for state administrative.

## LECTURER CV



Family name: ROCHER

First name: Muriel

Date of birth: 27/11/1970

Nationality: French

### Education:

Institution (Date from – Date to)	Degree(s) or Diploma(s) obtained
Université Paris VI - P & M. Curie 1989 - 1993	Bachelor's and Masters degrees in Sciences
Université Paris VI - P & M. Curie Department of Earth Sciences, 1993 - 1994	Postgraduate degree in Earth Sciences
- Université Paris VI - P & M. Curie Department of Earth Sciences, - Gaz de France 1995 - 1999	PhD in Tectonics (Earth Sciences)

### Language skills: Indicate competence on a scale of 1 (excellent) to 5 (basic):

Language	Reading	Speaking	Writing
French	1	1	1
English	2	2	2
Russian	4	5	5

Present position (company, position, technical field, etc.):

Engineer (Safety of Waste disposal facility), deputy head of unity for safety of waste disposal as well as mining and polluted sites

Key qualifications:

Long-term safety evaluation of radioactive waste disposal facilities; site characteristics (geology, hydrogeology, hydrology, weather, earthquakes...); repository design and construction (geotechnics); teaching/tutoring

Professional experience:

Date	Company - Location	Position	Description
2004, till now	IRSN, Fontenay aux Roses (France)	Chargé d'affaires	Review of Safety Assessment for waste disposal facilities: <ul style="list-style-type: none"><li>• Safety evaluation of ANDRA's 2005, 2009, 2013 and 2016* Safety case, for Cigéo geological disposal (IL and HL RW)</li><li>• IRSN correspondent of the implementer's URL ("Bure" site), since 2010</li><li>• R&amp;D– Geological and hydrogeological modeling of geological repository; geophysical prospects</li><li>• Technical secretary of EU SITEX-II project, June 2015-Dec 2017</li><li>• Several reviews on safety of surface disposal/repository sites for LL and IL -short lived RW, and of subsurface disposals for LL and IL-long lived RW</li></ul>
2002-2004	IRSN, Fontenay aux Roses (France)	Post-doctoral fellow	Research in geology and technical support to expertise/seismic hazard
2000-2001	Burgundy University, Dijon (France)	ATER	Teaching (bachelor's degree) and research in structural geology
1999-2000	INRS-Géoresources , Quebec (Canada)	Post-doctoral grant	Research in structural geology, supervision of students

Other relevant information (e.g. previous training, tutoring, etc):

#### Exemples of services/contracts

Riskaudit, UK/TS/39, **2012-2013**: Technical support to the SNRIU and its TSOs to develop their capabilities on the basis of transferred Western European safety principles and practices; subtask 3a

Training and workshop, **May-July, 2013**: BG EBRD project, Assistance to the Bulgarian Nuclear Regulatory Agency (BNRA) in activities relating to the decommissioning of Kozloduy NPP Units 1-4, tasks 2.7 & 4.8

#### Examples of training

IRSN/ENSTTI training, **June 16-20, 2014**: Module “Final Disposal Safety”: « **Safety assessment overview** », 3h

Master 2 Géologie-Géotechnique Paris VI University (UPMC), **Jan. 27, 2011 ; Jan. 10, 2012 ; Jan. 7, 2014**: « **L'évaluation de sûreté d'un stockage géologique par l'IRSN: le rôle des géologues** », 4h

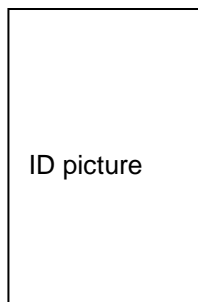
#### Examples of tutoring

Co-tutoring of an IRSN Ph-D student, **Oct. 2008 – Oct. 2011**: « Caractérisation et modélisation de la fracturation différentielle dans les alternances argilo-calcaires »

Co-tutoring of an UPMC Master 2 student, **Feb.- Sept. 2012**: « Rôle de l'anisotropie des argiles dans la fracturation différentielle »

Co-tutoring of an UPMC Master 2 student, **Feb.- Sept. 2016**: « Failles et systèmes décrochant dans les milieux géologiques multicouches »

## LECTURER CV



Family name: TICHAUER

First name: Michael

Date of birth: 05 FEB 1976

Nationality: FR

### Education:

Institution (Date from – Date to)	Degree(s) or Diploma(s) obtained
<p><b>Ecole des Mines de Nantes</b></p> <p><b>1994 – 1998</b></p>	<p><b>Joint Master, Engineering and Industrial Systems, Mathematics, Physics, Energy, Software Engineering, Industrial Quality, Industrial Systems</b></p> <p><b>Graduated in Quality, Safety and Reliability Engineering;, 1998</b></p>

Language skills: Indicate competence on a scale of 1 (excellent) to 5 (basic):

Language	Reading	Speaking	Writing
FR	1	1	1
EN	1	1	1
DE	3	4	4

Present position (company, position, technical field, etc.):

Head of Assessment for Operational Radiation Protection & Intervention Team at IRSN North

Key qualifications:

Nuclear Safety : radwaste management, polluted sites, NORM & radioactive waste disposal facilities, post-accidental management

Radiation Protection : Emergency environmental measurements, Radiological pollution characterization, Operational radiation protection intervention

Professional experience:

Date	Company - Location	Position	Description
2003-2017	IRSN Fontenay aux roses FRANCE	Various and numerous positions	Please see <a href="https://www.linkedin.com/in/tichauer/">https://www.linkedin.com/in/tichauer/</a> for details
2001-2003	EADS Telecom (now AIRBUS Group) Saint Quentin en Yvelines FRANCE	Product Line Manager	Product Line Manager, Product Manager, Marketing Division  - Product Line Strategy (core network security products, firewall, VPN, IDS)  - Product placement and Business Development  - Project Manager for the security product line (> 1Meuros projects)  - Team building and management (Software development, manufacturing, technical support, sales support, sales)
1998-2001	MATRAnet (now AIRBUS Group)	SW Test Manager	Software Test Manager  - Security software test planning and management  - Integration in various system environments

Other relevant information (e.g. previous training, tutoring, etc): XXX

## LECTURER CV



Family name: DETILLEUX

First name: VALÉRY

Date of birth: 16/01/1985

Nationality: Belgian

### Education:

Institution (Date from – Date to)	Degree(s) or Diploma(s) obtained
Université catholique de Louvain (UCL), Belgium [2006-2011]	PhD in Chemistry
Université catholique de Louvain (UCL), Louvain School of Management (LSM), Belgium [2007-2009]	Master in Management
Université catholique de Louvain (UCL), Belgium [2006-2007]	Master of advanced studies in Chemistry
Université catholique de Louvain (UCL), Belgium [2002-2006]	Master (Licence) in Chemistry

Language skills: Indicate competence on a scale of 1 (excellent) to 5 (basic):

Language	Reading	Speaking	Writing
French	1	1	1
English	1	2	2
Dutch	1	3	3



Present position (company, position, technical field, etc.): **Bel V, safety analyst**

Key qualifications: Design and safety of waste processing, storage and disposal facilities, safety assessment methods and practices, qualification of safety related equipment, knowledge of regulatory requirements and international recommendations on waste management.

Professional experience:

Date	Company - Location	Position	Description
<b>2011 - current</b>	<b>Bel V</b>	<b>Safety Analyst</b>	<ul style="list-style-type: none"><li>• Contribute to the project aimed at providing a technical support to the National Regulatory Authority (FANC) in the framework of the Belgian geological disposal programme</li><li>• Participation in the technical review of the post closure safety assessment of the Belgian surface repository</li><li>• Coordination of the project aimed at providing a technical support to the FANC in the framework of the licensing of a new facility for the storage of waste packages potentially affected by an ASR degradation</li><li>• Support to Bel V inspectors for waste management</li></ul>

			<p>issues</p> <ul style="list-style-type: none"> <li>• Coordination of Bel V technical review works devoted to NPPs Equipment Qualification</li> <li>• Participation in international projects and working groups on radioactive waste management (WENRA, IAEA, EC)</li> <li>• Leader of EC-H2020 SITEX-II Work Package 1 (Programming R&amp;D)</li> </ul>
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Other relevant information (e.g. previous training, tutoring, etc): XXX

Country	Date from - Date to
Belgium	2015
Belgium	2012
Belgium	2008

#### Recent publications

- P. Janssen, O. Destin, V. Detilleux (2016) "Examples of near-field modelling activities in Bel V for supporting the review of safety assessment for radioactive waste disposal facilities", ETSO EUROSAFE Forum 2016
- V. Detilleux, D. Pellegrini, F. Bernier, G. Heriard-Dubreuil, J. Miksova, A. Narkunienė (2016) "Overview of the Strategic Research Agenda in the field of safety of radioactive waste geological disposal developed by the Expertise Function in the EC-H2020-SITEX-II project", ETSO EUROSAFE Forum 2016
- EC H2020 SITEX-II Project, DRAFT Deliverable D1.1, "Strategic Research Agenda of the Expertise function in the field of geological disposal of radioactive waste", 22/04/2016.
- V. Detilleux, J.-D. Barnichon, V. Havlova, G. Sue, A. Narkunienė, C. Serres (2012) "R&D orientations for Technical Safety Organizations", EC-FP7 SITEX Deliverable 3.1.
- Lemy F., De Cannière, Bernier F., Wemaere I., Beuth T., Castel C., Detilleux V., Haverkate B.R.W., Havlova V., Hedberg B.T., Leuz A.-K., Mecke J., Mrskova A., Rocher M., Smidts O. & Vermote S. (2013) "Main key technical issues, expertise and support needed" EC-FP7 SITEX Deliverable 2.2.