
Sustainable Network of Independent Technical Expertise for Radioactive Waste Disposal (SITEX)

Christophe Serres¹, Frédéric Bernier², Vaclava Havlova³, Muriel Rocher¹, Adela Mrskova⁴, Gilles Hériard Dubreuil⁵

¹IRSN, France, ²FANC, Belgium, ³UJV, Czech Republic, ⁴DECOM, Slovakia, ⁵MUTADIS, France

Abstract:

SITEX is a 24 months FP7 Euratom project (from January 2012 to December 2013) led by IRSN and bringing together organisations representing technical safety organisations and nuclear safety authorities performing technical and scientific assessment of geological disposals for radioactive waste in the framework of their respective national regulatory review process of the safety case. Civil society outreach specialists of interaction with civil society are also involved in the project. SITEX aims at establishing the conditions required for developing sustainable interactions among experts from various horizons (nuclear safety authorities, technical safety organisations, civil society organisations...) capable of developing and coordinating joint and harmonized activities in relation with the safety assessment of the safety case. Among foreseen activities, partnership with the civil society experts is considered as a key function of the future network in order to contribute in enhancing trust in the decision making process. The SITEX program of work is split into a set of six workpackages that address technical and organizational issues allowing in fine to propose a structure of the activities and operating modes of the future network. These issues relate on the one hand to the study of the potential for sharing and developing technical expertise practices independently from the expertise developed by waste management organisations, on the other hand on the ability to implement coordinated R&D programs run by technical safety organisations in order to develop the scientific knowledge necessary to perform technical assessments.

1 CONTEXT OF SITEX AND OBJECTIVES

Under the leadership of more advanced geological disposal programs, waste management organisations (WMOs) in Europe decided to coordinate their efforts to be able, at horizon 2025, to implement first geological disposal (IGD-TP). This coordination is established through a common vision and strategic research agenda that foster exchanges and joint works about the scientific challenges that remain to be addressed before 2025. This knowledge aims at developing the future safety cases. As far as safety cases develop, the safety case review by regulatory bodies in the framework of the decision making process develops as well. In that context, people or organisations in charge of reviewing the safety case must in particular evaluate whether the elements of safety, and in particular that supported by scientific and technological results, are sufficiently convincing to be accepted by the regulator as a basis for proceeding with the decision making process. The assessment of the scientific and technical issues developed by the WMOs requires specific skills from the assessor in order to evaluate whether they allow compliance with the safety requirements issued by the regulator.

In that context, SITEX proposes to develop and coordinate these skills among the organisations in charge of implementing the regulatory review process with the aim to identifying and as far as possible to harmonizing the review practice and associated activities, grouped under the terminology : **expertise function**. This function aims at complementing already existing functions such as that developed by WMOs (**implementing function** devoted to the conception and safety demonstration of a geological disposal) and by regulators or nuclear safety authorities (**regulatory function** devoted to licensing activities and decision making). But the decision making process comprises a fourth actor,

the **civil society**, and SITEX intends to build the future expertise function network in interaction with the missions played by the civil society (see figure 1) in the perspective opened by the Aarhus Convention.

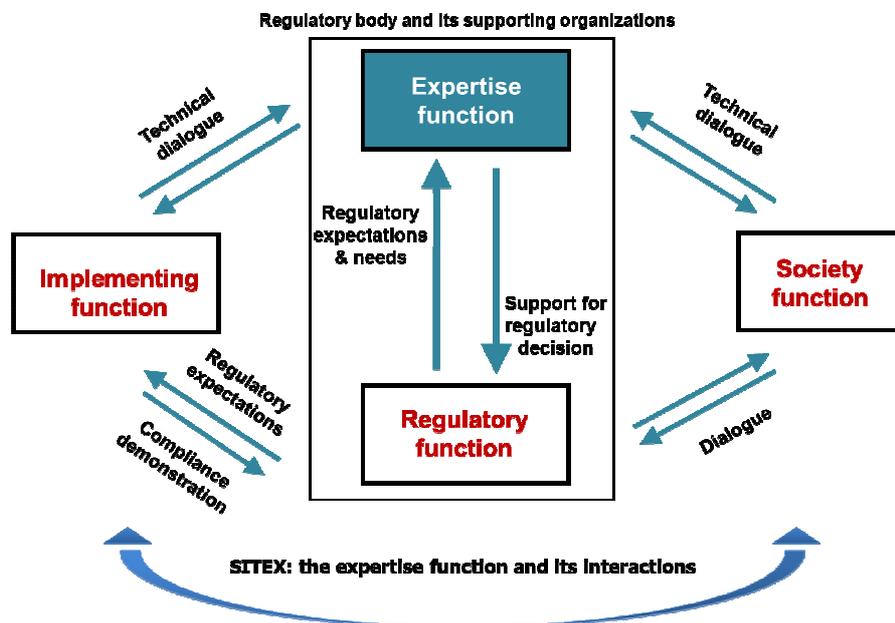


Figure 1: SITEX expertise function and its interactions

In order to identify the missions of the future expertise function network, 4 major axis are further investigated within SITEX:

- The needs for mutual understanding between regulatory bodies, technical safety organisations (TSOs) and waste management organisations (WMOs) on (i) the regulatory expectations at decision endpoints and (ii) how the scientific and technical elements carried out by the WMOs comply with these expectations. In that perspective, the needs for better developing some requirements or new regulatory guidance is addressed, taking into account exchanges with IGD-TP;
- The definition of TSO's R&D program that would ensure independent scientific and technical capabilities for reviewing the Safety Case and assessing the scientific arguments provided by WMOs. TSO's R&D program and priorities are defined, addressing as well available resources (scientists, experimental labs, numerical codes) within the different partners, in order to be able to propose mutualisation where possible;
- The needs in guidance development for harmonising the technical review method and in dedicated training and tutoring for spreading the expertise function culture and practices;
- The interaction with the civil society involved in the decision making process, in a manner more integrated than only through communication or dissemination. The challenge for SITEX network is to be able to create a safe forum where different stakeholders from the civil society are engaged sufficiently in advance in the development of the disposal project in order to enhance trust in the decision making process. It is also to create favorable conditions for Civil Society Organisations to develop their technical capacities and to meaningfully engage in the context of safety case review.

2 DESCRIPTION OF WORK

2.1 Regulatory expectations and needs

The main objective of this task (Work Package 2 – WP2) is to identify areas where development and harmonization of technical guidance is needed in priority. Topics for which it is felt that dialogue is needed are also identified. The scope of this WP encompasses all the aspects associated with the safety of geological disposal under development. The security of repositories and the safety of existing facilities are not addressed in this work.

This task provides an overview of existing technical guides including an identification of:

- Common points and differences;
- The needs for further development, harmonization and dialogue in particular with respect to the application of the EC directive 2011/70/Euratom.

In order to identify areas where development, harmonization and dialogue are needed, the following set of *safety requirements* covering the different aspects of a repository development programme and on which international consensus exists were identified and taken as reference :

- Draft WENRA Safety Reference Levels (SRL). A SRL is defined as a requirement against which the situation of WENRA member states is assessed. It is each country's responsibility to implement actions to ensure that SRLs are reached. There is also an engagement to transpose SRLs into national regulatory frameworks
- IAEA safety fundamentals and requirements
- EC Directive 2011/70/Euratom on Radioactive Waste & SF Management
- ICRP recommendations

The input and working methodology included the following steps:

- Existing "high-level" safety requirements developed in the EC directive, WENRA SRLs, ICRP recommendations and updated IAEA Safety Requirements were identified;
- These safety requirements were used as a basis for the identification of areas or safety issues for which guidance is a priori needed and the resulting list of safety issues covering all identified safety requirements was defined;
- Existing regulatory guides associated with these safety issues were identified, compared and discussed in order to identify and understand common points and differences;
- The needs for further development, harmonization and dialogue between stakeholders were identified based on:
- An a priori identification of development needs of TSOs and nuclear safety authorities (NSAs);
- Observed common points and differences;
- Interactions between TSOs and NSA as well as with other stakeholders (WMOs in particular – interactions with the IGD-TP is foreseen);

Priorities have been established taking into account the IGD-TP vision statement that "by 2025, the first geological disposal facilities for spent fuel, high-level waste, and other long-lived radioactive waste will be operating safely in Europe". The level of « urgency » (considering the time-frames associated with the decision-making process), the importance for safety, the level of interest expressed by the different partners and stakeholders are various criteria used to establish a list of prioritized issues. The main issues that deserve more attention from NSAs and TSOs concern mainly:

- The interpretation of ICRP 122 (radioactive waste) regarding the radiation protection principles applied to geological disposal and the weighting of criteria when applying optimization to site selection,
- The concept of reversibility and its benefits vs potential adverse effects,
- The hazards linked to concurrent activities and specificities of operation,
- The approach to deal with design modification during construction,
- The definition of operating limits and conditions and their verification during operation,
- The clearance of decommissioning material,
- The criteria for radiological protection of the environment.

2.2 Development of TSO's scientific skills

The high level of scientific knowledge used by WMOs in developing the safety case implies adequate level of expertise from scientific assessors in charge of the public mission of reviewing the safety case. Performing comprehensive safety reviews of high quality contributes in improving the decision making process. It is the reason why in order to develop their knowledge as well as the relevance and credibility of their technical expertise, technical experts of TSOs or regulatory bodies need to be in the front line of scientific advances. But because of time constraints, it is of crucial importance to be able to anticipate the development of knowledge and resources required to assess risks posed by nuclear facilities in the future, and in particular waste management safety. It is the reason why a number of TSOs and regulatory bodies have identified very early the scientific issues that had to be addressed in priority because of their key importance in the overall safety demonstration of the geological disposal. Most of these scientific issues are dealt with by WMOs organisations in their national research programs or by international cooperation. Separately, TSOs and regulatory bodies yield independent research activities in order to develop their own understanding of some of the processes that influence safety of disposal, with the view to questioning WMOs or comparing and testing some key assumptions governing the safety demonstration.

The purpose of this task (WP3) is:

- to identify current R&D activities performed by TSOs and define the future program that should be undertaken,
- to identify the available resources (scientific skills) and tools (experimental installations, modelling capacities...) that are already available to carry out this program or that should be further developed in order to improve the TSOs capabilities in performing their R&D programmes,
- to identify possible synergies between TSOs and regulatory bodies and propose a list researches of common interest according to the concept and advances of the different national programs

Interaction with IGD-TP is undertaken in order to assess the scientific areas where cooperation would be possible, without impairing the independence and roles of respective organisations.

Based on national experiences, SITEX has developed a common view on the key safety issues and the associated R&D actions that may be undertaken by a future TSO network. The key R&D actions are organized around the following three main axes that drive generally the review of the scientific arguments provided by the WMOs:

- The quality of the data on which rest the safety demonstration and in particular the adequacy of experimental methods used for producing the sets of data. The assessment of their domain of validity (possibly through experimental works) allows addressing the consistency and degree of confidence of the data produced;
- The understanding of the complex processes which may potentially influence the long term safety of the geological disposal and in particular the development of basic

scientific knowledge in the fields where there is a lack of knowledge, especially regarding the complex phenomena and interactions occurring all along the life of the repository and their influence on nuclear safety. In some cases, this understanding may require specific experimental tests aiming at assessing the key parameters that may warrant the performances of the different components of the repository. Such experiments may be designed in particular to simulate the behaviour of components in altered conditions and allow the assessors to rely on independent data and results for delivering appraisal on the specifications of construction that are to be justified by implementers;

- The assessment of the future evolution, in spatial extent and intensity (orders of magnitudes of perturbations) of the processes, as well as the assessment of their impact on the safety. Such calculations allow to preserve an independent evaluation of the Influence of assumptions made by the conceptor and of the related uncertainties.

Because national programmes are at very different phases (conceptualization, siting, design...) and because concepts/host rocks are different, the identified needs and priorities are not homogeneous between expertise bodies. The distinction is made between areas where interest is concept/specific and where it is more generic:

- Thematics more concept specific (not comprehensive):
 - o Waste matrix and source term behaviour and degradation: bitumen waste, glass fracturing...
 - o Container degradation: corrosion under specific conditions of disposal, role of μ -organisms in chemical interactions, radiolysis of water and iron and production of hydrogen...
 - o Engineered components interactions: geochemical and mechanical interactions, including effects of hydrogen migration and resaturation...
 - o Host rock: methods to detect heterogeneities in sedimentary rocks...
- Thematics of more generic concerns (not comprehensive):
 - o Modeling of coupled processes during transient phase (evolution of data, boundary conditions...)
 - o Upscaling methods from laboratory scale to site scale
 - o Accounting for uncertainties in scenarios
 - o Monitoring and measurement methods : what? where? when? (what is the « safe domain » of the disposal?, how are defined the limits, controls and conditions of the disposal behaviour during operation phase and how, what are the criteria for governing reversibility process?...)
 - o Expectations and potential role of civil society in the governance of the reversibility process during the operational phase

2.3 Review methodology and competence building

As far as safety cases mature and geological disposal projects evolve to the application for creation, organisations in charge of reviewing the safety cases have to prepare the review activities. The objective of this task (WP4) is to establish the conditions for developing common technical review methodologies so as to seek for harmonisation of the review methods and make as far as possible the expertise function consistent through the member states. In a first step a framework for the development of harmonised methods for reviewing the safety cases has been established. In a second stage, a plan for organising training and tutoring activities related to review methodology will be elaborated.

A first task was related to the overview of national practices when reviewing the safety cases. The approaches to perform the technical safety review amongst SITEX participating organisations revealed similarities, that allowed to go further in the definition of a standardized review methodology. According to the draft European Pilot Group (EPG) report, the SITEX participants have developed a preliminary grid of analysis based on the specific phases of development of the disposal program defined in the EPG. The main principle driving the development of the review for each phase is to adapt the level of analysis to the level of development of the project. The general framework is presented according to a general “grid of analysis” common to all phases but with various focus and assessment depending of the progress of the project.

These common issues to be addressed relate to the description of the **context of the safety case**, to the **focus of the technical review**, then to the assessment of the implementation of the **safety strategy**, the assessment of the set of data used, of the processes considered, of the models and computer codes used (**assessment basis**), to the **effectiveness of the safety functions** and of the performances of barriers, then to the **definition of scenarios for radiological and non-radiological impact calculations**, to the **management of uncertainties** and finally to the **integration of safety arguments and evidence**.

The selected phase to test the methodology refers to the end of “site investigation and selection phase”, leading to decision to select a site and start investigation for a reference design. It corresponds to the status of the SR-Can SKB report (implementer in Sweden) or to partly the Andra’s Dossier 2009 (implementer in France).

The “site investigation and selection phase” grid of analysis will be further discussed and consolidated within the partners with the view to pave the way for developing similar frame for the other stages of the safety case (as mentioned in the EPG report, conceptualization, reference design, construction, operational and post-closure phases). The use of the IAEA questionnaire developed by GEOSAF as well as the questions raised recently by GEOSAF2 on the operational safety should be considered in order to specify more precisely the issues to be reviewed by the experts. In parallel, the elaboration of a training plan will be started with the view to propose a harmonized training and tutoring activity among the partners that would allow to developing reviewing skills in concordance with the methodology developed above.

2.4 Interacting with the civil society

The objective of this task (WP5) is to set up the conditions for associating civil society in the expertise process. In addition to the review of international initiatives on stakeholders involvement a major step for the first year was to collect relevant experiences from various national initiatives to associate civil stakeholders in the process of developing a geological disposal project. Several case studies have been selected according to their ability to illustrate practical implementation of interactions between experts, in particular TSOs, and stakeholders in Europe in the last 15 years. They have been analyzed according to a systematic grid of assessment enabling comparative analysis and drawing of general lessons about the conditions and means of interactions between experts and civil society.

The selected case studies are mainly situated in the field of RWM but also include a case study related to innovative processes of interaction in the field of management of mining residues resulting of past mining activities as well as an example of development of TSO’s strategy of openness to society in the nuclear field. The choice of these case studies has also been guided by the possibility to access information in French or English language.

The nine case studies are :

- ARGONA focused science shop on impact of radioactive waste disposal (Czech Republic, 2008)
- ARGONA consensus panel on spent nuclear fuel management alternatives (Czech Republic, 2008)
- ARGONA Interaction Panel on “Siting and safety case” (Czech Republic, 2009)

- COWAM In Practice (CIP) National Stakeholder Groups (Europe, 2007-2009)
- CoRWM citizen panels (United Kingdom, 2005)
- The strategy of openness to society of the French Institute for Radiation Protection and Nuclear Safety (France, 2003-...)
- Cooperation between the IRSN and the Local Information Commissions in the framework of the preparation of the public debate in France related to the future application for creation of a geological disposal (2012-2013)
- Citizen and expert groups for the closure of repository Asse II (Germany, 2007-...)
- Pluralistic expert group on radioecology in Nord-Cotentin (France, 1997-2010)

Information on the selected cases was gathered through desk study on the basis of the available documentation on the cases in French and English language (with additional exploitation of documents in German language in the case of the citizen and expert groups for the closure of the repository of Asse II). This information has been complemented by two interviews of stakeholders engaged in the ARGONA European research project and the Asse II case.

The grid of analysis was structured as follow:

1. Origins and justification of interactions between TSOs and civil society
2. Organization of the interaction process
3. Characterization of the co-expertise process
4. Access of civil society actors to information
5. Outcomes of the process

A major part to be completed is to put conclusions of the case studies into perspective of further initiatives that should be developed by SITEX in the future to better interact with civil society and increase the quality of the expertise function by closer relationship with local stakeholders. Improved interactions between experts and the civil society are also expected to raise the capacities of the latter to engage in a meaningful way along the radioactive waste management decision-making at local, national or international levels and in particular all along the safety case review. The sustainable presence and engagement of the public along the decision-making process is understood here as a way to reinforce the quality of the decision-making as underlined by the Aarhus Convention.

In particular, the analysis of these case studies should pay a specific attention to the ability of the interaction process to contribute to more durable changes in the relationships between civil society and TSOs, between civil society and other institutional actors. For that, a workshop has been organized in September 2013 with SITEX partners and members of civil society. The goal of this workshop was to map the needs for the public to engage in the radioactive waste management decision making process and to identify opportunities for civil society and technical experts to interact in the framework of SITEX areas (review activities, definition and implementation of R&D, exchanges with nuclear safety authorities and possibly WMOs). This meeting with representatives from the civil society came to the conclusion that SITEX could provide with the required conditions for allowing a “safe forum” where civil society could participate in the expertise process at different levels. These conditions rely mainly on the openness of the organisations involved, and on a set of prerequisite values to be shared such as transparency and independancy. In that perspective, it is especially expected from civil society that experts make explicit :

- the scientific uncertainties,
- the criteria for assessing different technical solutions and how they lead to recommendations,
- the background documentation of expertise,
- the terms of the expertise while it is elaborated for the need of safety authorities,

- the traceability of the collective expert's opinion that should be provided in order to enable the public to identify the various views of the experts before achieving the trade-offs.

Moreover, it was requested that experts to adopt a genuine intellectually independent perspective in order to be able to voice its concerns (as a whistleblower), as soon as they are not properly taken into account by the decision-making process. It was also wished that experts to adopt a broader vision, not limiting their scope to a narrow perspective (e.g. linkage between radioactive waste management and energy strategy, to question the so-called need for transmutation reactors as a solution for radioactive waste management...).

Besides the conditions for allowing relevant interaction between experts and civil society, the workshop has identified several concrete research & experimentation initiatives in order to structure the public engagement along the decision making and safety case review. Proposals concern 1) the assessment of the application in practice of the EC directive 2011/70, 2) the assessment of the strategic research agendas of WMOs and TSOs and 3) the definition of the long term engagement of public during the operating phase of the geological disposal.

3 PRELIMINARY CONCLUSIONS AND DEFINITION OF SITEX MISSIONS

On the basis of the above activities, a general presentation of SITEX functions, opportunities of interactions and operating modes offered by the future network is proposed.

Four functions (see figure 2 below: A, B, C, D) could be carried out by the SITEX network in order to support national activities of expertise of partners and to initiate supranational activities of expertise. These functions are: Training and Competence Development, Review Practices and Services, R&D implementation, Experts interacting with civil society.

These functions correspond to the national and various activities that the experts or organisations undertake in order to accomplish their missions of expertise. The SITEX network develops these functions to facilitate and strengthen national action of member states, introducing a dimension of exchanges, joint programming and harmonization in their various activities.

For each function, the SITEX network could provide different opportunities of interactions (see figure 2 below: 1,2,3) depending on types and levels of cooperation between members of the network in each area. The first type of interactions between SITEX members is to allow the exchange of experiences and point of views. The second type of interactions is the sharing of resources (human resources, experimental devices, computer models, fundings). The most integrative collaboration between SITEX partners is the development of common practices and could lead to further harmonization where possible.

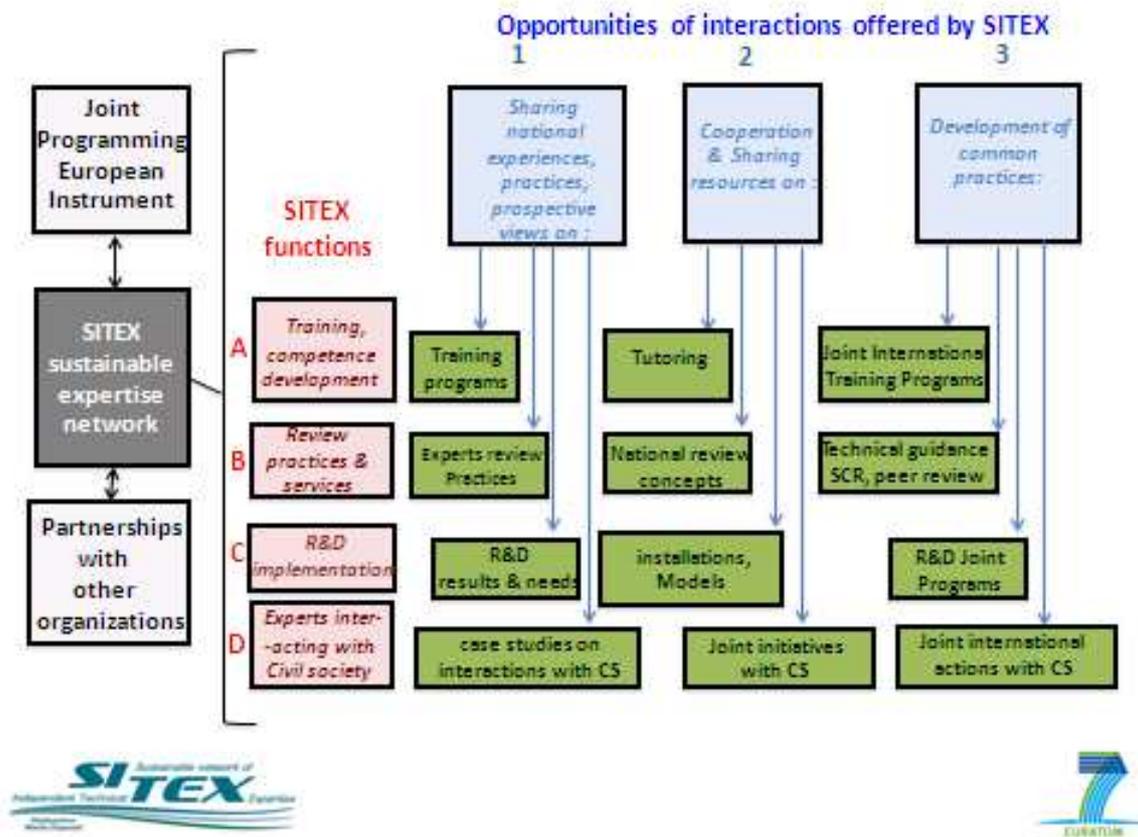


Figure 2: definition of SITEX missions

The crossings between SITEX functions and opportunities of interactions offered by the network provide different types of operating modes that SITEX network could implement in order to develop technical and independent expertise in the field of waste management safety and radiological protection. According to these above mentioned opportunities, two major perspectives are identified for the implementation of the SITEX network: 1) its ability to foster cooperation between regulatory bodies, TSOs and the civil society with the view to enhancing common understanding of key safety issues and challenges and to identifying possible harmonization of practices 2) the constitution of a scientific task force (mainly driven by TSOs) for research definition and implementation at European level, allowing to improve the coordination of scientific programmes between TSOs and to develop their own skills and analytical tools. It is highlighted that the development of this sustainable cooperative network with the aim of engaging the public with expertise along the safety case review should increase the quality of the expertise function, and contribute to increase trust in the decision making process.

Acknowledgement

The research leading to these results has received funding from the European Atomic Energy Community's Seventh Framework Programme (FP7/2007-2011) under grant agreement No. 295889, the project SITEX (Sustainable network of Independent Technical Expertise for Radioactive Waste Disposal).