



SITEX/ENSTTI training course on regulatory review and assessment of the safety case for disposal facilities

Module 1 – Safety case context, safety strategy, site characterisation and the facility description

9-13 March 2020, ENSTTI
Fontenay-aux-Roses, Paris, France

Introduction

This is a 5-day training module covering the safety case context, safety strategy, site characterisation and the facility description. It is the first part (Module 1) of a three module training course on regulatory review and assessment of the safety case for radioactive waste disposal facilities. Module 2 deals with safety assessment, specifically; operational safety assessment, site and engineering assessment, post closure radiological impact assessment and management system assessment. Module 3 is targeted at the topics of optimisation, uncertainty management, integration of safety arguments and regulatory review of safety. The training course is being presented within the context of the SITEX_Network within a broader framework of training of professionals involved with the safety of disposal of radioactive waste, in particular geological disposal, and participants are expected to complete the three modules. In detail, Module 1 addresses the regulatory requirements related to setting down the safety case context for different stages of the development of a geological disposal facility, similarly for setting down the safety strategy, undertaking site characterisation and the facility description to be included in the safety case. It covers the regulatory expectations for fulfilling these requirements and also practical experience and difficulties that can be encountered.

Training course objective

The objective of this training module is to provide trainees with an understanding of the regulatory requirements related to the safety case context, safety strategy, site characterisation and the facility description within the safety case for disposal of radioactive waste, with a special focus on geological disposal, and the regulatory expectations for meeting these requirements. The training will also address issues that arise in the regulatory process and experience from different countries in resolving the issues.

Target audience

The training course is addressed mainly to technical staff of regulatory authorities, technical support organisations and waste management organisations involved with geological disposal. The course will also be of interest to research organisation, consulting organisations and government and non-government organisations dealing with radioactive waste disposal or civil society experts in the field.

Training course description

The course introduces the safety case concept and its role in the licensing of disposal facilities, in particular in the licensing of geological disposal facilities. It explains the different aspects that need to be set down and clarified in the safety case context for different steps in the development of a geological disposal facility. It also discusses the concept of setting down a safety strategy and how the choice of site and location of the facility together with its design, excavation, construction and operation will fulfil the safety requirements for containment and long term isolation with multiple safety functions. The Module 1 discusses the information needed for safety demonstration in terms of the site characteristics, the facility design and the waste, resp. waste forms to be disposed. It presents the regulatory expectations of what should be presented in the safety case for the various stages of a facility development and for the supporting safety assessment of the site, design, facility engineering, the radiological impact and the management system of the operator/developers. An information about safety supporting research and interacting processes with civil society will be provided.

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 and organizations with an expertise function. The Module concludes with a final test. It will be held to assess the trainees' learning based on a multiple-choice test.

The training course will terminate with a general discussion on the results of final test and the student's feedback on the course (content, planning, organization ...) to enable ongoing improvement of future training courses. The presentation slides from the lectures will be distributed electronically to the participants.

The module timetable, list of lecturers with their brief CV and the synopsis of the lectures are presented hereafter.

	9:00-10:30	11:00-12:30	13:30-15:00		15:30-17:00	17:00-17:30
Mon	A.1 Introduction to safety demonstration, regulatory control and the course <i>ENSTTI</i>	A.2 The safety case context – purpose and scope <i>FANC</i>	A.3 Interacting processes and engaging civil society <i>Mutadis</i>	A.4 PEP exercise <i>IRSN/FANC</i>	A.4 (cont.) PEP exercise <i>IRSN/FANC</i>	A.5 Summary and discussion <i>ENSTTI/IRSN/FANC</i>
Tues	B.1 Safety strategy for geological disposal <i>ENSTTI</i>	B.2 Siting phase Based on the French case <i>IRSN</i>	B.3 Phases of facility location, design, construction and operation <i>IRSN</i>		B.4 Monitoring <i>FANC</i>	B.5 Summary and discussion <i>ENSTTI/IRSN/FANC</i>
Wed	C.1 Site data and information needs & how to use data in the SC <i>IRSN</i>	C.2 Geological, hydrogeological and geochemistry investigation & how to use data in SC <i>IRSN</i>	C.3 Supporting research <i>BELV</i>	C.4 Summary and discussion <i>ENSTTI/IRSN/BELV</i>	C.5 Laboratory visit <i>IRSN</i>	
Thu	D.1 Exercise/siting <i>IRSN/FANC</i>	D.2 Exercise/design <i>IRSN/FANC</i>	D.2 (cont.) Exercise/design <i>IRSN/FANC</i>	D.3 Feedback on exercises <i>IRSN/FANC</i>	D.4 Management systems and knowledge management <i>ENERCON</i>	D.5 Summary and discussion <i>ENSTTI/IRSN/FANC/ENERCON</i>
Fri	E.1 Regulatory experience in Europe <i>IRSN/FANC/ENERCON</i>	E.2 Round Table discussion <i>ENSTTI/IRSN/FANC/ENERCON</i>	E.3 Test <i>ENSTTI</i>		E.4 Summary and evaluation <i>ENSTTI /IRSN/FANC</i>	

Module content

Day 1 – Introduction to the module, the safety case and its context, research and stakeholder engagement

A.1 Introduction to safety demonstration, regulatory control and the course

Key words geological disposal facility, safety, licensing, safety case review and assessment
 geological disposal facility, safety demonstration, safety criteria

Synopsis The approach to safety demonstration for the different licensing steps of the facility development and operation are discussed and how the safety demonstration evolves from conceptual, making use of generic information and assumptions to becoming specific to the actual site and design. The criteria used to demonstrate safety are discussed together with their establishment and presentation. The concept of optimisation is discussed. The role of conservative and realistic assumptions is discussed, the development of confidence in the safety of the facility is addressed and the management of uncertainty and how these dimensions influence the decision-making processes. The regulatory process for the development, operation and closure of facilities is presented and discussed.

The learning objectives of the module are described within the context of the overall training course. The structure and content of the module are described together with an introduction of the lecturers and arrangements during the week.

A.2 The safety case context – purpose and scope

Key words geological disposal facility, safety case, purpose, scope

Synopsis The content of the safety case evolves as the process of selecting a site for the disposal facility and developing the design progress and the facility is excavated, constructed and operated. The purpose of the safety case for the discreet licensing steps is addressed and the how the requirements for safety demonstration at the different steps will be considered is discussed.

A.3/A.4 Interacting processes and engaging civil society, PEP exercise

Key words geological disposal facility, safety demonstration, interested and involved parties, civil society

Synopsis The development of geological disposal facilities involves a number of parties, both governmental and non-governmental. Governmental involvement can be national, local and regional and can involve policy, support, approval and control. Key organizations are disposal facility developers / operators, the nuclear regulatory authority, technical support organizations

and research entities. Various non-governmental bodies have an interest in geological disposal as does civil society in general. The interacting processes between the different parties play an important role in the development of facilities and this lecture discusses the roles of the different parties and their interactions and engagement. An exercise targeted at different kind of stakeholders involvement in the RWM will be performed using PEP tool.

Day 2 – Safety Strategy and its implementation in site selection, design and operation

B.1 Safety strategy for geological disposal

Key words geological disposal facility, safety strategy

Synopsis The safety strategy for geological disposal addresses how the functions of containment and isolation will be provided by the facility design and the host environment. It will cover the concept of multiple safety functions and how they will provide for defence in depth and sufficient safety margins over the timeframes of interest. It will also address how fulfilling the strategy will be demonstrated throughout the development and operation of the facility and how change is dealt with.

B.2 Siting phase

Key words geological disposal, high level radioactive waste, site selection

Synopsis The process of selecting a site for a geological disposal facility involves both technical and socio-political consideration. This lecture identifies siting process phases and presents approaches that have been used in site selection considering both dimensions to ensure a site is selected that has the necessary and appropriate characteristics and is acceptable to the various interested parties.

B.3 Phases of the facility location, design, construction and operation

Key words geological disposal facility, design, location, construction, operation, high level radioactive waste

Synopsis The location of a geological disposal facility on a site will be influenced by both the characteristics of the site, excavation/construction and operational considerations. The facility design will be influenced by the site characteristics, the waste inventory and the safety strategy adopted. The design is developed iteratively with the safety case and its supporting assessment. The processes involved in excavation and construction have to ensure that designed demonstrated in the safety case is realised and that the features important to safety provided by the host environment are preserved. The operations to be carried out at the facility involving receipt of the waste packages, their handling and emplacement in the facility and the

backfilling and sealing operations also have to be undertaken in line with the safety case. All the technical specifications for excavation, construction and operation have to be validated and the implementing procedures reviewed for completeness and adequacy. This lecture will address these aspects.

B.4 Monitoring

Key words geological disposal facility, monitoring programme, periodic observation, impact on environment, disposal components behaviour, public

Synopsis The necessity on monitoring of RW disposal facilities as a continuous or periodic observations and measurements will be a main topic of the lecture. Monitoring is to help evaluate the behaviour of the components of a waste disposal system and the impact of the waste disposal system on the public and the environment. An information how to design facility monitoring programme in different repository development phases and time scales, together with main factors influencing this programme and technical matters will be provided.

Day 3 – Site and facility investigation, site data and information needs (= Safety case “system description”); Supporting research and Laboratory visit

C.1 Site data, information and knowledge needs on waste characteristics, engineered barriers and disposal facility design; capture and use of site characteristics in the safety case

Key words geological disposal facility, safety case, data, information

Synopsis In order to develop the safety case and undertake safety assessment, data and information is needed on the site, the engineered facility and the waste and the features, events and processes related to them which will influence and determine the safety of the facility. Such data and information will be gathered over a period of time and knowledge of the relevant features, events and processes of importance will also evolve. The adequacy and confidence in the data, information and knowledge will develop iteratively with the safety case and supporting safety assessment. The lecture addresses the data and information needs and acquisition and preservation throughout development and operation

C.2 Focus on geological investigations, on hydrogeology and geochemistry investigations; how to use data in the safety case

Key words geological disposal facility, site investigation, geology, hydrogeology, geochemistry, safety case

Synopsis In order to provide for the data, information and knowledge needs which serve as a basic input to the safety case, geological investigation have to be undertaken on the site and in the

surrounding environs. The features, events and processes (FEPs) associated with the geology that will influence safety during disposal facility construction, operation and post closure have to be identified, characterised and quantified to the extent necessary to develop the safety case and demonstrate disposal safety. The investigation will have to determine the geological characteristics necessary to demonstrate their suitability to provide a suitable host environment and that will influence the constructability of the facility. The investigations in that sense have to provide an understanding of the evolution of the geological characteristics over the timeframes where the safety functions have to be ensured.

Long term potential radiological hazards from geological disposal of radioactive waste are predicated on the possible degradation of the containment barriers associated with the disposal facility by physical, chemical or microbial phenomena that are influenced by the prevailing hydrological and geochemical conditions. Similarly, these conditions have an impact on the mobilisation of radionuclides from the waste and their potential migration from the facility to the accessible biosphere. As such it is important that the hydrogeological and geochemical characteristics associated with the disposal facility, the site and its environs are investigated and that the associated FEPs influencing degradation of the safety functions and migration of radionuclides are identified, understood and quantified. The evolution of the characteristics with time is important as are disrupting events that can change the characteristics. The methodological approach to geological, and in particular hydrogeological and geochemical investigation is important as is the identification and quantification of uncertainties.

The lecture addresses these issues.

C.3 Supporting research

Key words geological disposal, research, geology, hydrogeology, geochemistry, corrosion, radionuclide migration

Synopsis The safety of geological disposal is demonstrated by analysing the physical and chemical phenomena associated with the features, events and processes that can impact the safety functions providing containment and isolation of the radioactive waste from the accessible biosphere over the timeframes that the waste poses a radiological hazard. Whilst a large body of generic knowledge exists on the phenomena of interest, each site and disposal facility has its own configuration and characteristics that have to be addressed in the safety case. It is necessary develop a sufficient understanding of how the phenomena will impact the safety functions assigned to the engineered and natural features of the disposal facility necessitating research programmes to be carried out. The research may be needed in surface laboratories and underground facilities. This lecture addresses the basis for such research programmes and their conduct.

C.5 Laboratory visit

Key words geological disposal, research

Synopsis The laboratory visit (including the visit in IRSN’s surface laboratory LUTECE in Fontenay-aux-Roses as well as virtual visit of IRSN’s URL at Tournemire) will enable participants an opportunity to see some elements of research undertaken by the technical safety organisation in support of the regulatory process. An opportunity will be given to discuss the approaches taken and the issues to be considered with researchers.

Day 4 – Exercises; Management system and knowledge management

D.1/D.3 Exercise on safety case development and regulatory review during a site selection phase

Key words geological disposal, siting, site characteristics, documentation

Synopsis The main objective of the activity is to learn about the review process associated with the phase of siting a deep geological disposal project with the aim of identifying good practices. A special attention is given to the interactions between stakeholders.

During the siting phase, the implementer confirms the suitability of potentially sites accordingly the safety strategy and characterizes these sites. It is frequently the phase during which the dialog between the main stakeholders is initiated. Interactions between stakeholders will be simulated. The trainees will play the role among the main stakeholders that are safety authorities, TSOs or civil society organisations (CSOs). The role of WMO will be played by the managers of the exercise, who prepared a simplified safety case. The objective and the content of the regulatory review must be adapted to take into account the development phase of the geological disposal facility (i.e. siting).

Review grids were developed to support the regulatory body review in the frame of SITEX-II EU project through the different phases of the development of a geological disposal. This tool will be made available to participants.

D.2/D.3 Exercise on safety case development and regulatory review during a design phase

Key words geological disposal, design phase, design characteristics, safety case

Synopsis This exercise has the same objective as the previous one but is associated to the reference design phase. During this phase the implementer adapts the conceptual design to the site properties, substantiates and finalises the design of the disposal facility. This is a crucial milestone in the development of a repository since it constitute the start of the licensing process.

D.4 Management systems and knowledge management

Key words geological, disposal, safety case, management system, knowledge management, documentation

Synopsis The development of a safety case for a geological disposal facility involves a considerable amount of scientific, engineering and technical work being undertaken over long time periods and involves a broad range of scientific, engineering and technical disciplines. It involves site investigation and characterisation, research, design, construction, operation and extensive modelling of phenomena, processes and impacts. In order to develop confidence in the safety arguments and the supporting safety assessment, all the work needs to be carried out at a high level of quality and an assurance needs to be developed of such quality. The approach adopted is to put in place management systems governing all work related to the safety demonstration. The managements systems must provide for planning of the work to be undertaken and the resources needed to carry out the work, they must provide processes and procedures for effective undertaking of the work and recording all the required outputs and verification by ongoing review and evaluation. In view of the large amounts of data and information involved, the need to validate all assumptions and the long timeframes involved, knowledge management is a particularly important aspect of the management systems controlling the development of a geological disposal facility and in the demonstration of its safety. The presentation discusses management systems for geological disposal, assessment of their adequacy and their effective implementation

Day 5 – Regulatory experience in Europe; Round table discussion, Test, Summary and course evaluation

E.1 Regulatory experience in Europe

Key words regulatory experience, geological disposal, safety case

Synopsis The presentation provides insights into the regulatory experience gained to date with exercising regulatory control over the development of geological disposal, facilities in Europe. The presentations are focussed particularly on the safety case and its evolution and the regulatory process of review and assessment of the safety case during the facility development.

E.2 Round table discussion

The round table discussion provides an opportunity for participants to raise issues for discussion that have arisen during the course and for which they wish to discuss further.