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## **GEOSAF Part III**

The International Intercomparison and Harmonisation Project

on

DEMONSTRATION OF THE OPERATIONAL AND LONG-TERM  
SAFETY OF GEOLOGICAL DISPOSAL FACILITIES FOR RADIOACTIVE  
WASTE

**TERMS OF REFERENCE**

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# 1 Background

International intercomparison and harmonization projects are one of the mechanisms developed by the IAEA for examining the application and use of safety standards, with a view to ensuring their effectiveness and working towards harmonization of approaches to the safety of radioactive waste management.

The IAEA has convened a number of **international intercomparison and harmonization projects** on the safety of radioactive waste management; in particular on the issues related to safety assessment, carried out in support of safety demonstration for radioactive waste management facilities and activities, decommissioning projects and radioactive waste disposal facilities. These include the project on the Practical Illustration and Use of the Safety Case Concept in the Management of Near Surface Disposal (PRISM), the international project ‘Evaluation and Demonstration of Safety during Decommissioning of Nuclear Facilities’ (DeSa); the international project ‘Safety Assessment Driven Radioactive Waste Management Solutions’ (SADRWMS); and the international project on ‘Environmental Modelling for Radiation Safety’ (EMRAS).

In the field of radioactive waste management and more specifically geological disposal of radioactive waste, during the period 2008-2015 the GEOSAF I and II projects on the demonstration of safety of geological disposal were organized:

- GEOSAF I’s objective was to harmonize views and opinions on the construction of a safety case for a geological disposal facility (GDF), mainly focused on long term safety.
- GEOSAF II has built further on GEOSAF I and IAEA standards such as SSR-5 [1], SSG-14 [2] and SSG-23 [3] were reviewed; it started in 2012 and tackled the integration of operational safety and post-closure safety in the frame of an integrated safety case.

Regarding the safety case, GEOSAF I and II have provided a collection of findings [4] addressing *what* is expected from a safety case. GEOSAF III will aim therefore at illustrating through practical examples and case studies *how* the safety case is to be built by Waste Management Organizations (WMO) and evaluated by Regulatory Bodies (RB) and Technical Support Organizations (TSO).

From the concepts put forth by GEOSAF II and widely recognized as useful for the demonstration that a geological disposal facility is safe during the operational and post-closure phase, GEOSAF III will aim at developing *practical guidance* for the safety case.

## 2 Description of the project

### 2.1 Scope of the project

It is proposed to use existing IAEA as well as non IAEA standards and safety cases as main inputs to GEOSAF III. It is also proposed that those safety cases will come from national programs where geological disposal facility projects have matured over the years to reach advanced milestones. From these examples of implementation of a

safety case, GEOSAF III will dig deeper into the main aspects developed in the GEOSAF II TECDOC-proposal [4].

## 2.2 General objectives of the project

GEOSAF III will explore existing standards and cover practical illustrations of the use and development of the following aspects identified in GEOSAF II:

- the identification of gaps in guidance of operational safety
- the Safety Envelope (SE)
- the Design Target (DT)
- the As-Built State (ABS)
- Derivation of DT with respect to uncertainty
- Management of deviations from the DT and the SE
- Requirements management
- Decision on corrective actions
- Operational Limits and Conditions (OLCs) for the operational phase
- Waste Acceptance Criteria (WAC)
- Quality Control/Quality Assurance (QC/QA) & Monitoring

One objective is to examine whether guidance on operational safety of geological disposal facilities exists, and if so, whether or not such information is readily accessible in a small number of well identified documents. A second objective is that guidance for identifying and using those aspects in the safety case will ultimately lead to a practical illustration of how the safety case may be updated during the operational phase of a Geological Disposal Facilities (GDF).

Guidance for those key aspects will also lead to a safety case that includes a sound QA/QC and monitoring program. However, GEOSAF III does not aim at describing the QC/QA and monitoring program which is bound to be reflected in the safety case since other projects focus on the construction of monitoring programs for a GDF and monitoring is also addressed in the IAEA Safety Standards [4]. More specifically, the identification of key parameters related to the safety of a GDF in all timeframes is seen as a key component of any GDF project, thus the need to verify from day one that (i) the facility's ABS conforms to the design basis, (ii) parameters relevant to the identification of deviations from the DT are correctly monitored, (iii) parameters relevant to the identification of deviations from the SE are correctly monitored and (iv) data can be used to assess during the operational phase whether safety is ensured and whether the project as a whole is right on track to deliver the required safety functions at the inception of the post-closure phase.

The use of such a QA/QC and monitoring programs leads therefore to the generation of a significant amount of data, which in turn will be used to address the following aspects:

- Management of deviations from the DT and the SE
- Requirements management
- Decision on corrective actions

Finally, guidance for these three last topics will help putting forth the data required to reassess and/or update the safety case.

The main aspects to be studied in GEOSAF III, using real-world examples of safety cases, and their interaction are schematically illustrated in Figure 1.



Figure 1. The main aspects to be studied in GEOSAF III through real-world safety cases.

## **3 Proposed Tasks and Working Methodology in GEOSAF III**

For practical and organizational purposes, the main aspects previously identified and illustrated in Figure 1 will be divided among three groups working in parallel but with frequent interaction. A core group for integration of working group's outputs might also be considered.

One prerequisite is to get examples of safety cases from member states. Members of WMOs and RBs/TSOs with prior knowledge on national programs shall be distributed to various working groups (WG).

### **3.1 Working Group 1 (WG1): Operational safety**

#### 3.1.1 Background on preliminary work in GEOSAF II

The operational safety task group of GEOSAF II examined whether guidance on operational safety of geological disposal facilities exists, and if so, whether or not such information is readily accessible in a small number of well identified documents. The group developed a matrix as a tool for performing gap analysis. The methodology followed in setting up the matrix is based on comparing non-IAEA documents and expert judgement with the existing body of IAEA documents. The matrix contains topics identified as important to operational safety of a geological disposal facility and the degree of coverage of these topics in IAEA documents.

The matrix was used to perform an analysis of potential gaps in the IAEA documents. This analysis illustrates how the matrix can be used in support of developing new guidance. The analysis indicates that much information already exists on operational safety. This information can be used to frame the reflection about operational safety for geological disposal. There are, however, several topics specific to geological disposal facilities for which the development of specific guides may be necessary.

#### 3.1.2 Proposed work methodology for WG1 of GEOSAF III

The matrix developed in GEOSAF II has been identified to be a tool that could be used in the forthcoming analysis for the need of guidance specific to geological disposal facilities. It can also be used to identify information in existing documents. In order to ensure that no topics have been missed, it was acknowledged that additional reviews should precede the start of establishing new guidance. Therefore, it is proposed that within GEOSAF III, WG1 on operational safety should take the following actions.

In GEOSAF II, topics on operational safety were subdivided into the ones specific to a GDF and those generic to all nuclear facilities. WG1 will review the specific topics that were assessed as not or poorly covered in publications with the scope «Geological Disposal » (see appendix in the progress report of the operational safety task group). These topics might be considered as “real gaps” from the previous analysis performed during GEOSAF II. In particular, WG1 will check how the issues are addressed in publications with the scopes « Disposal », « Waste management », «

Other », integrating the provisions identified and assessing if these are sufficient or if there is a need for additional guidance. Information will also be gathered from other sources (national, international sources, safety cases, ...). In addition, experience from other repositories in operation can be taken into account (e.g. WIPP, repositories for intermediate level waste) and if needed,

the existing list of topics shall be extended and/or provisions elaborated.

Then all the topics classified as specific for GDF (including those already « well-covered ») will be reviewed. For these topics, existing provisions in IAEA documentation and/or references to other sources of information are added in a skeleton document. The main structure of this skeleton document will be based on the list of specific topics for GDF which is already an outcome of the matrix analysis

- ⇒ Deliverables: The initial deliverables shall include a compilation of all specific topics and sub-topics in a skeleton document as the basis for the headings. This document will identify provisions and/or references to other sources of information. The document will also contain an Annex compiling the generic topics with their related IAEA references. In parallel to this work a proposal for the final structure of the guidance document will be developed, that will rearrange the topics into general themes with commentary. This document will have the structure of a Specific Safety Guide (SSG) document.

### 3.1.3 Work plan

It is envisaged that WG1 will arrange for working group meetings in between plenary meetings, as required. The technical activities require at least three working group meetings in between the plenary meetings.

- 2017 (Plenary Meeting): develop initial list with significant gaps and proposal of additional sources of information (clues)
- 2018 (Technical Meeting – April):
  - Prior to the meeting*
    - Validation of the IAEA Safety Standards gap analysis related to safety issues for operational period of geological disposal facility;
    - Development of preliminary structure of integrated guidance document on safety of geological repository during its operation
  - During the meeting*
    - Development of a skeleton document and supporting Annex with the generic and specific issues and their sources of information
    - First reflection on the « national » topics that might be used as sources of information and identify « unexpected unknowns »
- 2018 (Plenary Meeting - June):
  - Present priorities for resolution of gaps at the plenary
  - Discussion of the coverage of the topics at the plenary
  - Resolve the identified gaps with national sources of information (safety cases w.r.t. operations).

- Preliminary reflection on the safety guide document structure
  - 2019 (Technical Meeting – February):
    - Develop full list of specific topics and include IAEA provisions
    - Continue development on the safety guide document structure and coordinate with WG 2&3
  - 2019 (Plenary Meeting):
    - Finalizing the structure of the safety guide document and developing content based on the skeleton document
  - 2020 (Technical Meeting–February):
    - Editing/tuning guidance proposal
  - 2020 (Plenary Meeting):
    - Presentation of the outcomes
- ⇒ Final deliverable from WG1: The final deliverable of WG1 will be a consolidated report that will provide the basis for a future guidance document on operational safety of geological repositories.

### **3.2 Working Group 2 (WG 2): Consistency between requirements, design target and safety envelope**

WG2 will look at the topics as detailed below, taking into account the specific questions coming out of the GEOSAF III Inception Meeting (May 2016), now in Annex 1.

#### 3.2.1 Design Target and Safety Envelope

In general, any disposal project is realised in the national context including specific climate, geological, socio-political and other conditions that form in particular different requirements addressing radiation protection, environmental protection, general building and mining construction activities and many other aspects. Only part of all that requirements directly relates to the safety of GDF and forms the set of general level safety requirements or Safety Envelope. The SE can be affected in time by e.g. changes in the legal and regulatory framework (i.e. regulatory authority/stakeholders' requirements) that can be considered as factors external to the GDF itself and cannot be affected by any reasons arising from development of GDF project or internal factors. The main activity of the WG2 related to the aspects of DT and SE is to bring some clarifications to these concepts. A first task to do so is to elaborate on the definition that was written in GEOSAF II TECDOC proposal: mainly a description of what is and what is not meant with “SE” and “DT”.



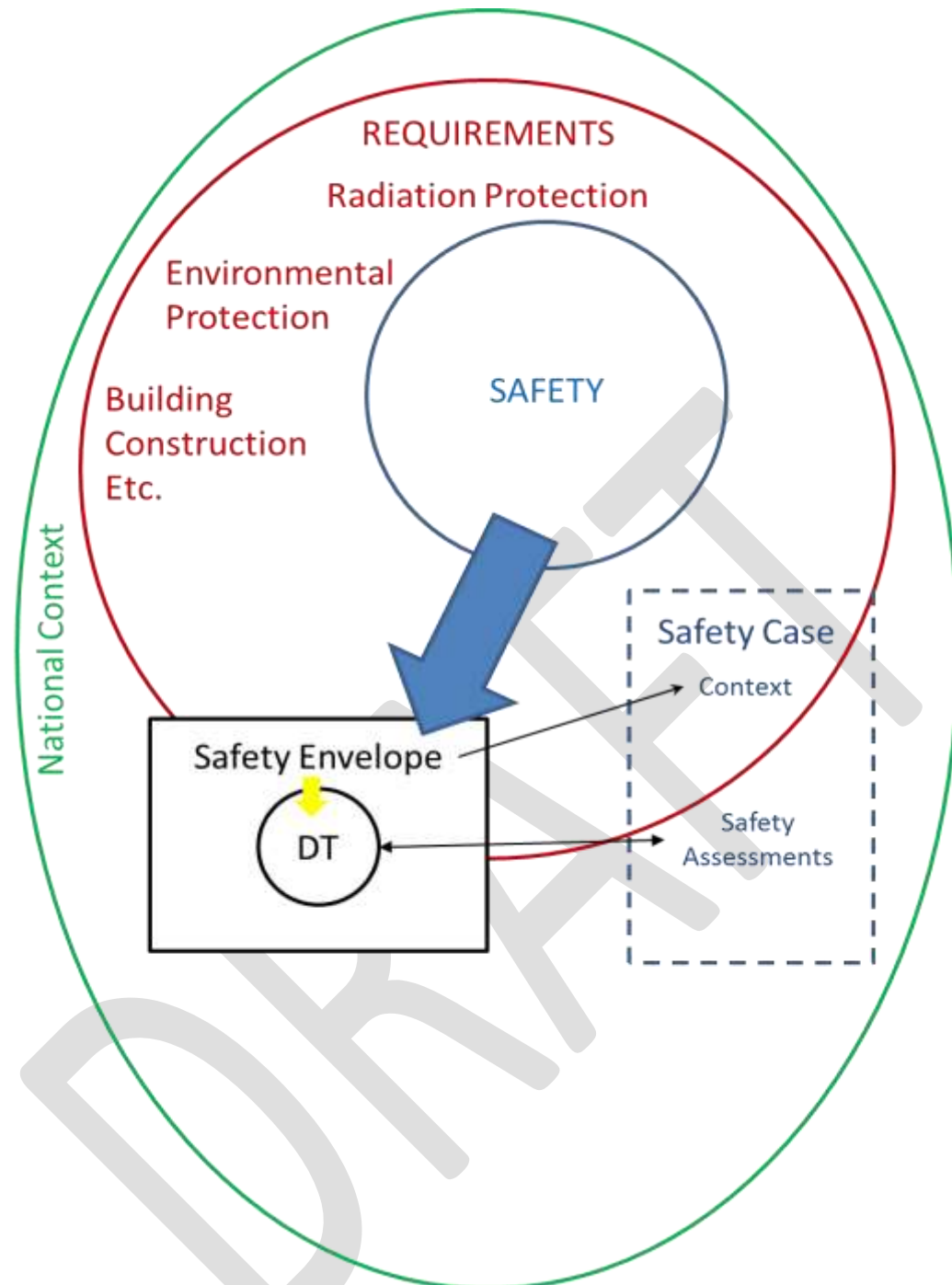


Figure 2. Forming the Safety Envelope from national requirements.

A second task is to carry out an analysis of how the concepts are illustrated or implemented in the safety cases or preliminary safety cases from national programmes. This activity will include looking for examples also from areas other than waste disposal. The result of this work could be a matrix summarizing how safety cases consider these two concepts and the link between them.

### 3.2.2 Requirements

With regards to requirements and requirements management, WG2 will aim to provide some clarifications to these terms.

WG2 will map the relations between requirements and other concepts (such as SE, DT, monitoring...) developed in GEOSAF II. A general description of the process to develop the DT starting from the user requirements could be made. The link between requirements and managing corrective actions will be investigated. This activity could lead to the formulation of key messages to structure the requirements and their management at an early stage, to the identification of the most important requirements, to the methodology to keep track of the changes (traceability), to the assurance that the requirements are properly written in terms of QA/QC principles. A few public references from international standards could be used:

- International council of systems engineers (INCOSE)
- NASA handbook
- International standard (ISO 15288)

### 3.2.3 Operational Limits and Conditions

The OLCs that are only linked to the operational phase (i.e. the OLCs that have no impact on post-closure safety) may be quite directly identified; therefore it is not a central part of WG2 working plan. Instead, WG2 will develop a list of OLCs that are related to the SE and DT, with implications on post-closure safety. For example, geotechnical works will need OLCs related to the host rock and consequently the post-closure safety. Another example would be related to OLCs on ventilation that ensure a safe underground environment for the workers; these OLCs however should also take into account post-closure safety considerations in the sense that the ventilation should not induce unacceptable damage by desiccation to the host rock (clay) or the engineered barrier (concrete). In addition the role of monitoring to verify the OLCs will be investigated.

Depending on national legislation, part of the regulations applicable to nuclear activities may apply to the construction activities since concurrent construction and operation activities necessitates the protection of the workers from both conventional and radiological hazards.

As the development of Waste Acceptance Criteria (WAC) is a crucial element in the overall safety case covering both operational and post-closure periods of GDF life cycle, WG2's work will aim also at clarifying the interface and links between WAC and OLC.

### 3.2.4 Interaction with other groups: update of Safety Case

This activity will likely start in the third year of GEOSAF III and the detailed work plan will be determined at the end of the second year.

### **3.3 Working group 3 (WG3): Managing uncertainties and deviations, implementing corrective actions and updating the safety case**

WG3 will look at the management of uncertainties and deviations from the DT and SE, when and how to implement corrective actions should deviations occur, as well as their potential implications for the safety case. WG3 needs to work closely with WG2 in order to come to a common understanding of the following points:

- SE and DT definition: how to assign parameters that are relevant to safety?
- What is the relationship between design, manufacturing, and construction requirements and the Design Targets at different stages of development (conceptual and repository evolution)?
- How will the DT take into account variations originating from construction, operations and long term/post closure scenarios?

Since the SE is to a great extent derived from external conditions (i.e. based on the regulatory authority/stakeholders' requirements), and might potentially be changed only due to external factors such as political decisions or changes, basic national legislative governance, etc., WG3 will concentrate on DT, which is (more or less) under control of the implementer/regulator and needs to be adjusted so that DT always will fall inside the SE.

WG3 will look at the topics as detailed below, taking into account the specific questions coming out of the GEOSAF III Inception Meeting (May 2016), now in Annex 2.

#### 3.3.1 Managing uncertainties

The management of uncertainties depends on their types. .

Tools to deal with identification and characterization uncertainties could be:

- Sensitivity analysis to determine if the uncertainty is relevant for safety
- FMEA (failure mode & effects analysis) to find deviations and possible failures
- Scenario analysis to deal with uncertainties related to the future evolution of the disposal system

#### 3.3.2 Confirmation and Managing deviations

During the process of developing a disposal system and during its operational phase deviations from the originally defined SE and DT might occur. Deviations from the SE might be caused by changed regulations or changes in stakeholder expectations. Deviations from the DT might be caused by new findings according to the development of science and technology or according to experience gained during the operation of the disposal facility. Deviation from the SE and the DT have to be identified, their relevance both for operational and post closure phase has to be assessed and the way to manage them during the disposal system development process has to be defined.

### 3.3.3 Managing corrective actions

Deviation from the SE and the DT may cause corrective actions. These actions have to be identified, their relevance for post closure safety has to be assessed and the way to manage them during the disposal system development process has to be defined.

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### 3.3.4 Updating the design target and related safety case and safety assessments

When the ABS falls outside of the DT, corrective actions to bring the ABS back into the DT might be needed. If this is not feasible, and the ABS is still within the SE, the DT, safety case and corresponding safety assessment must be updated. When the ABS falls outside the SE and corrective actions cannot bring the ABS back inside the SE, then further decisions/actions must be made.

## **3.4 Working methodology for WG2 and WG3**

All WGs should ensure consistency between their concepts, recommendations, and conclusions. In particular for WG2 and WG3, since there are many overlap and interdependencies of the issues to be addressed, interactions must be frequent, at both plenary meetings and additional working group meetings. The WGs do not have to wait for input from others, but exchange of ideas must be promoted at all stages.

The WGs will sequence the handling of questions on the project time line. The development of responses to the questions must be verified for mutual consistency. The set of questions intends to help or to encourage the formulation of report headings of the final report. It can be also a good practice if stakeholders (implementers, regulators) emphasize those questions that are high in their priorities.

### Work Plan for WG2

#### Year 1

During the first year, WG2 will look at some selected international guidance, other programs and specific safety cases in order to identify the elements that could be used to give material to the concepts previously summarized. WG2 will focus on relevant examples from different kind of waste disposal facilities and safety cases (LLW, ILW, HLW and SF) to obtain practical information on handling uncertainties, monitoring and deviation management. The input documentation could be:

- National safety cases, preliminary safety cases and lessons-learned (Sweden, Finland (the Chairs will request cooperation from people outside WG2 to get information about the Finnish safety case, Hungary, USA (WIPP), UK, France)
- Relevant reports from Modern2020
- Document from UK safety assessment principles and a few references from international standards could be used in that way (International council of systems engineers (INCOSE), NASA handbook, International standard (ISO 15288) used by the UK, another reference will come from the UK

Link with WG3: WG2 offers to investigate the sources of documents listed above and give the relevant sections to WG3 with respect to the topics from its work plan.

⇒ Meetings:

A consultancy meeting of the GEOSAF core group in the IAEA Headquarter, 11-13 December 2017.

- Discussion based on existing Safety Cases (from Sweden and Finland) and clarification of the terms “Safety Envelope” and “Design Target” and interlinks with the “Safety Case” and “Safety Assessment”.

A two(three)-day internal meeting Working Group meeting, Paris, February 2018.

⇒ Deliverables:

- Identification of the safety case documents available for WG activity, relevant sections of the safety cases, amount of the text to be worked through, allocation of responsibilities and sub-tasks between WG members;
- Preliminary description of the terms “Safety Envelope” and “Design Target” and interlinks with the “Safety Case” and “Safety Assessment”.

A joint Working Group meeting, IAEA Headquarter, Vienna, 9-13 April 2018.

⇒ Deliverables:

- List of relevant sections of the safety cases and text/elements/preliminary database for requirements that are useful.
- Elaboration on the description of the Safety Envelope and Design Target.
- Preliminary proposals from the WG2 for the table of contents for the final report.

## Year 2

Based on the information gathered in year 1, Year 2 aims at elaborating on the concepts previously reviewed, identifying the gaps and the need for further guidance or developments, if any.

- ⇒ Deliverable: Report containing all references used, the answer to as many of the questions (see annex) as possible and also the identification of questions for which insufficient knowledge was available to the group and potential need for further guidance or developments.

⇒ Meetings:

A WG2-internal meeting during year 2 is planned, before the plenary meeting of GEOSAF III (tentatively February 2019), to start writing down the implementation of the concepts detailed above that will have been discussed during year 1 from the reading of different documents and safety cases.

### Year 3

A joint workshop is planned with WG3 during year 3 before the plenary (around October 2019). The aim of this workshop will be to integrate in a common preliminary report what has been found and to check relevance with other IAEA projects (PRISMA...).

*A consultancy between Chairs and group leaders is expected before the last plenary meeting.*

### Work Plan for WG3

#### Year 1

During the first year, WG3 will look at some selected international guidance, other programs and specific safety cases in order to identify the elements that could be used to answer the questions related to the the WG3 topics. WG3 will look into relevant examples from different kind of waste disposal facilities and safety cases (LLW, ILW, HLW and SF) to obtain practical information on handling uncertainties, monitoring and the management of deviations.

Task 1: Making a list of documentation related to uncertainties, monitoring and handling of deviations

- Identify existing IAEA guidance that may be related to the WG topics
    - Use the results from the operational safety working group
    - Review SSG-31, SSG-23, SSR-5, SSG-14
  - Identify other references and sources, e.g., IGSC and EC programs/MODERN, the joint IAEA/NEA workshop, and national practices.
  - Enquire about other possible useful sources, to decide actions about them.
  - Make a LIST 1 of the relevant references and information therein. Identify text/elements that are useful to answer the questions. (group leader & deputy group leader take care of the task)
- ⇒ Deliverable: LIST 1 of relevant references and information related to uncertainties, monitoring and handling of deviations

Task 2: The way uncertainties, corrective actions, DT & SE are taken into account in safety cases

- Review safety cases from different member states in order to draw examples on how the following points are addressed:
  - How are DTs and SEs defined?
  - How are the handling of uncertainties, monitoring issues and the handling deviations addressed in the IAEA Safety Standards and ongoing IAEA projects?
  - How are the issues of managing corrective actions and safety case update addressed?

- Make a LIST 2 of the relevant examples from the national safety cases. Identify text/elements that are useful to answer the questions.
- ⇒ Deliverables: The LIST 1 of relevant references and sections therein and LIST 2 with national examples to be used in year 2.
- ⇒ Meetings:

A consultancy meeting of the GEOSAF core group in the IAEA Headquarter, 11-13 December 2017.

- Discussion based on existing Safety Cases (from Sweden and Finland) and clarification of the terms “Safety Envelope” and “Design Target” and interlinks with the “Safety Case”, “Safety Assessment” and their updates.

A two(three)-day internal meeting with WG2, Paris, February 2018.

- ⇒ Deliverables:
  - Identification of relevant references and sources of information related to uncertainties, monitoring and handling of deviations available for WG activity, amount of the text to be worked through, allocation of responsibilities and sub-tasks between WG members;
  - Draft a LIST 2 based on exchange of information on available national safety cases with the WG2 to be used in GEOSAF Part III.

A joint Working Group meeting, IAEA Headquarter, Vienna, 9-13 April 2018.

- ⇒ Deliverables:
  - LIST 2 of the relevant examples from the national safety cases. Identify text/elements that are useful to answer the questions from Annex 2;
  - Revision of the WG3 activity scope in line with a Working Group on the Use of Monitoring Programmes in the Safe Development of Geological Disposal Facilities for Radioactive Waste and MODERN2020;
  - Preliminary proposals from the WG3 for the table of contents for the final report.

## Year 2

Based on all information gathered during year 1, a drafting of the answer to the questions will be possible. There will also be the identification of gaps and the need for further guidance or developments. During this year, the results should also be merged with the developments from group 2.

### Task 3

- Answer the questions based on the collected information on:

- Uncertainties
- Monitoring and managing deviations
- Managing corrective actions and
- Updating the safety case
- Identify mismatch (gaps) between national safety cases and the IAEA Safety Standards.
- Propose some general ways of addressing the mismatch. Provide further guidance or developments.

### Year 3

During this year, the results should be merged with the developments from WG 2. Contributions to the common report for WG2 and WG3 will be prepared.

#### Task 4

- Integration of the results of WG2 and WG3. Second common workshop between group 2 and group 3.

#### Task 5

- Draft the report (common report for WG2 and WG3)
- ⇒ Deliverable: Report containing all references, the answer to as many of the questions as possible and also the identification of questions for which insufficient knowledge was available to the group and potential need for further guidance or developments.

### **3.5 Final deliverable from GEOSAF III**

The project aims at developing guidance on how safety cases are used and reassessed/updated with respect to the specific topics identified for GEOSAF III (see section 3).

The results of WG1, WG2 and WG3 will be integrated in a joint report which might, if appropriate, be published as one or more publications. An integration working group will be established at the beginning of the second year in order to facilitate this integration and ensure the deliverable is prepared in a timely manner.

## **4 References**

- [1] INTERNATIONAL ATOMIC ENERGY AGENCY, Disposal of Radioactive Waste, IAEA Safety Standards Series No. SSR-5, IAEA, Vienna (2011).
- [2] INTERNATIONAL ATOMIC ENERGY AGENCY, Geological Disposal Facilities for Radioactive Waste, IAEA Safety Standards Series No. SSG-14, IAEA, Vienna (2011).



[3] INTERNATIONAL ATOMIC ENERGY AGENCY, Safety Case and Safety Assessment for the Disposal of Radioactive Waste, IAEA Safety Standards Series No. SSG-23, IAEA, Vienna (2012).

[4] INTERNATIONAL ATOMIC ENERGY AGENCY, Monitoring and Surveillance of Radioactive Waste Disposal Facilities, IAEA Safety Standards Series No. SSG-31, IAEA, Vienna (2014).

[5] GEOSAF I and II reports:

- GEOSAF I report: <http://www-ns.iaea.org/downloads/rw/projects/geosaf/draft-final-report.pdf>
- GEOSAF I companion report: <http://www-ns.iaea.org/downloads/rw/projects/geosaf/companion-report-on-operational-safety.pdf>
- GEOSAF II TECDOC-proposal: Managing integration of post-closure safety and pre-closure activities in the Safety Case for Geological Disposal
- GEOSAF II: Task Group on Operational Safety, progress report, January 2015. ([http://www-ns.iaea.org/downloads/rw/projects/geosaf/geosaf\\_report\\_task\\_group.pdf](http://www-ns.iaea.org/downloads/rw/projects/geosaf/geosaf_report_task_group.pdf))

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## 5 ANNEX 1.

### Working Group 2 (WG3) – guiding questions

#### 5.1 Design Target and Safety Envelope

- Are there examples on how the DT and SE are implemented in national programs?
- What are the benefits for using DT and SE at every step of evolution of the safety case?
- What are the risks identified at every step in the Safety Case of non-implementation of DT and SE?
- How often DT and SE are expected to be updated?
- What guidance could be proposed to use the DT and SE concepts?
- What is the difference between design, manufacturing, and construction requirements and the DT at different stages of development (conceptual and repository evolution)?
- How will the SE take into account variations originating from construction, operations and long term/post closure scenarios?
- How to assign DT and SE parameters that are relevant to safety?

#### 5.2 Requirements

- How is it shown that requirements will lead to justified and motivated DT?
- How are requirements and their corresponding monitoring justified in the safety case?
- How are requirements relevant for safety (observable, measurable, controllable...) defined?
- What difference can be made between general (conceptual, stakeholders), design (safety related other aspects relevant), manufacturing and construction requirements, and how do these affect the safety case?
- How is the link between QA/QC and requirements ensured?
- Is there a need for harmonization (maybe guidance) of requirements management?
- How much or why the requirements are expected to change or managed at different stages of development and during construction and operation?

#### 5.3 Operational limits and conditions

- Data acquisition and parameter selection: what data or parameters are relevant to OLC?
- How are the risk analyses addressed in the Safety Case related to the definition of limits?
- How do OLC take into account DT and SE that are specific to the geological disposal concept?
- How to verify that all relevant parameters are included (completeness)?
- How are the action limits defined?

#### 5.4 Interaction with other groups: update of Safety Case

- How does the Requirement Management system complete and integrate arguments from requirements through operational limits to the DT, SE, and Safety Case?
- How is the consistency between requirements, SE and the Safety Case shown?
- How to identify situations when DT, SE, or Safety Case need updates, and how this process is implemented?

## **6 ANNEX 2.**

### **Working Group 3 (WG3) – guiding questions**

#### 6.1 Managing uncertainties

WG3 could address the following questions to guide the group's work:

- How are uncertainties associated with SE and DT identified during all phases?
  - What kind of uncertainties is associated with DT and SE? (For example, *parameter uncertainties, conceptual uncertainties, scenarios uncertainties, modelling uncertainties, feasibility issues associated with manufacturing*).
  - How do uncertainties evolve during the different phases of the development of a disposal facility?
  - How do assumptions taken at each stage influence the uncertainties on DT and SE?
  - How can uncertainties be identified and characterized?
- How to organize R&D and monitoring up to the closure of the facility in order to improve knowledge or to reduce uncertainties so that the as-built state will fall within the DT?
- How to identify which uncertainties will pose the greatest risk for not meeting the design target? How to put emphasis on these uncertainties?
- How to manage known or more or less known uncertainties and to account for unknown uncertainties during all phases related to DT and SE? What margin needs to exist between DT and SE? When do R&D and monitoring programs need to be updated?

#### 6.2 Confirmation and Managing deviations

WG3 could try to address the following questions in order to deal with the subject of management of deviations.

- How to tie parameters and their deviations to performance confirmation?
- How to identify deviations?
- How to differentiate deviations from anticipated variations?
- How to assess the consequences of deviations?
- How to link the concept of SE and DT to the guidance concerning monitoring and surveillance? Is QC/QA included in this?
- Do we have sufficient methods or tools in order to apply SSG-31 in the framework of SE and DT?

- Is SSG-31 sufficient or do we have to develop further guidance?
- At what level of deviation should the regulatory authority be notified?

### 6.3 Managing corrective actions

WG3 could address the following questions to help with the group's work on managing corrective actions.

- Are there mechanisms to identify corrective actions including emergency responses and to decide on their impact on DT/SE?
  - How to identify the potential corrective actions? How to assess the effectiveness of these potential corrective actions? How to determine their impact on the DT/SE?
  - How to decide which, if any, of the corrective actions need to be implemented?
- Do we have sufficient knowledge, methods, and tools to decide on, plan, and apply the corrective actions during different stages of the life cycle of the facility?
- How to link the concept of SE and DT to existing guidance concerning corrective actions?
- Is existing guidance sufficient or do we have to develop further guidance?

### 6.4 Updating the design target, safety envelope and related safety case and safety assessments

WG3 could address the following questions related to this subject.

- What are the triggers to update the SC and safety assessment or how often they should be updated?
  - What updates of the SC are related to the major steps in the development of the disposal system?
  - What updates are planned during operations?
  - What updates related to unplanned situations would be necessary? Does all corrective actions require update of the SC?
  - When updating DT, should SE also be revised or updated?
  - When performing periodical update of the SC for GDF should DT and SE be updated as well?
- How to link the concept of SE and DT to the guidance concerning SC and supporting safety assessments update? (link towards group 2)
- Is SSG-23 sufficient or do we have to develop further guidance to address DT and SE?
- How does update of DT, SE and corresponding SC & SA relate to environmental impact assessment update?