

GEOSAF

Operational Safety Working Group

Main outcomes

The GEOSAF Steering committee set up a working group dedicated on Operational Safety in 2010, considering that little work had been performed so far on that subject at the international level. This group was established to focus on hazards identification for the operational phase of a geological disposal facility and on the methodology used for the safety assessment. Both items are arguments incorporated into the safety case of a geological disposal facility.

The GEOSAF Operational Safety Working Group highlights the following results from the studies performed until summer 2011.

Operational safety context

In order to build a set of arguments for the safety case, the operator shall provide inputs on hazards, systems (general term encompassing all of the elements (items) of a facility or activity which contribute to protection and safety, except human factors) and controls, and layout of the geological disposal facility, which form the basis for the operational safety assessment. Little feedback comes from existing geological disposal facilities, therefore experience gained from various sources is to be taken into account:

- surface nuclear facilities,
- disposal facilities (both surface and underground when feedback is available),
- underground conventional facilities (mines, tunnels...),
- industrial facilities when applicable.

In particular, the identification of hazards applicable to the geological disposal facility shall reflect the set of events, situations, both internal and external, nuclear and non-nuclear, by analysing the experience gained from the facilities as mentioned above.

In this context, the operational safety assessment of a geological disposal facility shall be built on three pillars which are deeply connected to each others:

- the safety functions during the operational phase and the components aiming at fulfilling them,
- the activities and processes within the facility and its layout,
- the hazards applicable to a geological disposal facility.

Hazards identification and assessment methodology

As underlined above, hazards identification and assessment have to be performed as a set of arguments incorporated into the safety case for operational safety assessment purposes. A general methodology based on experience from various facilities (see “inputs for the safety case”) and different countries has been developed for identifying and assessing the hazards that may be foreseen in a geological disposal facility.

The practical implementations of such a methodology may vary between countries and/or operators, however all share the same basic principles that form the general methodology. These basic principles are more or less common to any nuclear facility and stick to the requirements of IAEA SSR-5. As a consequence, all studied implementations seem to be applicable for the development of a hazards assessment. It is recognised that the general methodology developed for

assessing the hazards linked to standard nuclear facilities is in principle applicable to geological disposal.

Pilot Study

A pilot study on the “Fire” hazard was performed in order to test the general methodology as mentioned before. Practical implementations of such a hazard assessment were brought up from different countries. It was shown that the assessment of the fire hazard, though performed through different practical steps, did not raise issues that are specific to a geological disposal. Therefore the methodology of hazards assessment in place seem to be efficient in providing the correct inputs for the safety case but the quantification of fire effects remains an open issue. As a matter of fact, this pilot study underlined the strong need for tools, models, experience feedback and knowledge on the effects of fire in the underground facilities, which have to take into account the peculiarities of the layout of a geological disposal facility: (long) drifts, size, accesses, etc. This conclusion would probably be expanded to other types of hazards.

Relationships between post-closure safety and operational safety

Besides considerations on methodologies for hazards assessment, strong relationships between operational safety and post-closure safety were outlined: on the one hand, design and operational constraints are set by post-closure safety requirements, while on the other hand, operation has some impact on post-closure safety. The definition of normal operation through the identification of the safety envelope of the facility, incidents and accidents, and the way the geological disposal facility is operated in each situation, remains a technical challenge at that point.

As a consequence, the GEOSAF Operational Safety Working Group identified further works in the field of operational safety of a geological disposal facility.

Quantification of hazards in safety assessment

As underlined in the pilot study, the quantification of the actual effects of identified hazards requires specific developments aiming at deriving and testing performance criteria (temperature, pressure, size, position...). They shall be chosen for the safety targets and the components important to safety, and controls shall be associated, taking into account the specific environment of a geological disposal facility.

Furthermore, scenarios involving incidents, accidents, failures of safety systems or controls shall be identified and screened. Special care shall be put on the selection of envelope scenarios that will be used as a reference for the design and assessment of a geological disposal facility.

Operation states of a geological disposal facility

The definition of normal operation, abnormal operation (incidents) and accidents, and the associated set of safety margins and conditions to get from one state to the others, is an area of knowledge to be developed. As few experience feedback is available from existing geological disposal facilities, special care should be taken on gaining experience from other facilities (see “inputs for the safety case”) for the definition of the safety envelope in line with the definition of normal operation.

Co-activity

A geological disposal facility is built, equipped and operated at the same time. As a result, different processes, nuclear (emplacement of waste packages, handling...) and non-nuclear (mining, civil engineering...) are likely to be located in the same place at the same time. Therefore, hazards assessment shall reflect the events that are linked to both nuclear and construction activities and their interactions.

Moreover, construction and operation in parallel raise issues on the ongoing development and update of the safety case, especially the safety report, which is aimed at reflecting the exact state of the facility. The challenge is to take into account an ever-changing environment, with a

great potential for variations of the hazards induced by the ever-changing activities performed in the geological disposal facility.

Need for guidelines

GEOSAF made strides in providing tools and guidelines for operators and regulators to build and/or assess the safety of a geological disposal facility through the use of the safety case, with a strong focus on post-closure safety. However, operational safety assessment shall be included in the safety case as well, but few guidelines exist to help operators and regulators for doing so. A good start could be the identification of detailed contents of the safety case for the topics related to operational safety, the application of the tools (questionnaire) developed during the GEOSAF project.

Relationships between operational safety and post-closure safety

Impacts of post-closure constraints on the design and implementation of the geological disposal facility and its safety envelope for the operational phase shall be identified. In contrast, the impact of operation, including construction, on post-closure safety shall be made clearer. As an example, the analysis of incidents and accidents during the operational phase with regard to post-closure safety functions and requirements needs to be underlined.

This highlights the importance of a specific and particularly comprehensive monitoring of construction and operation activities. Records should be kept and screened for both incidents and events occurring in normal operation, which may impact post-closure safety.

Relationships between operational safety and closure

Closure is a set of processes that will take place at the end of the operational phase. So far, very little feedback exists on the concepts of closure that will eventually be used, the materials, the procedures, etc. Therefore, the impact of closure processes on operational safety shall be identified, through the components and processes that are prepared during the operational phase for that particular moment.

A reference solution for closure shall be made available very early in the project, namely before construction begins, in order to guide the development of the design and the manner to operate the facility in a way compatible with the closure process. Reversibility and stepwise decision process may also lead to a specific management of a geological disposal facility, which would allow partial closure phases during the whole operational phase. The impact of partial closure both on operational safety and on post-closure safety shall then be identified as well.

Reversibility/Retrievability

Reversibility and retrievability are subjects already widely addressed by operators and by organisations such as OECD/NEA RWMC. As stressed above, they have some impact on operational safety. A major challenge at this time remains the identification of criteria and the associated monitoring of the facility that will guide the application in practice of the R&R principle. In particular, the identification and quantification of facility's states upon which strategic choices for operating the facility will be possible are crucial in the definition of the R&R principle. Therefore links shall be made between IAEA and above mentioned organisations in order to include the experience gained on the design, operation, closure and management of a geological disposal facility.

As a conclusion, the GEOSAF Operational Safety Working Group shows a strong interest in developing areas of knowledge to better grasp operational safety issues that are applicable to a geological disposal facility. The development of tools and the need for international harmonization on practices for implementation of the safety case are also acknowledged in order to help operators and regulators developing and/or assessing the arguments related to operational safety.