
Geological Disposal of Radioactive Waste: Elements of a Safety Approach

French-Belgian Working Group

AFCN/FANC: Federal Agency for Nuclear Control, Belgium

ASN: Autorité de sûreté nucléaire, France

AVN: Association Vincotte Nuclear, Belgium

IRSN : Institut de radioprotection et de sûreté nucléaire, France

ANDRA : Agence Nationale pour la gestion des Déchets Radioactifs, France

ONDRAF/NIRAS: National Agency for Radioactive Waste and Enriched Fissile Materials, Belgium

Abstract:

This paper presents the document “Geological Disposal of Radioactive Waste : Elements of a Safety Approach” which is the result of a common undertaking in collaboration in the field of nuclear safety and radiological protection between France and Belgium. The document was elaborated by a working group involving experts from the regulatory authorities, their technical supporting organisations and the implementers. The elements of the safety approach comprise the radiological protection objectives, the safety principles, the safety functions that form the basis for the safety case of a geological repository, as well as reflexion on the appraisal of acceptability of the safety case. The document has no regulatory or normative status, nor was it the intention to cover all aspects that are relevant for a safety case.

1 INTRODUCTION

This paper refers to a document [1] that has been developed within the general framework of the French-Belgian collaboration in the field of nuclear safety and radiological protection. Specific collaboration in the field of the safety approach to disposal in deep geological formations began in June 2000 and led to the creation of a working group involving experts of the regulatory authorities ASN(a) and AFCN/FANC(f), their respective technical support organisations, IRSN(d) and AVN(b), and the implementers ANDRA(c) and ONDRAF/NIRAS(e). This document has no regulatory and/or normative status as well it was not the intention to cover all the aspects of the safety.

Upon initiative of ASN and AFCN/FANC, and with due account for ongoing and published work from ICRP, IAEA and OECD/NEA, regular bilateral discussions have allowed the convergence of ideas and have resulted in the elaboration of the “Elements of a Safety Approach” document. This document establishes a link between the protection of man and the environment (basic objective of protection) and the disposal system through the application of safety principles and the identification of safety functions as well as the development of a framework for the judgement of the acceptability of safety cases by regulatory authorities and decision-makers.

2 ELEMENTS OF A SAFETY APPROACH

The concepts of safety functions, safety principles and radiological protection principles are described as an integral part of an approach to be taken into account in the development, the implementation and the evaluation of the long-term safety of a radioactive waste repository in deep geological formations. Based on the concentration and containment strategy, the proposed approach provides a structure for and facilitates the judgement of acceptability. In this sense, this proposed safety approach establishes a link between the basic objective of protection and the implementation of the safety principles, the radiological protection principles and the safety functions.

The safety approach is focussed on long-term safety which is purely “passive” in that sense that it cannot be based on maintenance or institutional control with regard to the very long time frames at stake. It must imply the implementation of passive means to ensure safety. This implementation of passive means during any given stage has specific repercussions on all subsequent stages.

The safety principles establish the orientation and methods that provide a framework for the definition of a strategy for developing a repository. The safety functions and their implementation contribute to the establishment of this strategy for the development of a disposal system and the soundness of this strategy is examined in a safety case. Based on these concepts of safety principles and safety functions and taking external programme and design constraints into account, the implementer develops its disposal project, in particular, allocating the safety functions to the different components of the disposal system. This allocation must be supported with arguments and justified in the safety case. The elements of the safety approach presented in this document underline the importance of the qualitative argumentation of a safety case. This allocation means that a strategy where the implementation of the safety functions is consistent with the safety and protection principles must enable the basic objective of protection to be achieved. Figure 1 illustrates the relationship between the different elements of the safety approach.

2.1 Example of elements of safety approach

As an example of elements of the safety approach, a focus is given in the following paragraphs on the safety principles and the judgement of acceptability.

2.1.1 Safety Principles

The important concepts generally used in the development of a safe repository (robustness, passivity, technical feasibility, simplicity) fall under the principle of defence-in-depth and the principle of demonstrability.

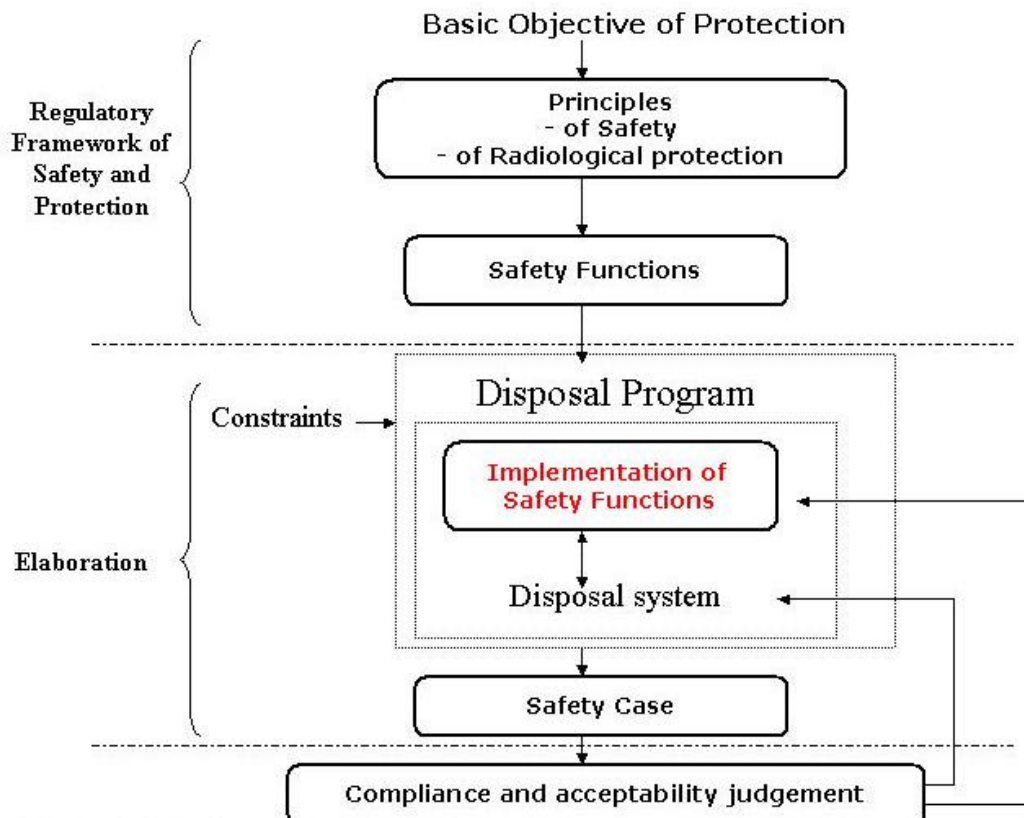
When applied to a repository in a geological formation, the principle of defence-in-depth implies the implementation of "multiple safety functions". In this case, it is not the number and redundancy of the barriers as such that take on the greatest importance in terms of safety, but the fact of being able to depend on different mechanisms and/or components to provide safety functions (isolation, containment, limitation and retardation).

The principle of “demonstrability” consists of adopting methods of system development that will make it possible to demonstrate that the functions and performances expected from the repository components will be fulfilled and maintained no matter what reasonably foreseeable disturbance may impact the system.

2.1.2 Judgement of acceptability

The radiological impact is judged on the basis of compliance with the fundamental objective of protection.

The bases for the long term radiological assessment have been subject to some developments on the potential weaknesses of the conventional indicators, on complementary elements of these conventional indicators and on scenario classification (normal evolution scenarios, altered evolution scenarios, human intrusion scenarios, "beyond design limit" scenarios and "what-if" scenarios) and associated criteria or reference values. "Conventional" indicators to quantify the radiological impact are effective dose rate and radiological risk.



On the basis of such iterations and at each stage of the programme, a judgement of acceptability of the safety case can be formulated. This judgement constitutes the basis of the decision either to move to the next stage or to reiterate.

3 CONCLUSION

The notions of safety principles, radiological principles, safety functions and the basis of the judgement of acceptability of the radiological impact assessment, which have been discussed in various international cooperative work, have been further integrated in a comprehensive framework for a safety approach. .

The schematic presentation of a structured safety approach should presumably enable better explanation and communication of the global safety issues to different stakeholders.

ACKNOWLEDGEMENTS

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REFERENCE

- [1] Geological Disposal of Radioactive Waste: Elements of a Safety Approach (in publication)