

## Concept for carrying out representative preliminary safety analyses in accordance with the Repository Safety Investigation Ordinance (EndlSiUntV)

In Step 2 of Phase I of the site selection procedure for a repository for high-level radioactive waste, the Bundesgesellschaft für Endlagerung (BGE) will develop a proposal for siting regions for surface exploration. The starting point for this work is the [Sub-areas Interim Report](#), whose publication marked the completion of Step 1 of Phase I of the repository search by the BGE. In the Interim Report, the BGE identified 90 sub-areas, including 60 sub-areas in steep rock salt (salt domes and salt walls), 14 sub-areas in flat-lying rock salt, nine sub-areas in clay rock, and seven sub-areas in crystalline host rock – in total, 54% of German national territory is covered by sub-areas. Based on the underlying data, it can be expected that these sub-areas offer favourable geological conditions for safe and permanent final disposal.

In order to organise surface exploration expediently in Phase II, it is necessary – in Step 2 of Phase I – to identify a number of siting regions with a manageable area for surface exploration. The siting regions must be narrowed down significantly with respect to the number and size of sub-areas. To this end, the BGE has three instruments at its disposal: representative preliminary safety analyses, renewed application of the geoscientific consideration criteria and, if necessary, application of the planning scientific weighing criteria.

The latter are only used to further narrow down areas that offer equivalent safety based on their geology. At this point in time, it is not possible to determine how many siting regions will be proposed. The BGE is currently working on the basis that there will be around 10 siting regions, but it may ultimately propose more or less than this number.

This document describes the proposed methodology for the first narrowing-down instrument: the representative preliminary safety analyses.

## Procedure for representative preliminary safety analyses

The representative preliminary safety analyses provide a holistic view of the safety and robustness of the repository system. At the heart of the procedure for these analyses are four categories into which areas are to be classified over the next few years of processing. Category D describes areas that are unsuitable for the final disposal of high-level radioactive waste. Category C describes areas with very low suitability. Category A describes areas with optimum suitability that are to be taken forward into the next step of assessment in Step 2 of Phase I: the renewed application of the geoscientific consideration criteria.

Category B describes areas with less suitability in which the safe containment of high-level radioactive waste appears to be possible but that do not perform as well as Category A areas (see Figure 1).

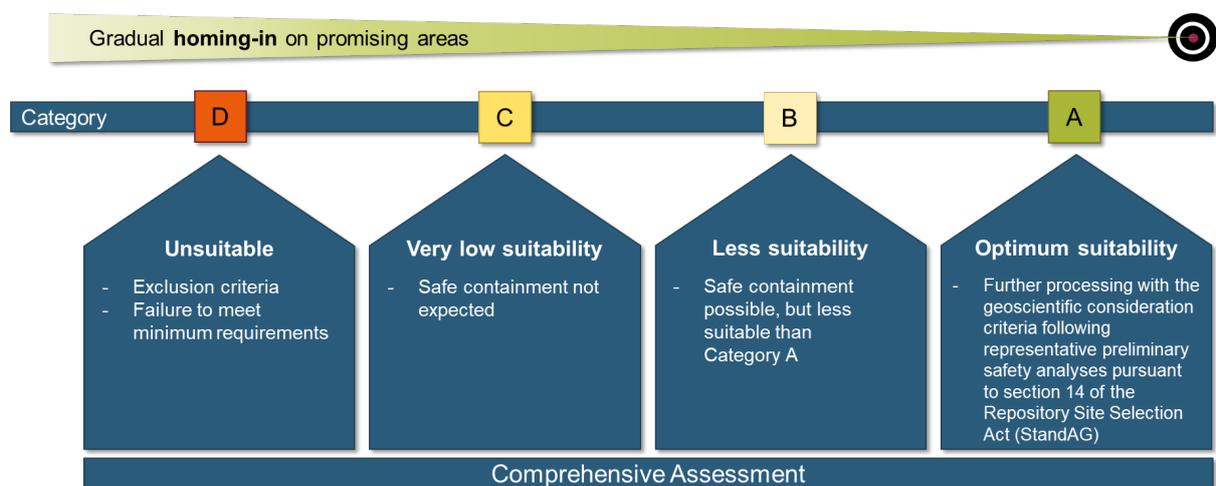


Figure 1. Categories for comprehensive assessment as part of representative preliminary safety analysis.

## Division into investigation areas

For the representative preliminary safety analyses, the sub-areas will be divided into “investigation areas”. The Repository Safety Investigation Ordinance (EndSiUntV) stipulates that the investigation areas must completely cover the sub-areas. The BGE will therefore designate an investigation area for each individual sub-area. Insofar as multiple safety concepts are conceivable in one sub-area, dedicated investigation areas must be designated for each safety concept. In principle, a distinction is drawn between two such concepts:

1. the concept of the containment-providing rock zone, in which the geology around the repository mine ensures the essential barrier for permanent and safe containment
2. the concept of the interaction between the technical and geotechnical barriers, in which the geology serves as a further barrier.

With regard to the 60 salt domes and salt walls that are still being considered as part of the procedure, this is also a sensible division in terms of the size of the areas. In large sub-areas

in which the host rock is clay rock, crystalline rock or flat-lying rock salt, the BGE will further subdivide the investigation areas into investigation sub-areas if necessary in order to make the representative preliminary safety analyses more comprehensible and more representative. The common feature of the investigation sub-areas is that they have the most uniform geoscientific characteristics possible for processing and assessment within the representative preliminary safety analyses. However, it may also be the case that these investigation sub-areas are subdivided into further areas as part of this work, for example if a minimum requirement is not met or an exclusion criteria applies in part of the area. The processing then ends only for this affected area, and the rest of the investigation sub-area is examined further.

### Category D

Several assessment steps are carried out in order to systematically review all investigation areas and investigation sub-areas with regard to their potential suitability for the designation of a “containment-providing rock zone”. Here, areas can fail to meet the exclusion criteria or minimum requirements, which are reviewed on an ongoing basis throughout the representative preliminary safety analyses, because new insights are constantly being gained from existing or newly acquired data. These areas are assigned to Category D – in other words, they are excluded from further processing and are not suitable for final disposal.

### Overarching work

So-called “geosyntheses” – comprehensive descriptions of the geology – are prepared for all investigation areas. Geosynthesis in particular is a process that is refined and expanded for an area on an ongoing basis depending on the processing step. For areas that remain in the procedure, the geosyntheses are only completed towards the end of the representative preliminary safety analyses, which also incorporate a preliminary safety concept, including a preliminary design of the repository. Here, a distinction is drawn between safety concepts that rely primarily on a containment-providing rock zone and those in which the retention capacity is derived from geotechnical structures such as closure structures and from the container. In this early phase of the site selection procedure, the first general concepts for final disposal are developed by making appropriate reference to the host rock with a view to drawing up the preliminary design of the repository.

In addition, the BGE compiles a waste inventory that serves as the basis for designing a possible repository. This work is important for all investigation areas.

## **Category C – qualitative assessment**

Areas that are not assigned to Category D are to undergo further examination. Here, the aim is to find out whether a containment-providing rock zone can be designated within an area – and how safe this zone might be. For example, this assessment step evaluates the scope for spatial characterisation of the rock mass. It also examines whether the geological conditions will remain stable in the long term, as well as taking account of further aspects that indicate poor suitability. If this step of the assessment does not yield a predominantly good evaluation, the area in question is assigned to Category C, which denotes areas with very low suitability for a repository.

## **Category C – quantitative assessment**

The remaining areas are now considered quantitatively. The Repository Safety Requirements Ordinance (EndlSiAnfV) contains corresponding limit values that must be complied with. These limit values are very strict. When it comes to quantitative determination, they are used by the BGE in conjunction with “transport models” to examine the route by which the emplaced radionuclides could potentially be transported within the rock over a period of one million years. The areas that keep the radionuclides in the containment-providing rock zone and that can therefore meet the limit values perform better than those from which radionuclides could escape. The latter are assigned to Category C. On the whole, areas are therefore put into Category C if the BGE can say for certain that they do not include the site providing the best possible safety. These areas are also excluded from further consideration. If the areas pass the tests as part of the qualitative and quantitative assessment process, they will undergo further consideration.

## **Category A and B**

In the last step of the assessment – a safety-related discussion – all previous qualitative and quantitative assessments are considered together. This discussion once again includes a comparative evaluation and collation of all relevant information. The aim is to engage in a holistic discussion of the suitability of areas that were not assigned to Category D or C and thereby to identify the most suitable areas. These areas are assigned to Category A, and the other, less suitable, areas are assigned to Category B.

For Category A areas, a systematic description is then made of the relevant uncertainties. For areas that have also performed very well in the geoscientific consideration and that are being proposed as siting regions, the BGE demonstrates a means of reducing uncertainties. This can be achieved by assessing the exploration requirements and potential other research and development requirements with a view to carrying out the further developed preliminary safety analyses in Phase II.

## **Comprehensive assessment**

In principle, the comprehensive assessment of the repository system is carried out for each entire investigation area – in other words, each area within an investigation area is comprehensively assessed with regard to the repository system regardless of its assignment to Category A, B, C or D. This assessment can take place at different points during a representative preliminary safety analysis: in the case of Category D areas, it takes place at the moment when an exclusion criteria applies or a minimum requirement is not met. This is possible in each step of the representative preliminary safety analyses. In the case of Category C areas, the lack of suitability is not determined until the subsequent “hurdle race” – i.e. the systematic assessment of an area’s suitability as a containment-providing rock zone, which identifies any lack of suitability. In turn, this is the time for comprehensive assessment of the repository system and for the report, which provides a description of the reasons for the assessment. Such a description is then also provided for Category B and Category A areas.

## **Summary**

The procedure for the representative preliminary safety analyses aims to identify the best areas for the final storage of high-level radioactive waste. During the processing of elements of the representative preliminary safety analyses, weaknesses in the areas are therefore continually sought in order to assess whether these areas should be processed further. For areas with no or poor suitability, processing ends at this stage of the repository site selection procedure. Indeed, in the case of the site providing the best possible safety for a million years, it is insufficient for it to be anything less than completely suitable. The BGE’s processing methodology is based on the principle of reaching a depth of processing that allows the quality of the areas to be assessed in each case. More in-depth consideration is therefore always carried out for areas that have a chance of being assigned to Category A.