Note:
This is a translation of the ESK statement entitled
“Anforderungen an eine Periodische Sicherheitsüberprüfung für Endlager für schwach- und mittelradioaktive Abfallstoffe”
In case of discrepancies between the English translation and the German original, the original shall prevail.

Recommendation of the Nuclear Waste Management Commission

Requirements for a periodic safety review for disposal facilities for low- and intermediate-level radioactive waste

CONTENTS

1 Introduction

In its request to the ESK, the Federal Office for the Safety of Nuclear Waste Management (BASE) asks for advice on the subject of periodic safety reviews for disposal facilities for low- and intermediate-level radioactive waste. BASE explains the background to this as follows:

According to § 19a in conjunction with § 9h AtG [1], the licence holder is obliged to carry out a review and assessment of the nuclear safety of the respective facility every ten years and to continuously improve the nuclear safety of the facility. The results of the review and assessment are to be submitted to the supervisory authority.

Periodic safety reviews are an established instrument for continuously improving the safety of facilities. For nuclear power plants, there are transparent requirements for the content and scope of periodic safety reviews at the regulatory level. There are also corresponding ESK guidelines for conducting periodic safety reviews for storage facilities according to § 6 AtG. For disposal facilities for low- and intermediate-level radioactive waste and the Asse II mine, the content-related requirements for the performance of periodic safety reviews result, for example, from the licences. However, a comprehensive set of regulations that summarises the requirements in a transparent and comprehensible manner and develops them further where necessary does not yet exist. Here, BASE will start drafting the regulations on behalf of the BMUV.

In order to fulfil BASE's request for advice, the ESK set up the ad hoc working group on periodic safety reviews for disposal facilities (PERIODISCHE SICHERHEITSÜBERPRÜFUNGEN FÜR ENDLAGER (PSÜ ELA)) at its 104th meeting on 22 February 2023, which included members of the ESK as well as members of the ESK Committee on FINAL DISPOSAL (EL). The ad hoc working group held five meetings between June 2023 and March 2024 to prepare a draft recommendation and presented preliminary results to the EL Committee at its 99th meeting on 25 January 2024. At its 115th meeting on 25 April 2024, the ESK discussed the consultation results and adopted the present recommendation.

The present recommendation identifies elements that should be taken into account in a periodic safety review (hereinafter: PSR). For this purpose, the ESK guidelines on periodic safety reviews in storage facilities [2] and the GRS report on the concept for a periodic safety review for the Konrad repository *(Konzept für eine periodische Sicherheitsüberprüfung für das Endlager Konrad)* [3] are essentially used as starting points, reviewed with regard to their suitability for the above problem description and supplemented by considerations resulting from international agreements and regulations as well as experience gained in other countries. In detail, the GRS report [3] offers greater suitability for PSRs for disposal facilities than the ESK guidelines [2]. However, the general thematic structure (the table of contents) of both texts is very similar.

Issues relating to plant security and physical protection are not the subject of this ESK recommendation.

2 PSR regulations abroad and international recommendations

The IAEA safety standards only provide general information on periodic safety reviews of disposal facilities. According to Specific Safety Requirements SSR-5 “Disposal of Radioactive Waste” [4], the safety of existing facilities shall be assessed periodically and in the event of planned significant modifications or changes to the

conditions of the authorisation (Requirement 26). Operating experience was to be utilised. If necessary, measures were to be put in place in the event that any safety requirements are not met. In particular, decisions on such "reasonably practicable" measures were to be taken in consideration of broader technical, social and political issues for facilities that had not been constructed to current standards. However, Requirement 11 (Step by step development and evaluation of disposal facilities) already requires periodic reviews during operation and following closure of a facility, up to termination of the facility's licence. Similar references to these requirements can be found – with reference also to General Safety Requirements GSR Part 4 "Safety Assessment for Facilities and Activities" – in Specific Safety Guide SSG 23 "The Safety Case and Safety Assessment for the Disposal of Radioactive Waste" in paras 3.11 to 3.12 [5].

In its "Radioactive Waste Disposal Facilities Safety Reference Levels", para 2.4.3 [6], WENRA refers to these regulations and demands the following:

- review and analysis of operating experience,
- review of operating experience in radiation protection aspects,
- review of the waste acceptance criteria and waste quality controls,
- review of knowledge and experience of aspects affecting post-closure safety,
- review of the assumptions made in the safety case to confirm that they are still valid, and
- review of compliance with current regulatory requirements.

These points are concretised in Appendix 4, which also requires a review of whether the objectives for operation, closure and post-closure remain achievable.

In addition, Specific Safety Guide SSG-25 "Periodic Safety Review for Nuclear Power Plants" of the IAEA, para 4.5, [7] is cited with its requirement that a "basis document" in which the scope and objectives of the PSR are defined should be agreed between the regulatory body and the operating organisation before the start of the PSR. The PSR should also include an action plan for reasonable and practicable safety improvements.

Existing geological repositories for which periodic safety reviews are carried out are, in particular, the Waste Isolation Plant (WIPP) in the USA and the SFR repository in Sweden. With regard to the consideration of long-term safety aspects, the regulations of WENRA and experience from the so-called "recertification" of the WIPP were particularly taken into account in the formulation of the respective recommendations.

PSRs are also carried out every ten years in France, for example at the disposal facilities Centre de stockage de la Manche (CSM) and Centre de stockage de l'Aube (CSA). The report presented includes the following points:

- description of the facility,
- balancing of hydrological/radiological monitoring,
- safety situation in the current phase, including a list of events,
- description of the closure concept,
- safety considerations also with regard to the post-operational phase, and
- description of the long-term documentation.

The topical areas mentioned in international examples and recommendations go beyond the focus of a PSR in Germany on nuclear safety aspects during the operation of a facility as required by the Atomic Energy Act (AtG). Aspects relating to long-term safety are addressed in Chapter 3.6.

3 Structure of a PSR for a disposal facility for low- and intermediate-level radioactive waste

According to [8], the objective of the PSR is to review and assess the safety status of a nuclear installation in its entirety after a longer operating period on the basis of licences granted, the actual condition of the existing facility and the requirements of the state of the art in science and technology and thus supplement the permanent review by governmental supervision of the operation.

PSRs have already been successfully carried out in nuclear power plants for many years. However, the facilities, processes and safety aspects to be considered differ fundamentally from those in disposal facilities. The applicability of the content of the corresponding PSR regulations is therefore limited. However, credit can be taken from their logic and structure. From the ESK's point of view, the GRS report [3] presents a comprehensive concept for conducting a PSR for the Konrad repository and covers essential contents of a PSR for disposal facilities for low- and intermediate-level radioactive waste. In the following, the topics to be considered in a PSR for low- and intermediate-level radioactive waste are addressed on the basis of the thematic structure of the GRS report and, where appropriate, changes or additions are proposed.

To carry out a PSR, the following points are to be presented as a reference for a review:

- the legal framework on which the licence/plan approval of the disposal facility is based,
- all material items (installations, inventories, ...) that are relevant for operation from a safety/radiation protection point of view,
- the operational rules and regulations (operating regulations, instructions, system descriptions, etc.) required for specified normal operation,
- the safety-relevant state of the art in science and technology for the respective topical areas to be reviewed.

The starting point and basis for the first PSR after commissioning is the state of the facility at the time of commissioning as stipulated by licensing law, including the specifications from the official acceptance prior to commissioning.

3.1 Protection goals

PSRs are carried out with a focus on protection goals. According to § 8(1) of the Radiation Protection Act (StrlSchG) [9], the general rule is that any unnecessary exposure or contamination of man and the environment must be avoided (§ 8(1)). Furthermore, it is stipulated that the exposure or contamination of man and the environment is to be kept as low as possible, even below the limits, taking into account the state of the art in

science and technology and all circumstances of the individual case, ([9], § 8(2)). The following protection goals are derived from this:

- confinement of radioactive material, and
- avoidance of unnecessary exposure, limitation and control of occupational and public exposures.

As mentioned at the beginning, according to the AtG, a PSR has the task of reviewing and assessing the nuclear safety of a facility. In particular, if effects on nuclear safety cannot be ruled out, the interfaces with other areas of law, e.g. occupational health and safety, environmental, mining and water law also have to be considered.

3.2 Scope of application

In general, the PSR regulations to be drawn up cover all structures, systems and components as well as operational regulations of a disposal facility that have been or will be installed and established for the disposal of low- and intermediate-level radioactive waste, considering emplacement operation, closure operation up to sealing and aspects of long-term safety. The obligation to carry out PSRs ends with the completed closure of the disposal facility. At this point, a concept for possible monitoring should have been drawn up.

The GRS report [3] explicitly only deals with the Konrad repository against the background of the situation at the time the report was prepared. Focusing on the Konrad repository, which is currently under construction, is considered appropriate for the new PSR regulations.

The existing Morsleben repository for radioactive waste (ERAM) is to be considered separately. There is no plan approval decision for the ERAM, as is the case for the Konrad repository, but rather a permanent operating licence from the authority competent at the time of application for operation of the repository. This licence stipulates that currently overall reviews are to be carried out every five years which are, in principle, comparable to a PSR [3], [10]. Aspects of long-term safety are not dealt with in these reviews, but only in the plan application for closure. No emplacement operation has to be considered for the ERAM, only closure operation and sealing. It is therefore advisable to deal with the ERAM separately and not to consider it in the new guideline to be prepared for a PSR.

In perspective, the PSR regulations also have to take into account that a further disposal facility for low- and intermediate-level radioactive waste will be required. The National Programme for radioactive waste and spent fuel management [11] proposes that this be constructed at the same site as the disposal facility for high-level radioactive waste according to the Site Selection Act (StandAG) [12]. The StandAG in turn requires an assessment of whether this is possible without compromising the safety of the disposal facility for high-level radioactive waste. § 21 of the Disposal Facility Safety Requirements Ordinance (EndlSiAnfV) [13] requires a separate disposal mine for such a case. Furthermore, it requires that there must be no safety-relevant interdependencies or adverse influences between the technical infrastructure of this disposal mine and the technical infrastructure of the disposal mine for high-level radioactive waste. It is therefore advisable to adapt the PSR for this disposal facility with regard to the contents to be reviewed where necessary.

Another special case is the Asse II mine, which is not a disposal facility for low- and intermediate-level radioactive waste and thus does not fall within the scope of the planned PSR regulations, especially as fact finding is currently based solely on a licensing decision under the AtG. For the Asse II mine, the PSR must be considered on the basis of the application under the AtG, particularly in the context of the operation for the retrieval of radioactive waste ("Lex Asse") [14]. Here, too, reviews are to be provided for, although they differ significantly from those for disposal facilities (e.g. with regard to retrieval operation, consideration of the post-operational phase after retrieval of the waste). The Asse II mine should therefore not be dealt with in the new PSR regulations.

The ESK recommends focusing the PSR regulations to be drawn up on the Konrad repository and also considering, in perspective, another future disposal facility for low- and intermediate-level radioactive waste. However, the inclusion of further content in the topical areas to be reviewed is not excluded for this future disposal facility.

3.3 Responsibilities, periods and conduct

Responsibilities, periods and conduct are regulated by the AtG [1] and [8], respectively, and are only briefly outlined below.

Responsibilities: The operator of the facility (BGE) is responsible for carrying out the PSR. The relevant documents are to be submitted to the nuclear supervisory authority (BASE). The latter may use the PSR to specify requirements and measures for ensuring specified normal operation of the disposal facility and monitors their implementation (see also [1], § 9h in conjunction with § 19a).

Periods: According to § 19a AtG, a PSR must be carried out every 10 years (see also [2]) and for the first time after the start of operation. This period is to be understood as a binding maximum period between PSRs.

Conduct and documentation of the PSR: The GRS report [3] describes the individual steps of the PSR in accordance with the Basics of the Periodic Safety Review [8]. Accordingly, the operator has to submit a PSR timetable, subreports on the individual topical areas to be reviewed and an overall review report. The report contains the conclusions of this review and, if applicable, the precautions that the operator intends to take to eliminate any deficiencies identified or to improve the safety of the facility. The documents are then reviewed by the supervisory authority. Where appropriate, the authority will impose additional requirements that are to be met. Any necessary improvement measures are to be determined by the operator in agreement with the authority.

The PSR ends with the confirmation of the review result by the supervisory authority. The ESK follows the proposal in the GRS report [3] and recommends agreeing the timetable with the supervisory authority at the beginning, thus enabling it to intervene, if necessary, and provide for accompanying participation. There is varying experience with regard to the time required for the implementation of a PSR. Accompanying participation by the supervisory authority may help to make the procedure more efficient.

3.4 PSR structure

The GRS report [3] proposes dividing the review reports into a main report and subreports on specific topical areas relevant in terms of nuclear safety, for which guidelines have also been developed. The topical areas to be reviewed comprise the following:

- emplacement operation,
- radiation protection,
- fire and explosion protection,
- personnel / organisation,
- physical protection,
- mine safety (also includes safety aspects of ventilation of the facility),
- long-term safety, and
- external hazards.

As mentioned in Chapter 1, the ESK recommendation does not address issues of plant security and physical protection. In addition to the points mentioned above, the ESK also recommends that the following topics be addressed in areas to be reviewed:

- Accident analysis:

  According to the ESK guidelines [2], the review is to be carried out with a focus on protection goals. From the ESK's point of view, the operator must demonstrate whether the assumptions on which the licence/plan approval is based are still valid.

- Long-term documentation:

  Documentation and archiving are already the subject of a PSR. For a disposal facility, however, the preservation of information over several centuries (long-term documentation [15]) is also being discussed as part of the site selection procedure. This topic should also be considered in the PSR.

3.5 PSR scope

Both the GRS report [3] and the ESK guidelines [2] specify the scope of the PSR. As described above, the GRS report [3] proposes the preparation of topic-related subreports.

The overall review report should also contain the following information (see also [2]):

- an up-to-date description of the facility that includes the safety concept, design features and the main safety measures,

- a summary of the safety-relevant changes that were implemented or occurred during the review period,

- general aspects, such as experience with safety management and any changes to the organisation of the facility, competences, responsibilities, processes and the corresponding human resources,
- main results and findings from the reviewed topical areas,
- an evaluation of operating experience both from the facility concerned and from other facilities in Germany and abroad, and
- an assessment of the safety significance of the results.

The following is to be presented in the subreports proposed in the GRS report [3] for each topical area:

- the results of the previous PSR or a comparison with the licensing documentation and documentation of operation, respectively,
- a target/actual comparison between the current and the licensed status, including the emplaced radionuclide inventories, the behaviour of the waste forms, etc.,
- the evaluation of operational management and operating experience (operating technology, occurrences) and experience feedback, and
- whether the precautions taken against adverse effects to human health and the environment as required in the light of the state of the art in science and technology are still ensured.

The PSR results for the topical areas to be reviewed are to be described and their safety significance assessed. Necessary improvements and measures, including the timetable for implementing the measures, are to be specified.

The plan approval decision or the licence of a facility is based on the applicable safety principles and these are thus established (right of continuance). Nevertheless, when drawing up the regulations for the PSR, it should be determined whether and to what extent the changes in the prevailing safety philosophy occurring in the period under review and the resulting changes in updated regulations should be taken into account in the PSR.

As part of the PSR, an overall assessment is to be made of the ageing management measures implemented during the period under review and the knowledge gained by this.

According to § 19a AtG, a PSR must also identify opportunities for optimisation with regard to safety for all topics. In this context, the ESK also recommends examining the extent to which simplifications, e.g. in processes or technologies, are possible while maintaining the same level of safety.

3.6 Topical areas and content

The content of the topical areas proposed in the GRS report [3] is briefly outlined below. From the ESK's point of view, these can be dealt with in separate subreports to enhance clarity of presentation. It should be noted that the GRS report [3] focuses on the Konrad repository. The procedure required in the topical areas to be reviewed is already partly the subject of the project: Evaluation of the safety requirements of the Konrad repository in the light of the state of the art in science and technology (ÜsiKo) [1], which is currently in Phase II.

All topical areas to be reviewed that are described in a PSR are concerned with the documentation and assessment of safety-related events and findings during the period under review.

In general, it should be noted that if the operator becomes aware that the necessary precautions against adverse effects to human health and the environment can no longer be ensured or that this can no longer be demonstrated, this must be brought to the attention of the supervisory authority without delay. The necessary measures are then to be agreed with the supervisory authority in a timely manner.

Topical area emplacement operation

The GRS report [3] recommends a tabular comparison of safety-relevant topics in licensing documentation and documentation of operation, sorted according to the categories: systems and components as well as emplacement process with the current status. The experience gained in the course of emplacement operation and with the operating equipment should be analysed on the basis of the results of periodic inspections, preventive and corrective maintenance and on the basis of occurrences. This also includes experience with waste acceptance, including the development of the stored inventories.

In addition, the ESK recommends including aspects of the transition from emplacement to closure operation in the canon of topics as operating life of the disposal facility progresses. This includes, among other things, an analysis of the evolution of the remaining cavities, the sealing structures, long-term monitoring and an assessment of the safety of emplacement drifts that have already been backfilled.

Topical area radiation protection

Here too, the GRS report [3] proposes a tabular target/actual comparison of aspects relating to structural, technical and operational radiation protection as well as radiation protection monitoring. Radiological measurement data and their analysis should also be presented. The ESK agrees with this recommendation.

Topical area fire and explosion protection

This topical area includes verifying compliance with the licensing requirements for fire/explosion prevention and defensive fire/explosion protection in technical and organisational terms.

[1] https://www.bge.de/en/konrad/main-topics/main-topic-evaluation-of-the-safety-requirements-for-the-konrad-repository/

Topical area personnel/organisation

The operator must, among other things, deal with the personnel organisation of radiation protection and the corresponding responsibilities (radiation protection supervisor, person responsible under nuclear law, safety reviews, provision of the requisite technical qualification, etc.). A mine book or operating manual is to be referred to to describe the operational and personnel organisation. Other subjects of this topical area are the presentation of safety management and measures to ensure a high level of safety culture in order to prove, among other things, that internal organisation and processes meet the requirements of operational and long-term safety.

Topical area mine safety

This complex includes all aspects relevant in terms of nuclear safety with regard to occupational health and safety and concerns, among other things, the ventilation-related and geotechnical conditions.

Topical area long-term safety

In the case of nuclear power plants and storage facilities for radioactive waste, nuclear safety is reviewed and assessed as part of a PSR according to the AtG until the end of the operating period, i.e. until release of the corresponding facility from supervision under this Act. In contrast to the aforementioned facilities, the purpose of a disposal facility for radioactive waste is to ensure the long-term protection of man and the environment from the effects of this waste also after the operating period (long-term safety) (see e.g. [12]). Consequently, a PSR for a disposal facility should also maintain a focus on the entire evolution of the facility and thus also on long-term safety. This was also proposed in the GRS report [3] and by the IAEA and WENRA and is also envisaged abroad. This does not necessarily mean that new long-term safety analyses are required in a PSR. Rather, new findings are to be documented and, if appropriate, quantitatively assessed as to whether and to what extent they have an impact on the validity of the assumptions on long-term safety on which the plan approval/licence is based.

New findings may result, in particular, from

- geological, geophysical, geochemical, hydrological or meteorological data and information obtained in the meantime,
- the site characterisation within the framework of mining measures carried out in the meantime,
- the behaviour of sealing structures,
- the behaviour of the emplaced waste packages,
- monitoring,
- experience from construction and operation, and

- changes to the waste acceptance criteria.

Topical area external hazards

This topical area deals with a comparison of the presentation of site-specific relevant external hazards (e.g. earthquakes, floods, etc.), the site hazard analysis and the corresponding protective measures with the current status.

4 References

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[11] Programm für eine verantwortungsvolle und sichere Entsorgung bestrahlter Brennelemente und radioaktiver Abfälle, (Nationales Entsorgungsprogramm), August 2015

[12] Gesetz zur Suche und Auswahl eines Standortes für ein Endlager für hochradioaktive Abfälle (Standortauswahlgesetz - StandAG), 05.05.2017

[13] Verordnung über Sicherheitsanforderungen an die Endlagerung hochradioaktiver Abfälle (Endlagersicherheitsanforderungsverordnung - EndlSiAnfV), 06.10.2020

[14] Gesetz zur Beschleunigung der Rückholung radioaktiver Abfälle und der Stilllegung der Schachtanlage Asse II, 20.04.2013

[15] www.base.bund.de/DE/themen/soa/langzeitdokumentation/langzeitdokumentation.html