Note:
This is a translation of the ESK statement entitled
"Sicherheitstechnische und logistische Anforderungen an ein Bereitstellungslager für das Endlager Konrad"
In case of discrepancies between the English translation and the German original, the original shall prevail.

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Statement

Safety-related and logistical requirements for a central reception storage facility for the Konrad repository

Contents

1 Introduction

The BMU requested the ESK to issue a statement on which framework conditions have to be met from a technical point of view for the planned central reception storage facility for waste to be delivered to the Konrad repository for disposal and how these conditions affect criteria for determining the site of such a facility.

From the ESK's point of view, safety issues play a role here on the one hand. All the safety requirements that exist for the storage and handling of radioactive waste in accordance with the state of the art in science and technology are to be met for a future central reception storage facility. For this purpose, the current requirements and experience from the operation of storage facilities are to be considered. In addition, the findings from the considerations going beyond the design, the so-called “stress tests”, will also have to be taken into account.

On the other hand, the function of such a facility places considerable demands on the functioning of the facility as well as on the transport to and from it, since the throughput of the quantities envisaged for emplacement in the Konrad repository must also be ensured logistically. Therefore, this issue is also the subject of this statement.

From a technical point of view, a central reception storage facility directly at the site of the Konrad repository would have obvious advantages because the distances would be short and no public transport routes would have to be used for the transport from such a facility to the Konrad repository. However, it cannot be ruled out that there may be obstacles to realise it at the site of the Konrad repository. Therefore, the following statement assumes a central reception storage facility spatially separated from the Konrad repository, as this is the covering case. The site for it must fulfil a number of safety and logistical requirements which must be applied as criteria within the site selection procedure; these requirements are also considered in this statement.

This statement does not deal with the question of organising this procedure or the process in the political and social sphere. The criteria set out in this statement for the planned central reception storage facility are therefore, from the ESK's point of view, indispensable in the overall procedure. However, they are not comprehensive in the sense that all aspects to be considered in such a procedure are covered.

The statement was prepared by a working group of ESK members and adopted at the 68th ESK meeting on 26 July 2018.

2 Challenges in the delivery of waste packages to the Konrad repository

The Konrad repository has been licensed as a disposal facility for radioactive waste with negligible heat generation for an emplacement volume of 303,000 m^3. In one-shift operation, an average of 10,000 m^3 per year can be emplaced, so that the total emplacement period is about 30 years. It is currently being examined whether the annual emplacement volume can be increased by multi-shift operation in order to compensate for delays in commissioning or to shorten the emplacement period.

Delivery to the Konrad repository should take place according to the "just-in-time" principle by road and by rail. For this reason, only a buffer hall is foreseen at the repository site, which essentially serves to temporarily store the waste already delivered in the event of operational disruptions. Depending on the type of waste package, the capacity is between 150 and 260 transport units. In one-shift operation, this corresponds to the emplacement volume of about two to three weeks. There are no plans to build a reception storage facility for waste to be disposed of in the Konrad repository at the repository site itself.

Originally, it was planned that the repository operator – initially the BfS or rather the DBE commissioned by the BfS, today the BGE – would request delivery of waste packages finally conditioned for disposal (G2 packages) from the different parties for emplacement just in time. In the meantime, there have been optimisation considerations to replace the on-call system with coordination centres in which, in addition to the BGE, the EWN, responsible for public waste, and the BGZ, responsible for waste from energy suppliers and industry, are also represented. The task of these coordination centres is to schedule the delivery of the waste to the Konrad repository between the different parties and the different sites where the waste is stored so far in accordance with the BGE's emplacement planning and the availability of G2 packages with a lead time of about 18 months. This lead time results from the fact that on the basis of a notification of the available waste packages by the coordination centres and the operating parameters to be taken into account by the repository operator, an iterative optimisation of the campaign and emplacement planning is carried out until the respective partial quantities are finally requested for delivery about two months before the actual emplacement.

The emplacement of (fully product-controlled) waste packages (G2 type) in the Konrad repository is subject to various restrictions. In the individual chambers, groups of cubic and cylindrical waste packages are emplaced alternately. For reasons of safety and operation optimisation, care must be taken to ensure that certain parameters, such as the nuclear fuel content of the waste, the cumulative values for accidents (*Störfallsummenwerte*), the criticality cumulative values (*Kritikalitätssummenwerte*) and the thermal cumulative values (*thermische Summenwerte*) over the entirety of waste emplaced section by section, do not exceed the permissible values. Further restrictions on the composition of individual emplacement batches may result from the requirements of the qualified permission issued under water law (*gehobene wasserrechtliche Erlaubnis*) as well as from the requirements on stack integrity, transport law provisions, container type-specific requirements and any additional technical measures that may be required. In order to ensure emplacement in compliance with the licence, it is therefore necessary to optimise the arrangement of the waste packages to be emplaced in accordance with the regulations specified for this purpose in the plan approval decision [1]. Due to a lack of space for this work, this is practically not feasible at the Konrad repository.

The waste, in turn, is stored at many different storage facility sites until it is delivered to the disposal facility. These include not only the central storage facilities at Ahaus, Gorleben, Greifswald and Mitterteich, but also various storage facilities at the nuclear power plant sites, the research facilities – such as in Jülich, Karlsruhe, Geesthacht etc. – and the *Land* collecting facilities (*Landessammelstellen*). Depending on the respective storage concept, some of the waste in these storage facilities is not readily accessible and can only be made available according to the "first in, last out" principle. Due to the respective space and licensing situation, an optimised composition of complete emplacement batches for "just-in-time" delivery to the Konrad repository is not possible everywhere. It may also be the case that waste from different sites and from different parties obliged to deliver has to be combined into one batch for optimised emplacement in the Konrad repository. As

a result, continuous “just-in-time” delivery of optimised emplacement batches is not possible without a central reception storage facility.

Another challenge is the handling of cylindrical packages (round packages). These are usually transported vertically but must be handled horizontally at the Konrad repository. This is to be done with the aid of a turning device and so-called swap pallets with which the round packages can be handled horizontally. A larger number of swap pallets is required. For reasons of optimisation, it is considered appropriate to reload the round packages and to store and maintain the required equipment centrally. This, however, requires sufficient space, which is not available at the Konrad repository.

In addition, for some waste packages it may become necessary that immediately before delivery to the Konrad repository, measures have to be taken to fully comply with the Konrad waste acceptance requirements for disposal [2]. These include the proof of pressureless delivery (internal pressure less than 1.2 bar), the proof that the free liquid content amounts to a maximum of 1% of the net package volume and – where necessary – the proof of integrity of the sealing system. For this purpose, suitable equipment with ventilation/filter systems and radiation protection measuring equipment have to be provided for which adequate floor space is required.

For the reasons given above, a central reception storage facility is indispensable for optimised delivery of waste to the Konrad repository. However, a number of aspects and boundary conditions must be taken into account, which are dealt with below.

3 Safety requirements for a central reception storage facility for the Konrad repository

The requirements of the ESK recommendation “ESK guidelines for the storage of radioactive waste with negligible heat generation” [3] are relevant for the central reception storage facility for the Konrad repository and must be observed and implemented during planning, construction and operation. For a facility that fulfils the requirements of the ESK recommendation, precautions against damage in accordance with the state of the art in science and technology have also been taken. The ESK stress test also demonstrated the robustness of facilities for the storage of conditioned radioactive waste [4]. In the following, those requirements which are of particular importance for the central reception storage facility for the Konrad repository are explicitly addressed.

Concerning the storage concept: Only those packages are to be stored in the central reception storage facility which fully comply with the Konrad waste acceptance requirements for disposal. These are so-called G2 packages, i.e. conditioned radioactive waste packaged in suitable containers whose product control has been completed and whose documentation has been confirmed by the BGE body entrusted with this task. There is no relevant release of activity from these waste packages into the ambient air. However, monitoring of the air in the storage area and in the handling areas is necessary for occupational radiological protection as well as for verifying that there is no relevant activity release from the packages.

The extent of handling and monitoring measures with personnel deployment in the storage area is to be kept as low as possible.

Radiation protection instrumentation: Monitoring the dose rate in the storage areas, the handling areas, as well as the reception and retrieval areas, the premises and the surrounding area is of great importance here since the central reception storage facility will be operated very dynamically with many storage and retrieval operations.

Contamination monitoring: Persons, workplaces, traffic routes and movable objects shall be adequately checked for contamination and the results documented. Organisational specifications are to be made and suitable means kept available for the removal of contamination.

Requirements for buildings: For the design of the building, the intended duration of use is to be considered with regard to durability and functional performance of the building materials. Due to the foreseeable intensive use of the central reception storage facility, adequate compressive strength and wear resistance as well as the dimensioning and design of the base plate play an important role for all conceivable partial occupancy conditions.

Incoming and outgoing inspection: The identity of all packages and their conformity with the documentation is to be confirmed by visual inspections. In addition, the contamination and dose rate of the packages are to be checked. Packages showing abnormalities during the incoming inspection are to be set aside in a separate buffer and handling area until clarification and determination of the further proceeding. A separate buffer and handling area is also required in the event that the outgoing inspections reveal abnormalities or measures are still required for delivery to the Konrad repository. Repair possibilities must be provided for regarding the removal of minor transport or handling damage to the packages (e.g. paint damage).

With regard to occupational radiological protection (radiological protection of personnel), it has to be taken into account that due to the planned high throughputs of packages, sufficient space for structural and technical devices has to be planned for the protection of workplaces when receiving and delivering the packages.

Implementation of measures on the packages: For measures in the central reception storage facility which may release radioactive substances from the packages (e.g. pressure relief or post-drying of packages), separate, monitored units (working areas) are to be provided which are equipped with a ventilation and filter system as well as radiation protection instrumentation suitable for accounting.

Accident analysis: As in storage facilities for conditioned radioactive waste designed, constructed and operated in accordance with ESK recommendations [3], it has to be possible to control all conceivable accidents. The robustness of the storage facilities was also confirmed within the framework of the ESK stress test [4] for mechanical and thermal impacts exceeding the design basis load, e.g. during a postulated aircraft crash. In addition, unfavourable conditions with regard to natural and man-made external hazards can be minimised by selection of a suitable site for the central reception storage facility.

4 Logistical requirements for a central reception storage facility for the Konrad repository

Both external and internal logistics have an influence not only on the selection of the site but also on the required size of the premises.

4.1 External logistics

The waste packages are delivered to the central reception storage facility from many different waste storage facilities or directly from a conditioning plant. Since not all of these facilities have a rail connection, delivery can take place by rail as well as by truck. Therefore, a mandatory prerequisite for selecting the site for a central reception storage facility is that it has both a connection to a railway line suitable for heavy loads and to a road suitable for heavy loads.

The railway line must be a double-track one because, depending on the mode of operation of the Konrad repository, up to three block trains with waste packages have to be transported from the central reception storage facility to the repository and back empty daily. Delivery to the Konrad repository could then theoretically be carried out completely by rail, which makes the delivery logistics more robust against disturbances with regard to the “just-in-time” concept. However, the possibility of transport by truck from the central reception storage facility to the Konrad repository should not be abandoned in principle in order to be able to react flexibly enough.

Since, from today's point of view, the central reception storage facility will hardly go into operation earlier than the repository itself, at least in the initial phase, more waste will have to be transported from the various storage facilities to the central reception facility than from there to the repository, as otherwise no buffer can be built up for optimised composition of emplacement batches. This presupposes that the road connection will also be suitable for a corresponding transport frequency.

The transports to and from the central reception storage facility should be carried out spatially separated from each other in order to largely avoid mutual impairment of the respective activities. This applies to both rail and road transports.

In addition, the site of the central reception storage facility should be dimensioned so as to provide sufficient shunting and parking space (both for trucks and rail vehicles) and, if necessary, space for repair and maintenance of the transport equipment, including storage and maintenance of the swap pallets required.

In view of the fact that numerous transports have to be carried out regularly over several decades during operation of the Konrad repository, it would be appropriate to carry out the transports with its own fleet of vehicles and equipment in order to be as independent as possible of third parties and thus of influenceable disturbances during transport. At least, a long-term contract with corresponding capacity commitments should be concluded with one or more qualified transport/logistics companies. By exclusively using the vehicles for nuclear transports, their use could be further optimised based on uniform regulations for handling and use of the vehicles.

4.2 Internal logistics

Spatial separation of transports to and from the facility should also be made in order to optimise the operational processes within the central reception storage facility and to make them as robust as possible against disruptions in the external logistics chains. For reasons of radiation protection, storage and retrieval should be handled remotely to the largest possible extent, i.e. with as few direct handling operations as possible and with separate equipment (cranes, handling equipment, etc.).

Inside the facility, good accessibility to all waste packages is to be ensured. This is necessary to be able to compose optimised emplacement batches for Konrad as easily as possible and at the same time minimise radiation exposure for the operating personnel. In addition, hereby the inspection possibility of individual waste packages which remain in the facility for a longer period improves. This means that, in addition to the required storage space, there must also be sufficient space for transport routes and areas for the provision of the finished emplacement batches as well as for the inspection and, if necessary, post-treatment of individual waste packages.

Depending on the age of the waste packages or the period of storage in the central reception storage facility, measures may still be required immediately before delivery to the repository to ensure full compliance with the Konrad waste acceptance requirements (internal pressure less than 1.2 bar, maximum free liquid content of the net package volume 1%, integrity of the sealing system; see Chapter 2). Proven technical solutions are available for this. The establishment of corresponding installations is to be taken into account when dimensioning the central reception storage facility and thus also the site. In order to ensure continuity of deliveries to the Konrad repository, these installations should be designed redundantly.

5 Essential criteria for the site of a central reception storage facility for the Konrad repository

5.1 Essential criteria from a safety point of view

From a safety point of view, the essential criteria for the site mainly result from the protection of the planned facility against external hazards. The criteria which are essential from the ESK's point of view are described and justified in the following.

- The site must not be located in an area endangered by flooding. When determining the probability of flooding, future developments during the expected operating period shall be taken into account.

- The site must not be located in an area where subsidence is likely to affect the stability of the central reception storage facility.

- The site should not be within the area of influence by neighbouring installations with the potential for accidents, e.g. major accident installations under the Twelfth Ordinance on the Implementation of the Federal Immission Control Act (Major Accidents Ordinance – 12th BImSchV). The area of influence is defined in accordance with the usual provisions in the respective legal field. For sites within the area of

influence of installations with the potential for major accidents, a situation acceptable in terms of safety would have to be established by compensatory measures.

- The site must be chosen such that possible major fires in the neighbourhood cannot affect the central reception storage facility.

- For a site that was previously used for industrial, military or similar purposes, it must be reliably clarified that there are no more substances (e.g. explosive substances) or spatial situations (e.g. underground cavities not properly backfilled) in the subsoil that could pose a hazard to the central reception storage facility.

- It must be reliably clarified for the site that there are no explosives in the subsoil, e.g. from the Second World War.

- The site should be located in earthquake zone 0 according to DIN. This ensures that seismic influences on the safety of the facility are not to be feared without the need for more elaborate measures. Although sites in higher earthquake zones are also conceivable, here, however, a situation acceptable in terms of safety would have to be established by compensatory measures.

5.2 Essential criteria from a logistical point of view

The choice of site also determines a number of boundary conditions that can have an impact on logistics in practice. From the ESK's point of view, the following essential criteria are important for ensuring logistics:

- The site must be located next to a double-track railway line and, if possible, be accessible from more than one direction. Only in this way, sufficient availability for continuous rail transport will be ensured.

- If possible, the potential site should have either an existing railway connection or an abandoned one whose essential elements (e.g. railway line, possibility of branching off from the railway network) still exist. If a completely new railway connection would have to be built for a site or an existing one would have to be overhauled, it has to be estimated on the basis of the specific and actual conditions whether it will be possible to build a railway connection suitable for heavy loads in due time.

- It must be possible, with reasonable means and in due time, to connect the site to the general road network or to use a former connection. This connection must be suitable for heavy loads and must lead to a point in the general road network which allows heavy loads to be transported in several directions.

- The site should be no more than 150 – 200 km away from the Konrad repository in order to avoid unnecessary additional transportation. In addition, the potential for difficulties in the continuity of delivery to the Konrad repository increases strongly with increasing distance.

- The necessary infrastructural media must be available at the site in the necessary capacity or be producible in a manageable time. This applies, in particular, to electricity, water and data lines, for which redundant connections may have to be provided.

- The site must be of sufficient size for the facility equipment, for the necessary spaces for the transport vehicles, including their maintenance, and for the installations required for physical protection. It will be essential to define the area required for the facility as early as possible with a view to the search for and selection of the site.

6 References

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