PACKAGE APPROVAL FOR TYPE DUAL PURPOSE CASK PACKAGES

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ABSTRACT

In Germany, the Atomic Energy Act regulates the disposal of spent fuel in a way that it has to be disposed of as radioactive waste in a controlled manner (direct disposal). For this purpose, proof must be given that the safe storage in interim storage facilities is guaranteed until the radioactive waste is delivered to a facility for final disposal. The German guideline for the dry interim storage advises to use massive metallic casks, for example made from monolithic cast iron with a double lid system. At the beginning of the storage period, the storage casks have also to be approved as transport package according to the transport regulations. The transportability has to be demonstrated, e.g. by maintaining the package approval over the entire storage period or otherwise.

The legal requirements can be fulfilled by the use of so-called Dual Purpose Casks (DPC), casks able to be used for transport and storage of the radioactive waste. In Germany, the licensing of such casks has to be undertaken for transport and storage separately. As a result, the validity of the package approval is limited to 5 years; however, the storage license is valid over the whole storage period, e.g. 40 years. In order to harmonise the legal status of the DPC, the prolongation of the package approval validity until the end of the storage period plus the transport away from the storage would be favourable.

From the technical point of view, this could be achieved by evaluating and assessing the storage conditions with impact on the package performance under transport conditions also within the package approval procedure. Additionally, measures would have to be established to check the compliance of the loaded casks in relation to the approved design over the storage period. The measures would concern the operating experience related to the quality assurance program, ageing aspects related to safety related frame work as well as the inspection program prior to the off-site-transport.

The authors describe the German situation, the discrepancies between transport and storage regulations and present approaches for solutions.

INTRODUCTION

In Germany, the Atomic Energy Act (AtG) [1] regulates the utilisation of residual radioactive material and disposal of radioactive waste. It is stated in § 9a para. 1, that “Whoever erects, operates, otherwise holds, essentially modifies, decommissions or disposes installations in which nuclear fuel is handled, or handles radioactive material outside such installations, or operates installations for the generation of ionising radiation, shall make provisions to assure that residual radioactive material as well as disassembled or dismantled radioactive components are utilised without detrimental effects in conformity with the purposes referred to in § 1, subparas. 2 to 4, or are disposed of as radioactive waste (direct disposal) in controlled manner. The delivery of irradiated nuclear fuel originating from the operation of installations for the fission of nuclear fuel for the commercial generation of electricity to an

installation for the reprocessing of irradiated nuclear fuel for the purposes of non-detrimental utilisation shall become unlawful as of 1 July 2005." Further, according to § 9a para. 1b of the act, it is stated that "For the purposes of controlled disposal, proof must be furnished showing that the safe storage in interim storage facilities of both irradiated nuclear fuel and returned radioactive waste from the reprocessing of irradiated nuclear fuel is guaranteed until such time as it is surrendered to a facility for disposal." For other radioactive waste similar rules have to be applied according to § 9a para. 2 of the act or by an ordinance issued thereunder.

In order to support the technical design and the operation of facilities for the interim storage recommendations of the German Nuclear Waste Management Commission (ESK) have been issued as "Guidelines for dry cask storage of spent fuel and heat-generating waste" and "Guidelines for interim storage of radioactive waste with negligible heat-generation".

The guideline for the dry interim storage of high-level radioactive waste [2] advises to use massive metallic casks such as made from monolithic cast iron with a double lid system, which have to be approved as transport package according to the transport regulations at the beginning of the storage period and for which the package approval should either be maintained over the entire storage period or the permanent transportability has to be regularly demonstrated otherwise.

Also the guideline for the interim storage of radioactive waste with negligible heat-generation [3] advises that the requirements of the transport regulations should be fulfilled by the waste container itself or with use of an appropriate overpack.

It can be summarized that the concept of interim storage of low-, intermediate- and high-level radioactive waste in Germany assumes the safe storage of the radioactive material in packagings that comply with the transport regulations [4]. Therefore, it must be questioned whether the regime of transport regulations is able to support such requirements.

DRY INTERIM STORAGE USING DUAL PURPOSE CASKS

The solution for the dry interim storage is to place the radioactive material in casks designed for both storage and transport, which are defined as Dual Purpose Casks (DPC).

Figure 1. DPC CASTOR® HAW28M at interim storage facility

For high-level radioactive waste GNS developed and continually improves its CASTOR® cask design family. The typical design characteristics are the ductile cast iron (DCI) body with radial cooling fins, embedded neutron moderator material in axial boreholes of the cask wall and cylindrical moderator plates at the lid and bottom ends. The outer surface of the cask is protected by a multi-layer coating.

In the cylindrical cavity, a basket is located which serves for the spatial arrangement of fuel assemblies or HAW canisters (high-level radioactive waste canisters) and which facilitates heat removal, criticality safety and radiation shielding. The cavity is closed by a bolted primary lid and a metal seal. The primary lid has an access to the cask cavity which is required for evacuation and filling of the cask with inert gas. The access is closed by a closure lid, equipped with a metal seal. Cask body, primary lid and closure lid with their bolts and the metallic gaskets form the primary containment barrier. The corrosion resistance of the cask cavity surfaces is improved by nickel coating.

A secondary barrier can be formed using a secondary lid bolted onto the cask body above the primary lid. Also the secondary lid allows access to the inter lid space to fill the space with helium under overpressure, to permanently monitor this pressure via a pressure switch under storage conditions. The pressure switch delivers the leak-tightness control information to the monitoring system during long-term storage. Additionally, a protection plate can be installed above the secondary lid during storage.

For handling of the cask (i. e. for vertical or horizontal transport and for tilting up or down) two pairs of trunnions are bolted at the top and bottom areas, respectively. During transport on public routes, the cask is assembled with impact limiters as part of the package.

Such DPC for high-level radioactive waste and spent fuel are generally designed with a double lid system. In addition, a repair concept is established for the very unlikely event of a primary lid containment failure. The repair concept based on a third, welded lid, which will form together with the intact secondary lid a new double barrier boundary. Due to this concept, additional equipment (e.g. hot cells) is not necessarily required for storage.

For low- and intermediate-level radioactive waste GNS designed DPC based on a single containment boundary concept such as the MOSAIK® cask family.

Figure 2. DPC MOSAIK® II-15 at storage facility

The typical design characteristics of this cask family are the ductile cast iron cask body with bolted lid and equipped with an elastomeric gasket. The outer surface of the cask is protected by a multi-layer coating. According to the waste stream to be stored, the lid system and internal arrangements of the cask, such as the lead shielding or drying equipment, can be adapted.

In Germany, storage facilities containing DPC packages require a “storage license” following the Atomic Energy Act. This license is site-specific and related to the radioactive materials to be stored. The DPC is part of the safety case of the storage and takes over safety functions in terms of the safe storage of the radioactive material. Applicant for this “storage license” is the

owner of the storage facility. In that case, the package designer and manufacturer of the DPC does only acts as supplier to the owner of the storage facility.

The first storage license according to § 6 of the Atomic Energy Act for a central German interim storage facility, namely the Gorleben-Interim-Storage-Facility (TBL-G), was granted to GNS 30 years ago in September 1983. The license has been amended several times until the mid 1990s. In 1995 the license was replaced by a new one. This new license was amended four times, the last amendment was granted in 2010. The license is valid for a period of 40 years.

According to the storage license only casks with a valid design approval certificate according to the transport regulations are allowed to be stored. As these certificates are typically limited, the periodic prolongation of the package design approval of all stored cask types is necessary.

Later granted storage licenses for decentralized interim storage facilities (located close to the NPPs) differ in that way, as the licenses do not generally require the permanent maintaining of the package design approval, but require the "demonstration of transportability".

In addition, at Gorleben site a storage facility for low- and intermediate-level radioactive operational waste from German nuclear power plants is licensed according to § 7 of the German Radiation Protection Ordinance (StrlSchV) [5].

Taking the licensed cask types at the Gorleben Facility into account, twelve approval certificate prolongations are concerned regularly. The experience of several prolongation cycles shows that permanent paper management for the storage license is necessary, in some cases cask components need to be modified (e.g. adaptation of impact limiters), significant personnel resource are bound and the storage license holder often faces the challenge to get in violation with the storage license due to a potentially expiring package design approval. From the storage operator’s point of view the question is whether a balanced solution for the package approval can be found by a different approach.

TRANSPORTATION USING DUAL PURPOSE CASKS

A DPC provided for transport is usually equipped with impact limiters and often following a one-lid containment system concept. Nevertheless, most of the safety relevant DPC components are the same for transport and for storage.

Figure 3. DPC CASTOR® HAW28M during transportation

The DPC as transport packages concerns the off-site transportation. The acceptance criteria for this DPC transport version package are defined in the national and international transport

regulations. However, the DPC needs to be designed so that it can be used in an operational mode that is different from usual transport packages. Normally, the DPC transport package needs to be transported only one time from the storage facility to a final repository or conditioning facility. This transport will take place after a long period of interim storage, probably several decades of storage. This should be considered for the package design approval and is normally not considered in the procedure for conventional transport packages.

Figure 4. DPC MOSAIK® II-15 during preparation for transportation

According to the international transport regulations package design approval is required to manufacture and use a DPC as transport package. The package design approval procedure for Germany is prescribed in the ”Guideline for the design approval procedure of packages for the transport of radioactive material, of special form radioactive material and low dispersible radioactive material” [6]. From the beginning of the DPC concept it was applied for and approved as nearly 100 percent conventional transport package. This resulted in short validity periods, usually of 3 years for the package design approval. Therefore, aging aspects and periodic inspections plans were mainly focused on this validity period. However, the exception already implemented in the package approval was an inspection plan to be used for the loaded cask before removal from the storage facility because of the expiration of the periodic inspection validity during the interim storage.

As from 2004 with a new revision of the aforementioned German guideline for the design approval procedure a validity period of more than 3 years became possible if the applicant could substantiate a request for such longer validity period. This was the result of discussions with the competent authority to reflect more the storage purpose of the cask also within the package design approval. Under the condition that remanufacturing of the cask is excluded, all cask are loaded and stored and transportation is not scheduled in the near future, a 5 year validity could be applied for package designs approved according to the 1985 edition of the IAEA regulations and a 10 year validity for package designs approved according to the 1996 edition of the IAEA regulations. For new package design approvals according to the 1996 edition the 5 year validity could be applied generally.

According to this agreement GNS received two 5 year approvals for 1985 designs and two 10 years approvals for 1996 designs.

Recent discussion with the German Competent Authorities resulted in arrangements, that 5 years can be applied independently of the IAEA edition of the design, because the regulation makes no difference in the use of the package. In addition, 10 years can be applied under the same rules as before but independently of the IAEA edition of the design, provided that an assessment report is part of the application. This assessment report shall address the impact of

changed regulations and methods on the design, the operational experience with the casks and an aging management which focuses on the further validity of the safety relevant input parameter of the design and on the stipulations of the inspection plan to be applied before removal of the loaded cask from the storage facility. This was an innovative step forward to consider both purposes of a DPC within the package approval.

For the sake of completeness it must be mentioned that comparable rules are also implemented in the design approval procedure of the Czech Republic. This shows that the problematic is important when interim storage using DPC's is seriously practiced.

INNOVATIONS FOR THE TRANSPORT REGULATIONS

The aforementioned practices are in national agreements which made the use of DPC more reliable for the storage facility operator. However, the dangerous goods regulations are international agreements which normally do not take national special issues into consideration. Whereas DPC are operated in several countries, it is or it should be of interest for each country operating DPC to stipulate these special circumstances in the international dangerous goods regulations for class 7 goods.

The following items are proposed to initiate discussions about necessary changes of the regulations with regard to the above mentioned specifics:

- The use of packagings manufactured according to an approved package design shall not be made illegitimate by transitional arrangements of the regulations. This also needs to be applied to package designs not requiring competent authority approval.

- The expiry date of the package design approval according to para. 834 of the regulations should become a defined requirement.

- Such expiry date could differentiate between package design approvals for manufacturing, loading/unloading and ongoing use for transportation and as such for already stored DPC.

- Consequently, the package design approval could be divided in an "approval for regular transport use" and an "approval for DPC use" for the storage time period.

- This would lead to a separate approval for stored DPCs for the storage period without the need for permanent prolongation of the approval. Instead a monitoring process to regularly evaluate the general framework could be established, e.g. changing regulations and design methods, operation experience, aging aspects.

- During the storage period this monitoring process focuses on further validity of the safety relevant input parameter of the design and on the stipulations of necessary inspections before final transport of DPC (instead of revisions of the approval itself).

- The transformation of a package from the "regular transport use approval" to the "approval for DPC use" could be performed after final loading and delivery to the interim storage, e.g. by registration of the serial number of the stored DPC at the competent authority.

REFERENCES

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