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Establishing of a Monitoring Process to Support Long-running Package Approvals of Dual Purpose Casks

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Abstract

According to the German Atomic Energy Act, the safe storage of the irradiated nuclear fuel in transport and storage casks inside interim storage facilities has to be guaranteed until their handover to a final repository. By the use of Dual Purpose Casks (DPC) placed in dedicated on-site and, in the past, central storage buildings this legal requirement is implemented by the operators of the nuclear power plants. The licensing of such installations comprises the licensing of the storage of the irradiated nuclear fuel itself in casks, but requires additionally a package design approval for these transport and storage casks to demonstrate the compliance with the transport regulations.

Traditionally, the validity period of a storage license, normally 40-50 years for the whole legally allowed interim storage period, differs significantly from the validity period of a package design approval, which is limited to 5 years in the international practice. In order to harmonize the legal status of the DPC, the extension of the package approval validity until the end of the storage period including the subsequent transport after storage to a final repository would be favorable.

Some time ago and based on the initiative of GNS the discussion was started in Germany to develop rules and requirements as a first basis for an extended validity period of the package design approvals. Rules and requirements have been detailed and improved further and constitute today a coherent framework for a validity period of German package design approvals for DPC which can be extended to the validity of the storage license. Measures to be performed by the applicant like evaluation of the operation experience during storage, consideration of physical and chemical aging effects for the safety relevant boundary conditions of the safety case as well as for the inspection program to be applied before transport after storage as well as the assessment of aging of the legal, regulatory and design methodology bases are established as first of its kind.

The authors describe their experience concerning the implementation of the measures and the effectiveness of a monitoring process according to the transport regulations.

Introduction

The most favorable solution for the dry interim storage of spent nuclear fuel is to place the radioactive material in casks designed for both storage and transport, which are well known as Dual Purpose Casks (DPC). Such casks are able to be stored in dedicated storage facilities, where the DPC is part of the safety case of the storage facility and takes over the main safety functions in terms of the safe storage of the radioactive material.

In Germany, storage facilities containing DPC packages require a “storage license” following the Atomic Energy Act [1]. This license is site-specific and related to the radioactive materials to be stored. Applicant for this “storage license” is the owner/operator of the storage facility. In that case, the package designer and manufacturer of a DPC does only act 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 BLG, subsidiary of GNS, 33 years ago in September 1983. In 1995 the license was replaced by a new one. This new license is valid for a period of 40 years.

To keep the possibility of dispatching the casks at any time, the storage license stipulates that only casks with a valid package design approval certificate according to the transport regulations are allowed to be stored. As these certificates are typically limited in the period of validity, the package design approvals of all stored cask types have to be renewed periodically.



Figure 1 DPC CASTOR® HAW28M at Gorleben storage facility

Taking into account the licensed cask types at the Gorleben storage facility, twelve approval certificates are renewed regularly. Our experience shows after several renewal cycles that the basic safety features of the casks are robust and the transport after storage can be ensured with the casks and the designated equipment (e.g. impact limiter, transport cradle). In fact, regular paperwork is necessary also for the maintenance of the storage license after renewal of the package approval.

Often the storage operator faces the challenge not to violate the storage license due to a potential expiry of the package design approvals. 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.

Regulatory Framework

In order to manufacture and use a DPC as Type B transport package, package design approval is required according to the international transport regulations [2]. The time limitations of the package design approval certificate and possible criteria for that are not stipulated in the regulations. However, para. 838 of the regulation defines the content of the certificate and gives advice to include the date of issue and the expiry date. That suggests the conclusion that the definition of the validity period is in control of each national competent authority.

For Germany the package design approval procedure 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" [3]. The DPCs are applied for and approved as conventional transport packages according to the transport regulations. This results in validity periods in line with the guideline, in former times usually 3 years. As from 2004 with a new revision of the guideline, a validity period of more than 3 years became possible as long as the applicant could substantiate a request for a longer validity period.

Implementation of special DPC approval conditions

In order to emphasize the storage purpose of a DPC within the package design approval certificate, intensive discussions were initiated by GNS with the German competent authorities BAM and BfS during the revision process of the aforementioned guideline. As the result the first conditions and obligations for longer-running package design approvals were recorded. Under the condition that remanufacturing of the cask is excluded, all cask are loaded and placed in a storage facility and transportation is not scheduled in the near future, a 5 year validity period 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 designs to be approved according to the 1996 edition a 5 year validity could be applied for generally as the maximum time frame which the competent authority may consider necessary to update the quality assurance aspects for further remanufacturing.

For the 10 year validity the additional conditions were defined because changes of the regulations have to be evaluated on a regular basis and every 5 years an evaluation of the further applicability of design rules and methods used in the safety case has to be performed. The resulting assessment reports will be submitted to BAM and BfS and will be a precondition for maintaining the period of validity of the approval and becomes part of the approval after release by BAM and approval by BfS.

According to these conditions GNS received two 5 year approvals for '85 designs and two 10 years approvals for '96 designs until 2007.

In 2012 in the light of the first assessment report, German competent authorities and GNS readjusted and extended the concept of the longer-running package design approval for DPC's. Since then 5 years can be applied for, regardless of the IAEA edition of the design, because the regulation makes no distinction in the use of the package. In addition, 10 years can be applied for under the same rules as before but independent of the IAEA edition of the design, provided that an extended assessment report is part of the application [4]. Such an extended 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 transport after storage. This was the real innovative step forward to consider both purposes of a DPC within the package approval.

Now, having gained a lot of experiences in performing assessments of DPCs, it was elaborated by the German competent authorities and GNS that the validity period of the package design approval can be definitely linked to the validity of the storage license, provided, that the assessment report is regularly updated. For the assessment reports it is only additionally considered necessary to ensure that the aging management covers the complete live cycle of all manufactured casks in use of a package design, that aging management of knowledge should also be part of the assessment and the procedures for operation and maintenance should be additionally considered.

The complete system implemented is called at GNS "monitoring process according to the transport regulations" and represents the approach of assessment of a DPC to keep the package design approval alive.

In summer of 2016 GNS prepared its first application of renewal of a package design approval with an expiry date more than 20 years lay ahead.

Monitoring Process

Due to the different focus of use of a package design approval the extension of the validity period of the package design approval to the validity of the storage license is linked to the conditions, that all casks of a design are loaded and placed in a storage facility, remanufacturing of casks is excluded and transportation is at the earliest intended to be done after storage.

For the extension of the validity period a monitoring process has to be established. The monitoring process will be the instrument to consider changing standards of evaluation and experience feedback from the life cycle of the casks during the validity of the package approval.

Thereby, the monitoring process serves to maintain the package design approval without revision (renewal) of the package design approval and furthermore to guarantee the transport after storage by adaption of the inspection plan applied before transport after storage.

The monitoring process has to be laid down as a condition in the package design approval certificate to give legal certainty to all parties involved and to establish a mandatory requirement of the

competent authority responsible for the transport after storage.

Subject of the monitoring process is an aging management for the design and a systematic assessment of the experience feedback from manufacturing and operation of the casks. By the aging management especially legal changes, regulatory changes, changes of analysis methods as well as physical and chemical aging effects are systematically compiled and assessed.

Fundamentals of the aging management are – in the sense of a graduated safety concept – the relevant input parameter of the safety proof of the casks. This shall be done by considering for example the sealing behavior, loss of pre-tension forces in case of screwed connections, corrosion behavior, stability under load of the moderator material and, if necessary from the design point view, the behavior of the inventory.

Basis for the systematic assessment of the experience feedback from manufacturing and operation of the cask is the compilation of unusual events by the package design approval holder. In that process all relevant findings of periodical safety assessments and results of inspections during storage could also be assessed. Due to the cross-operator evaluation of the experience feedback from the storage operation reliable conclusions about the as-is state of the casks can be drawn by the package design approval holder.

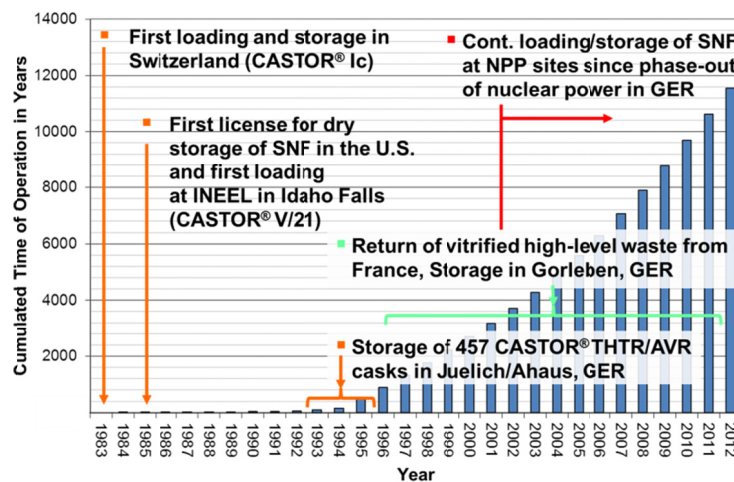


Figure 2 Cumulated time of operation of CASTOR® casks worldwide [5]

Then the assessments from the aging management program as well as from the share of experience of manufacturing and operation are collected to an application document and submitted to the competent authorities in 5 years intervals. The results of the assessment can take effect on the safety proofs as well as on the inspection plan to be applied before transport after storage.

It may happen that additional safety analyses are necessary which could or could not substantiate a revision of the package design approval. If a modification of the design seems to be adequate in a long term the revision of the package design approval can be initiated having in mind that the transport after storage has to be ensured. Compared to the usual procedure of the past, now the

modification of the design is no longer the result of the instantaneous reaction to maintain the package design approval, but it is a scheduled modification according to the state of the art before transport after storage, which means, at the moment of necessity.

However, managing design changes should not be the main focus of the monitoring. Instead, the adaptation of the inspection plan applied before transport after storage is the preferred method. By doing so, additional work and inspection steps could be implemented so that the package will finally meet the specification according to the package design approval.

Prospects and Challenges

The current review cycle of the IAEA regulation SSR-6 will create special aging management considerations which will come in force as 2018 edition of the regulation. From then on, most of the concept described above will be mandatory for every application for package design approval.

Due to the comprehensive assessments already performed, a good preparation has been done for the upcoming changes of the regulations. Challenges are emphasized if the different histories of very old designs or designs which are widely distributed have to be assessed. For a successful assessment an appropriate structure of presentation had to be developed and the available documentation level of design, manufacturing and operation life was decisive. Furthermore, the “human factor” of assessment had to be equalized which means the ability to gladly criticize things not to be responsible for. In doing so, an objectified transfer of design methodologies, material selections and operation procedures can be managed over generations of designers and experts.

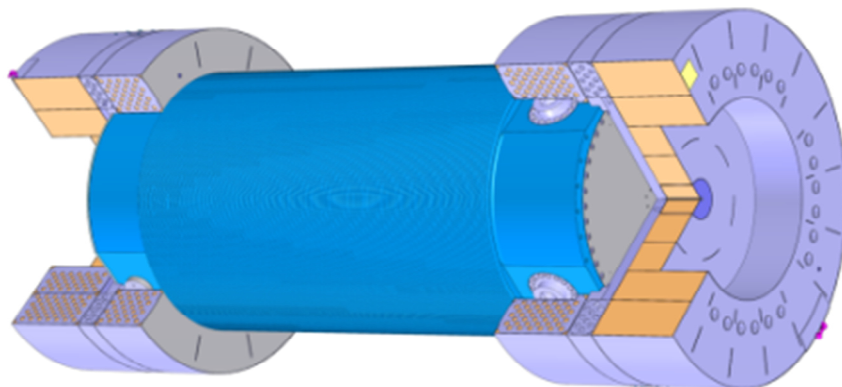


Figure 3 CASTOR® geo in transport configuration

For current design developments, like for the CASTOR® geo cask family, there is the opportunity to implement the results of already performed assessments in the design as well as in operation procedures. This is mainly related to material selection, e.g. to control long-term creep behavior, to test procedures, e.g. to ensure verifiability of the future as-is state, or related to operation procedures, e.g. to ensure comprehensive documentation of the live-cycle of the casks by the operator.

It is clear that not every question arising in the future can be already answered on the beginning of granting a package design approval. However, the prescribed monitoring process supports maintenance of the package design approval by the stepwise transfer of the design knowledge.

Conclusions

On the basis of experiences in performing assessments of DPCs in storage, it was elaborated that the validity period of the package design approval can be definitely linked to the validity of a storage license.

Precondition for the extension of the validity period is a monitoring process according to the transport regulations. The monitoring process will be the instrument to consider changing standards of evaluation and experience feedback from the life cycle of the casks during the validity of the package approval.

Thereby, the monitoring process serves to maintain the package design approval without revision (renewal) of the package design approval and furthermore to guarantee the transport after storage by adaption of the inspection plan applied before transport after storage.

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