

# **PACKAGE DESIGN APPROVAL CERTIFICATE SPECIFICATION - HOW SPECIFIC IS SPECIFIC ENOUGH?**

Frank-Michael Börst, Frank Nitsche

Federal Office For Radiation Protection, P.O. Box 100149, D-38201 Salzgitter, Germany

## **ABSTRACT**

The BfS as competent authority for package design approval in Germany is responsible for the specifications given in a package design approval certificate.

The package design approval certificate must specify the packaging and its contents as well as instructions to handle and use the package in such a way that it can be demonstrated that any real manufactured and used package of that design complies fully with the certificate and the corresponding safety analysis report. In this regard it seems to be desirable to specify as much as possible of the contents, the design and the instructions in the certificate.

On the other hand it must be considered that there is a need for changes/improvements based on experience with the package design which affects the specifications given in the certificate. This can be solved in principle by a revision of the certificate which will be the case if safety related changes are necessary. This process, however, is very often time consuming and complex and not necessary if only non-safety related changes are made. For such cases the introduction of a special design type list will be presented which allows for the specification of changes without revision of the whole certificate. The need to specify instructions for use and repeated testing of the package in the certificate will also be discussed as important elements to assure compliance with the certificate and the transport regulations for each package design in use.

Practical applications and experience with approval procedures in Germany will be presented.

## **INTRODUCTION**

The necessary contents of an approval certificate is described in paragraph 729 of the IAEA Regulations for the Safe Transport of Radioactive Material, As Amended 1990 (Safety Series No. 6) [1] as well as in paragraph 833 of the latest edition of the Regulations, TS-R-1 (ST-1, Revised) [2]. In particular the specification of the authorized radioactive contents and the description of the packaging are important elements of the certificate. In the following some aspects of such a specification and description will be discussed in case packages containing spent fuel assemblies or High Active Waste (HAW).

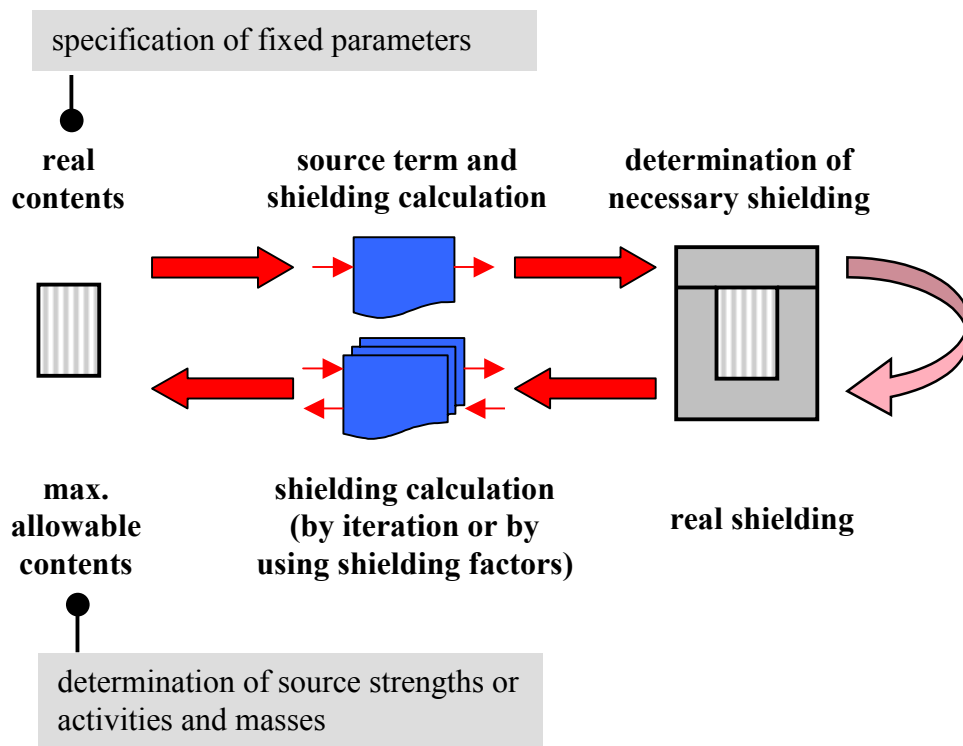
## RADIOACTIVE CONTENTS DESCRIPTION

The Federal Office for Radiation Protection as the Competent Authority for the package design approvals for Type B packages and packages containing fissile material requires from the applicants that the contents description must be detailed enough to ensure the compliance with the Regulations concerning the dose rate limits and the subcriticality, if applicable.

While the fixing of the necessary parameters due to the fissile characteristics can be done in most cases with covering values (e.g. maximum enrichment, maximum masses for the fissile nuclides combined with the description of the physical and chemical form of this material) there is a large variety to describe the contents due to the radioactive properties. This can be done either by specification of

- fixed parameters for minimum and maximum enrichment, max. burn-up, specific power of the last irradiation cycle and minimum cooling time, or
- source strengths, energy dependent for the gamma dose rate and spectral type dependent for the neutron dose rate, or
- activities and/or masses of nuclides/actinides relevant for the dose rate outside the cask.

The specifications according to the 1<sup>st</sup> and 2<sup>nd</sup> bullit are described in detail in [3]. The procedure to obtain these specifications is shown in principle in Fig. 1.



**Fig. 1: Specification or Determination of contents parameters**

All of these possible descriptions have some pros and cons. The use of fixed parameters e.g. is the easiest way for loading a cask but not the most flexible one. On the one hand the relevant parameters during and at the end of the irradiation and cooling period, respectively, which are all documented in the Nuclear Power Plant, only have to be checked. On the other hand it is a disadvantage (for the designer/licence holder) of this kind of specification that for many cases the shielding capabilities of a cask could not be used in full. For example: If there is a fuel assembly with max. enrichment but not with max. burn-up or specific power in the last cycle this would allow a shorter cooling time as specified in the certificate to obtain a source strength which can be shielded sufficiently by the cask to fulfill the dose rate limits. Nevertheless the loading of such a fuel assembly is not allowed before the minimum cooling time is reached.

In the past there was several times the need to load fuel assemblies showing deviations from the fixed parameters as prescribed in the approval certificate. Although they could be loaded due to the shielding capabilities of the cask this is not allowed without a revision of the approval certificate if the contents description is given as described above.

Another way to describe the allowable contents of a cask is in addition to the geometrical parameters of the fuel assemblies the energy and spectral type dependent specification of the source strength or the specification of activities and masses for gamma dose rate relevant nuclides and actinides which are responsible for the neutron dose rate, respectively. These values can be obtained either by source term calculations or by commitment, e.g. in the case of HAW. The advantages of these methods are that parameters can vary and there is no need to revise the design approval certificate as long as the following equation is fulfilled:

For fuel assemblies:

$$\sum_{i=1}^n \frac{G_i}{G_{i0}} + \sum_{j=1}^2 \frac{N_j}{N_{j0}} \leq 1$$

with:

$G_i$  real gamma source strength of energy group  $i$

$G_{i0}$  gamma reference source strength of energy group  $i$

$N_j$  real neutron source strength of spectral type  $j$  ( $N_1$  and  $N_2$  are the source strengths due to  $(\alpha,n)$ -reactions on the fuel oxygen and spontaneous fission)

$N_{j0}$  neutron reference source strength of spectral type  $j$

For HAW canisters:

$$\sum_{i=1}^n \frac{A_i}{A_{i0}} \leq 0,9 \quad (0,9 \text{ to cover all other nuclides and actinides with less relevance to dose rate})$$

with:

$A_i$  real activities (nuclides relevant to gamma dose rate) and masses (actinides relevant to neutron dose rate) of nuclide/actinide  $i$

$A_{i0}$  reference activity/mass of nuclide/actinide  $i$

These equations mean that each ratio  $G_i/G_{i0} = 1$ ,  $N_j/N_{j0} = 1$  and  $A_i/A_{i0} = 1$ , respectively, will lead to the same reference dose rate at a specified distance from the cask. In most cases the applicant had chosen the dose rate limit 2 meters away from the vehicle surfaces (0,1 mSv/h) as the most restrictive limit. By restricting the sum to be less or equal 1, or in the case of HAW to be less or equal 0,9 it is ensured that the resulting dose rate can not exceed the chosen dose rate. An disadvantage (for the licence holder) is the necessity to show the compliance with the above mentioned equation for each fuel assembly and each HAW canister, respectively, which may necessitate many additional calculations.

For some years the contents description by using source strength and activities/masses was favoured by the applicants and was accepted by the BfS with good experiences in practice.

## DESIGN TYPE LIST AND CERTIFICATE OF MODIFICATION

In addition to the development of the contents description there was also a need to improve the packaging description to cover older versions of the „main“ parts list as well as improved design elements with non-safety relevant changes due to practical experiences without revising the approval certificate.

In the past only the actual main parts list which covers all the drawings and sub parts list was laid down in the approval certificate. Older versions of the parts list after which several casks were built were not included in the certificate. This seemed to be a formal incorrectness and therefore BfS decided to introduce a „design type list“ (see Fig. 2) into the design approval certificate which includes the actual and all previous (if needed) revisions of the main parts list.


- Anlage 5 zum Zulassungsschein D/4311/B(U)F-85 (Rev. 5) -


**Typenliste**  
für Transport- und Lagerbehälter CASTOR 440/84

Behälter vom Typ CASTOR 440/84, die nach den nachstehend genannten Stücklisten gefertigt wurden bzw. werden, entsprechen der in diesem Zulassungsschein genannten Bauart (s.a. Nebenbestimmungen 2, 3 und 7).

Stücklisten-Revision	Freigabe der BAM
500.025/1, Rev. 9	Prüfungszeugnis (AZ: 1.6/10085) vom 29.03.1995
500.025/1, Rev. 12	1. Nachtrag zum Prüfungszeugnis 1.6/10085 (AZ: III.3/30407) vom 26.03.1996
500.025/1, Rev. 13	Schreiben der BAM (AZ: III.32/Ma/wg (07.96)) vom 18.07.1996
500.025/1, Rev. 15	Gutachterliche Stellungnahme (AZ: III.32/15.97/Ma/wg) vom 19.02.1997
500.025/1, Rev. 19 (mit Korrekturen der BAM vom 07.10.1998)	Schreiben der BAM (AZ: III.32/Ma/Eck/08) vom 08.10.1998
500.025/1, Rev. 22	Gutachterliche Stellungnahme (AZ: III.3/20608) vom 26.03.2001 mit den Korrekturen der BAM vom 02.05.2001 (AZ: III.32/Jo) *)

\*) Die in der Gutachterlichen Stellungnahme unter U-1 bis U-4, U-6 bis U-8 und U-30 zitierten Antragsunterlagen werden Bestandteil der vorliegenden Zulassung.

Salzgitter, den 11. Mai 2001  
Im Auftrag  
  
Börst



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**Clearance by BAM** →

**Allowable Revisions of Parts List** →

**Approval by BfS** →

**Fig. 2: Example of a Design Type List**

Another benefit of the introduction of the design type list was that changes and improvements that are non-safety relevant or where the safety is equivalent to the examined one as laid down in the Safety Analysis Report can be handled in an easy way. Because of signing the design type list separately it can be replaced without making a revision of the whole certificate. In some cases the change of a drawing or a sub parts list can lead also to many changes in other related drawings and parts lists, which would result in a very intensive work to create a new design type list. In addition to that it is not possible to change the parts list of manufactured casks if design improvements are desirable. Another procedure to handle changes and improvements was therefore developed in such a way that the applicant provides a “certificate of modification” with a detailed description of the change itself and the justification why it is non-safety relevant.

Both the revised parts list as well as the certificate of modification will be examined by BAM as the competent authority for the evaluation of mechanical, thermal and leaktightness properties as well as for the quality assurance programmes of a cask and by BfS for the evaluation of sufficient shielding and sub-criticality. If the evaluation has a positive result either

- an extended design type list will be issued by BfS and becomes part of the approval certificate if a revision of the parts list had been made, or
- an agreement will be given by BfS if the applicant applies for the accepting of a certificate of modification.

Both the agreement and the certificate of modification becomes part of the cask documentation. If some more casks shall be built all modifications have to be included into the constructional documentation when the applicant will apply for the next revision of the certificate approval.

The following should give some examples where the design type list has been added by a new revision of the parts list or the certificate of modification was accepted by BAM and BfS:

- the improvement of closing gaps specially at the trunnions to prevent contamination (result of the contamination incident in 1998)
- The fixing of the caution plate was done by riveting. On the back side of the plate contamination was found. Because the decontamination was complicated, the fixing will now be done by screws to remove the plate for decontamination, if necessary, or before loading under water.
- a pressure relief valve had to fit into a bottom plate outside the containment system which has no safety relevant function to avoid a potential overpressure

## **DEVELOPMENT OF INSTRUCTIONS FOR USE AND REPEATED TESTING**

Generally it is possible to divide the Safety Analysis Report into three main parts (and some applicants do this). The first part includes all evidences to show that all safety requirements as prescribed in the regulations are fulfilled. The second part contains all parts lists and drawings and in the third part all necessary instructions for the use and repeated testing of the package are given. This documentation is cited in the certificate, often by using indexes, and so becomes part of the

design approval. In addition to that, important instructions such as the main instruction for the use and the instructions for repeated testing are stated explicitly in the certificate.

Sometimes there is, however, a need to use a company own instruction, e.g. due to the companies quality management system, which was formally not covered by the design approval certificate in the past. To handle these cases a statement is included in the main instruction that allows the use of other instructions too, provided that they are equivalent to the approved instructions and for which the licence holder is responsible for. In the case that an approved instruction which is part of the design approval as described above has to be modified due to practical experiences the clearance by BAM, for instructions concerning e.g. the testing of contamination or shielding in cooperation with BfS, is required.

## CONCLUSIONS

Good experiences have been made since the time where the new description of the packaging - with the introduction of a „design type list“ and the „certificate of modification“ - and the new contents description have been used within German package design approval certificates. On the one hand the descriptions are detailed enough to comply with the applicable requirements of the Regulations and on the other hand they provide a certain degree of flexibility to cover practical needs. The need for revising a certificate could so be reduced in most cases to safety relevant changes.

## REFERENCES

- [1] *International Atomic Energy Agency*  
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- [3] *Sowa, W.; Kühl, H.; Hüggenberg, R.*  
Optimized Description of Radioactive Contents of Packages containing Irradiated Fuel Assemblies.  
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