Proceedings of the 18th International Symposium on the Packaging and Transportation of Radioactive Materials
PATRAM 2016
September 18-23, 2016, Kobe, Japan

4021 Consideration of the "Dual Purpose Cask Concept" in the IAEA Transport Regulations

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Abstract

The joint TRANSSC/WASSC Working Group (JWG) was established in April 2011, and has developed a technical document "Methodology for a Safety Case of a Dual Purpose Cask for Storage and Transport of Spent Fuel" (TECDOC-DPCSC, to be published). To follow the Terms of Reference, the WG has also recommended TRANSSC to incorporate a concept of dual purpose cask (DPC) into the IAEA Transport Regulations, SSR-6. Proposals to incorporate DPC concept to SSR-6 were first submitted to the 2013 initiated review cycle, and have been improved through discussions at the WGs in TRANSSC meetings, the consultancy meeting and the corresponding group led by Japan. In the 2015 initiated review cycle, the proposals were further elaborated and approved as one of major changes important to safety to initiate the revision cycle.

SSR-6 text changes comprise the introduction of "shipment after storage" to the scope of the Regulations. A few technical and administrative requirements on packages to be used for shipment after storage have been added in order to assure transportability after storage as follows.

- The design of such packages shall take into account ageing mechanisms.
- For such packages, maintenance of package performance to comply with applicable Regulations and certificates of approval during storage shall be ensured before the shipment after storage.
- In an application for approval of such package designs, an Ageing Management Programme (AMP) and a Gap Analysis Programme (GAP) shall be submitted by the applicant.

Guidance (SSG-26) text changes consider explanations of shipment after storage and more details of ageing consideration in package designs, additional explanations on AMP (the IAEA Coordinated Research Programme on AMP will be commenced in 2016), GAP and a countermeasure to certification lost in the country of origin of the design are included.

The draft of SSR-6 with changes incorporated was provided in February 2016, and have subjected to Member States 120-day review at present. Revision process of SSG-26 is proceeding a half year later than that of SSR-6. Those revised documents are expected to be published as the 2018 Editions.

Introduction

The Transport Safety Standards Committee (TRANSSC) and the Waste Safety Standards Committee (WASSC) of the International Atomic Energy Agency (IAEA) agreed at their joint meeting in July 2009 to establish a joint working group in order to resolve issues related to both of their safety areas. In June 2010, the IAEA hosted the International Conference on Management of Spent Fuel from Nuclear Power Reactors, in which Member States agreed to develop guidance for integrated safety cases for both storage and transport of DPC containing spent nuclear fuel.

To address the conference recommendation, the IAEA initiated a "Joint Working Group on Guidance for an Integrated Transport and Storage Safety Case for Dual Purpose Casks for Spent Nuclear Fuel" (JWG) in April 2011. The JWG, formed by experts from Algeria, Armenia, Belgium, Canada, China, France, Germany, Indonesia, Iran, Japan, Korea, Lithuania, Malaysia, Pakistan, Russia, Slovakia, South Africa, Spain, Switzerland, the United Kingdom and the United States, drafted guidance to prepare a safety case for DPC (DPCSC) as an IAEA technical document in its 3rd Meeting in April 2013 [1]. The document is under the IAEA process to publish as the IAEA-TECDOC "Methodology for a Safety Case of a Dual Purpose Cask for Storage and Transport of Spent Fuel" [2].

Further, to follow its terms of references, the JWG developed recommendations to TRANSSC and WASSC for changes to be made to existing IAEA Safety Requirements and Safety Guides relevant to licensing and use of DPC for spent fuel. The followings were the recommendations to TRANSSC.

- Conformity to future transport regulations with potential changes is an issue for DPCs waiting for future transport. It is recommended to consider introducing a definition of DPC packages in the IAEA transport regulations (SSR-6).
- There should be a requirement or guidance to SSR-6 to consider ageing of packages that are intended to be stored for a long time before the shipment.
- Any change of the IAEA transport regulations shall consider that in the section "Transitional Arrangements" in SSR-6 DPCs need to be considered in an appropriate manner so that they can be transported after storage. This applies to DPCs already fabricated and being used for storage of spent fuel.
- The key issue is how to maintain the DPCSC for transport during storage – recognizing that storage may be for an extended period of time – so that the DPC can be used for transport regardless of the period of storage. This requires periodic review of the DPCSC and periodic inspections of the DPC. In the review, the gap analysis should be made to identify any impact of changes of SSR-6 to the DPCSC and to existing DPCs. Compensating arrangements, if necessary, should be proposed at that time. The gap analysis should consider changes in regulations and change in knowledge since the previous approval period. Therefore, it is recommended to TRANSSC to develop an appropriate guidance material on this matter in SSG-26.
- SSR-6 should be reviewed with respect to the timespan between loading of the package and the

completion of the shipment after storage to be consistent with the operation of a DPC, which will be transported more than a few decades after loading; e.g. it should be clarified that interpretation of para. 229 of the 2012 Edition of SSR-6 does not imply that the maximum allowable timespan for a transport postulated is less than one year.

TRANSSC Member States have endeavored to incorporate DPC concept to the current regulations to provide provisions to ensure transportability in the future, i.e., “shipment after storage”.

History of Review/Revision Cycle of the Transport Regulations related to DPC

In pursuance to the JWG recommendations to TRANSSC, two Member States of TRANSSC, Switzerland and Japan, submitted proposals to change the 2012 Edition of Regulations for the Safe Transport of Radioactive Material (SSR-6, the Regulations) [3] and Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (2012 Edition) (SSG-26, the Guidance) [4] to the 2013 initiated Review Cycle of SSR-6 and SSG-26 in order to incorporate DPC concept to the Regulations. The 27th TRANSSC Meeting in November 2013 approved the proposals as an issue to be moved forward and resolved by a technical meeting or a working group, but decided to close the Review Cycle since the set of proposals were not enough matured to move to a Revision Cycle, which would be initiated in 2015.

By a Working Group in the 28th TRANSSC Meeting in July 2014, the proposals were discussed and forwarded to a Corresponding Group to be led by Japan in order to provide text changes to SSR-6 and SSG-26 for the next Cycle. The Group was established in September 2014 with experts from Belgium, France, Germany, Hungary, Japan, Pakistan, Russia, Spain, Switzerland, the United States and the World Nuclear Transport Institute and submitted the text change proposals to the 2015 initiated Review Cycle in April 2015. The Proposals were further refined by the working groups in the 30th TRANSSC Meeting in June and the Extra-ordinary TRANSSC Meeting in September. Finally, they were approved to be incorporated into the next editions of SSR-6 and SSG-26 by the 31st TRANSSC Meeting in November 2016, which also concluded to initiate Revision Cycle to publish the next editions of the Regulations and the Guidance.

The drafts of revised SSR-6 and SSG-26 including the incorporation of DPC concept were prepared by the Consultancy Meeting CS-53565 in February 2016. The 32nd TRANSSC Meeting in June 2016 approved the draft of revised SSR-6 to be subjected to Member States 120-day review, which started on 27 July and will be closed on 21 November 2016. The final draft of the revised Regulations is scheduled to be approved by the 34th TRANSSC Meeting in June 2017, and published as the 2018 Edition of the Regulations in the following year. Through revision of the Recommendations on the Transport of Dangerous Goods – Model Regulations of the United Nation (UN Orange Book), followed by the revisions of transport modal regulations such as the International Maritime Dangerous Goods Code (IMDG Code) of the International Maritime Organization or the Technical Instructions for the Safe Transport of Dangerous Goods by Air of the International Civil Aviation Organization (ICAO-TI), the requirements of SSR-6 are expected to be

mandatory in Member States on 1 January 2021. Revision process of SSG-26 is scheduled to be proceeded a half year behind that of SSR-6.

Incorporation of the DPC Concept to the Regulations

In spite of thoughts that there was no need to change the Regulations which should be conformed with even in the case of transport of DPC after long-term storage, the incorporation of DPC concept to the Regulations was generally supported by Member States, since the transport of DPC would require specific considerations that should be specified in the current transport regulations in order to ensure transportability during and after long-term storage. In development of change proposals, minimization of changes to SSR-6 and SSG-26 and generalization of requirements were taken into account.

The most important point was how to specify concept of DPC in the Regulations. As DPC was basically classified as Type B(U) package for transport, it was preferred to avoid defining a new classification of package such as Type DPC since improper definition might limit applicability of the Regulations in future. Hence, focusing on the fact that transport of DPC after long-term storage was a form of transport activity which required specific considerations beforehand, such activity was added to the scope of the Regulations in para. 106 as "shipment after storage".

SCOPE

106. These Regulations apply to the transport of *radioactive material* by all modes on land, water, or in the air, including transport that is incidental to the use of the *radioactive material*. Transport comprises all operations and conditions associated with, and involved in, the movement of *radioactive material*; these include the *design*, manufacture, maintenance and repair of *packaging*, and the preparation, consigning, loading, carriage including in-transit storage, ***shipment*** **after storage,** unloading and receipt at the final destination of loads of *radioactive material* and *packages*.

Justifications of above addition are as follows:

- As the Regulations have already provided the classifications of material and package needed (e.g., a DPC containing spent fuel can be basically classified as Type B(U) package), there is no need to add a new classification of package such as DPC from viewpoint of transport. Adding a definition of DPC based on current knowledge may narrow down future applicability of the Regulations.
- No definition for "shipment" or "storage" is required, since the both terms have defined in the IAEA Safety Glossary [5]. Neither does "shipment after storage" need a new definition, as its concept is understandable instinctively.
- On the other hand, "shipment after storage" requires specific considerations on ageing of packaging components and radioactive contents and changes of transport regulations and technology to ensure transportability after long-term storage, where such specifics can be prescribed in the Regulations.

- A term “shipment after storage” is a transport activity which can widely applicable to radioactive contents other than spent fuel that addressed in the TECDOC-DPCSC (e.g., high level radioactive waste), or wastes already packed as package waiting for shipment to a disposal facility to be constructed in future, or to load packages that shipped into, stored for more than a decade, then shipped out from facility like the LEU Bank planned by the IAEA.

The storage period anticipated here is up to approximately 100 years as defined in SSG-15 “Storage of Spent Fuel” [6] or in WS-G-1.6 “Storage of Radioactive Waste” [7]. Therefore, such storage is different from “storage in transit” in the Regulations, since the latter is part of single transport activity. Those justifications and considerations are addressed in para. 106.1bis of SSG-26 proposed to be revised.

Technical Requirements

In design of package intended to be subjected to shipment after storage, it is essential to take ageing effects during long-term storage into account. This consideration is stipulated as part of “GENERAL REQUIREMENTS FOR ALL PACKAGINGS AND PACKAGES” in Section VI of SSR-6 as follows.

612bis. The *design* of *packages* shall take into account ageing mechanisms.

This provision was initially proposed to be applied only package design intended to be used for shipment after storage, since ageing had already been well considered in design of packages repeatedly used to transport for several years to a few decades even without such provision. However, a comment that “this consideration was essential for all package designs” eliminated the text “intended to be used for shipment after storage”. Then, a comment “not all the package design need to consider ageing” followed. Hence, explanations below will be added to SSG-26.

- Package designs should take ageing mechanism commensurate to their operational conditions of that package into account.
- In the design of once-through use packaging (e.g., cardboard box for Excepted Packages or Type A Packages) need no consideration on ageing effects.
- For packagings used repeatedly, ageing effects should be considered in their design, and monitored and controlled within acceptable range through periodical inspection and maintenance.
- For packages subjected to shipment after storage, further considerations on ageing mechanism should be taken in their design including their radioactive contents, and controlled by an Ageing Management Program in order to ensure transportability after long-term storage.

In addition, for packages used for shipment after storage, transportability with compliance to the Regulations shall be maintained throughout the storage period and at the moment of shipment after storage. This is reflected as additional subpara. (e) in para. 503 of SSR-6 on “REQUIREMENTS

BEFORE EACH SHIPMENT" to confirm compliance with the Regulations and the Certificate of Package Design Approval during storage period of such packages.

503. Before each shipment of any package, it shall be ensured that all the requirements specified in the relevant provisions of these Regulations and in the applicable certificates of approval have been fulfilled. The following requirements shall also be fulfilled, if applicable:

(e) For *packages* intended to be used for *shipment* after storage, it shall be ensured that all *packaging* components and *radioactive contents* have been maintained during storage in a manner such that all the requirements specified in the relevant provisions of these Regulations and in the applicable certificates of *approval* have been fulfilled.

This concept is applicable not limited to DPC, and has already been included in para. 502.3 of TS-G-1.1 (ST-1) or even in earlier editions of the Guidance. So, only minor changes of terms in para. 503.3 have been proposed.

To complete the considerations to ageing mechanism, Ageing Management Program has to be provided by the package designer. Further, to ensure transportability after storage, changes of transport regulations and technology during long-term storage shall be coped with. For this purpose Gap Analysis Program to review initial package design periodically confirming compliance with transport regulations at that moment or difference from most recent technology and taking countermeasures when needed shall be also provided. As it was thought inappropriate to place detailed technical requirements for these Programs, the framework was prescribed in the chapter of administrative requirements below.

Concerning the maximum normal operating pressure (MNOP) mentioned in the recommendations from JWG, no change to the current definition of MNOP in para. 229 of SSR-6 was proposed in order to maintain a concept that actual transport activity (i.e., movement of package) should be concluded within one year. Instead, a caution "For packages used for transport after storage, the pressure development before shipment should be considered in the calculation of MNOP" has been added to SSG-26 as para. 229.4.

Administrative Requirements

The design of packages intended to be used for transport after storage shall be approved including consideration on ageing mechanism (i.e., Ageing Management Program) and management on changes of the Regulations and technology (i.e., Gap Analysis Program) to ensure transportability after storage. Thus, two provisions have been added to para. 809 of SSR-6 (APPROVAL OF PACKAGE DESIGNS – application) as follows.

809. An application for *approval* shall include:

(f)bis If the *package* is to be used for *shipment* after storage, the applicant shall state and justify

the consideration of ageing mechanisms on the safety analysis and within the proposed operating and maintenance instructions.

(j) For *packages* which are used for *shipment* after storage, a gap analysis programme shall be provided. The gap analysis programme shall describe a systematic procedure to consider changes of regulations, changes in technical knowledge and changes of the state of the *package design* during storage.

In the change proposals to SSG-6, explanation of concept on these Programs with reference to the IAEA-TECDOC [2] together with introduction of several technical documents relevant to these Programs to support applicants to provide them.

Since DPCs to contain spent fuel or high level radioactive waste are classified as Type B(U) packages, they can be transported anywhere under the unilateral approval awarded by the competent authority of the country of origin of the design. On the other hand, in the case that the storage of DPC takes place in the country other than that of origin of the design, the DPC may no longer be authorized to be transported when the original package design approval is withdrawn or not renewed in the country of origin of the design. Such problem has already been encountered. Though this was not a problem of the Regulations themselves, a remedy was felt to be proposed somehow. Hence, as para. 840.3 of SSG-26 (validation of certificates), a countermeasure, that the competent authority of the country of storage takes place may issue and maintain their own package design approval that may be based on an assessment already made by the competent authority of origin of design, completed by an additional assessment addressing aspects specific to shipment after storage as ageing management, gap analysis, requirements before shipment and different approval periods, has been proposed.

Future Works

New requirements will be enforced in 2021 when process of Revision Cycle proceeds as scheduled.

In the application of design approval of packages intended to be used for shipment after storage, two documents, i.e., Ageing Management Program and Gap Analysis Program, will be required to be submitted by the applicant to the competent authority. This may add burden to both applicants and competent authorities in preparation and review respectively. To reduce those burdens, it may be effective to develop formats for the Program commonly used among Member States.

As referred in proposed SSG-26 revision, methodology and some examples of Ageing Management Program are available in the references. A lot more material will be presented in PATRAM 2016. To explicate ageing mechanism of packaging components and radioactive contents during long-term storage, more knowledge and data need to be accumulated under cooperation among Member States to develop a data bank or a compendium. One of such effort is about to start as the IAEA Coordinated Research Project on Ageing Management Program for Spent Fuel Dry Storage Systems.

As a transport package approval is normally issued for a period of a few to several years, and the transport regulations may change from time to time, periodical update of the DPC design based on gap analysis between the current and revised provisions shall be conducted during long-term storage. This shall also be applied when a new technology or knowledge will be revealed. Gap Analysis Program is a program to ensure these processes. If a gap is found, transitional provisions or conditional licensing, such as to allow postponing the implementation of design change to packages by the moment of shipment after storage, should be considered.

Conclusions

Years of endeavors by experts from Member States to incorporate concept of Dual Purpose Cask to the IAEA Transport Regulations are about to be completed. The new Regulations, expected to be published in 2018, provide technical and administrative requirements for packages intended to be used for shipment after storage to ensure transportability of such packages after long-term storage.

Acknowledgement

The authors gratefully appreciate efforts from experts who have contributed to provide the draft of TECDOC-DPCSC, participated in the discussion on proposed changes to SSR-6 and SSG-26, or reviewed and offered their comments to the proposals.

References

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