DUAL USE CASKS FOR THE STORAGE AND TRANSPORT OF RADIOACTIVE MATERIALS IN THE NEW LEGISLATION OF THE CZECH REPUBLIC

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SUMMARY

The state regulatory body responsible for the approvals of transport, storage and disposal packages for transporting, storing or disposing of radioactive materials in the Czech Republic is the State Office for Nuclear Safety (SÚJB).

Basic requirements for the approvals of such packages the Czech Republic are defined in the paragraph 23 of the Act No. 18/1997 on Peaceful Application of the Atomic Energy and Ionizing Radiation (Atomic Act). This law had passed through the Czech Parliament on February 26, 1997 and came into the force on July 1, 1997. Regulation of the State Office for Nuclear Safety No 142/97 on Design Approval of Packaging for Shipment, Storage or Disposal of Radionuclide Sources and Nuclear Materials, and on Design Approval of Ionizing Radiation Sources and some Manufactured Articles for Handling Ionizing Radiation Sources (Design Approval Regulation) which also came into the force on 1 July 1997 brings detailed conditions for packages licensing.

The mentioned SÚJB Regulation introduces not only transport packages type IP, A or B, but also the type S (storage) and D (disposal) and the dual purpose - transport - storage packages. The paper briefly discusses the basis for the SÚJB approach to the approvals of respective types of the packages for radioactive materials. The role of the IAEA "Regulations for the Safe Transport of Radioactive Material" for the development of this Czech Regulation is stressed in the paper. The interface between dual use (transport - storage) containers is discussed and the significance of the national «storage« requirements and their compatibility with the IAEA "Regulations for the Safe Transport of Radioactive Material" (1) is mentioned. The experience with the licensing of dual purpose - transport and storage in CR is briefly described as well.

The paper underlines the significance of internationally accepted rules, basic requirements and fundamental test procedures for the transport packages and tries to mention some dual cask "storage" features and their interface with the appropriate transport requirements. Paper also asks for more intensive international cooperation in this field taking into an account some articles of the "Convention on the Safety of Spent Fuel Management and on the Safety of

Radioactive Waste Management". The IAEA «Regulations for the Safe Transport of Radioactive Material are considered «as a good example and a pattern for preparation of some fundamental rules focused on "transported storage" - especially for the spent nuclear fuel or for high radioactive waste.

INTRODUCTION

Fresh nuclear fuel was supplied to former Czechoslovakia from the previous U.S.S.R. and spent fuel after 5 years cooling period was originally planned to be re-exported. The transports of spent nuclear fuel from Czechoslovak NPPs were stopped in 1988 and the spent nuclear fuel assemblies from NPP Dukovany were (after 3 years cooling period) transported only to the wet interim storage facility at Jaslovske, Bohunice in the Slovak Republic. These transports were stopped in 1992.

After splitting of Czechoslovakia on January 1st, 1993, the Czech utility stored a substantial part of its spent fuel - 1176 spent fuel assemblies (FA) in the territory of Slovak Republic. Consequently the need for construction of an away from reactor spent fuel storage had become even more urgent for Czech Republic than before. Czech utility had to start the construction of the Interim Spent Fuel Storage Facility at Dukovany (ISFSF) very fast and facing public opinion against long-term storage at NPP Dukovany site. In these circumstances the operator decided to choose DUAL PURPOSE - storage and transport casks as a demonstration of preparedness to move the spent fuel from the site to final repository. After finishing licensing process (including the period of trial operation it took more nearly six years), the Interim Spent Fuel Storage Facility with CASTOR - 440/84 casks was successfully commissioned in January 1997.

In order to move 1176 spent fuel assemblies from Dukovany (CR) to Jaslovske, Bohunice in the Slovak Republic, 26 transports with 40 containers C-30, B(U) type were necessary. In order to ship this spent fuel back to Dukovany only 14 transports were needed. Eight of them still using older C-30 casks moved 456 spent fuel assemblies, while the rest of the fuel - 720 spent fuel assemblies were transported in the new CASTOR - 440/84 casks during six transports only. Because the last CASTOR cask had been loaded only partly (54 FA), it was reopened in the NPP Dukovany spent fuel pond and filled up to its full capacity (84 FA). Other eight CASTOR casks were only inspected and placed into the ISFSF.

The appearance of dual purpose - transport and storage casks on the Czech nuclear scene has brought several positive consequences and as usual some problems as well.
Utilizing huge dual cask reduced the number of transports. The possibility to load, dry and seal them in the wet storage of NPP Jaslovske Bohunice according to their (Czech) storage license enabled both operator and the regulatory body to minimize the number of operations with spent fuel at Dukovany NPP. The readiness to transport spent fuel from the Dukovany site together with the safe operation of the storage has probably slightly positive influenced the public opinion. While significant protests during ISFSF Dukovany construction from the neighboring villages were typical no major campaign is appearing now when the Environmental Impact Assessment (EIA) for enlarging ISFSF Dukovany has already been published. Furthermore the operation of reopening of partly loaded cask has demonstrated the ability of the operator to retrieve loaded FA as well as the ability to repair or change the cask.

The modular character of the storage in the casks reduces the consequence of some reviewed accidents (aircrash, terrorist attack etc). Modularity has also its economical dimension and allows the operator to pay gradually.

On the other hand both the operator and regulatory body had to solve several new problems and still have some new major challenges to deal with. The initial and the most serious problem represented the licensing of dual purpose container itself.

LICENSING PROCEDURES OF DUAL PURPOSE CASK - CASTOR-440/84

Because no specific national Regulation dealing with transport and storage cask was available in the Czech Republic in the year 1993, SÚJB followed two parallel directions of the safety evaluations based mainly on the IAEA recommendations (1):

Transport container B (U) F type which licensing was based on IAEA requirements (1) that provides precise criteria and procedures necessary for designer, licensee and regulatory body.

Licensing of storage container had to accept general principles of safety evaluations of dry storage components derived from mainly from IAEA documents (2, 3) and USNRC (4).

The main requirements for storage casks were identified as following:

- double barrier
- permanent checking of the leaktightness
- ensure subcriticality (optimum moderation - during the drying procedure)
- ensure decay heat removal (maximum cladding temperature)
- ensure shielding (max 10 mrem on the cask surface)

safety against:

- air plane crash
- crash of heavy loads
- gas cloud explosion
- burial
- sabotage

In order to ensure an objective evaluation of the safety of CASTOR cask SÚJB organized both reviewing the substantial parts of the submitted safety documentation and some research activities focused on this type of cask. Several independent institutes - The Nuclear Research Institute in Rez, Faculty of Mechanical Engineering and Faculty of Nuclear Engineering of Czech Technical University Prague, Institute of Chemical Technology, Prague were involved in the licensing process as the SÚJB consultants.

Great effort was also devoted to spent fuel computer codes qualification. A special research project focused on corrosion problems and problems of drying the cask content was completed, Criticality benchmark experiment of CASTOR-440/84 type was realized etc.

During the years 1993 - 1995 revisions 0 - 3 of the CASTOR-440/84 cask safety documentation were gradually submitted to the SÚJB. After expert reviews and evaluations of this safety documentation including supervisory calculations and some experiments were both transport and storage licenses issued by the SÚJB on October 27th, 1995.

The experience gained in the process of the safety evaluations showed that the most important safety criteria for the "storage side of the cask" were often met via fulfilling relevant "transport" requirements. Especially the "transport requirements" focused on subcriticality, decay heat removal (maximum temperature) and shielding were found satisfactory also for storage. Because every cask has to be "tailored" to the handling conditions of the respective NPP and the ISFSF, in Dukovany case the possibility of a drop from approximately 18m (reactor hall - transport corridor) structural load evaluated for the 9m drop test were not fully applicable. But the evaluations of additional wooden impact limiters installed on a special railroad car were based on the original structural load calculations. Major difference was in the requirements concerning the long-term behavior of the cask body and other component material. Three or five year's validity of the transport license faces minimal problems and both the maintenance and in service inspection of a transport cask are much more easier. The service life of a is normally considered 40 to 50 year (5), the license is usually issued for 20 year period. While the maintenance of a storage cask did not represent major problem for us the way of in service inspection of a storage cask could not cover the same extend than those for a transport cask. Therefore the request for additional inspection and proving the characteristic features for a cask intended to be transported after a long storage period was arisen by SÚJB external experts (6). Following regulatory body request the operator is preparing a program of archiving samples of the storage cask material.

In connection with the licensing process, SÚJB in cooperation with external experts had developed some tools focused on the safety of the storage casks:

- DATA BASE of the spent fuel in CASTOR - 440/84 casks - giving the possibility to calculate the activity of isotopes, neutron and gamma sources in loaded casks at any time
- independent periodical measurements of neutron and gamma fields spectra were introduced
- two projects sponsored by the Czech government on the WWER fuel cladding behavior were or are being carried out:
  a) under «normal» storage conditions (finished)
  b) under «accident» conditions in the storage (temperatures above 500°C, internal pressures above 4mpa)

SÚJB also contributed to the initiating and carrying out of several international projects:

- In order to cope with the fact that Western computer codes generally are not adapted to reflect the differences of WWER fuel, thanking the support of the US NRC, Oak Ridge NL, OECD/NEA and IAEA a project of installation and training of the SCALE 4.3 code system was organized in the NRI Rez (13-17 Oct. 97).
- Benchmarking of American code COBRA-SFS (thermal-hydraulic of spent fuel storage and transportation systems), was carried out by the KFKI, Atomic Energy Research Institute, Budapest, Hungary. This work was partly based on the data released by the operator of the ISFSF Dukovany, project was sponsored by the IAEA and the code itself was released by DOE.

- A project of studying mechanical properties of WWER cladding material and spent fuel behavior during long-term dry storage during dry storage period has started at the VNIPIET, St. Petersburg, Russian Federation. This project is sponsored by the IAEA.

LEGAL BASIS

Our first lesson of dry storage component licensing procedures had been just completed when new Czech "Atomic Act" passed through the Czech Parliament (on February 26, 1997) and the State Office for Nuclear Safety in accordance with § 47, Paragraph 7 to implement § 23 of the Law No 18/1997 Coll. on Peaceful Uses of Nuclear Energy and Ionizing Radiation (Atomic Act), issued its Design Approval Regulation.

This Regulation sets the way of the use of transport, storage and disposal packages designated for defined radioactive content in the territory of the Czech Republic both for the packages manufactured in the Czech Republic or imported ones. The fundamental concept of the requirements for defined types of the transport packages is derived from IAEA recommendations based on Safety Series No 6. Regulations for the Safe Transport of Radioactive Material, 1985 Edition as Amended 1990.

The classification of transport packages fully corresponds to the IAEA classification, but the above mentioned Czech Regulation defines also storage and disposal ones, as can be seen from the following types:

- type PZ-1, PZ-2 or PZ-3 (IP) packages,
- type A packages,
- type B packages,
- dual - transport and storage packages,
- type S packages - for the storage of radioactive materials
- type D packages - for disposal of radioactive waste.

Any application for issuing SÚJB license according to this regulation shall include:

- description of the nuclear or radioactive materials for which the given packaging is designed,
- detailed description of the type of packaging, including the complete technical drawings, list of materials and technological processes used for the packaging manufacturing,
- quality assurance program applied during packaging manufacturing as it will be implemented for the type-series under approval, as well as the quality assurance program for the packaging design,
- documents on the radiation protection assurance and document on the nuclear safety assurance, if the package contains fissile material,
- if the packaged radionuclides generate heat - also evaluation of measures for safe removal of heat - under all proposed modes of transport or storage,
- decommissioning concept, including safe management of radioactive wastes.

The regulation also establishes the procedures of obligatory tests and tests documentation. While there is not any significant difference concerning the content of the requirements as compared to relevant IAEA safety series, the principal difference is apparent concerning their form. SÚJB devoted relevant effort to make this regulation more «user friendly» than its IAEA pattern. The requirements for the relevant packages types are specified in Appendices No 2 - 9 to this Regulation, namely:

Apendix No 2 -	General requirements for packages
Apendix No 3 -	Requirements for the packagings and packages of type IP-1, IP-2 and IP-3
Apendix No 4-	Table 1 A1 and A 2 values
Apendix No 5-	Requirements for type A packages
Apendix No 6-	Requirements for type B packages
Apendix No 7-	Requirements for type S packages
Apendix No 8 -	Requirements for packagings and packages for transport, storage and disposal of special fissile material and Plutonium-241
Apendix No. 9 -	Tests for packages

As far as the requirements for the storage (S) type of packages, they are generally derived from those for transport ones - depending on the characteristics of their radioactive content and some additional «storage» requirements for example such as:

- The long-term service life of materials used to fabricate the packages shall demonstrably correspond to the designed storage time, materials with the service life shorter than the designed storage time may be used for easily replaceable components.
- The design of a package shall anticipate controls of the packages leak-tightness during their storage.
- Contents of packages shall be before storage sufficiently dried and put under the defined medium. The Office shall make a decision, upon the licensee proposal, on the dryness criteria and parameters of such a medium.
- A S type package shall be so designed that during the normal operation and design accidents it will retain sufficient shielding. Shielding of the package shall ensure that on the dose equivalent on the exterior is lower than 10 mSv/h, event at the maximum allowable activity of the design contents of radionuclides.
- A S type package shall be so designed that at the ambient temperature of 38^0 C the heat generated inside the package by its radioactive contents does not under the normal conditions impair the package in such way that it may fail to meet the leak-tightness and shielding conditions, if its contents were left uncontrolled for one week. Special attention shall be paid to heat effects which may:

  - change the spacing, geometrical form or physical state of the radioactive contents, or if radionuclides are sealed within special container - cause deformation or melting of this container or the radionuclides,

  - reduce the package efficiency as a result of its inhomogeneous thermal expansion, or as a result of the shielding material rupture or melting,

  - accelerate corrosion - under simultaneous influence of moisture.

- The residual heat removal shall be ensured also under the design accidents conditions.
- A proof of the mechanical resistance of a package shall be submitted. such proof shall be adequate to the design handling of a package.

Demonstration of compliance with the approved type of the properties and parameters for the individual manufactured or imported packages shall be ensured by the manufacturer. importer or the person who puts such goods into circulation.

After evaluation of requirements of this regulation is SÚJB allowed to issue its license. which can have some conditions. namely those which specifies compliance of an individual package with the approved type.

DUAL PURPOSE CASKS AND INTERNATIONAL REQUIREMNTS FOR SAFE STORAGE OF SPENT FUEL

The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management was opened for signature on September 29th 1997. the first day of the 41st regular session of the IAEA General Conference. Following the information of Press Release No 97/29, after a week 23 States, including the Czech Republic, have signed the Joint Convention. In spite of the fact that the entering of the Joint Convention will take its time some discussions, especially such concerning transboundary movement already took place during the Joint Convention preparatory process. The content of such discussions was reflected in a special TCM session in April 1998, which was initiated directly by the IAEA General Conference. This TCM was focused on International Instruments Related to the Safe Transport of Radioactive Material.

The advantage of dual purpose transport and storage cask technology is apparent. Dual cask technology for example reduces both the number of shipments and spent fuel handling lowering this way also the operator exposure. This technology represents also minimizing low radioactive waste generated during the operation of a facility using it. These examples show that utilization of dual purpose casks directly contributes to meet some general safety requirements as they are set in the Article 4 of this Convection.

These were only illustrative examples trying to indicate that the effort of both transport and storage international community of experts should be more intensively concentrated and more effectively co-ordinated and focused on the interface between storage and transport technology, especially to the basic safety features of dual purpose casks.

CONCLUSIONS

Following the experience gained in the licensing process of a dual purpose - storage and transport container for the spent fuel. As well as following the preparation of Czech relevant regulatory guide, based on generally accepted IAEA recommendations led the authors to propose initiating more intensive effort concentrated and more effectively co-ordinated to the interface between storage and transport technology, especially to the basic safety features of dual purpose casks. The IAEA «Regulations for the Safe Transport of Radioactive Material

are considered «as a good example and a pattern for preparation of some fundamental rules focused on "transported storage" - especially for the spent nuclear fuel or for high radioactive waste.

As the initial impute for discussions of some basic safety requirements for dual purpose cask could be taken into the considerations some of following topics:

- double barrier
- permanent checking of the leaktightness
- basic criteria for the drying procedure
- criteria for the quality internal inert media
- maximum allowable temperature of the cask surface
- maximum allowable dose rates limits on the cask surface
- long term behavior aging, maintenance and in service inspections
- additional criteria for a cask intended to be transported after a long storage period

The authors are convinced that formulating these and relevant other requirements for transport and storage cask designed for spent fuel or highly radioactive waste could be a valuable contribution of increasing of the safety both of storage and transport of this radioactive material in the future.

REFERENCES

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