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Switzerland's regulatory approach to manufacturing and use of dual purpose casks for transport and storage of vitrified high level waste and spent nuclear fuel

B. Roith
Swiss Federal Nuclear Safety Inspectorate ENSI, Switzerland

F. Koch
Swiss Federal Nuclear Safety Inspectorate ENSI, Switzerland

S. Theis
Swiss Federal Nuclear Safety Inspectorate ENSI, Switzerland

N. Catoja
SVTI-N, Swiss Association for Technical Inspections, Nuclear Inspectorate

U. Röder-Roith
SVTI-N, Swiss Association for Technical Inspections, Nuclear Inspectorate

Abstract

After the political decision to stop reprocessing of spent fuel (SF) by mid-2006, the availability of dual purpose casks (DPCs) became as vital for the SF-management of Swiss nuclear power plants as they already were for the repatriation of reprocessing waste from France and the United Kingdom. Soon the Swiss regulatory authority (ENSI) received several applications of transport and storage casks designs for use in the interim storage facilities. The guideline ENSI-G05 specifies the detailed requirements for the interim storage casks based on general requirements in the nuclear energy act and ordinance. Today 12 different casks designs have either been approved by ENSI or are in the approval process.

ENSIs transport group has developed a dedicated management process to deal with the specific aspects of such applications: the close relationship between transport and storage requirements which however show important differences in detail resulting in two separate safety files, one of them reflecting the transport configuration and international ADR requirements and the other one reflecting the storage configuration and national storage requirements.

Following the design approval with respect to transport and storage requirements ENSI carries out a product specific manufacturing control for each single DPC. Whilst design approval is largely based on the manpower of permanent staff, manufacturing control is generally sub-contracted to independent external expert organizations. However, according to regulatory guide ENSI G05 the primary responsibility for the quality of the produced DPCs is with the cask owner i.e. the customer of the manufacturer. Together with the manufacturer, the owner has to carry out the most detailed manufacturing control program the results of which have to be submitted to ENSI and the in-dependent expert.

The regulatory guide ENSI G05 defines in detail the responsibilities and duties of involved parties in the framework of storage cask manufacturing. In the last IRRS-mission it was recommended that ENSI should publish a corresponding document covering these issues in the framework of transport regulations. According to Swiss regulation the various responsibilities for class 7 dangerous goods transport in Switzerland is shared amongst 3 authorities which have issued a joint guidance document covering design construction and operation/use of qualified packages starting from IP- up to B(U)F-classification.

Both documents also cover the operational lifetime of packages in addressing issues such as operational records, updating of the safety documentation, periodic maintenance and testing, repairs and ageing management programs.

Introduction

In the 2005 edition of the Swiss Nuclear Energy Ordinance the Swiss government included a moratorium of 10 year to stop reprocessing of spent nuclear fuel. Until June 2006 all the 5 Swiss reactors sent most of their used fuel to the reprocessing plants in La Hague and Sellafield. Therefore there was no implicit need for dual purpose casks for spend fuel in Switzerland. After the moratorium Swiss utilities started procurement activities for dry transport and storage casks; one of the utilities already had launched a wet storage facility project.

Today in Switzerland there are 2 BWR sites with different fuel designs and 2 PWR sites also with different fuel assemblies. Even more complicating there are three different operator companies involved. These conditions lead to a variety of different casks designs from different vendors.

HSK, the later ENSI, as the Swiss regulatory authority had already published a guideline before 2006 to specify the technical storage requirements for dual purpose casks and the responsibility of the owner of these casks. The guideline was mainly applied to casks for high active waste from the reprocessing plants to be repatriated to Switzerland for storage and subsequent disposal. In the beginning of the century two plants already started direct storage of their fuel in dual purpose casks and did not send their contracted amount completely to the reprocessing plants.

Actual status – storage guideline

The following figure shows the quantity of casks with were annually put on store starting with the first storage in 2001 into the central interim storage facility ZZL. In 2008 the second interim facility, ZWIBEZ at the KKB site, was put into operation.

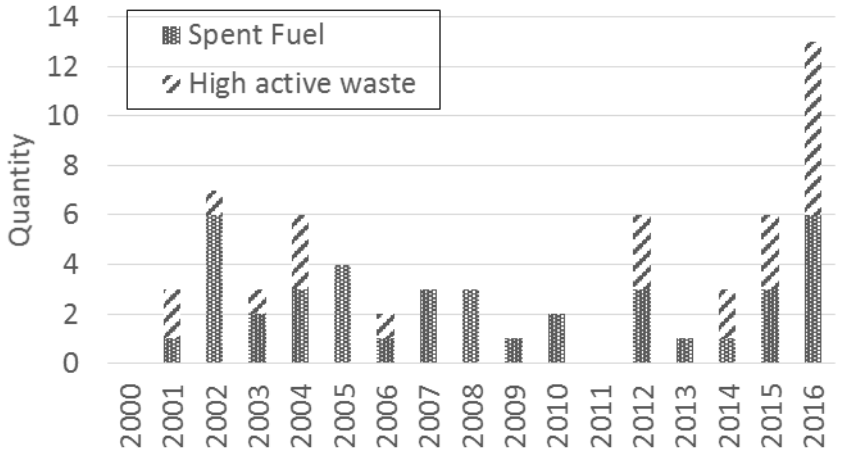

Figure 1: Quantity of stored casks

In 2008 HSK/ENSI updated the existing guideline on storage casks introducing the new ENSI-G05 [1]. This guideline addresses three main areas of requirements.

The first technical part includes all requirements which must be fulfilled by the design. The requirements are grouped into the four safety features: mechanical integrity, heat removal, shielding and criticality control. Accident conditions covered include aircraft crash and subsequent kerosene fire earthquake and complete burial of the cask.

The second technical part addresses manufacturing control and testing/quality check of individual casks of an approved design. Here all activities of the future owner during fabrication of each cask are specified as well as the involvement of the approving regulator. The regulator may decide to be represented by an independent expert. The general approach of manufacturing control is product specific, not process oriented, and includes control of pre manufacturing documents, onsite inspections, final QA-checks and control of the post manufacturing documentation. The third part of the guideline includes requirements during use of the cask, periodic maintenance, repairs and modifications. One major issue of the guideline is not only to specify the individual requirements but also to assign clear responsibilities to the acting parties, not only during manufacturing but also during use of the DPCs.

Storage requirements

Actual 12 different casks designs have been approved or are in the approval process for interim storage on the basis of the guideline ENSI-G05 [1] in Switzerland. All these casks designs were developed by foreign producers which means that according to ADR [2] there is a transport certificate to the corresponding foreign competent authority. The requirements of ADR or SSR6 [3] are in some points different to the Swiss storage requirements of the guideline ENSI-G05 [1]. All cask designers accommodate this fact by preparing two different safety files for each design, one for transport and a second one for storage. In some cases like criticality control the analyses addressing the transport

requirements are also covering the storage conditions; in other cases it is vice versa. Regarding the dose rate criteria, for example, the storage requirements are more restrictive than the transport requirements; the reference point of the calculation for the 2m criteria is the direct surface of the cask, whereas under transport conditions it is the surface of the package which includes the shock-absorbers. Therefore the storage dose rate calculation covers the transport calculation. In many safety considerations it is important to consider the specific configuration of the cask or package including shock absorbers, protection plates (airplane crash covers) additional shielding provisions, etc. The different configurations have usually impacts on the heat removal and on the mechanical analysis. Generally it is all but obvious which of the configurations lead to the more conservative results thus covering the respective corresponding configuration.

Manufacturing control

The second part of the guideline ENSI-G05 is dedicated to the manufacturing control of each individual cask. It is the future cask owner, a Swiss utility, who finally has to confirm the conformity of each produced item with the approved storage safety file. The regulatory body is also involved in selected steps of the manufacturing control procedure. The idea of the implemented system is to control each important manufacturing test and at the end each cask must pass two different test, a load test and a leak tightness test. Before the fabrication starts the quality system of the cask designer will be approved. This includes the QC-management of subcontracted items and services. Important, i.e. safety relevant manufacturing steps must be qualified by the supplier in presence of the authority or the authorized expert organization. Therefore a lot of pre manufacturing documents for the qualification will be control by authorized expert. After the acceptance of all the documents the authorized expert is present at the workshop during the qualification run. A successful qualification including all finishing tests will be documented and triggers the approval to start routine/series manufacturing. This qualification process must be repeated if major changes or new suppliers are proposed. The series manufacturing of casks is controlled by the pre manufacturing documents and routine inspections during fabrication. Through the control of the pre manufacturing documents with the safety file as basis the authorized expert immediately recognizes any changes in the fabrication and also if there is a planned deviation. Any deviation can be examined by the competent authority in relation to the safety file. Retrospectively reported deviations can only be accepted for the concerned cask or set of casks whilst accepted prospective modifications may apply to all future casks of the same type. The authorized expert is also present during key tests like definition of mechanical strength or special material fabrication for neutron absorber material during fabrication. The shells or welds which are part of the containment will be controlled by non-destructive tests also in presence of the authorized expert. All fabrication steps and test will be documented and controlled by manufacturer, cask designer, Swiss utility and authorized expert. If a non-conformity occurs the authorized expert will be informed in 10 days. In urgent cases the expert can even stop fabrication and restart only after the impact of the non-conformity related to the safety file is controlled and acceptable. After the complete fabrication is

finished and the cask is ready for use the Swiss owner must report to ENSI including the following points: check of the complete documentation; list of all deviations; list of inspections Swiss utility was present; volume of documentation, conformity to approved storage safety file. Also the authorized expert has to report on his supervision documentation of the cask. These two reports are the bases for the conformity report of ENSI called “Verwendungsfreigabe” (approval for use). The conformity reports can sometimes include some cask specific conditions like reduced heat load coming from non-conformities and is the reference approval document for use of the individual cask.

This product bases supervision system was implemented with the first cask production in the beginning of the century. At the time the main focus was on the final tests and the safety goal of mechanical integrity. The actual status is to control the fabrication with equal focus on all four safety goals. Regarding to the human resources this product based system is more intensive than a process based system. The advantage, however, is that it enables competent manufacturing control even if the manufacturing site is mainly working for other customers or different product groups. The possibility of instant interference in case of detected deviations also saves time and money by reducing volume and time of corrective measures. This most transparent process also fosters continuous improvement by all parties involved in the manufacturing. All changes during fabrication are known by the authority and can also be included in the next revision of the safety files. The final goal of all these efforts is to achieve and control a stable and high-quality series manufacturing of casks. If this status is reached the supervision can be adapt which can be lead to reduced onsite inspections. However, the ultimate responsibility for the quality of manufacturing always remains with the future cask owner.

Storage period

After the conformity of an individual cask with the approved storage safety file has been confirmed, the operator of the interim storage facility can apply for the permission to store a specified content in that approved cask. ENSI will in this process check if there is full conformance of the proposed loading with the specified contents of the cask including any cask-specific conditions. The resulting document of this procedure is the “Einlagerungsfreigabe” (permission of delivery for interim storage) including the loading plan. ENSI also integrated a systematic and periodic safety evaluation of each single cask during the storage period every 10 years. Main points of this evaluation are the transportability of the cask and if all requirements from the storage guideline ENSI-G05 are still covered by the cask.

Transport guideline

In the year 2011 an IRRS mission was carried at ENSI. One suggestion of this mission was that ENSI should publish a comparable document to the guideline ENSI-G05 covering the same issues also in the frame of transport regulations. Such document had not been considered necessary because there are currently no cask producers in Switzerland. The corresponding document, the “Leitfaden für Verpackung radioaktiver Stoffe” [4] (guidelines for packages of radioactive goods) was published in July 2015 and is now available in German, English and French. It was a common effort of all three

authorities which share responsibilities in the area of public transport of class 7 goods in Switzerland. The main topics of this document are

- More general action in the field of quality system and auditions and
- Responsibilities for each member of fabrication and use chain of the package (designer, assembler, owner, and user) including interfaces, documentation flow and possible surveillance.

Regarding the responsibilities there is also the consideration of different packages.

Challenges

For any DPC design ENSI gets two different safety files and in most cases the transport safety file is approved by a foreign competent authority issueing a transport certificate which is approved by ENSI. As transport certificates are regularly reissued, also the corresponding safety files are periodically updated which may result in discrepancies to the corresponding storage safety files. Vice versa, if ENSI finds some problems during the approval process of the cask type for storage condition a design change is not possible without requesting for a new transport license in the "home country" of the cask design. One alternative option is to issue a dedicated Swiss transport certificate including the full scope assessment of the transport safety file by the same organization. Another option is to issue in a similar way a dedicated Swiss transport certificate, however this time based on the assessment of the foreign certificate. Minor changes of the design can be included by a separate Swiss addendum to the transport safety file on which the foreign certificate is based. This addendum will be reference in the Swiss transport certificate. Another problem is the duration of interim storage: The validity of a transport certificate is short, typically 5 years, compared to the anticipated interim storage period of 40+ years. If major changes are deemed necessary in the transport licensing process the new transport certificates will most probably not cover the older designs any more, thereby questioning the transportability after storage to the site of the final repository. Only recently this problem area has gained more international attention and a first working group effort has produced an IAEA document on the subject focusing on the specific problems of DPC use such as ageing management during storage. In view of all these problems a strong cooperation including an exchange of technical assessments must be implemented between the two competent authorities for transport and for storage.

Conclusion

Dual purpose casks for transport and storage must fulfill many different requirements from different areas of the legal system. Even more confusing dual purpose casks are not stored in the same physical configuration as they are transported and their fabrication and assembly takes place in foreign countries. In the lucky case of Switzerland the competent authority for storage of spent fuel elements as well as for their storage is the same, ENSI. Hence and based on the experience of more than 20 years a mature regulatory process has been established and refined covering design, construction and use of dual purpose casks for spent nuclear fuel and high level vitrified residues from reprocessing. This regulatory process has successfully been applied to more than 10 different cask designs and more than 50

individual casks. Future challenges include the development of transport safety files while their corresponding storage safety files remain static and ageing management of stored DPCs. .

References

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[3] IAEA; IAEA Safety Standards for protecting people and the environment: Regulations for the Safe Transport of Radioactive Material 2012 Edition – Specific Safety Requirements – No. SSR-6

[4] ENSI; Quality Management Guide for the Manufacture and Use of Packaging for the Transport of Radioactive Material, July 2015