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AGEING MANAGEMENT GUIDE FOR DRY STORAGE OF DUAL PURPOSE CASKS IN SWITZERLAND

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ABSTRACT

For several years, many activities concerning ageing issues of dry storage casks for spent fuel have been going on. As an initial activity on the international level, a joint working group of the transport and waste safety committees of the IAEA, TRANSSC and WASSC has worked on the subject. As a result, the group issued the TECDOC [1] and the IAEA has introduced ageing management requirements in the 2018 revision of the Transport Regulations [2].

Following the international activities and considering the foreseen long interim storage period, ENSI has identified the need for research and for administrative actions in the field of spent fuel dry storage [3]. This resulted in several actions taken by the authority: issuing specific Swiss package design approvals for foreign dual purpose casks instead of validations (transport), introducing an obligation for any approved package design for dry storage to provide periodical ageing justifications, amending ENSI guidelines to introduce ageing management requirements for dry storage package designs, and developing a guide to provide a harmonized approach for ageing justifications.

In accomplishing the identified actions a guide for ageing management of dual purpose casks (DPC) in dry storage has been published in December 2018 [4] and will be presented by this paper. The guide intends to help users implementing an ageing management program and transferring the results into periodical safety justifications. Such justifications have to be provided periodically to the competent authority for review. The guide ensures a comprehensive and harmonised approach to ageing justifications issues by all relevant Swiss stakeholders. The guide provides advice for documentation, definition of relevant DPC components, analyses of ageing effects, definition of necessary measures, ageing of contents, implementing an ageing management program and evaluation of DPC ageing with respect to transportability and the foreseen storage periods. It identifies the corresponding responsibilities and takes into account the envisaged storage configuration.

Based on the guide, Swiss stakeholders have already launched the implementation of the guide in a collaborative manner. This includes common procedures to address ageing issues for DPCs, update of management systems, and a roadmap for providing ageing justifications to the authority.

INTRODUCTION

Spent fuel generated by nuclear power reactors needs to be cooled in the reactor pool at first directly after use. Typically, reactor pools have capacities assuming reprocessing or disposal of spent fuel after a certain period of time. Additionally original designs were not based on the use of MOX fuel, which requires significantly longer cooling times in wet storage. So, additional storage options have to be considered as extended wet storage capacities or dry storage in casks designed for storage and transport (DPC). All Swiss NPP have opted for the DPC as the final predisposal solution including those with extended wet storage capacities.

The safety justifications of a DPC are usually based on a design lifetime of 40 years of storage considering the conditions of the dedicated storage facility. However, establishing an operational deep geological repository in Switzerland will take about four more decades [5]. This put the spot on the questions how long spent fuel can be stored in dry conditions in DPCs and how safety margins for storage periods more than 40 years can be quantified. Such considerations have to address package components as well as the properties of the loaded spent fuel.

At the international level, many activities concerning ageing issues of DPCs for spent fuel have been going on. As an initial activity on the international level, a joint working group of the IAEA transport and waste safety committees, TRANSSC and WASSC, has worked on the subject. As a result, the group issued the TECDOC [1] and the IAEA has introduced ageing management requirements in the 2018 revision of the Transport Regulations [2].

Following the international activities and considering the foreseen long interim storage period, ENSI has launched an internal project for long-term storage of DPC supported by external experts [6-8]. The project carried out in 2015 and 2016 has identified necessary research and administrative actions in the field of spent fuel dry storage [9]. The implementation of the identified actions have been initiated in 2017 and 2018. The following table presents the status of the actions taken by the authority up to now.

Issuing specific Swiss package design approvals for foreign dual purpose casks instead of validations (transport)	accomplished
Introducing an obligation for any approved package design for dry storage to provide periodical ageing justifications	accomplished
Amending ENSI guidelines to introduce ageing management requirements for dry storage package designs	initiated
Developing a guide to provide a harmonized approach for ageing justifications	accomplished

There are other actions taken by the operators such as developing procedures to cooperate in ageing management both on the technical side and on the administrative side. The operators have already started to review existing documentations for stored DPC. The compilation of ageing justifications

accompanied by technical investigations will be the next steps.

From the regulatory perspective, a guide for ageing management of dual purpose casks (DPC) in dry storage has been published in December 2018 [4]. The objective of the guide is to support the stakeholders in providing comprehensive and satisfying justifications and to ensure a harmonised approach to ageing justifications in general. The safety justifications have to be provided periodically to the competent authority for review, a requirement, which has already been introduced as a standard obligation in package design approvals for storage in Switzerland. The guide has been developed in accordance with the standardised procedure including consideration of relevant comments of stakeholders.

BASIC IDEAS

The guide describes necessary safety justifications, which have to be provided for the ageing of DPC. The justifications shall cover cask components, radioactive contents and organisational aspects. So, the potential degradation of cask components is discussed in connection with the continuing decay of the radioactive content. Additionally, organisational aspects include changes of the ownership e. g. accomplishing the decommissioning of a NPP, necessary knowledge transfer of cask design and handling, supply chain management for replacement parts and others. According to requirements introduced by the 2018 revision of the Transport Regulations [2], the ageing justifications have to consider technical ageing phenomena, changing of regulatory requirements and new technologies relevant for DPC.

The guide already addresses the requirements for *shipment after storage* introduced by the 2018 revision of the Transport Regulations [2], which come into force in the regulations for the respective transport modes and the national regulations in 2021. With respect to storage requirements, the guide addresses both the periodic safety reviews of nuclear installations (existing guide ENSI-A03 [10]) and the recently introduced obligation in package design approvals for dry storage. A general requirement for ageing justifications of stored packages will be additionally introduced in ongoing updates of the specific storage guides ENSI-B17 [11] and ENSI-G05 [12].

For transport, Swiss legislation is based on the dangerous goods regulatory framework such as ADR, RID, AND, IMDG-code and ICAO-TI. With respect to storage, Swiss legislation is based on the nuclear energy act and the nuclear energy ordinance. The latter one gives ENSI the order to develop and issue supplementary guides to further detail the regulatory requirements. All the aforementioned documents are legally binding. The ageing management guide is not directly based on an order in the nuclear energy ordinance. Therefore, it is a document, which supports the operators but it is neither legally binding nor obligatory.

The guide assumes, that ageing justifications are based on the existing approvals and the respective safety reports for transport and storage. The limits set by these documents have to be respected. Any

ageing justifications should demonstrate, that the existing limits are fulfilled and will be still fulfilled for at least the following review period. Therefore, an inspection/verification program has to be provided in addition to control the respective limits. In the case of deviations from those limits, a separate application for the revision of approvals have to be launched including new safety justifications for the DPC design. This is not part of the ageing justifications and the ageing management guide.

CONTENT OF THE GUIDE

The guide consists of 12 chapters altogether, which can be grouped in the following way:

General chapters

1. Introduction
2. Subject matter and scope
3. Regulatory basis
4. Definitions

General justifications

5. Procedure, documents and competences
6. Content of application
7. External developments

Specific justifications

8. Identification of relevant components
9. Analysis of technical ageing effects and identification of necessary actions
10. Organisation

Evaluation

11. Evaluation concerning transport requirements
12. Evaluation concerning storage requirements

The general chapters are standard ones for ENSI guides and do not require additional explanation.

Chapter 5 provides an overview concerning the general procedure, the available documents, and the scope of the justifications with respect to the classification, selection of relevant components and ageing phenomena as well as reasoning for the consideration of a single DPC or a group of DPC. The clarification of competences is also part of chapter 5: Justifications have to be provided mainly by the owner of the DPC and the respective content. However, contributions are also required by the operator of the storage facility, because this operator will usually perform the inspections and record the results necessary to complete ageing justifications. Chapter 6 gives rather specific advice for the necessary documents to be provided for regulatory review. Chapter 7 includes changes of regulatory requirements and the consideration of new technologies relevant for DPC.

Chapter 8 covers the specific justifications for the identification and classification of the relevant package components in a rather detailed way as well as the consideration of the ageing of the radioactive content. Chapter 9 provides a procedure for the analysis of technical ageing effects, which will be further detailed in the following section “ageing justifications” in this paper. The organisational aspects in chapter 10 are also specific with respect to the specific storage facility and different DPC owners. Their qualification programs, supply management, quality assurance, knowledge management, resources, maintenance of handling equipment are considered regarding the long storage period including the final transport.

The chapters 11 and 12 summarises all the general and specific ageing justifications and link the results to the criteria provided in the relevant approvals and the corresponding safety analysis. This evaluation is the basis for required actions and measures such as update of inspection programs or launching the applications for the revision of the approvals considering changed conditions.

AGEING JUSTIFICATIONS

Chapter 9 is probably the heart of the ageing management guide and the recommended justifications. This chapter describes the analysis of technical ageing effects and the identification of necessary actions. The basic idea is the setup of many, so called ageing surveillance programs (ASP). The ASP is based on the ageing justifications for components of NPP, which are already implemented in Switzerland. Every ASP consists of a specific component and a specific ageing phenomenon (see figure 1).

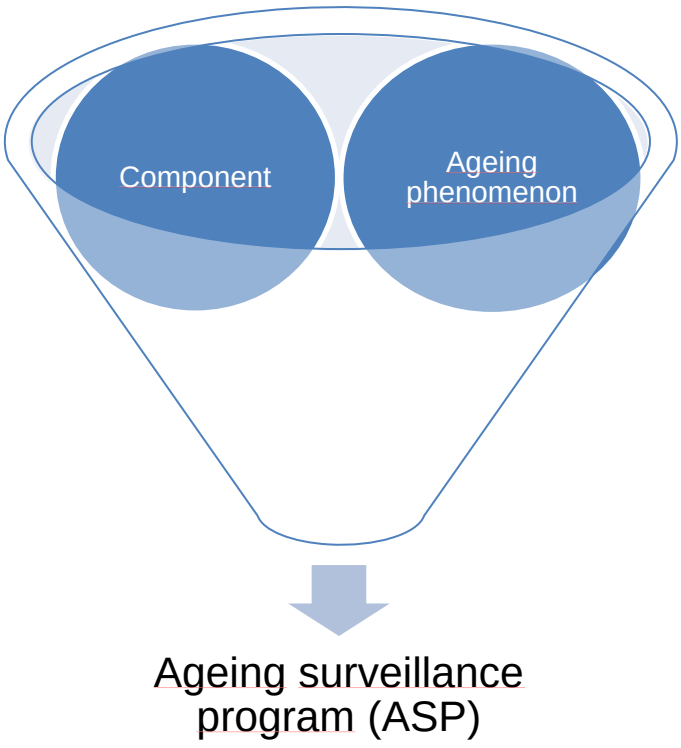

Figure 1. Setup of an ageing surveillance program (ASP)

Applying this approach, a lot of ASP have to be developed for a DPC design. One component may be combined with multiple ageing phenomena. Consequently, there will be multiple ASP for one single component. Some examples are given in figure 2.

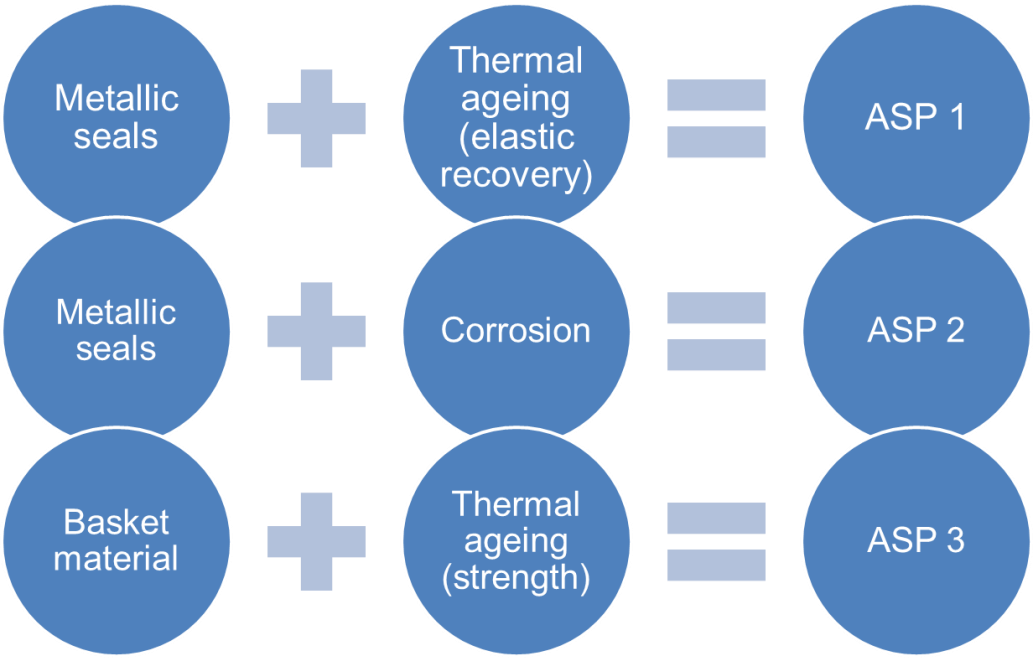

Figure 2. Examples for ageing surveillance programs (ASP)

Every ASP should contain the following elements:

- Scope (concerned component, materials, environmental conditions)
- Description of the test procedure
- Identification of the investigated ageing effect
- Comparison with the criteria and trend analysis
- Justification of the criteria
- Identification and implementation of necessary corrective actions
- Justification of the effectiveness of the corrective actions
- Authority control
- Evaluation of results considering prior experiences or other relevant information

EVALUATION

According to the guide, an ageing justification concludes with a final evaluation of the results provided by the aforementioned analyses as detailed in the chapters 11 and 12 of the ageing management guide. All the results have to be compared to the criteria given by the relevant approvals and the corresponding safety reports (marked as transport requirements and storage requirements in figure 3). Depending on the results, the evaluation requires the definition of measures such as amendments of ASP or in the case of deviations to the requirements, an application for the revision of the approvals.

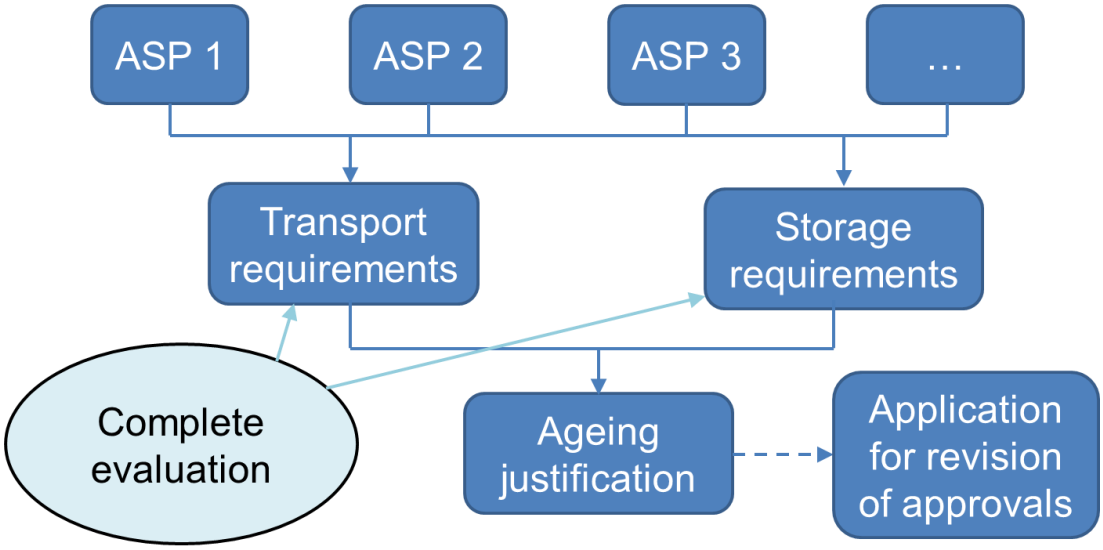

Figure 3. Evaluation of ageing surveillance programs (ASP)

CONCLUSIONS

With the presented guide, ENSI has accomplished another task in its program for the ageing of DPC. The guide has been available since October 2018 and officially published on the ENSI website in January 2019 [4]. In contrast to other ENSI guides, the ageing management guide is not a binding document. It is a document, which provides advice to the users at the level of recommendations. This should help the operators to prepare ageing justifications for DPC for regulatory review. Therefore, the guide contributes to a comprehensive and harmonised Swiss approach, which initiates and facilitates the necessary workload for the operators and the competent authority. The guide considers the internationally agreed transport requirements [2] and the relevant guidance [1].

Parallel to the development of the guide, the operators have already started to setup an ageing management process including administrative and technical collaboration. Following the publication of the guide, the operators prepare the first ageing justifications for authority review. Additionally, a roadmap exists for the preparation of ageing justifications for all DPC designs stored in Switzerland.

After the publication of the German version of the guide, ENSI plans translations in French and English until the end of 2019 as a next step. In the future, gathering sufficient experience during the next years, the guide may be transferred in a rather binding ENSI document.

The ageing management guide is an important element of the ageing management strategy implemented by the competent authority. Nevertheless, the ageing issue in general is still in the starting phase. The guide provides a framework for the future ageing management activities, which needs to be supported by additional research and development projects launched by the operators to identify and to quantify the relevant technical ageing effects.

ACKNOWLEDGMENTS

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