Proceedings of the 17th International Symposium on the Packaging and Transportation of Radioactive Materials
PATRAM 2013
August 18-23, 2013, San Francisco, CA, USA

267- Developing an Unloading Strategy Following NPP Shut Down: Example of Doel 1&2

Authors : Nathalie Allimann Areva -TN International, Olivier Lefebvre and Luc Janssen Synatom,

nathalie.allimann@areva.com, *Olivier.Lefebvre3@Synatom.com*, *Luc.Janssen@Synatom.com*

ABSTRACT

Since the Doel 1&2 nuclear power plant shutdown announcement in Belgium, planned for 2015, Synatom has had the challenge of emptying the deactivation pond with an optimized schedule.

Reprocessing was the reference strategy for the used fuel management of Doel 1& 2 until 1993. After a debate in Parliament in late 1993 putting the reprocessing option on hold for 5 years ,the used fuel of Doel 1&2 was stored in TN®24 SH casks in the interim storage building SCG on the site. On January 1, 2013, 25 TN®24 SH were already in storage, and six other ordered casks had to be delivered.

In order to keep the post-shutdown period as short as possible, Synatom put in place an efficient spent fuel management strategy: TN International conducted a feasibility study to unload the pond of Doel 1&2 with the existing TN®24 cask SH in a maximum period of 3 years after shutdown. The aim of those studies was to demonstrate the feasibility of the operation and to optimize the capacity of the cask in terms of fuel characteristics (in particular the possibility to unload fuel assemblies with short cooling time).

Analyses were based on data of fuel currently in ponds and planned to be unloaded until final shutdown. Constraints on the duration of the on-site loading and transfer operation were considered, for example, the number of days for a complete loading cycle.

First, TN International assessed each fuel family in terms of thermal power and sources to optimize the proposed loading plans.

Secondly, based on thermal and radiological numerical calculations, 5 partial heterogeneous TN®24 SH loading plans to unload the pond in 3 years after the definitive plant shutdown have been proposed. These loading plans respect all transport criteria of the applicable Certificate of Compliance as well as the relevant storage criteria.

Methodologies developed by TN International enable the rapid optimization of these loading plans in case of modification of data such as fuel characteristics, hypothesis of cooling time, schedule of operations…

The purpose of the paper is to describe this global approach and its benefits.

INTRODUCTION

Since the announcement of the shutdown of the Doel 1&2 nuclear power plants in Belgium, planned for 2015, Synatom has had the challenge of emptying the deactivation pond with an optimized schedule.

The used fuel of Doel 1&2 is currently stored in TN®24 SH casks in the interim storage building SCG located on the Doel nuclear site close to the reactor buildings. TN®24 SH transport and storage casks are supplied by TN International, part of the AREVA Logistics Business Unit.

In order to keep the post-shutdown period as short as possible, Synatom has put in place an efficient used fuel management strategy: the AREVA Logistics BU conducted a feasibility study to unload the Doel 1&2 pond with the existing cask TN®24 SH in a maximum period of 3 years after shutdown.

THE USED FUEL MANAGEMENT STRATEGY STUDY FOR DOEL 1 & 2

Objectives of the study

The goal of the used fuel management strategy study was to do a quantitative evaluation of different scenarios.

1/ In the case of a fully loaded TN®24 SH, evaluation of the duration of the unloading of the used fuel pond

2/ Analysis of the loading strategy of the TN®24 SH, based on the hypothesis of an unloading of the used fuel reactor pond in 3 years; Analysis of different partial basket loadings and an optimized basket design if needed

Basic data and hypothesis

The basis of the study was as follows:

Spent fuel data

Synatom evaluated 556 used fuel assemblies based on hypothetical realistic scenarios of reactor operations until 2015, including used fuel already in the pond. Characteristics of the used fuel considered are enrichment, burnup and cooling time.

Loading operation hypothesis

Duration of the loading operation of one TN®24 SH was evaluated by Synatom. This operation is performed in the reactor pond (no dedicated pit). Doel 1&2 are not equipped with a special cask preparation area and the entrance area of the reactor building is therefore “transformed” into a cask preparation area for operations.

Figure 1 : The TN®24 SH dual purpose cask handling operation

Synatom has provided an estimation of the loading schedule of the TN®24 SH casks in 2017 and 2018, taking into account human resources occupation for other operations which will be roughly the loading of one cask each month.

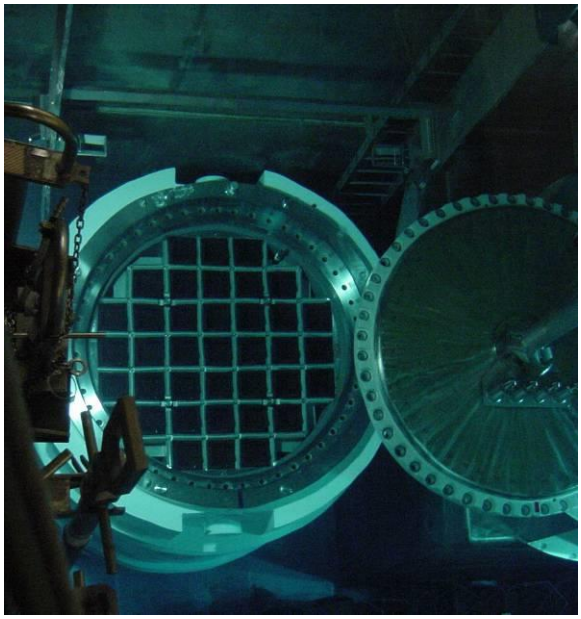

Figure 2 : The TN®24 SH dual purpose cask loading operation

1/ In the case of a fully loaded TN®24 SH, evaluation of the duration of the unloading of the spent fuel pond

On the basis of spent fuel assembly data, the cooling time needed is normally 5 years before loading in TN®24 SH.

So in order to optimize the duration of the pond unloading, a specific analysis of loading strategy have been implemented.

2/ Analysis of the loading strategy of the TN®24 SH, based of the hypothesis of an unloading of the used fuel reactor pond in 3 years

First, the AREVA Logistics BU assessed 23 fuel families in terms of thermal power and sources to optimize the proposed loading plans.

Secondly, based on thermal and radiological numerical calculations, five partial heterogeneous loading plans for TN®24 SH casks were proposed. These loading plans respect all transport criteria of the applicable Certificate of Compliance as well as the relevant storage criteria.

The result of the analysis is that to ensure the unloading of the pond in 3 years approximately 21 TN®24 SH transport and storage casks should be needed, to be loaded in 2017 and 2018. Synatom has launched the manufacturing of 10 TN®24 SH casks in June 2013.

Methodologies developed by the AREVA Logistics BU allow for the incorporation of any modification of data (such as fuel characteristics, hypothesis of cooling time, schedule of operations) to rapidly optimize these loading plans. Such models do not require additional costly calculations in case of basic data change.

Implementation of the loading strategy integrated into the current transport license

The TN®24 SH is currently licensed AIEA-96 B(U) for transport in France and Belgium until May 2017. The renewal of the transport license should normally occur during the loading operations planned in 2017 and 2018.

In June 2013, Synatom started the process of renewal of the transport license earlier than expected and in parallel the extension of the license with the new loading plans to get a license renewal by mid-2016. This is an excellent way to mitigate risks.

CONCLUSION

Synatom faces the important challenge of the Doel 1&2 shutdown in 2015 (2*433 MW, powered up in 1975). Synatom and TN International have been working closely together in anticipation of the loading operations of the TN®24 SH casks in 2017 and 2018.

Synatom is now confident that it is possible to achieve its goal of unloading the pond in only three years with the solutions provided by the AREVA Logistics BU:

- Optimized loading plans
- Cost-effective methodologies for data modifications
- The ability to manage last core transport and storage efficiently

Moreover, as these solutions are compliant with the closed fuel cycle option, Synatom will be able to opt for the transport and treatment of used fuel at the La Hague facility in France at any time in the future.