TESTING OF THE CANDU SPENT FUEL STORAGE BASKET PACKAGE

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ABSTRACT

The paper described the results of testing for a CANDU Spent Fuel Storage Basket Package Prototype intended to be used for transport and storage of the CANDU spent fuel bundles within NPP CANDU Cernavoda, Romania. (1) The results obtained proved that the objectives of those tests were achieved

INTRODUCTION

The CANDU NPP Cernavoda has been commissioned in 1996. The amount of the radioactive wastes is estimated to be cca. 550 m^3 /year. Among this quantity, the High Level Radioactive Wastes (spent fuel) is about 100 t/year, 5000 CANDU fuel bundles, respectively.
Note: a CANDU fuel bundle has 37 fuel elements.

The CANDU spent fuel storage basket is intended to be used as a package to storage the spent fuel inside the pool of the CANDU NPP for a period of 7 to 10 years. (1) This storage has two functions: transport and storage. The prototype of the basket is shown in the figure below, Figure no. 1:

Fig. 1. The prototype of the CANDU spent fuel storage basket

The main technical characteristics are:

- ***Storage capacity***: 60 CANDU fuel bundles;
- ***Out-Diameter***: 1,070 mm (max);
- ***Out-Diameter***: 1,040 mm;
- ***Height***: 550 mm;
- ***Operating position***: Vertical;
- ***Manufacturing material***: 2NiCr185;W1.4306; AISI 304L.
- ***The weight of one CANDU spent fuel bundle***: 23.6 kg
- ***The weight of the spent fuel (total):*** 1,316 kg
- **The total weight of the basket (including the weight of spent fuel)**: 1,800 kg
- ***Operating position*****:** vertical

The basket itself has two parts: the basket and its lid. The entire basket is manufactured from stainless steel.

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Production testing

During manufacturing the prototype has been subjected to a series of production tests (1, 2) in order to prove the compliance with the design and technical specification requirements.

These requirements refer to the following:

- ***Checking of the main design and operational parameters with respect to the dimensions, the weight of the lid, the total weight of the basket (without spent fuel bundles) and with 60 spent fuel bundles;***
- ***Checking of the leakage after the basket being prepared for drop test;***
- ***Checking of the -up and down- basket facilities;***

Test pass criteria: (1, 2)

- The leakage rate < 10^{-5} Atm/cm^3/sec (according to the ASME Section V, pt. T-1053.1);
- For dimensions: max. effective deviation: 11.44 mm (allowable), the value of limit of the tangent: ± 22mm/m, the angular deviation: ± 1^o and $15^{'}$. All the deviations values are to be determined by computations.

The welding of the lid (after the simulated spent fuel has been introduced inside the basket) has been checked through the penetration liquid methods

Results: all the determined deviation values were within the acceptance criteria. Also, the welding corresponds to the technical specification requirements

Qualification testing

Note: All the tests were performed within INR Pitesti - Reliability and Testing Laboratory which is the single accredited laboratory in Romania to perform tests for radioactive waste packages (both type A and B). The

Romanian National Nuclear Regulatory Body – National Commission for Nuclear Activities Control (CNCAN, issued the license in 1997. (2)

Drop testing

The prototype of the CANDU spent fuel basket storage has been subjected to two-drop tests, both of them from 7 m height: (2)

- The test no. 1 was performed on the bottom of the storage facility (simulated by the tower);
- The test no 2 was performed on the other basket located on the bottom of the storage facility.

In order to perform those two drop tests, within Institute for Nuclear Research Pitesti has been manufactured a dedicated tower, as shown in Figure no. 2:

Fig. 2. The testing tower

The basket with the simulated contents (60 CANDU fresh fuel bundles) was manipulated by means of a 16 tones crane (as can be seen below in the figure 3:

Fig. 3. The basket during preparing of the 7m drop tests

Before performing of the 7m drop test, the sample has been subjected to a He leakage test and the determined leakage rate was under the ***test pass criteria value*** – 10^{-5} Atm/cm^3/sec. (1, 2)

After performing of the first 7m drop test the sample has been subjected, again, to the leakage test and the determined rate was within the acceptance criteria limit. (1, 2)

The second 7m drop test has been performed in the same condition and same leakage tests – before and after the test has been performed. The test pass criteria were achieved so the test has been considered passed and the prototype accepted for future manufacturing. (1, 2)

In figure no. 4, the basket is shown after dropping, while the upper part of the tower has been removed:

Fig. 4. The CANDU spent fuel storage basket prototype after the 7m drop tests

CONCLUSIONS

This CANDU spent fuel storage basket package has been manufactured for the first time in Romania and is intended to be used within NPP CANDU Cernavoda to transport and store the spent fuel within intermediate storage disposal located on site. By using simulated content (fresh fuel bundles) during 7m drop tests, we took a serious option for the manufacturing of the basket and, in the same time, our confidence level on the quality of the basket to be manufactured has been increased. Our National Nuclear Regulatory Body licensed our test facilities and the tests have been performed under the approval of the Competent Authority.

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