# Current Status of Spent Nuclear Fuel Integrity Evaluation R&D in the Major Countries

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## 1. Introduction

Interim SNF (Spent Nuclear Fuel) Dry Storage could be defined as to be located inside nuclear power plant site and has been managed by the utility (not the government). The definition of 'interim' is getting longer than the initial expectation because of huge delay of disposal facility opening and no more fascinating processing option. The cask or canister has been concerned for containment safety in the last decades, but these systems have developed very robustly by the commercial cask vendors. By the way, SNF itself faces another challenges of integrity evaluation for the extended storage time beyond its initial licensed period. This article is willing to briefly introduce what is current situation in the major SNF dry storage countries for this and where should our country take a step towards.

## 2. Status of Europe

### *2.1 Overall Status*

European Union is now planning a joint program on radioactive waste management and disposal which includes SNF integrity R&D work for 10 years in two steps. Following each national topics belong to this joint program.

### *2.2 Germany*

SNF R&D Project title of the joint program is 'Development of a fracture mechanics approach to describe brittle failure of fuel cladding during long term interim storage (BRUZL)' . BAM, Germany R&D licensing organization takes a header role by leading Spanish university for thermo-mechanical-chemical properties, Spanish research organization for pellet behavior and Germany university for pellet-cladding interactions in dry storage & transportation situation. Figure 1 shows the basic testing and modeling plan of BRUZL project.

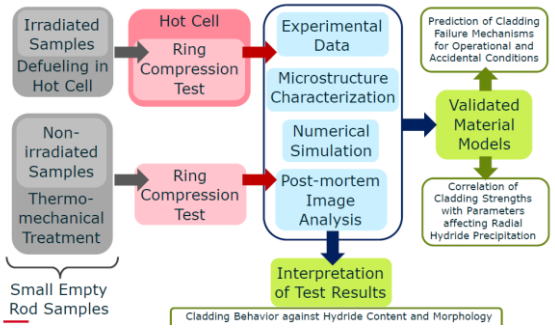


Fig. 1. Testing Plan of Cladding in BRUZL.

### *2.3 Swiss*

NAGRA [1], the Swiss radioactive waste management organization, has started SNF integrity R&D like Figure 2 even though their fundamental mission is deeply dispose SNF underground. The reason of their research is to keep SNF handling facility and space clean while they do repackaging.

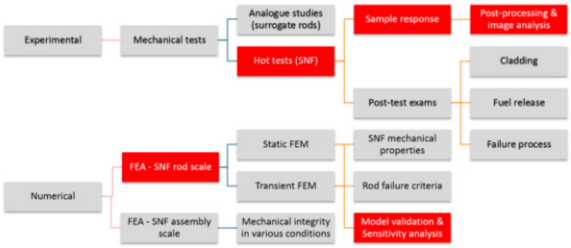


Fig. 2. SNF Integrity R&D in NAGRA.

### *2.4 Spain*

ENUSA, the Spanish nuclear fuel supply company, is doing SNF integrity R&D which is dedicated to handling problem. This R&D has three step: first, they lowered the initially 100% concerned SNF to 75% by analyzing already existing available information. Secondly, they eliminate 28% possible concerns by performing visual inspection. Finally, they narrow down the concerning target from 47% to 11% by testing fuel assembly condition. This approach is very reasonable and acceptable to plan the fuel testing matrix.

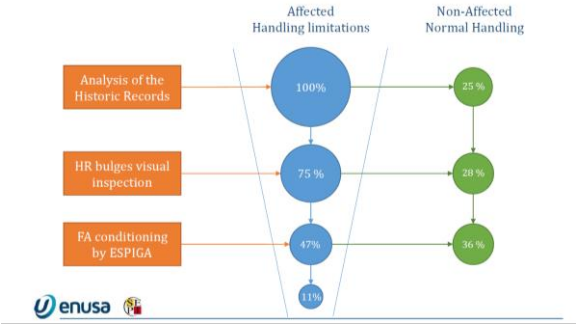


Fig. 3. SNF Assembly based Integrity R&D in Spain.

## 3. Status of USA

### *3.1 High Burnup DEMO Sister Rod Testing*

High Burnup DEMO program has started its 10 years operation from November 2017. One of the main goal of this demo is to clarify SNF degradation while dry storage operation. For the 'before DEMO condition (t=0)', 25 sister rods are under examination in ORNL, PNNL and ANL for various single effect testing. These initial testing results could contribute to produce high burnup (~55 GWd/t) characterization material data.

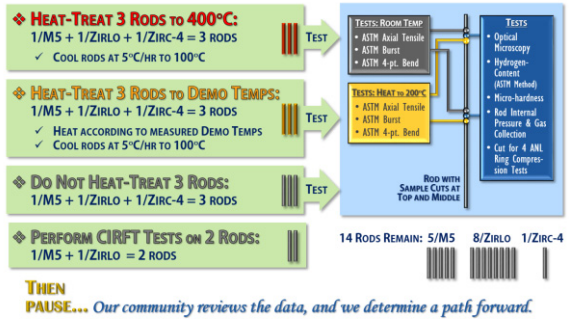


Fig. 4. High Burnup DEMO Sister Rod Testing Plan.

## 4. Status of Korea

### *4.1 Where are we standing?*

Majority(over 70%) of SNF already discharged from reactor is less than 45 GWd/t level and therefore current Korean R&D is focusing on this burnup range. The distinguished meaning of this step is to develop testing device, establish quality assurance procedure for the testing, arrange testing matrix, integrate anticipation coding, and broaden expertise network. Expected main results of this step is shown in Figure 5 which includes SNF testing data, material property anticipating code, and small-scale demonstration exam.

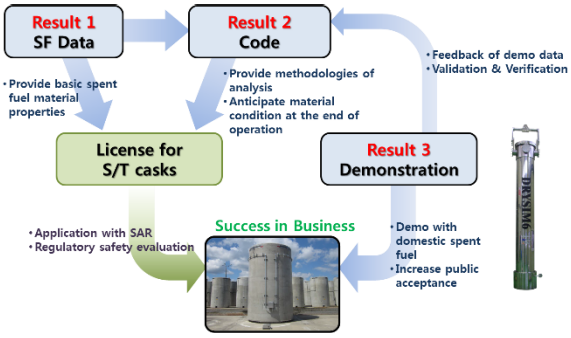


Fig. 5. Expected Korean SNF R&D results.

### *4.2 What is our next step?*

Based on the current R&D results, next step have to expand work level up to fuel assembly-wise integrity severely because the fuel retrievability which is the mandatory mission of dry storage management is the most important goal in the SNF handling with burnup level increasing.

## 5. Conclusion

As SNF Dry Storage is getting longer than the initial 'interim' purpose, the importance of SNF integrity evaluation work is getting higher, especially for the extended storage era. Current status of the major countries on this shows us the near future SNF R&D direction.

## ACKNOWLEDGEMENT

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## REFERENCES

[1] NAGRA, "Overview of European Joint Project activities on WP proposal-Spent Fuel Characterization & Evolution Until Disposal, 2nd GRS Workshop on Safety of Extended Dry Storage of Spent Nuclear Fuel, 2018.