WAITING FOR THE REPOSITORY – DRY STORAGE ACTIVITIES AT PSI

PIOTR KONARSKI[1,*], CEDRIC COZZO[1], GRIGORI KHVOSTOV[1], HAKIM FERROUKHI[1]

[1]PSI Center for Nuclear Engineering and Sciences, Forschungsstrasse 111, 5232 Villigen, Switzerland

** Corresponding author email: piotr.konarski@psi.ch*

In Switzerland, used nuclear fuel is safely stored in dry storage casks until the geological repository becomes operational. To ensure the long-term safety of this interim storage, researchers at the Paul Scherrer Institut (PSI), in collaboration with the Swiss Federal Nuclear Safety Inspectorate (ENSI), are conducting detailed studies on the behavior of nuclear fuel during dry storage. This research focuses on the complex thermo-mechanical and chemical phenomena that occur within the fuel rods under storage conditions. Encapsulated in zirconium alloy cladding, the nuclear fuel is stored in inert gas within multilayered casks. Over time, processes such as hydrogen diffusion, hydride precipitation, creep deformation, and helium accumulation can affect the integrity of the cladding. PSI has developed advanced simulation tools to model these phenomena and predict their implications for the safety of long-term storage and subsequent transfer to the disposal repository. These models incorporate reactor operation histories, hydrogen uptake and redistribution, and thermal gradients to evaluate the likelihood of cladding degradation, including the formation of radial hydrides, which pose a risk to structural integrity. Validation of these models is conducted using PSI's unique experimental facilities, which provide data on material behavior under relevant conditions. The obtained results demonstrate the ability to simulate key phenomena and provide insights into the safe handling and transfer of used fuel. Future work includes international benchmarking to further refine these tools and enhance their predictive capabilities. This research supports the development of optimized cask designs that improve safety while minimizing the environmental footprint of dry storage. The outcomes of this work contribute to Switzerland’s commitment to safe, sustainable, and scientifically grounded nuclear waste management practices.

084_abstract