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Study on Temperature Estimation Method of PWR Spent Fuel Cladding in Dry Storage

In Japan, a need for additional spent fuel storage capacity is increasing due to a decrease in the residual storage capacity of at reactor (AR) spent fuel pools. The Japan's first away from reactor (AFR) dry storage facility for spent fuel, the Recyclable Fuel Storage Center in Mutsu-shi, Aomori, has completed its construction, and dry storage using Dual Purpose Casks (DPC) in this facility is under safety review based on the new regulatory requirements. Both spent PWR fuels and spent BWR fuels will be stored there.
In the case of DPC storage, if there is no mechanical impact such as DPC overturning or fluctuation of the inter-lid pressure during the storage period, integrity of DPC and stored fuel will be considered to be maintained throughout the storage period, and DPC will be shipped without opening DPC lids for pre-shipment inspection. So the evaluation of integrity of stored spent fuel is one of the key technologies for DPC storage. For dry storage, hydride reorientation and creep of fuel cladding are considered as main deterioration mechanisms, and both depend on the cladding temperature history. Although the investigations for the other aging issues are necessary, in this paper we focus on the temperature change during the storage and explain an approach for fuel cladding temperature estimation by measuring the surface temperature of DPC.
Japan has experiences of AR BWR spent fuel dry storage with the integrity check of the stored BWR spent fuels. Meanwhile, due to the lack of PWR spent fuel dry storage experience, the electric utilities are preparing a long-term storage test campaign in advance of the start of actual storage at the Recyclable Fuel Storage Center. The regulator has participated in this campaign from the planning phase, and developed an analysis tool with the purpose for comprehension of stored spent fuel cladding temperature history. This tool aims to estimate the cladding temperature not by direct measurement but through measurement of the surface temperature distribution of the test container. Validation of the tool by comparing the analytical results to the measured temperature distributions of the test container in the preliminary heat-transfer test was conducted. The analytical results well agreed with the measured temperature distributions, which support the conclusion that the fuel cladding temperature could be estimated from the surface temperature distribution of the test container.

Country/ int. organization

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