



Contribution ID: 129

Type: oral

Fresh PWR Assembly Measurements with a New Fast Neutron Collar

Friday, 24 October 2014 11:40 (20 minutes)

The primary tool for the physical verification of LWR fresh fuel assemblies is the neutron collar [1]. In order to minimize the dependence on the operator's declaration for poison fuel rods, it can be operated in fast mode. Until now, measurements in this mode were time-consuming, taking ~ 1hr for reasonable precision. In order to improve this performance a new collar for PWR assemblies, still based on ^3He tubes, but with better performance, was designed using simulations [2]. This paper reports on the experiments undertaken to demonstrate that the performance of the new collar, as fabricated, corresponded to the modeling predictions. Measurements have been made with the same PWR mock-up assembly that was used for the original collar calibration work [1]. These measurements have shown that the experimental performance of the new collar is very similar to the simulated performance. The U235 content of a 4.5% enriched fuel assembly can be determined with an uncertainty of $\pm 2\%$ in a total measurement time (active plus passive) of less than 1000 seconds. The effect of poison pins was also determined. The results show that the size of the poison pin effect agrees with the simulated predictions, reducing the effect of 12 pins with 5.2% Gd from over 20% in thermal mode to 3.6%. Experimental tests were also made on the response of the detector to changes in the location of the fissile material within the assembly.

1. H.O. Menlove, J. E. Stewart, S. Z. Qiao, T. R. Wenz and G.P.D. Verrecchia, Los Alamos National Laboratory Report LA-11965-MS November 1980
2. L. G. Evans, M. T. Swinhoe, H. O. Menlove, P. Schwabach, P. De Baere and M. C. Browne, Nuclear Instruments and Methods A 729 (2013) 740-746

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Session Classification: NDA Measurements III: Neutron Measurements