

ABSTRACT

In this study the spent nuclear fuel storage rack design calculations have been performed for the spent fuel storage rack of 22 MW pool type Egypt Second Research Reactor (ETRR2). These calculations were aimed at: demonstrating the safety storage aspects of the spent fuel rack; developing mathematical models for neutronic, radiological, and thermalhydraulic analyses of ETRR2 storage pool rack and their theoretical validation; using computer codes for natural convection cooling of ETRR2 storage pool rack and its theoretical validation, and improving modeling procedures and validating methodology by computer codes.

Standard computer codes WIMS-D/4 and CITVAP, v3.1 were employed to calculate the rack cross section libraries; neutron fluxes subcritical multiplication factors. The analytical predictions were validated by MCNP5 code calculations. The agreement is found to be generally good. In addition calculation check was made using the results that performed with MONK, v6.3 Monte Carlo code.

The radiological consequence analysis of ETRR2 storage rack was also performed. The isotopic composition and decay characteristics of spent fuel element of ETRR2 storage rack were studied using standard computer code ORIGEN, v2.1. The code was used to calculate the concentrations of uranium and plutonium isotopes, radioactivity, decay heat and spontaneous fission neutron source as function of decay time. The amount of fissile plutonium produced during decay and its contribution to total fissionable materials occurring in the system was assessed. Similarly, the contribution of light elements, actinides and fission products to the total activity and the total decay heat as a function of cooling time was also studied.

The spent fuel decay heat power was calculated by ORIGEN 2.1 and compared with that calculated by the Argentinean Company (INVAP). Good agreement was observed between the results.

The steady state thermal hydraulic analysis of ETRR2 storage rack was carried out to compute the decay heat after reactor shutdown, coolant temperature, temperature

distribution in the rack. Computer code CONVEC, v3.4 was used for the analysis of natural convection cooling of ETRR2 storage rack. The calculated parameters, for the natural convection cooling, were validated by using RELAP5 Computer code. Good agreement was observed between the results of two codes.

Based on the preceding analyses, following conclusions are drawn:

- The ETRR2 spent fuel is stored safely in the storage pool rack,
- The model developed for the steady state thermal hydraulic analysis of ETRR2 storage rack is quite adequate,
- The theoretical predictions of CONVEC code are in good agreement with RELAP5 code theoretical calculations.
- Good agreement between the theoretical and analytical values has validated the used methodology and computer codes.