Research Reactor Accidents: Analysis and Impacts

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Abstract

The reference reactor and reference environment employed in this paper are the Greek research reactor (GRR) and Athens with its surrounding region respectively. GRR is a typical 5 MW open-pool type, light water moderated and cooled research reactor with MTR type fuel elements. The reactor is currently operating with a mixed core of low enrichment uranium (LEU) fuel containing 20% of U^{235}, and high enrichment uranium (HEU) fuel containing ~93% of U^{235}. GRR is located within the limits of Athens the capital of Greece, a large population center with over three million inhabitants. The evaluation of the safety of GRR is based on the analysis of the response of the reactor to postulated disturbances, and to postulated malfunctions, failures of equipment, or operator errors. The accidents studied are classified into groups that ensure the consideration of a large spectrum of appropriate accidents. The analysis focuses on the risks stemming from reactivity accidents, coolant flow blockage accidents, loss of coolant accidents, etc. Among the accidents considered in the safety analysis report of GRR a 20% core melt loss of coolant accident, is considered to be the most severe accident in respect to potential consequences for the population residing in and around Athens. This accident delineates the radiation risks of all accidents that are considered credible.

The estimation of accident consequences is performed by using the MACCS2 code. To assess the source term, more than thirty isotopes are taken into account. The reactor operating schedule that is currently employed amounts to 8 hours/day for 5 days/week. The yearly meteorological record utilized in the calculations has been set up by appropriate processing of the data produced by the instrumentation of the meteorological mast installed on the "Demokritos" premises. The demographic data that were utilized were drawn from the 1991 national census, and the area that is covered in the consequence analysis, includes over 3,400,000 inhabitants, and extents to a distance of 32 km from the reactor site.

The results of the analysis indicate that only the 20% core melt loss of coolant accident would induce consequences of non-trivial (but rather limited) magnitude with the current 8 hours/day, 5 days/week operating schedule of GRR.