

Criticality Detection Method Based on Fission Product Gamma Radioactivity Measurement

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Abstract — *In this paper, a method is proposed to evaluate the extent of subcriticality of an accident-damaged nuclear reactor. With this method the activity ratio of two fission product (FP) rare gas nuclides ^{88}Kr and ^{135}Xe is measured. From the measured value, the value of the nuclides in the fuel region is estimated by correcting for the time lag incurred when the gases diffuse from the fuel region to the measuring point. A simple expression for an effective multiplication factor has been derived that uses the corrected ^{88}Kr -to- ^{135}Xe activity ratio and the ^{88}Kr -to- ^{135}Xe fission yield ratios of ^{244}Cm and ^{235}U but that does not require information on the amount or distribution of the fuel material, making the proposed method very simple. This method has the advantage that FP rare gases can easily leak from the reactor core through many openings and gaps, reaching germanium counters without reacting with other materials.*

Keywords — *Criticality safety, fission product rare gases, gamma radioactivity measurement, germanium counter.*

Note — *Some figures may be in color only in the electronic version.*