VAREX, A Code for Variational Analysis of Reactivity Effects: 
Description and Examples

Jan Leen Kloosterman
Interfaculty Reactor Institute
Delft University of Technology
Mekelweg 15, NL-2629 JB Delft, Netherlands
J.L.Kloosterman@IRI.TUDelft.nl, www.iri.tudelft.nl

Jim C. Kuijper
NRG
P.O. Box 25, NL 1755 ZG Petten, Netherlands
Kuijper@NRG-nl.com, www.nrg-nl.com

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ABSTRACT

The code VAREX is described that calculates by first-order perturbation theory the contributions of individual nuclides to reactivity changes induced by, for example, a change of temperature or nuclide densities. Furthermore, VAREX calculates the contributions that make up the well-known four-factor formula in reactor physics, which has proven to be a very useful tool to characterize the neutron spectrum. The (effective) delayed neutron fractions per nuclide and for the whole geometry are calculated by use of two nuclear data libraries that are based on JEF2.2. Finally, the mean neutron generation time can be calculated. Results of calculations are given to show the reader the type of information that VAREX can provide.

1. INTRODUCTION

The fuel temperature coefficient (FTC), and the moderator temperature coefficient (MTC) are important parameters that determine to a large extend the time-dependent behavior of a nuclear reactor. Often one is interested only in the sign and the absolute value of the two-mentioned reactivity coefficients, but sometimes more information is needed to get insight into the physics of the underlying problem. Extra information can be obtained by first-order perturbation theory, which can be used to calculate the contribution of the individual isotopes to the reactivity change upon a variation of the temperature and/or the nuclide densities.

This paper describes the code VAREX, which originally was the acronym for Variational Analysis of Reactivity Effect with XSDRNPM. It calculates by first-order perturbation theory the isotopic contributions to reactivity changes. Later, modifications to the code were made to include the calculation of the (effective) delayed neutron fractions and accompanied decay constants of individual nuclides and mixtures, as well as