2021 International Nuclear Atlantic Conference – INAC 2021
Virtual meeting, Brazil, November 29 – December 2, 2021

ISBN: 978-65-594-1256-3

Burnup and axial power profile optimization using an analytical linear reactivity model

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1. Introduction

The main objective of this work is to develop an analytical linear model of reactivity without approximation to be applied on maximizing the burnup and smoothing the axial power profile. The basic assumption of this model is supported by the linear relationship between reactivity and burnup.

2. Methodology

Mathematically, this assumption can be written as $\rho = \rho_o - A \times B$, where ρ is the system reactivity, ρ_o is the initial reactivity without any burning, A is the rate at which reactivity decreases with fuel burnup and B is the burnup. The choice of reactivity is based on the fact that it presents a more linear profile as a function of burnup than the multiplication factor. Other models may include higher burnup powers. However, they are not linear models.

3. Results and Discussion

The key point of the model is to define ρ, ρ_o and B as a function of each axial point. The model allows to get the maximum burn and the flattest power profile possible. This power profile establishes the enrichment distribution along the fuel rod. The first results on a typical PWR core, confirming the reference paper. They show that only a portion of the fuel rod beginning and end tips require a different enrichment. Other core are being analyzed.

4. Conclusions

Although the research is in a preliminary stage, the analyses suggests that the linear reactivity model is functional.

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