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Title of the Paper with Capitalization as Appropriate

Isabella R. Magalhães[1], Patrícia A. L. Reis[1], Antonella L. Costa[1], Clarysson A. M. Da Silva[1] and Claubia Pereira[1].

[1]isabella.magalhaes13@gmail.com.
[1] Universidade Federal de Minas Gerais; Escola de Engenharia; Departamento de Engenharia Nuclear. Av. Pres. Antônio Carlos, 6627 - Pampulha, Belo Horizonte - MG, 31270-901

1. Introduction

Taking into account the expectation of expansion of the global nuclear matrix, materials research is important to increase efficiency, safety, economy and environment respect. Materials that combine the possibility of increasing safety and efficiency in the energy production process can be labeled like Accident Tolerant Fuels - ATF.

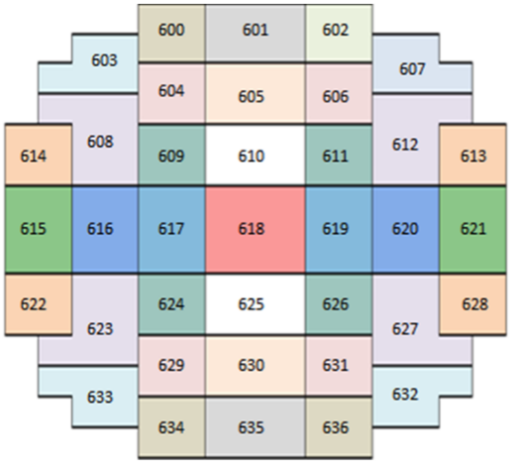
Oxidation resistance is an ATF characteristic, as well as good thermal conductivity and low chemical reactivity, and FeCrAl alloys are recognized for these [1]. In nuclear reactors, the great complexity of the system's behavior requires continuous verification and evaluation to the system to ensure that safety limits are not exceeded [4]. Therefore, the use of computational codes capable of determining the temporal and spatial distribution of thermalhydraulic conditions linked to the materials properties used and heat structures is essential for the safety analysis of nuclear reactors.

Studies related to the theme of accident-resistant materials have been developed at the Departamento de Engenharia Nuclear da Universidade Federal de Minas Gerais. Such works generated publications [5, 6, 7, 8, 9, 10, 11, 12]. In this work, three FeCrAl alloys will be evaluate as cladding. The simulations will be done using two different fuels, UO_2 and U_3Si_2. UO_2 it's the reference fuel used in Light Water Reactors – LWRs and U_3Si_2 is an ATF proposed since 60's.

The model used in simulations is based on the Angra II nuclear power plant, developed with technical information from the plant FSAR (Final Safety Analysis Report) [19]. RELAP5 is a generic code developed by (Idaho National Laboratory (INL) to meet the need for safety analysis by United States Nuclear Regulatory Commission (NRC) [2]. In addition to the behavior calculations of reactor's thermo-fluid-dynamic system during a transient, this code can be used to simulate a wide variety of thermal hydraulic transients, including the ability to perform neutronic calculations coupled to the thermal hydraulics behavior.

2. Methodology

The simulations will be carried out using the model based on the FSAR, studies with such model and claddings have been carried out, by the authors, since 2019. However, the model has been improved since then; the latest version used in this work is also being presented at this same congress. The main change since the last work [13] was the radial power distribution of the core, made with the objective of approximating the obtained results to the real ones. Below is the axial power distribution.



In this model, the data, density, thermal conductivity and specific heat of the 3 different compositions of FeCrAl alloys as cladding and UO_2 and U_3Si_2 as fuels are used. The objective is to establish a comparison between the different coating-fuel sets, in search of lower working temperatures, to minimize the wear of materials.

3. Results and Discussion

After the simulations, part of the data obtained is presented in the table below.

Table I: Temperature data using five different claddings and two fuels

Material	Zircaloy	C06M	C35M	C36M	KANTHAL APTM
UO_2	2101.7524K	2100.4021K	2097.4695K	2101.5247K	2187.2803K
U_3Si_2	1150.6975K	1149.8508K	1148.0167K	1150.5547K	1174.172K
Cladding	629.52985K	629.52985K	629.52985K	629.52985K	629.79205K

The data presented are from the center of the core, channel 618 according to the figure shown, at half height of the fuel rod, in the center of the fuel. It is possible to notice that temperatures are lower when metal alloys are combined with U_3Si_2, the lower the temperature, the less wear on the materials in the long term. The outside temperature of the cladding is the same in all cases because the local potency is equal.

4. Conclusions

According to the initial results, U_3Si_2 fuel presents better results considering thermo-hydraulic analysis. It is noteworthy that more studies need to be done, in other regions of the core and analyzing the behavior of materials in transient situations.

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