INTRODUCTION

The Rod Ejection Accident (REA) is the most limiting case among Reactivity Induced Accident (RIA). Due to the fast reactivity insertion which can lead to prompt criticality and thus to a sharp fuel enthalpy increase in the affected part of the core, REA can cause severe fuel damage. The REA is usually an asymmetric transient where neutron kinetics and the thermal-hydraulics are strongly coupled (through Doppler feedback). The following analyses have been performed on a UOX/MOX mixed core loading with the coupled code ATHLET-QUABOX/CUBBOX.

MODEL AND TRANSIENT DESCRIPTION

A generic PWR core has been used. The ejected control rod is the most penalizing one and has a neutronic weight of 484pcm. The rod is ejected after 2s of 0-transient and within 0.1s. Simulations have been performed using realistic (512pcm) or artificially decreased (416pcm) delayed neutron fractions for two different core states (HZP and 30% of the nominal power).

IMPORTANCE OF THE DELAYED NEUTRON FRACTION

The use of a lower $\beta_{eff}$ increases the relative reactivity insertion and thus results in a significantly faster and higher power peak. In the present case, it leads to prompt criticality (416 < 484pcm) whereas the reactivity insertion stays below the realistic $\beta_{eff}$ value. However, the maximum fuel enthalpy and enthalpy rise are not significantly affected since the reactivity insertion to be compensated is the same.

IMPORTANCE OF THE INITIAL POWER LEVEL

For the 30% power case, the initial fuel temperature (i.e. fuel enthalpy) is logically higher than at HZP. Moreover higher values for the enthalpy rise can also be observed. The justification for this behavior results from one basic property of the Doppler coefficient: it decreases with the temperature (square root dependency). In 30% load conditions, the fuel temperature is higher and therefore a larger fuel temperature increase is required to compensate the same positive reactivity introduced by the rod ejection.

IMPORTANCE OF THE NUCLEAR DATA UNCERTAINTIES

The XSUSA tool, developed in GRS has been applied in order to propagate the uncertainties from the nuclear data through the XS generation process (including burnup calculation) up to the simulation of the REA described in the “Purdue Benchmark” specifications. Median and mean values are based on 100 runs with variated XS-Libs. The blue band shows the 95% quantile. Although the results are preliminary, the influence of nuclear data uncertainties is clearly shown.