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SPATIAL NEUTRON KINETICS IN THE ATUCHA I NUCLEAR POWER PLANT TAKING INTO ACCOUNT A SPACE AND TIME-DEPENDENT BORON CLOUD COMPUTED BY CFD STUDIES

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Abstract. In general, most of the safety transient cases that are typically analyzed in nuclear power plants can be performed using the point reactor kinetic equations to model the neutronic behavior of the core. This approximation usually introduces negligible errors with respect to the full three-dimensional spatial kinetics computation, and at the same time reduces both the problem complexity and the computational effort involved. Nevertheless, there exist some cases---most notably those that involve loss of coolant---where changes in the spatial distribution of power should be taken into account in order to correctly evaluate the long-term plant state. Moreover, the actuation of the second shutdown system---which in this case is based on the fast injection of a boron-based liquid absorber into the core---needs particular attention to be accurately solved and increases the difficulty of the problem. This article describes the development of a suitable computational model of the Atucha~I Nuclear Power Plant core which can be used to either evaluate the contribution to the total reactivity of the boron cloud---computed by three-dimensional computational fluid dynamics studies which are described in a separate article---as a function of time to be used in point reactor kinetics approximations or to perform full spatial neutronic calculations coupled with plant codes, including both thermal-hydraulic and control system feedback.