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OPTimization analysis of PWR reactors in the framework of the introduction of renewable energies in the french energy mix

In the actual context of energetic transition, the increase of the intermittent renewable energies contribution (as wind farms or solar energy) is a major issue. On the one hand, the French government aims at increasing their part up to 30% by 2030, against 6% today. On the other hand, their intermittent production may lead to an important imbalance between production and consumption. Consequently, the other ways of production must adapt to those variations, especially nuclear energy which is the most important in France. The nuclear power plants (NPP) are already able to adjust their production in the so-called load-following mode. In this operating mode, the power plant is controlled using control rods (neutron absorber) or soluble boron. However, the control rods may introduce unacceptable spatial perturbations in the core, especially if the power variations are large and/or fast, and the use of the soluble boron produces waste effluents that need to be processed. The purpose of this work is to optimize the manageability of the power plants to cope with large power variations, and its final goal is to tune the control parameters in order to be able to make the load-following at a shorter time scale and larger power amplitude scale, or increase the safety margins to do so.

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