The Use of Coupled Code Technique for Best Estimate Safety Analysis of Nuclear Power Plants

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Issues connected with the thermal-hydraulics and neutronics of nuclear plants still challenge the design, safety and the operation of Light Water nuclear Reactors (LWR). The lack of full understanding of complex mechanisms related to the interaction between these issues imposed the adoption of conservative safety limits. Those safety margins put restrictions on the optimal exploitation of the plants and consequently reduced economic profit of the plant.

In the light of the sustained development in computer technology, the possibilities of code capabilities have been enlarged substantially. Consequently, advanced safety evaluations and design optimizations that were not possible few years ago can now be performed. In fact, during the last decades Best Estimate (BE) neutronic and thermal-hydraulic calculations were so far carried out following rather parallel paths with only few interactions between them. Nowadays, it becomes possible to switch to new generation of computational tools, namely, Coupled Code technique. The application of such method is mandatory for the analysis of accident conditions where strong coupling between the core neutronics and the primary circuit thermal-hydraulics, and more especially when asymmetrical processes take place in the core leading to local space-dependent power generation. Through the current study, a demonstration of the maturity level achieved in the calculation of 3-D core performance during complex accident scenarios in NPPs is emphasized. Typical applications are outlined and discussed showing the main features and limitations of this technique.

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