HEMERA: a 3d coupled core-plant system for accidental reactor transient simulation
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In the framework of their collaboration to develop a system to study reactor transients in "safety-representative conditions", IRSN and CEA have launched the development of a fully coupled 3D computational chain, called HEMERA (Highly Evolutionary Methods for Extensive Reactor Analyses). Currently, control rod ejection and main steam line break accidents are investigated.

The HEMERA System

Codes assembled in HEMERA are:

- **CRONOS2**: 3D neutronics core calculation,
- **FLICA4**: 3D thermal-hydraulics core calculation,
- **CATHARE**: primary and secondary circuits modelling.

For the coupling, an explicit technique which consists in solving the neutronics and thermal-hydraulic equations separately has been adopted in the system. Driving codes and data exchanges are managed by the ISAS software. A specificity of the HEMERA system is the possibility to make a pin by pin (neutronics/thermal-hydraulics sub-channels) description in a specific assembly of the core.

Perspectives:

Among the new features already planned for HEMERA, we can mention improvements coming from coupling with a code for fuel integrity analysis; SALOME platform 7 will replace ISAS for easier calculation supervision and management.

Rod Ejection Accident (REA) transient

The REA is a very quick expulsion of a control assembly out of the core that leads to a fast reactivity insertion and a rapid increase of the reactor power. The increase of power is limited by the feedbacks, essentially moderator and Doppler effects.

- In this case, HEMERA chain was used for testing penalising methods in safety analyses.

Main Steam Line Break (MSLB) transient

The MSLB is a Design Basis Accident in PWRs, which involves coupled physical phenomena such as the neutronics and thermal-hydraulic of the core.

- The HEMERA simulation shows that all the core power is located at the top of the core, around the jammed control rod.
- The case studied meets the safety criteria.