Karlsruhe Institute of Technology

Institut für Neutronenphysik und Reaktortechnik
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Datum: Sonntag, 10. Mai 2015
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Unser Zeichen: IGGT

Validation of the ASTEC code with the KIT experiment QUENCH-06, and assessment of modelling uncertainties using the URANIE software

The Fukushima accidents in 2011 have shown that further improvements on Severe Accident Management (SAM) are still necessary. Among the different strategies to stop the core degradation process, one of the most important is the injection of water into the overheated core (e.g. core reflooding). However, several experimental studies (e.g. the KIT-QUENCH and CORA facilities) have shown that before the water manages to cool down the overheated core, the oxidation process of the Zircaloy-4 claddings can be intensified. As a result, the measure may backfire in terms of enhanced fission product release and enhanced hydrogen generation, this fact jeopardizing the containment at an early phase of the accident.

The availability of state-of-the art validated numerical simulation tools is relevant to estimate the current knowledge on severe accidents, and to assess if further efforts on R&D are necessary to gain a deeper understanding of certain phenomena. The reference European code ASTEC, jointly developed by the "*Institut de Radioprotection et de Sûreté Nucléaire (IRSN)" and the "*Gesellschaft für Anlagen und Reaktorsicherheit (GRS)" is able to simulate the progression of a severe accident from the initiating event till the release of radioactive to the environment.

Nevertheless, the ASTEC code requires further validation against experimental facilities handling key physical phenomena in a severe accident sequence, and further application to nuclear power plants. Within the European project CESAM (2013-2017), embedded within the framework program FP7, ASTEC capabilities concerning SAM will be improved both via validation against reactor-scalable experiments and plant calculations on European NPPs.

In the frame of the present work the ASTECV2.1 code will be validated against the QUENCH Nr-06 experiment, this test studying the impact of the reflooding of an overheated core on the hydrogen generation and core degradation progression. As a second step, an assessment of the ASTECV21 modelling uncertainties of the QUENCH-06 will be performed by use of the URANIE software, and the main sources of uncertainty will be identified.

- Pre-requisites: Mechanical engineering, Physics, Reactor Physics, programming skills
- Welcoming skills: use of Linux OS
- Duration: 4-6 Months
- Location: KIT Campus North, Institute for Neutron Physics and Reactor Technology (INR), Building 521
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