Plant Simulation and Safety
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Projektarbeit

Thema: **Analyse und Bewertung der Eigenschaften und des Verhaltens von unfalltoleranten Hüllrohren in Leistungsreaktoren**

Title: Analysis and evaluation of the properties and behavior of accident-tolerant claddings in nuclear power plants

Task description:

The use of accident analysis codes for the simulation of relevant phenomena during beyond-design-basis accidents in nuclear power plants is a focus of current activities in international reactor safety research. Using the thermohydraulics code ATHLET-CD, which is part of the AC² program package of the Gesellschaft für Anlagen- und Reaktorsicherheit (GRS), phenomena are investigated which can occur, for example, predominantly during the core degradation phase. In this context, materials research is addressing advanced fuel assembly concepts to establish another safety aspect in the high-temperature environment of a LWR. Accident Tolerant Fuel (ATF) concepts use the advantages of selected materials to control or limit accidents. This means, for example, limiting a possible hydrogen release and an overall more resistant structure.

In an international research project of OECD-NEA, experiments with ATF materials are conducted and accompanied by benchmark simulations of high-performance system codes. The experimental investigations include, for example, chromium(Cr)-coated Zircaloy (Zry) fuel rod bundles which are used for postulated loss-of-coolant scenarios with reflooding of the partly degraded bundle. In this work, the behavior of accident tolerant cladding tubes (e.g., Cr-coated Zry cladding) under accident conditions is to be investigated. This includes, for example, the study of general material properties of the Cr-coating and its oxidation kinetics in a steam atmosphere. Great attention has to be paid to the degradation process of the coating at high temperatures, the protection and oxidation mechanisms of the Cr-coated cladding, as well as the mutual interdiffusion between coating and zirconium alloy. The investigation of further ATF claddings is possible, depending on the work progress.

The results of the work are to be documented in a comprehensible and descriptive manner. Further details are to be discussed with the supervisor. Two copies of the work as well as an electronic version remain at PSS. Binding and layout are to be designed according to the given specifications. PSS reserves the right to use the results for further scientific work. According to the regulations for Mechanical Engineering (Bachelor, PO 13), the duration of the students‘ scientific thesis is limited to 180 h. PSS reserves the right to discontinue the supervision if it exceeds this time limit.

Start: **08.03.2022**
Supervisor: **Gregor Stahlberg, M. Sc. (stahlberg@pss.rub.de)**

Prof. Dr.-Ing. M.K. Koch