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# #04-97 CABRI test events monitoring through three measurement systems

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The CABRI experimental pulse reactor, located at the Cadarache nuclear research center, southern France, is devoted to the study of Reactivity Initiated Accidents (RIA). When certain conditions (mostly temperature, pressure and flowrate conditions) are obtained, a power excursion, triggered by the 3He reactivity injection system, is performed on a nuclear fuel test rod in order to simulate a control rod ejection accident. The aim of the experiment, designed by the IRSN, is to observe both the fuel and cladding behavior of the test rod placed into the center of the reactor during the power excursion.
Several test rods pre-irradiated in pressurized nuclear power plants and with different characteristics (burn up, cladding material, fuel type, Zirconia thickness) are considered for the programs performed in the CABRI reactor.
Physical phenomena occurring during the power transient are monitored by various measuring systems designed or operated by the IRSN. Each system provides various information in the different phases of the experiment. Three main measuring systems will be considered in this paper.
The first one is the CABRI test device. It holds the test rod and is also equipped with a variety of sensors that allow to record several thermal and hydraulic parameters of the system (such as temperature, pressure and flowrate) in the channel where the test rod is placed, as well as some other more exotic sensors which can measure more complex phenomena (like microphones, transient flowmeters, etc⋯).
The hodoscope, the second main measuring system coupled with the CABRI reactor, is a unique online fuel motion monitoring system, dedicated to the measurement of the fast neutrons emitted by the tested rod during the power pulse. This system is used to observe the degradation of the fissile column, and is able to measure fuel motion, potentially linked to clad failure, if it arises during the power excursion.
The third equipment is the IRIS (Installation for radiography, imaging and spectrometry) facility dedicated to pre and post non-destructive examinations of the rodlet. This measuring system is equipped by two main parts:
• A gamma spectrometry system which is used to measure gamma rays emitted by the fission products in the test rod.
• An X-ray facility which aims at performing x-ray radiographies and tomography images.
During the experimental sequence, different events are recorded. This paper focuses on the cladding failure that occurred during the TOP (Transient Over Power) and that can be determined by the three above mentioned systems signals. The test device instrumentation allows to determine the timing of the failure and the investigation of its consequences in the vicinity of the test rod from a thermal and hydraulic point of view, while the hodoscope measures fuel elongation and relocation during the power excursion. The IRIS facility, then, helps to confirm the failure, its location and its extent. These three systems are complementary and they allow the analysis of the same event from different perspectives. Their combination will ease the interpretation of the events in the next steps of the test results analysis. The study case taken into account in this article concerns nuclear fuel after three irradiation cycles in a commercial PWR.

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