Eddy current detection of cladding defects due to fuel pellet imperfections

Abstract:
An eddy current device has been used to localise cladding defects on irradiated fuel rods. The system has been initially tested with cold specimens, provided very good results and is now in regular operation in a hot cell at the Institute for Transuranium Elements (ITU). In this paper we demonstrate the system's performance and present recent results on a series of irradiated fuel rods with PCI-failures and partly long splits (secondary failures). The rods were delivered in tight capsules and only gamma scans could be done in the β-, γ-reception cell. Big defects were well visible through distortions in the gamma profile, whereas the smaller ones were very hardly detectable. They could be precisely localised later on, as soon as we cut the fuel rod and examined the individual segments with the eddy current device in an α cell. Careful sampling around the defect location, specimen preparation and detailed microscopic analysis confirmed cladding cracks driven by fuel pellet imperfections or, more specifically, by missing chips from the pellet surfaces (MPS). MPS in fuel rods increase the probability of cladding failures caused by power changes. In addition to uniform stresses engendered by pellet expansion, local strains are applied onto the cladding at regions where a piece of pellet is missing. In the examined rods the MPS meniscus sizes varied between 26° and 44°.

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