Karlsruhe Institute of Technology

Secondary Hydriding during LOCA – Results from the QUENCH-L0 Test

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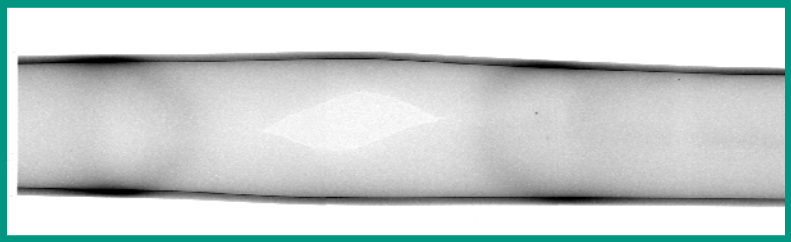

KIT – University of the State of Baden-Wuerttemberg and
National Research Center of the Helmholtz Association

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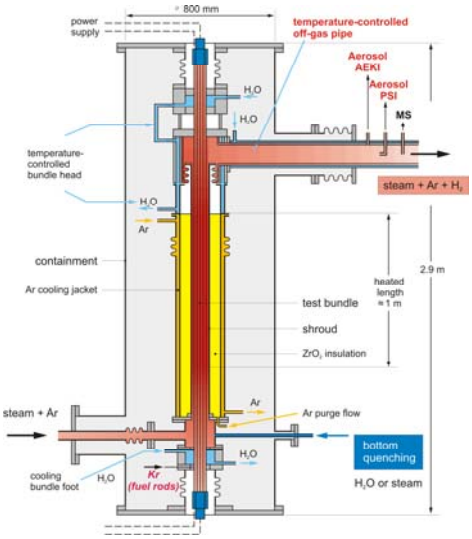
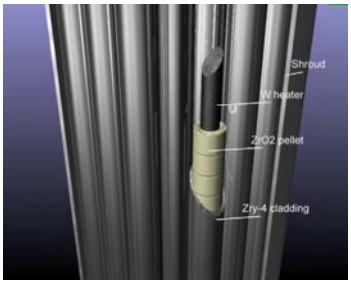
Content

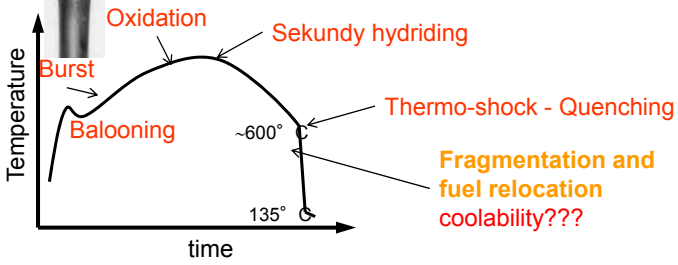
Introduction



In the framework of the KIT QUENCH program design basis loss of coolant accidents (LOCA) and severe accidents (accidents beyond LOCA) are simulated experimentally on fuel rod bundle scale in large scale tests.

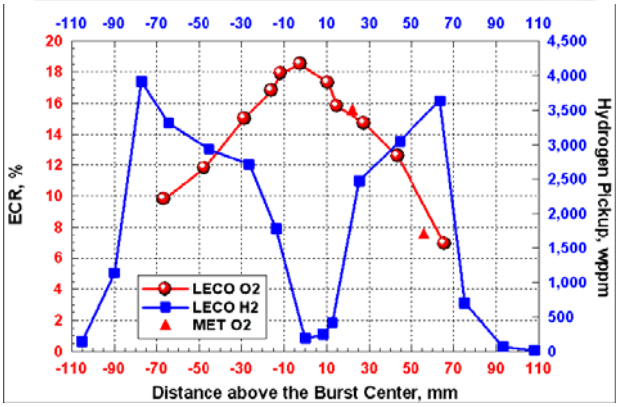


Processes occurring during LOCA



Time dependence of the cladding temperature during a loss of coolant accident

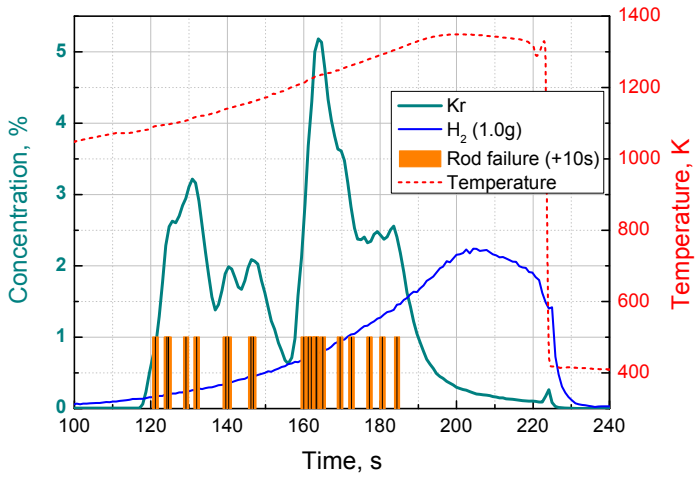
Sekundary hydriding



Influence on mechanical propoerties?

M. Billone et al.
NUREG/CR-6967/ANL-07/04

QUENCH-L0 (commissioning test)

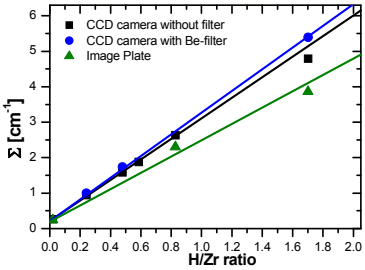


Neutron radiography

X-ray radiography

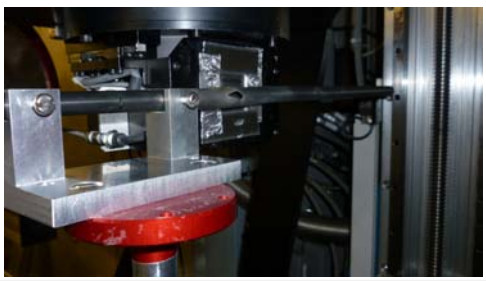
neutron radiography

GKSS Geesthacht 1991



Experiments

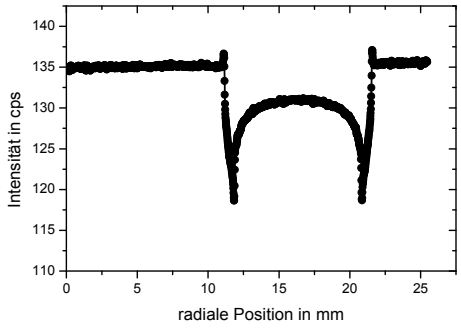
- ICON facility (SINQ, PSI Villigen, CH)
- 13.-16.08.2010 (radiography)
- 09.-17.09.2010 (tomography)
- Illumination time per image: 300 s (radiography)
  625 x 90 s (tomography)
- Spatial resolution: ~ 23 µm (radiography)
  ~ 46 µm (tomography)



Results Radiography rod 15 (p_i = 3 bar)

Z=700mm

Z=1120mm

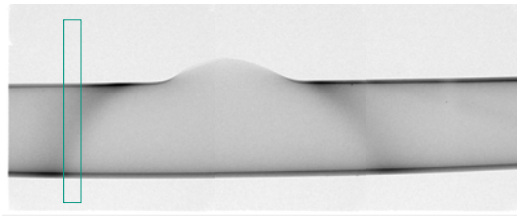


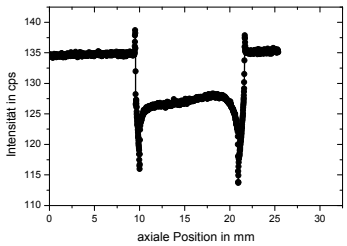
Σ = 0.215,

Is in the range measured for not-oxidized Zry-4

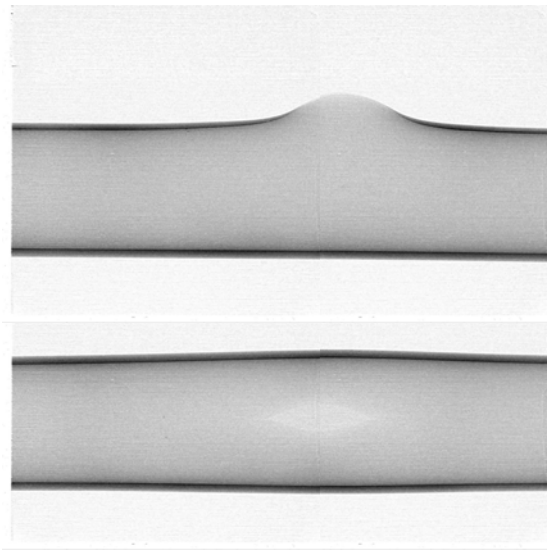
(Σ = 0.197 .. 0.216)

Results Radiography rod 03 (p_i = 55 bar, Δt = 104 s)

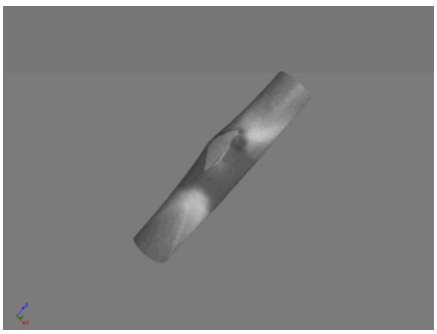


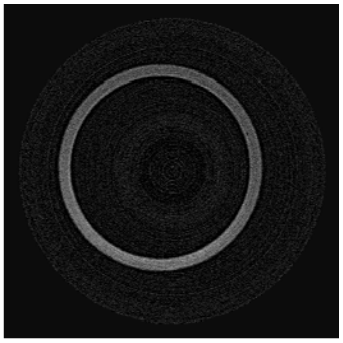


Results Radiography rod 17 (p_i = 40 bar, Δt = 71 s)



Results Tomography rod 01 (p_i = 50 bar, Δt = 112 s)





x_H = 1330 wppm

Summary and Conclusions

- Secondary hydriding was investigated by means of neutron radiography and tomography.
- The hydrogen distribution is not symmetric.
- The extension of the hydrided zone seems to depend on the time between bursting and quenching.
- Maximal hydrogen concentrations of ~1300 ppm was determined.
- No influence of inner pressure or crack length is obliviously.
- Strong influence of the hydrogen bands on the crack positions in the tensile tests (not shown in this presesntation)

Thanks

The QUENCH-LOCA tests and pre-test investigations are sponsored by the German Verein der Grosskraftwerksbetreiber **VGB**

KIT:
The QUENCH team, particularly C. Goulet,
J. Moch, C. Roessger and M. Walter (mechanical tests)

PSI:
S. Hartmann

Thanks for your attention, questions?