



Selected experimental and simulative results in the cooperative-project DCS-Monitor

Project duration: 01.02.2016 – 31.05.2019

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Situation in Germany

- No availability of a long-term storage facility for heat generating high-level radioactive waste
- Since 01.07.2005 storage discharged spent fuel elements on-site of nuclear power plants presented by the German Atomic Energy Act)
- Approval of interim storages and TSC for 40 years
- Aim: availability of long-term storage in 2050 storage
- Conflicting objectives:
 - Maximum safety and the broadest possible public participation
 - Short duration of the process (planning, approve and building)
 - Very unlikely opening of a long-term storages for heat generating high-level radioactive waste in 2050 /10/
 - Expected commissioning and start of storage according to the long-term storages commission only in the 21st century /10/



CASTOR® in the interim storage of nuclear power plant Neckarwestheim

Source: EnBW Energie Baden-Württemberg AG (www.enbw.com)

Cooperative project

Partner:

- Between Dresden Technical University (TUD) and Zittau/Goerlitz University of Applied Sciences (HSZG)
- Supported by Federal Ministry for Economic Affairs and Energy

Goal:

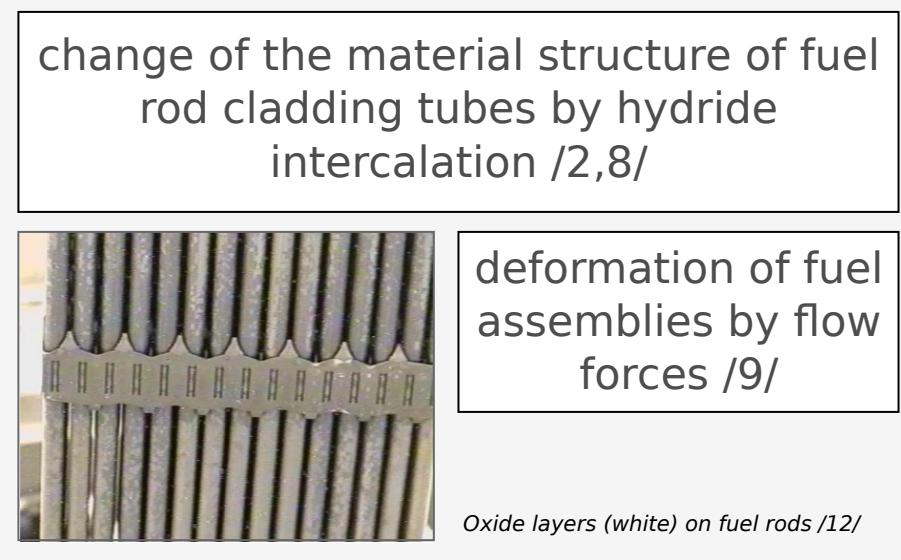
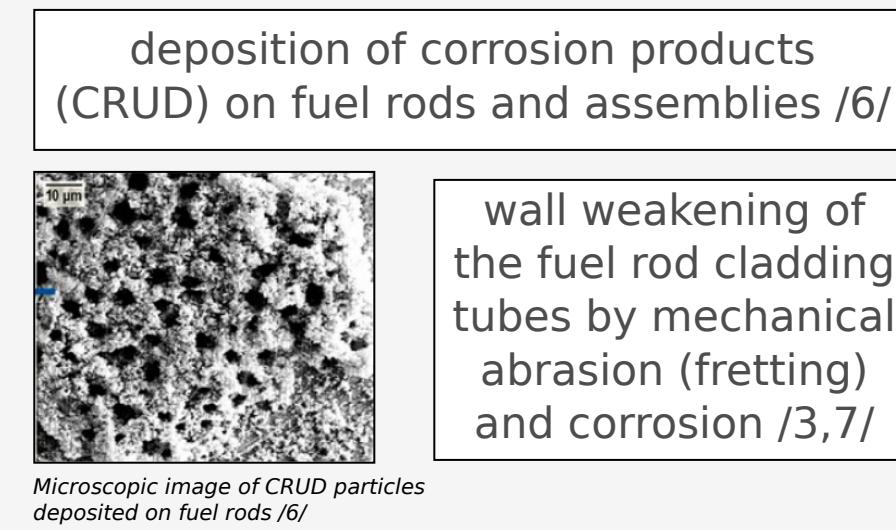
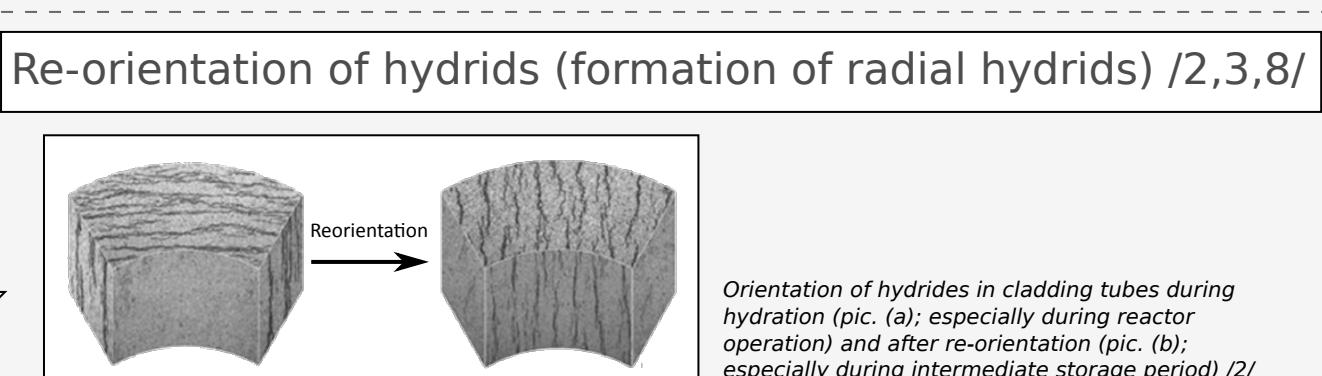
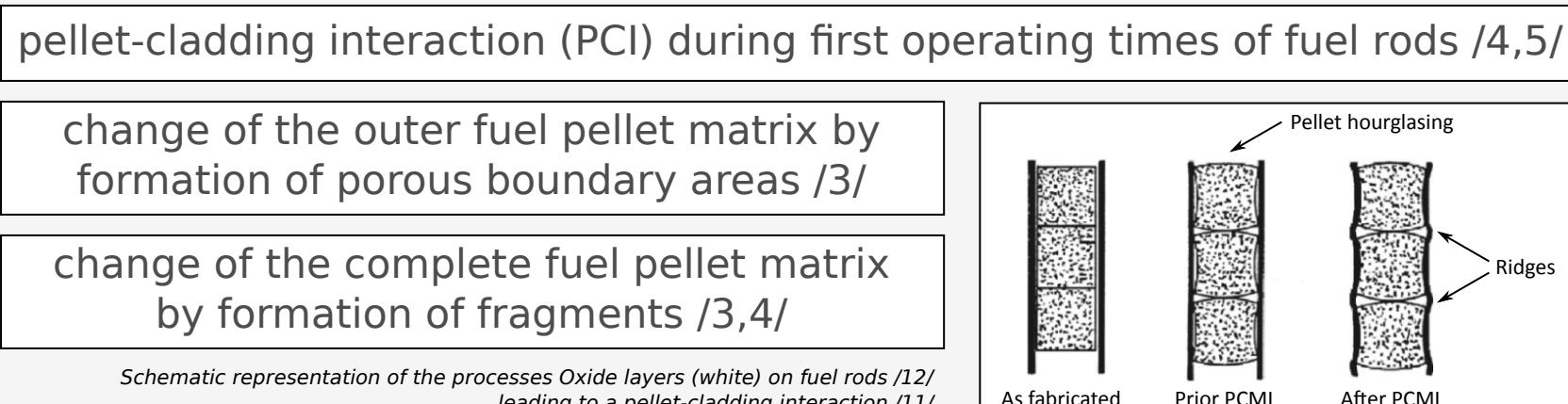
overall goal to investigate and evaluate several physical measurement methods /1/:

- Gamma emission with simulation-based and experimental methods,
 - Neutron emission with simulation-based methods,
 - Muon transmission with simulation-based methods,
 - Thermography with simulation-based and experimental methods,
 - Acoustic emission analysis with experimental methods,
 - Vibration analysis with experimental methods,
- for non-invasive long term monitoring of transport and storage casks (TSC) and the TSC inventory

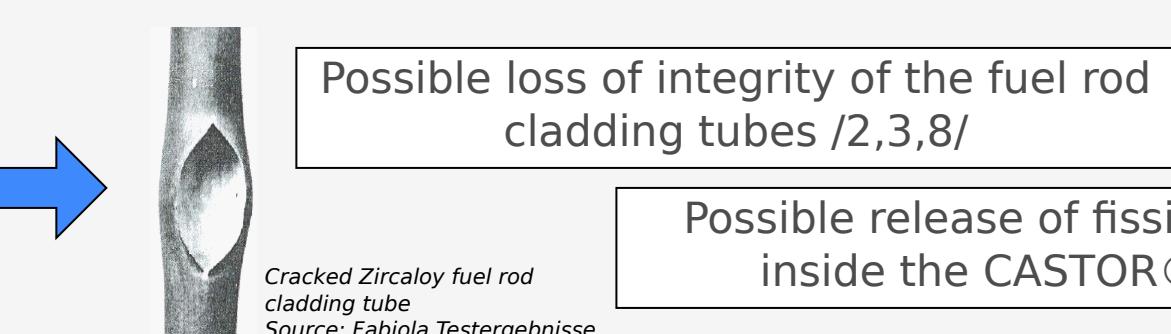


>>> What to do when the approval of the intermediate storage and the CASTOR® expires? <<<

Possible damages of storage cask inventory (spent fuel)



Temperature-dependent wall expansion of the fuel rod cladding tubes (creep) /2,3,8/

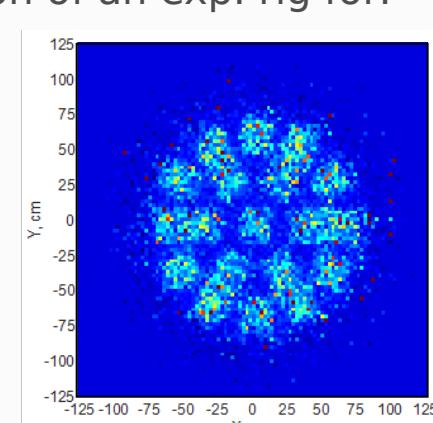


Possible release of fission products inside the CASTOR® /2,3,8/

Radiography

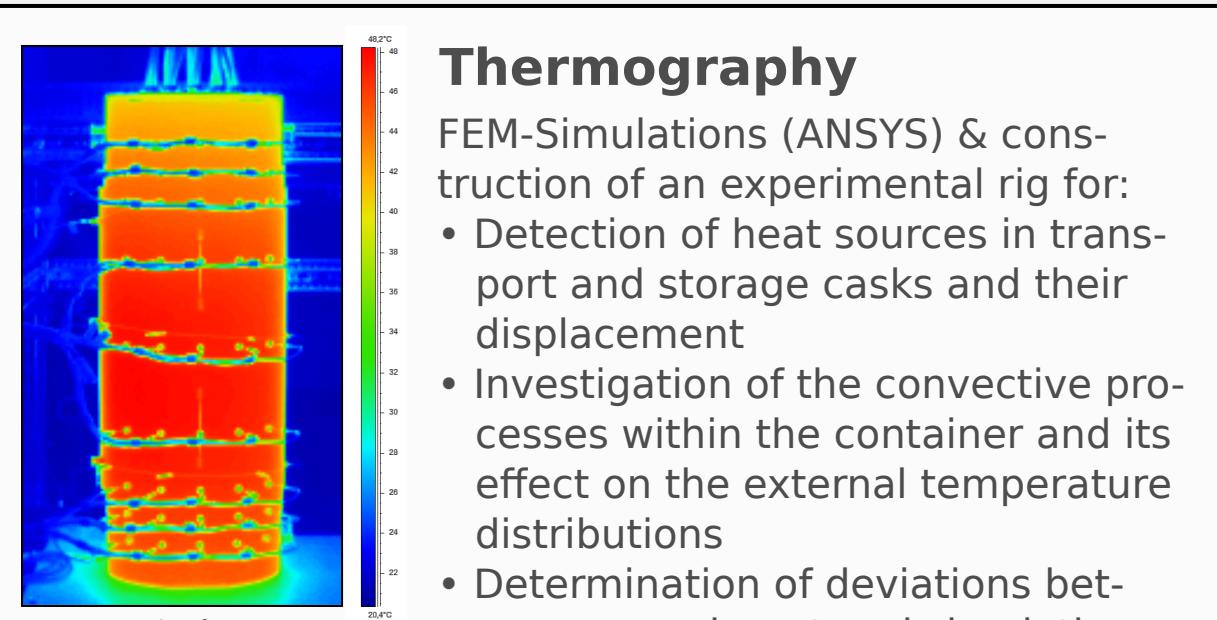
Simulations (MCNP) & construction of an exp. rig for:

- Detection of radiation sources and their displacement
- Investigation of the shielding behavior of basket for accommodating the fuel assemblies and fuel elements itself
- Determination of deviations between experiment and simulation (gamma flux only)



Thermography

- FEM-Simulations (ANSYS) & construction of an experimental rig for:
- Detection of heat sources in transport and storage casks and their displacement
 - Investigation of the convective processes within the container and its effect on the external temperature distributions
 - Determination of deviations between experiment and simulation



Summary

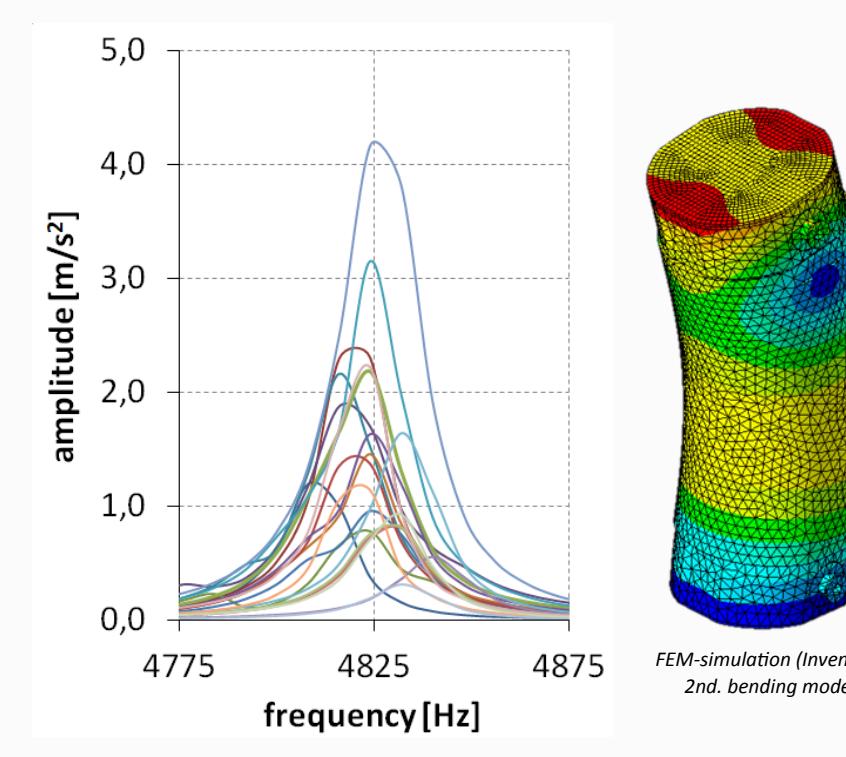
- Extensive research on damage scenarios of fuel elements
- Experimental analysis of the four potential methods with specifically designed rigs:

- Radiography: High informativ value for outer fuel assemblies, inner ones self-shielded
- Thermography: Too much damping because of the construction
- Vibration Analysis: Shifting of resonancy frequencies by displacements of masses inside the TSC → condition with artificial neuronal networks (ANN) classifiable
- Acoustical spectroscopy: Kind of cladding rod damage with frequency spectrum while bursting with ANNs classifiable

Vibration analysis

Construction of an experimental rig for:

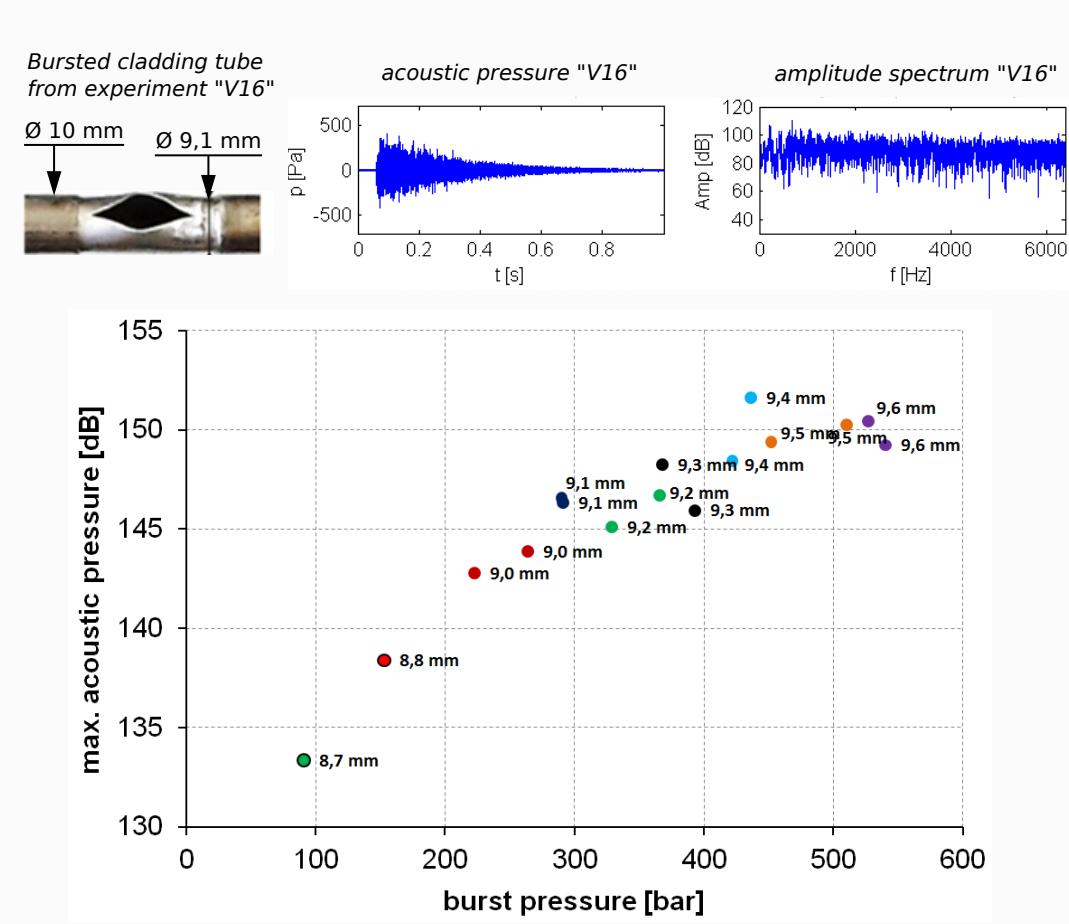
- Recording and analyzing specific vibration signatures
- Investigation of the influence of different fillings and damage of fuel elements
- Determination of deviations between experiment and FEM-simulation



Acoustical spectroscopy

Construction of an experimental rig for:

- Recording and analysis of specific burst crack signatures
- Acoustic detection of various damage states of fuel rod cladding tubes



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