PIE - a Need for Future Developments

by

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PIE - a Need for Future Developments

- Introduction
- Hot cell work and development of commercial products
- Examples for industrial applications
  - Fuel
  - Refabrication of rodlets
  - Corrosion
- Future trends
- Conclusions

Fuel Assemblies are the Key Business for Siemens' Nuclear Cycle

FOCUS

HTP

ATRIUM

PWR

BWR

Milestones in the Development of Siemens BWR Fuel Assemblies

Average Discharge Burnup [MWd/kg]

Burnup of Peak Reload Batch

Average of All Discharged FA

Year of Discharge 19

Zirconium spacers

Substitution of 7x7 by 8x8 geometry

Gd₂O₃ burnable neutron absorber

Year of Introduction

Burnup Increase is a Result of Many Parameters

- Structure materials
  - Fuel rod cladding
  - Spacer grid
  - Guide tube
  - etc

- Fuel
  - $\text{UO}_2$
  - $\text{UO}_2/\text{PuO}_2$
  - $\text{UO}_2/\text{Gd}_2\text{O}_3$

- External parameter
  - Fuel assembly design
  - Fuel strategy
  - Coolant chemistry

Different Kinds of Hot Cell Work

- More detailed measurements already performed in the FA-pool of the plant.

- Contribution to the design data base or modelling of irradiation behaviour by destructive examinations
e.g. fission gas release, fuel density, EPMA, ceramography etc.

- Examination of special cases
e.g. new or unexpected phenomena.
  e.g. rod failure.
Fission Gas Release Measurements are Used to Predict the Inner Rod Pressure at High Burnup
A Porous Structure is Formed at the Fuel Rim at High Burnup

SEM at different radial positions

Rod cross section
Xe Release Profiles (Matrix) Calculated with CARO-E in Comparison to EPMA Measurements

Presented at the EHPGM
Loen-Norway, May 24-29, 1999
by F. Sontheimer

Refabrication of Rodlets of Irradiated Long Rods

A Wide Spectrum of Corrosion Resistant Cladding Materials are Available Today
Future Trends in PIE work

- Support of further burnup increase. Fuel and structural material related questions will receive more attention.
- Growing importance of effects of coolant chemistry on corrosion.
- Refabrication of rodlets with high burnup.
- Shorter response times on materials' behaviour.
- CONCLUSIONS -

- Up to now, hot cell work has improved the knowledge on the materials’ behaviour, contributed to their development and provided a lot of data for licensing purposes.

- In future, hot cell work is needed on an even broader basis, since the spectrum of components to be optimised by different techniques will become larger.

- To meet shorter response times, key techniques should also be time optimised.