



Structural Integrity in Radiochemical Plant

Safety Research Strategy

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Date 23/11/2005

Slide 2

Purpose

- Definition
 - Lifetime assessment of steel/Zr components at Sellafield (i.e. excluding concrete structures, and cement waste matrices)
- Explain the strategy for targeted plant materials research
- Use four examples to demonstrate how the strategy has been used to direct development programmes
- Demonstrate progress to date and future development plans
- Summarise the current position

Research Strategy

- Understanding/predicting degradation processes
 - Theoretical/laboratory investigations
- Development of NDE
- Application of NDE to check theory
- Refinement of predictions

Degradation Processes

- Corrosion
 - Nitric acid media (e.g. HA liquors/MA liquors)
 - Water (cooling water/pond water)
 - Atmospheric (ILW/LLW solid waste storage)
- Mechanical
 - Fatigue
 - Fretting/Wear
 - Erosion

Key Plant Issues

- Integrity of Pu plant materials particularly transition joints
- HA liquor storage plant
- AGR Fuel Cladding Corrosion
- ILW storage

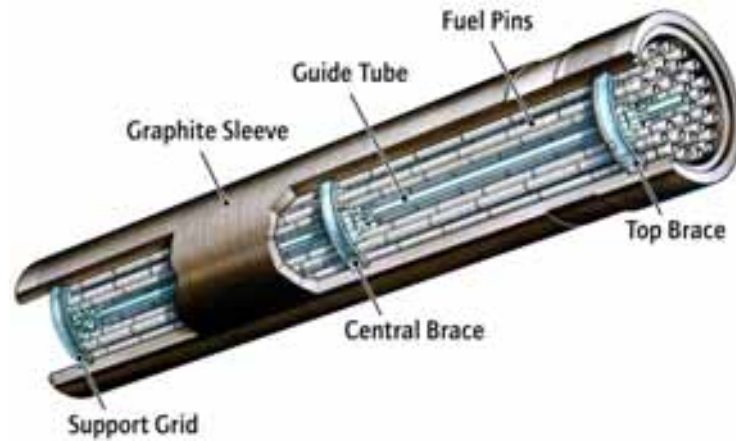
Integrity of Pu plant materials

- Strategy
 - Maintain transition joints at benign temperature
 - Monitor regularly for corrosion loss (principally by ultrasonics and radiography)
- Forward Plan
 - Inspections continue but no degradation observed on Zr or S/S, hence no further research

HA Storage Plant

- Strategy
 - Develop simulants to replicate corrosion in irradiated HA concentrate
 - Assess effect of corrosion accelerators (Np, Ru, NOx)
 - Define corrosion vs temp relationship for HA concentrate
 - Develop inhibitors for waterside corrosion
 - Periodic peer review of research programmes
- Future work
 - Continue work on Np, Ru and effect of radiation
 - Deployment strategy for use of inhibitors

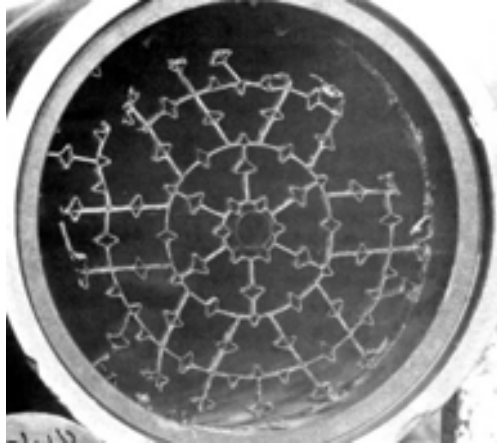
AGR Fuel Element



AGR long term storage - issues

- Inhibitor developed for 12GWd/te fuel
- Fuel now expected 33GWd/te (and above)
- Reactor induced segregation occurs (sensitisation)
- Grain boundaries severely Cr depleted
- Attack in pure water (1-2ppm Cl⁻), stress assisted
- Original inhibitor not appropriate for co-storage with MEBs

Corroded AGR Brace



AGR Fuel Cladding Corrosion (long term storage)

- Strategy
 - Store dismantled in existing ponds
 - Corrosion inhibitors to prevent localised attack
 - In pond corrosion monitoring
 - Peer review of research programmes (internal/external)
- Future Work (using active brace material)
 - Repeat historic caustic inhibitor work on active brace material
 - Assess suitable alternative inhibitors
 - Develop suitable monitoring devices (FSM, zRA)

ILW solid waste storage

- Strategy
 - Store in high integrity packages
 - Create benign environment (temp, humidity, cemented product)
 - Provision of on-going inspection
 - Further treatment of packages if required

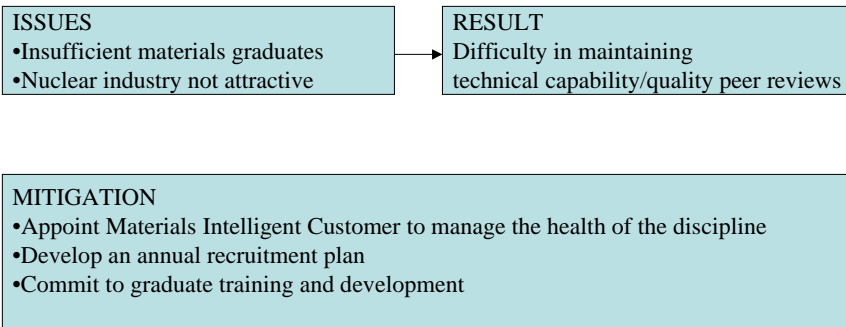
ILW solid waste storage

- Future Work
- Develop improved monitoring/surveillance techniques for localised corrosion by:
 - Sharing of condition monitoring strategies across UK
 - Technical exchanges and collaborations
 - Generic monitoring developments (URA Manchester, RCNDE)

Summary

- Underpinning science and technology is relatively mature.
- Strategies in place for developing mechanistic understanding of degradation processes.
- Targeted plant inspections/NDE strategies in place.
- Use of internal and external peer review.
- Collaborations with other industry members (including Nexia) and academic establishments (e.g. Manchester URA, Imperial College, Bath, Warwick)
- Feedback from relevant conferences

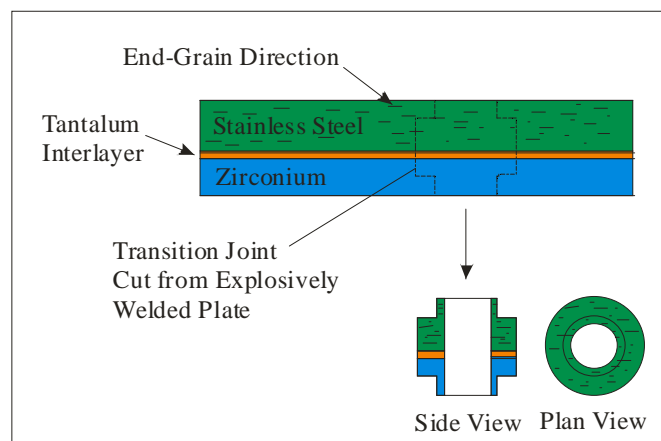
Summary - Challenges



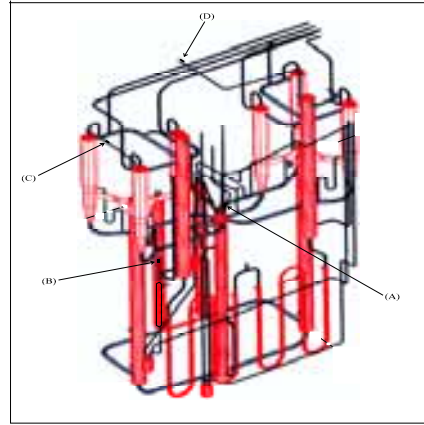
Technical Details

The following slides will be used if the committee have a specific interested in the technical details

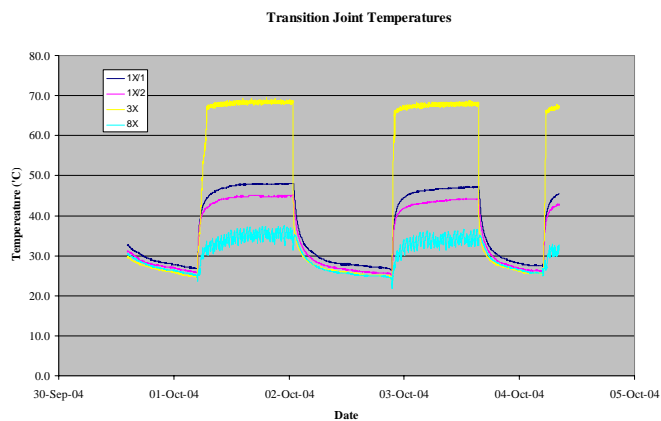
Manufacture of Transition Joints



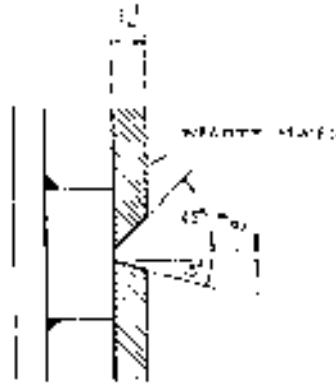
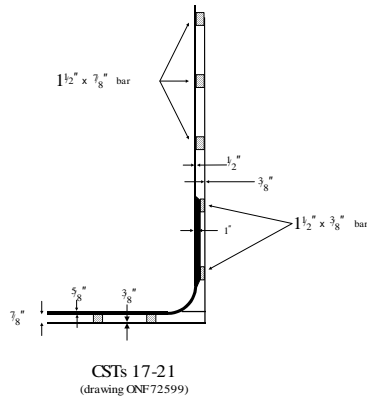
Pu Evaporator Cell



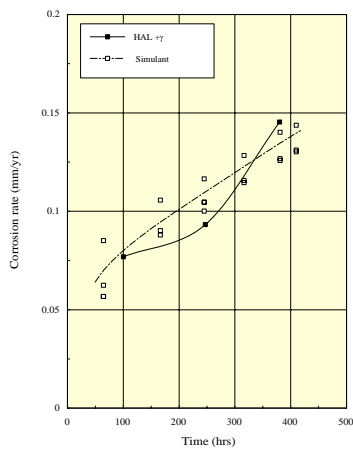
Pu plants - Transition Joint Temperature



HAST jacket design



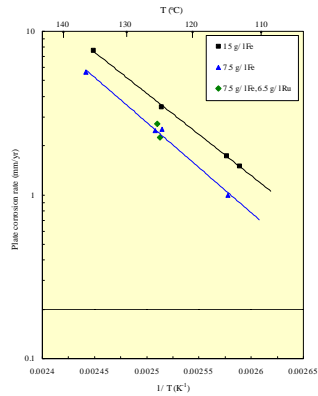
HAL Simulant



HAL : 48 GWd/te, 15 yr cooled, 250 l/te concentration, 5 g/l Fe, 8M nitric acid

Simulant: contains species which should accelerate corrosion *in the presence of radiation*

Effect of temperature on HA liquor corrosion rate



Corrosion rate falls rapidly as temp decreases

4M nitric acid + 6M nitrate + Fe/Ru as indicated

Wet Fuel Storage

- Contracts for 80 years storage (from 2006)
- Maximise use of existing facilities (i.e. wet storage)
- Historic experience (~97% of worldwide stored fuel)
- Extensive and positive experience with all types of fuel over 50 years
- Water provides cooling and shielding
- Allows inspection/examination of fuel