



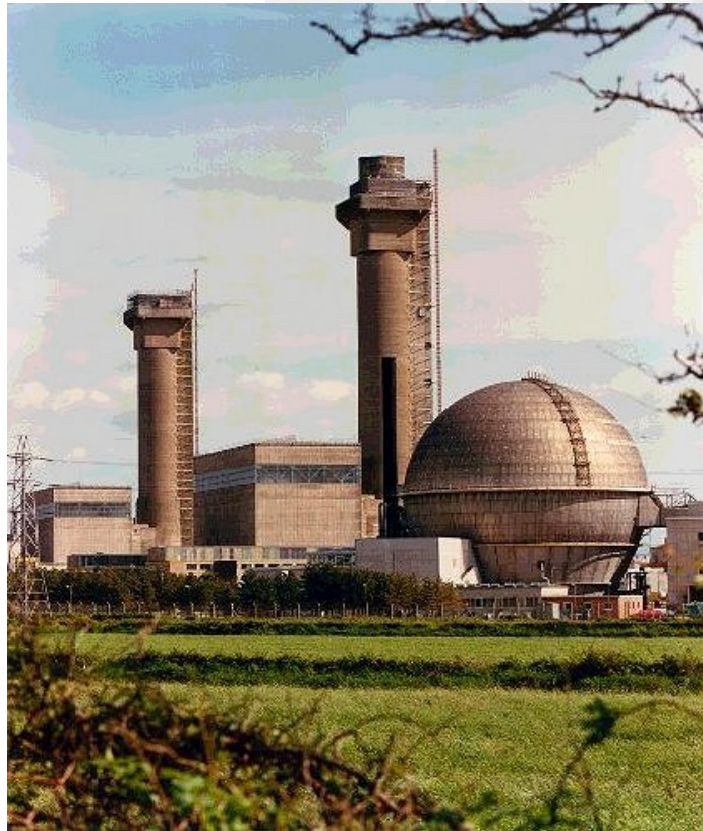
Windscale Piles Decommissioning

Peter Mann UKAEA

Feb 2008

Windscale Piles Decommissioning

Introduction



- The Piles and their History
- Phase 1 Decommissioning
- Current Plans

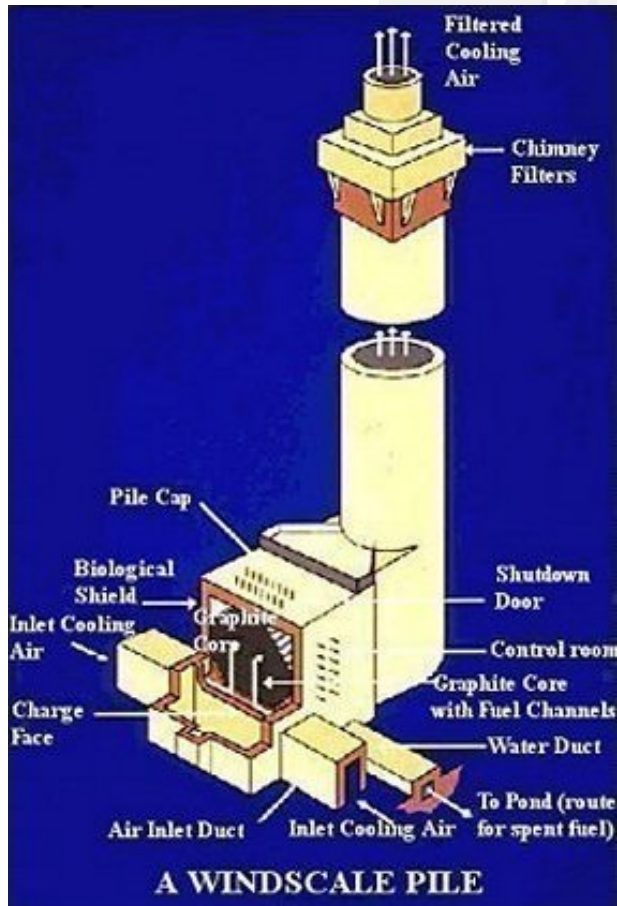
Windscale Piles Decommissioning

Early History of the Piles

- Needed to produce weapons material (Pu)
- Two piles designed and built in late 1940s
- Operated 1950-1957
- Fire in Pile 1 in 1957
- Not operated after 1957
 - uneconomic to rectify and restart

Windscale Piles Decommissioning

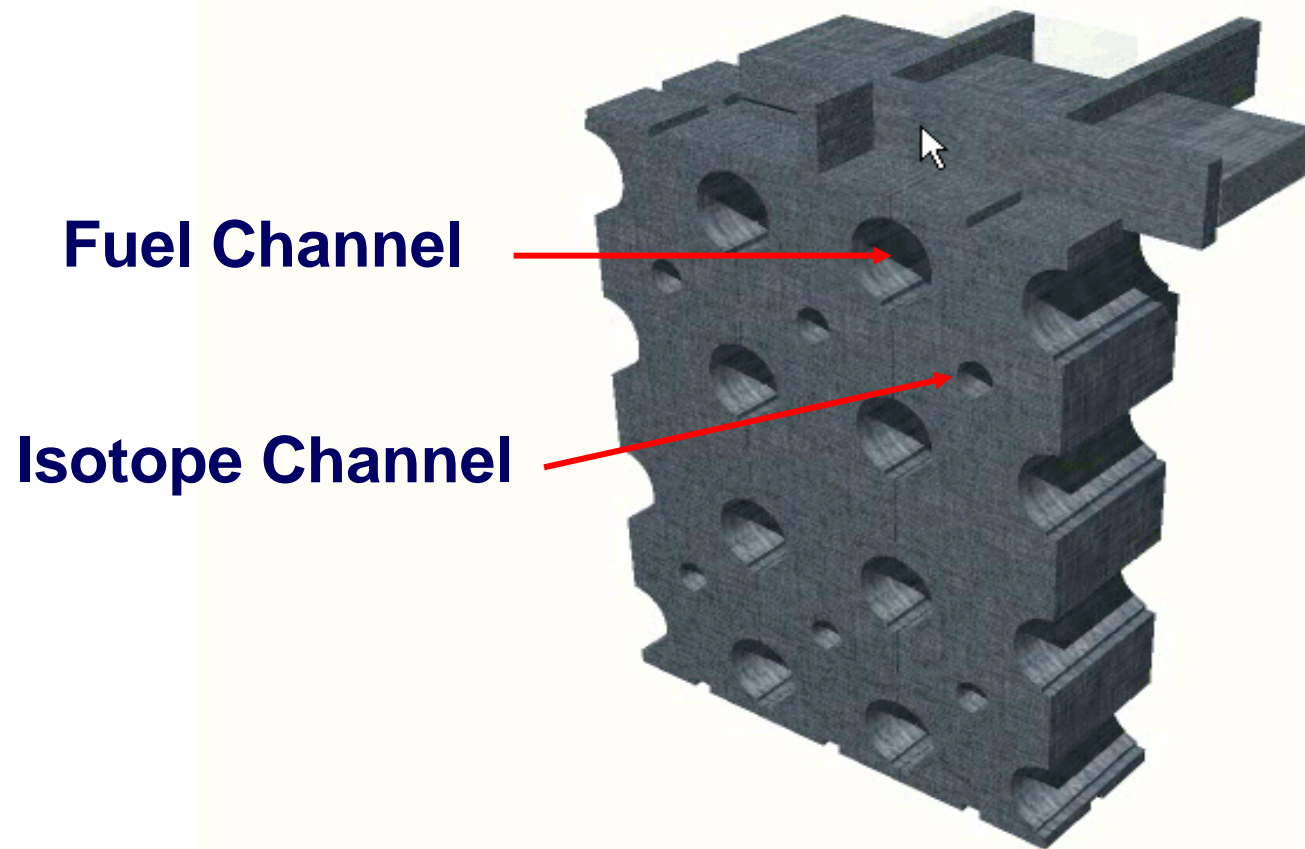
Brief Description of Piles



- Graphite Moderated
- Horizontal fuel channels
- Fuel:
 - natural uranium metal rods
 - clad in finned aluminium
- Air cooled

Windscale Piles Decommissioning

Graphite Interlocking

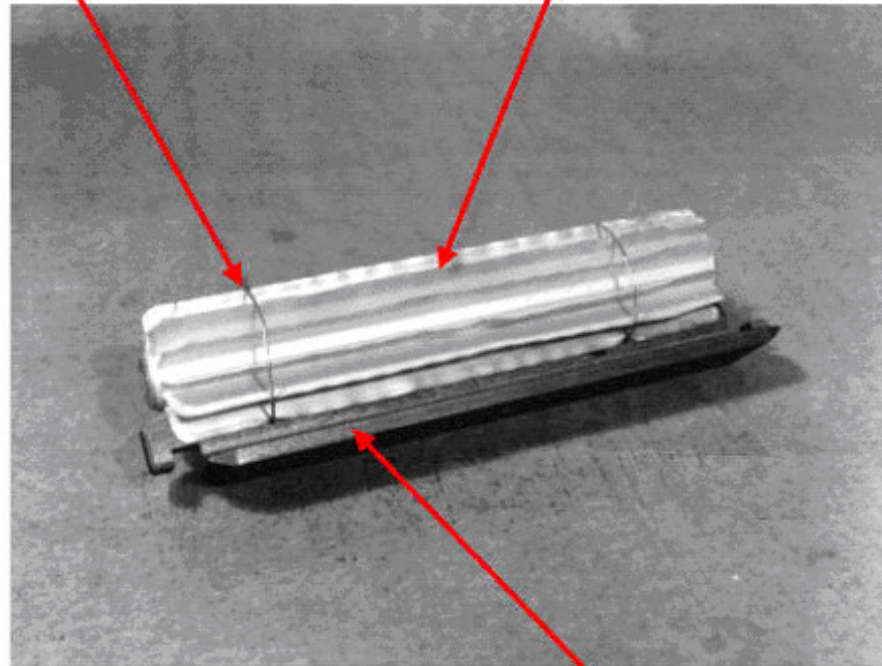


Windscale Piles Decommissioning

Fuel Element

Aluminium Wire

Aluminium Fins



Graphite Boat

Windscale Piles Decommissioning

Phase I Decommissioning

- Securing the safety of the facility

- Commenced early 1980's
 - Sealing of bioshield
 - Installation of ventilation and monitoring
 - Loose fuel removal from outside core
 - Drain-down of water duct
 - Core Surveys & Option Studies
 - Completed June 1999

Windscale Piles Decommissioning

Air Duct Clearance - before



Windscale Piles Decommissioning

Seismic Barrier in Cleaned up Air Duct



Windscale Piles Decommissioning

Water Duct Clearance - Before



Windscale Piles Decommissioning

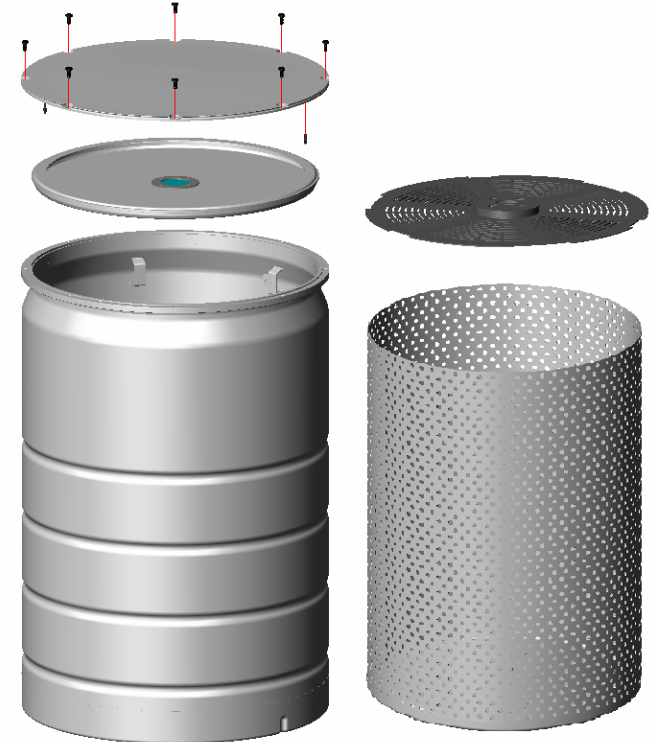
Water Duct Clearance - After



Windscale Piles Decommissioning

Project Parameters

- 15 te fuel and isotopes – 8,500 items
- 4,000 te graphite – 300,000 items
- 8,500 m³ ILW
- 16,000 m³ LLW
- 17,000 m³ high volume low activity concrete
- 30,000 m³ exempt waste



Windscale Piles Decommissioning

Significant Project Milestone Pile 1 Operational Safety Case (OSC) Approved

- NII Approved New Pile 1 OSC
 - Fuel Fire Not Credible
 - Criticality Not Credible
 - Dust Explosion Not Credible
- Allows 'Conventional' Decommissioning Approach
- Enable accelerated schedule
- Reduced Decommissioning Cost

Windscale Piles Decommissioning

Characterisation

- Concrete and Thermal Shield sampling
- Non-intrusive and intrusive image capture
- Fuel debris sampling :-
 - Qualitative complete
 - Quantitative planned

Windscale Piles Decommissioning

- Images from Non-Intrusive Inspection

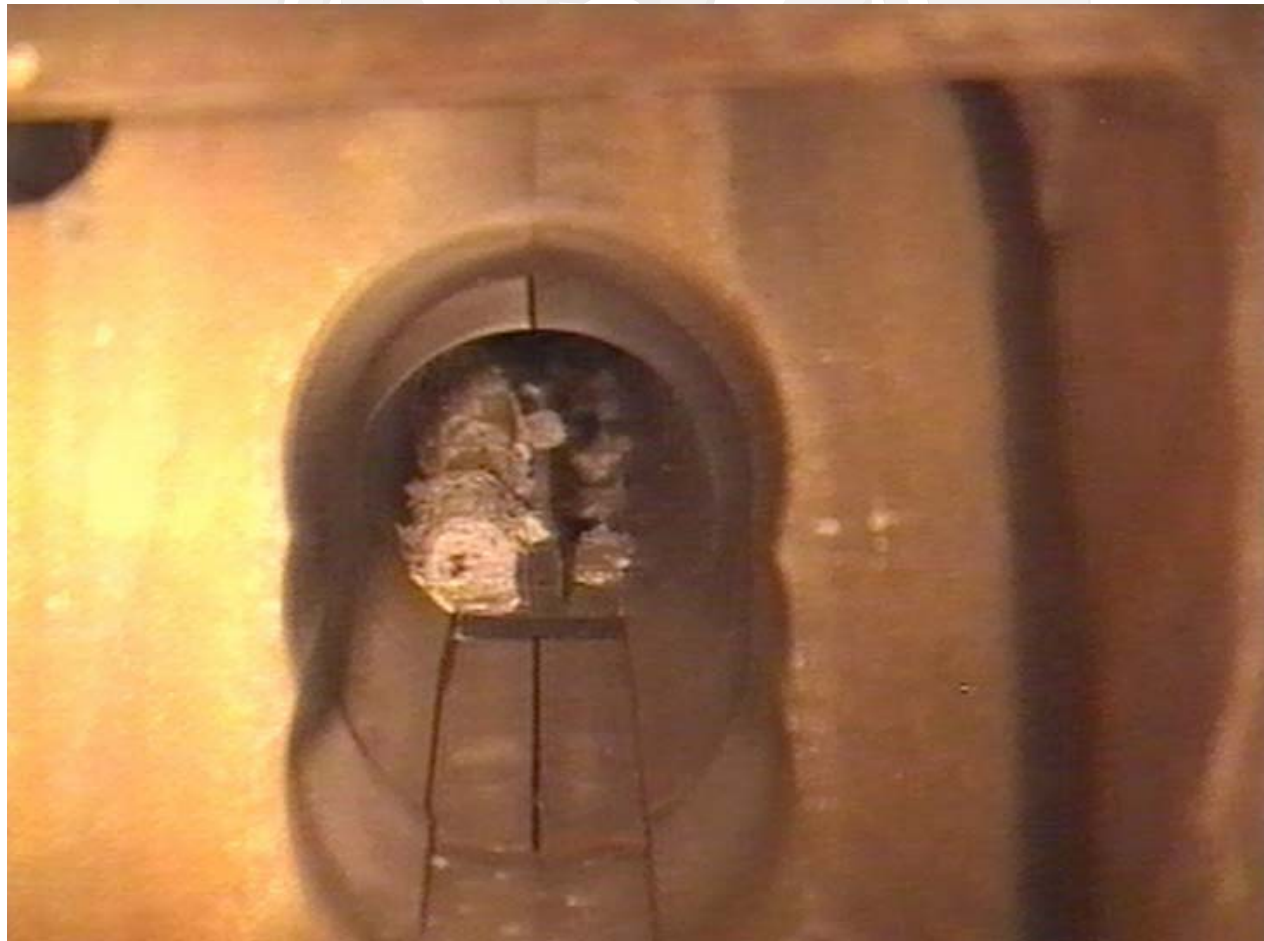
Windscale Piles Decommissioning

Slightly Damaged Fuel



Windscale Piles Decommissioning

Damaged Fuel



Windscale Piles Decommissioning

Damaged Fuel



Windscale Piles Decommissioning

Destroyed Fuel



Windscale Piles Decommissioning

Destroyed Fuel



Windscale Piles Decommissioning

Intact Isotope Cartridge



Windscale Piles Decommissioning

- Images from Intrusive Inspection

Windscale Piles Decommissioning

Intact Graphite Boat



Windscale Piles Decommissioning

Damaged Graphite Boats



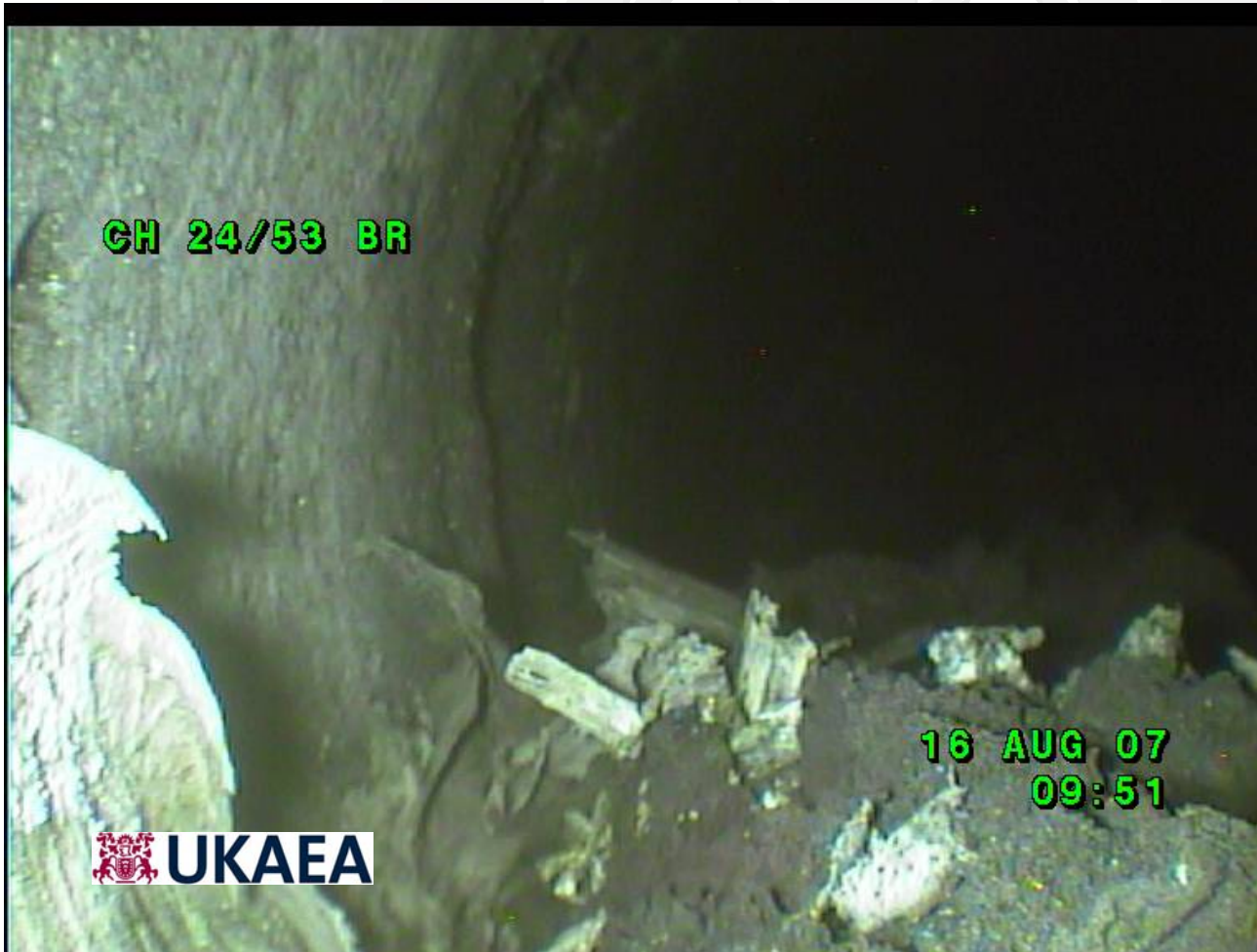
Windscale Piles Decommissioning

Melted Fuel



Windscale Piles Decommissioning

Debris In Channel



Windscale Piles Decommissioning

Eroded Graphite



Windscale Piles Decommissioning

Fuel Cartridge and Boat



Windscale Piles Decommissioning

Waste Form Development

- Polymer Encapsulation Trials
- Ash Liner development

Windscale Piles Decommissioning

Polymer Selection



Windscale Piles Decommissioning

Formulation and Encapsulation Performance (1)



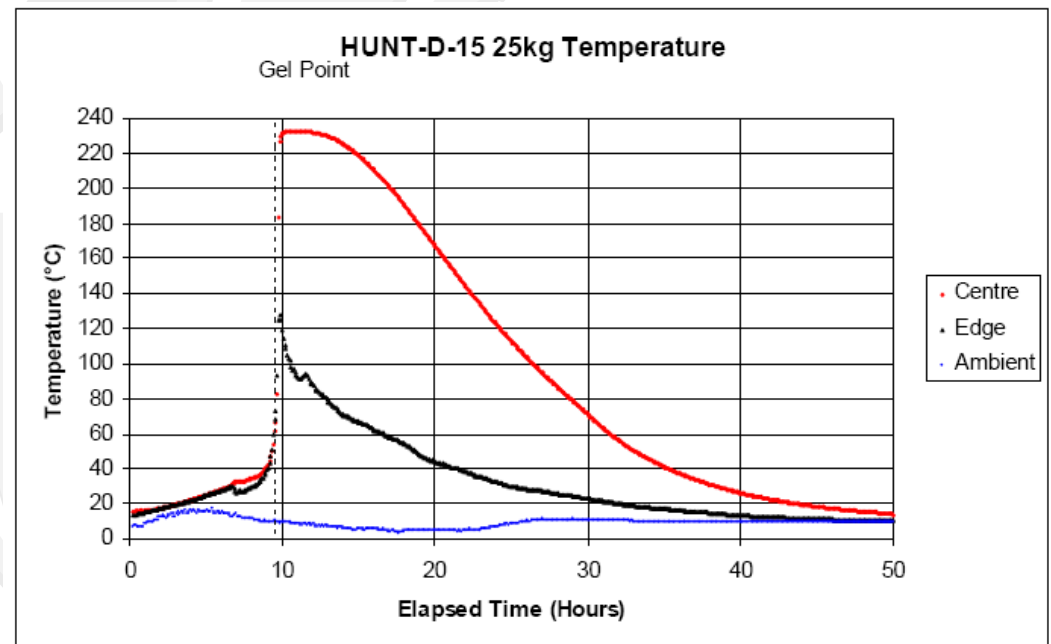
Windscale Piles Decommissioning

Formulation and Encapsulation Performance (2)



Windscale Piles Decommissioning

Formulation and Encapsulation Performance (3)



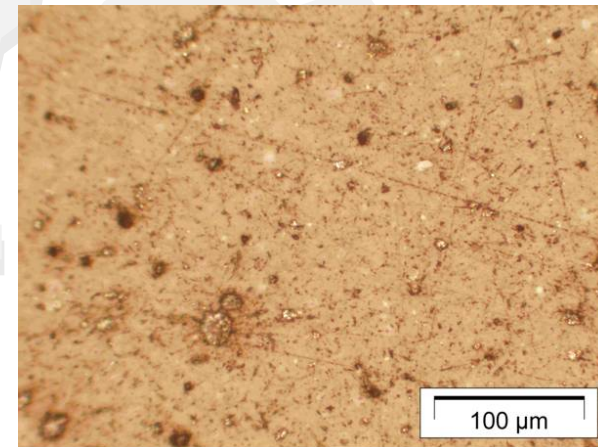
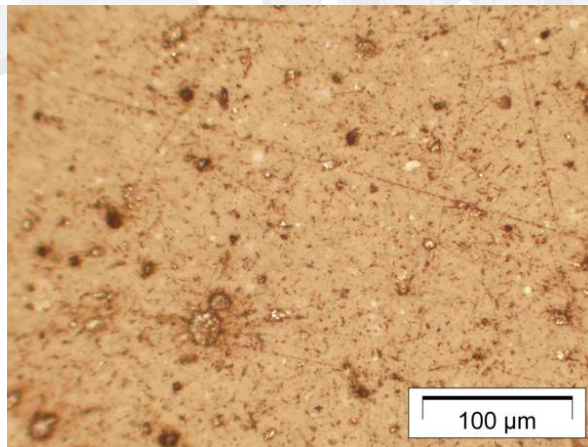
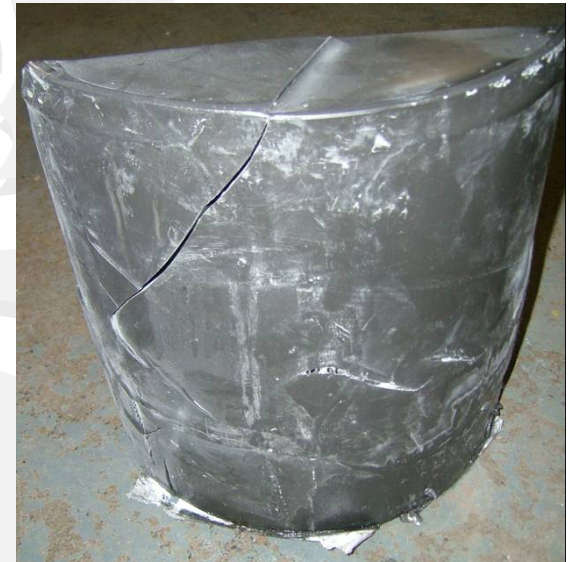
Windscale Piles Decommissioning

Ash Liner Concept Development Trials (1)



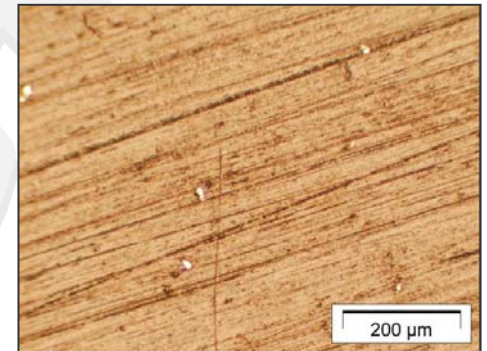
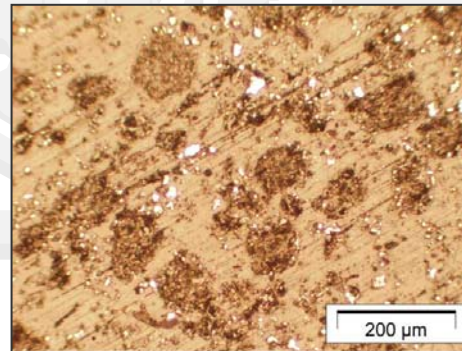
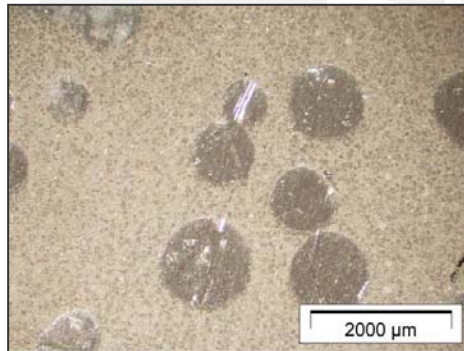
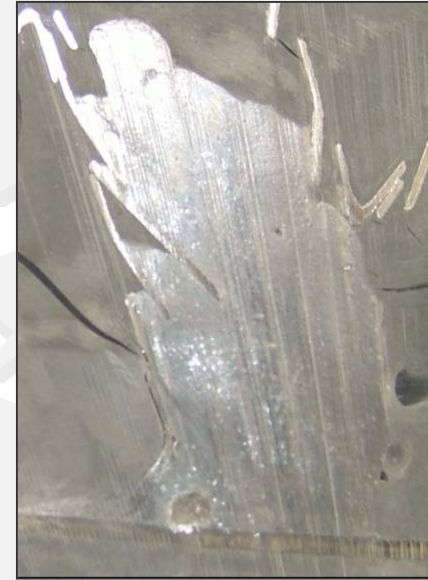
Windscale Piles Decommissioning

Ash Liner Concept Development Trials (2)



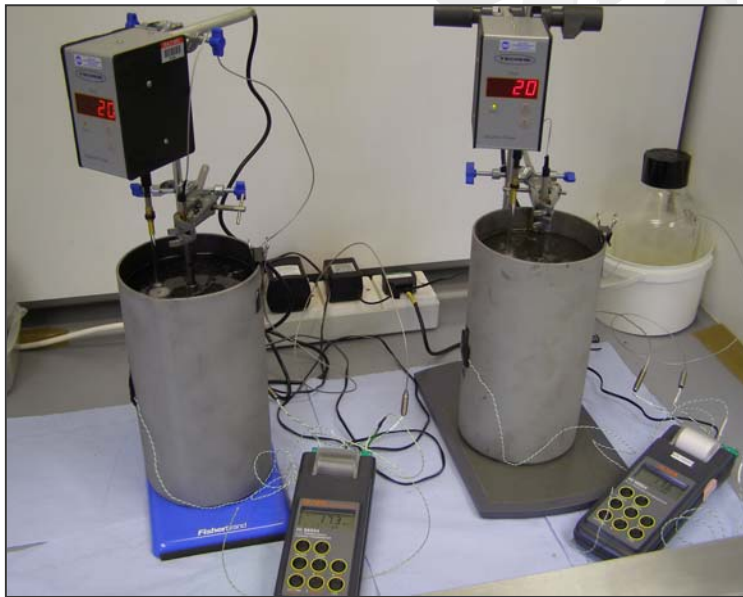
Windscale Piles Decommissioning

Ash Liner Concept Development Trials ('chimneys')

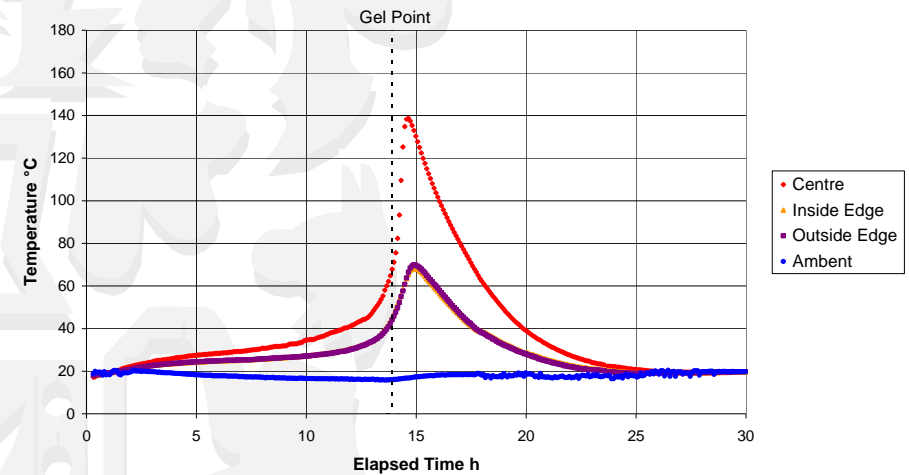


Windscale Piles Decommissioning

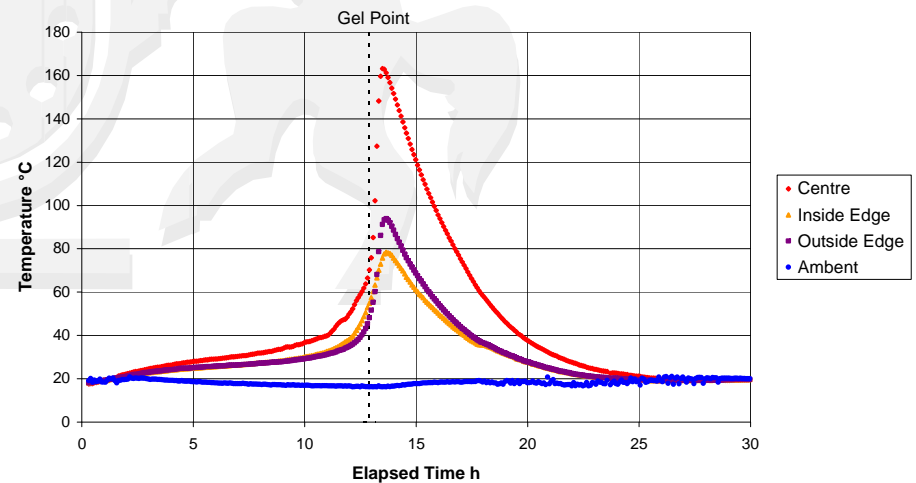
Full Scale Exotherm Trials (1)



Mild Steel Liner Temperature



Stainless Steel Liner Temperature



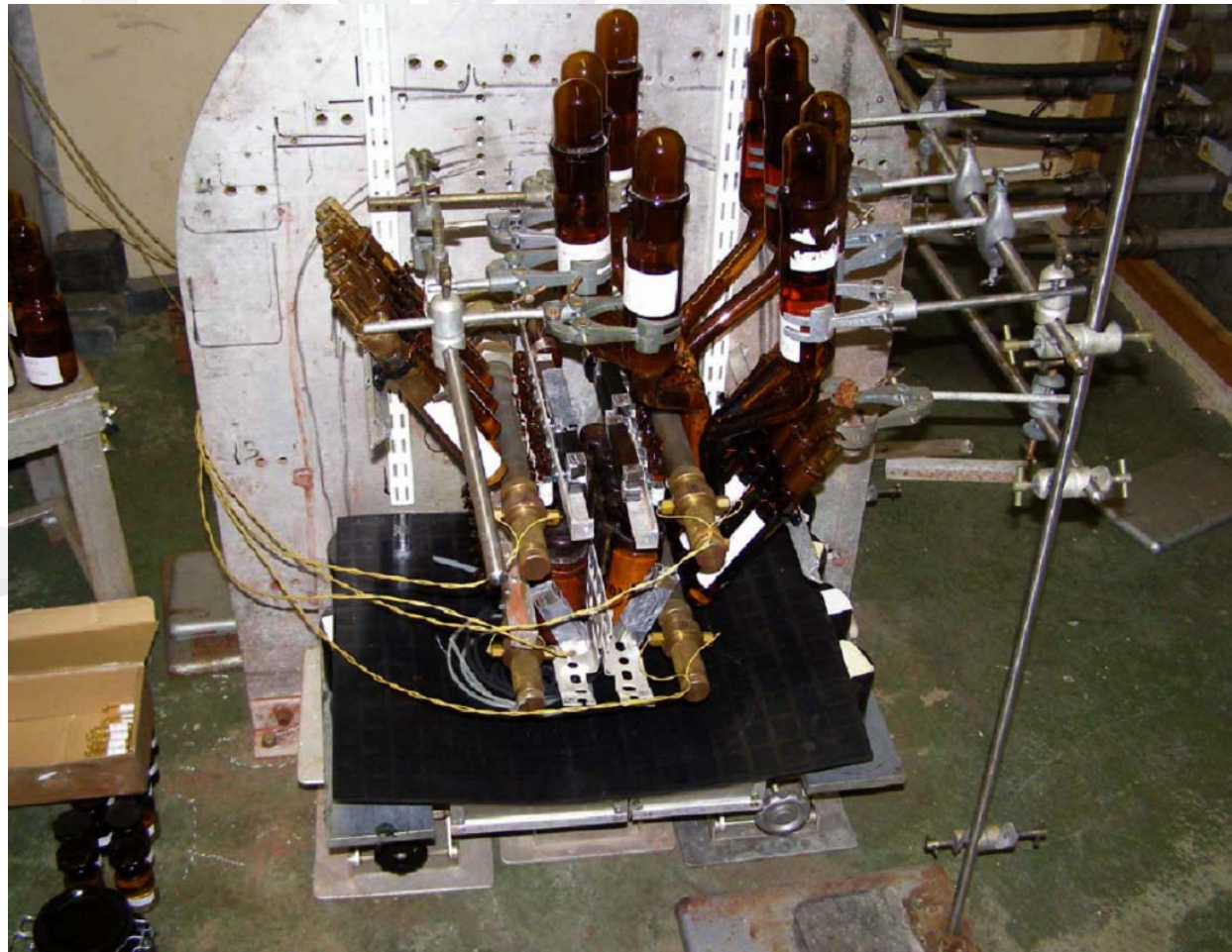
Windscale Piles Decommissioning

Full Scale Exotherm Trials (2)



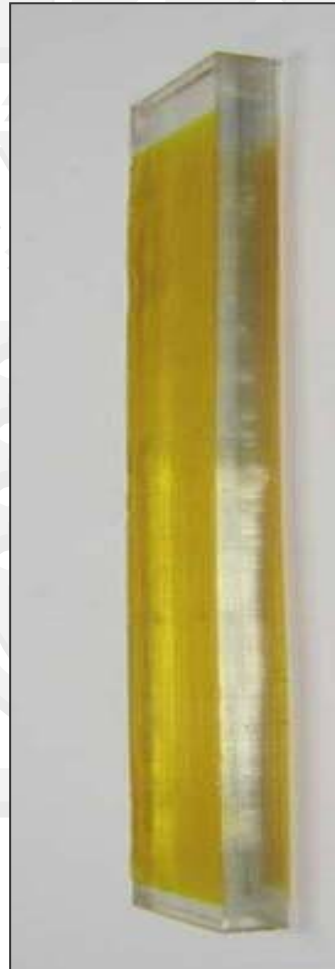
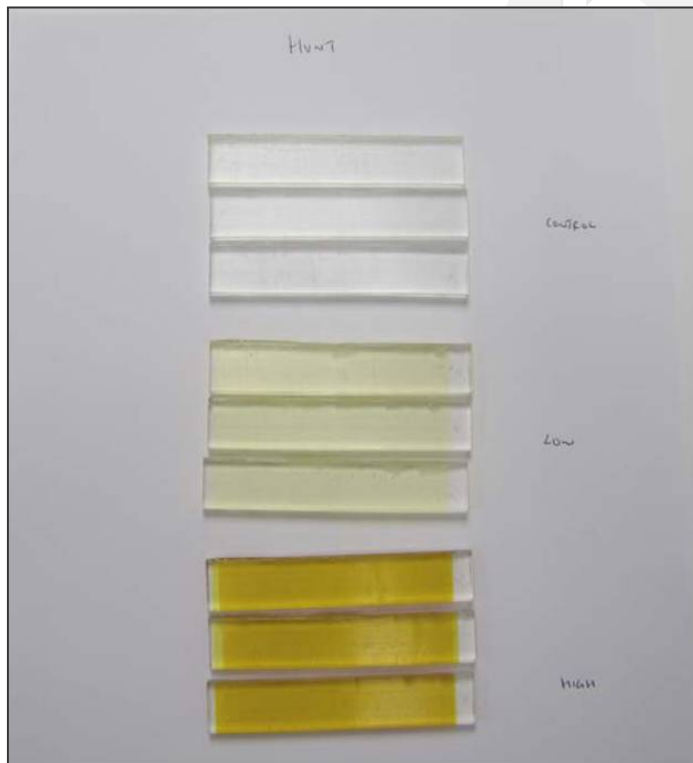
Windscale Piles Decommissioning

Alpha and Gamma Irradiation (1)



Windscale Piles Decommissioning

Alpha and Gamma Irradiation (2)



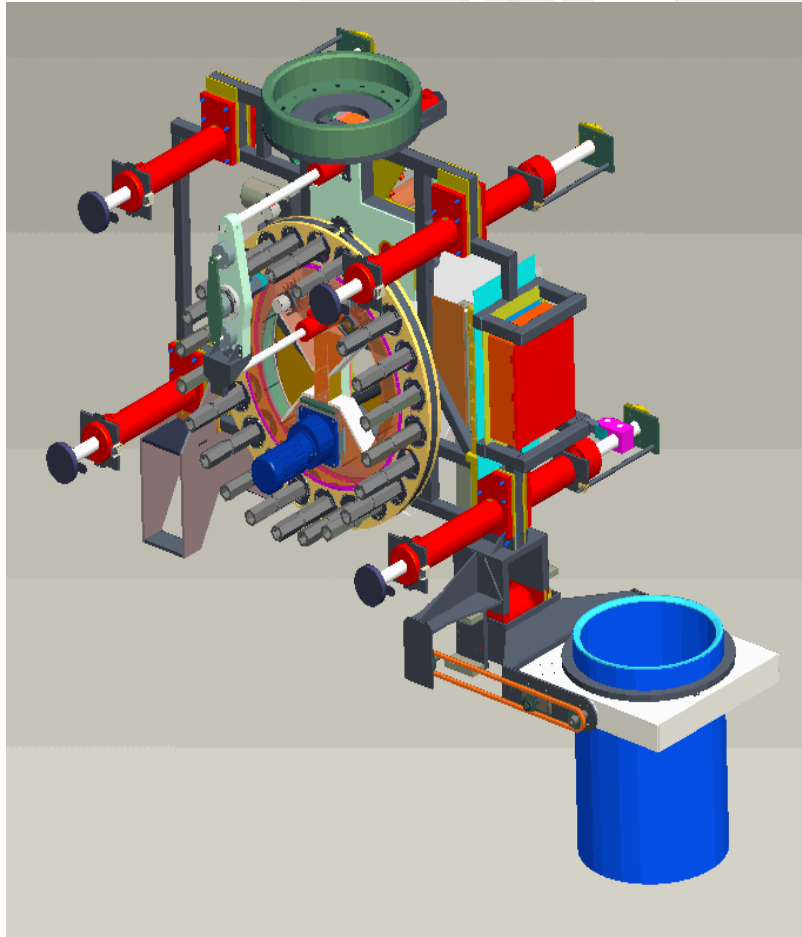
Windscale Piles Decommissioning

Fuel and Isotope removal Equipment

- Rotary magazine concept
- 9m retrieval tool in 2m space
- Working prototype built and tested

Windscale Piles Decommissioning

Fuel Channel Retrieval Tool



Windscale Piles Decommissioning

Summary

- Pile 1 fire in 1957
- Phase 1 clean-up 1980-90s
- New safety case
- Ongoing survey inside fire-affected zone
- Encapsulation Trials underway
- Prototype Fuel & Isotope retrieval equipment