Spent Fuel Management in the UK

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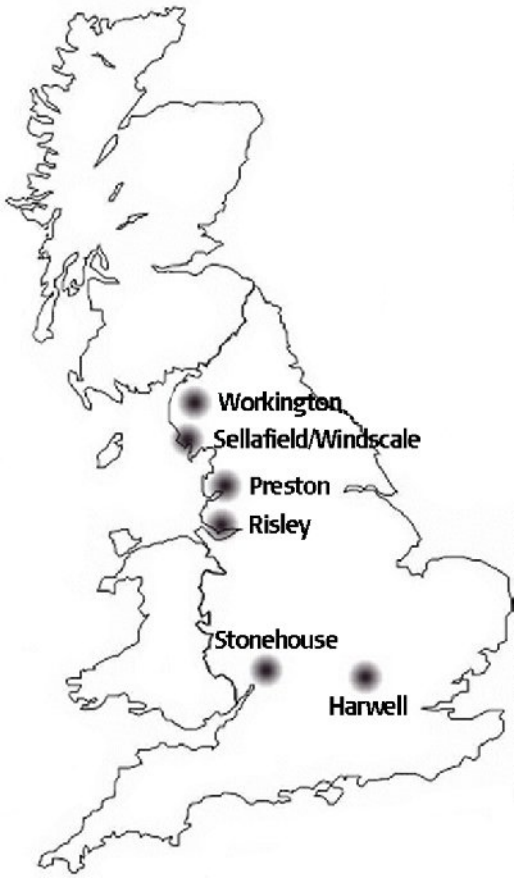
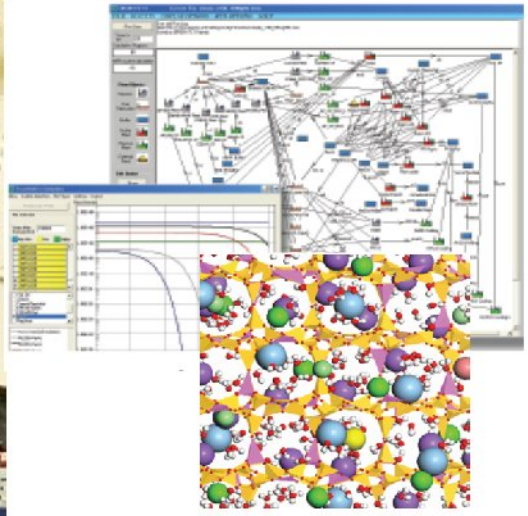
Introduction

- **National Nuclear Laboratory**
- UK's leading civil nuclear research organisation
- owned by Government, managed by Serco Battelle Univ of Manchester Consortium





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Spent Fuel Management in UK

UK Government policy states that spent fuel management is a matter for the commercial judgement of its owners, subject to meeting the necessary regulatory requirements.

Resulting picture for domestic spent fuel management includes:

- Interim stored and reprocessed
- Interim stored pending geological disposal
- Interim stored pending a decision to recycle or dispose

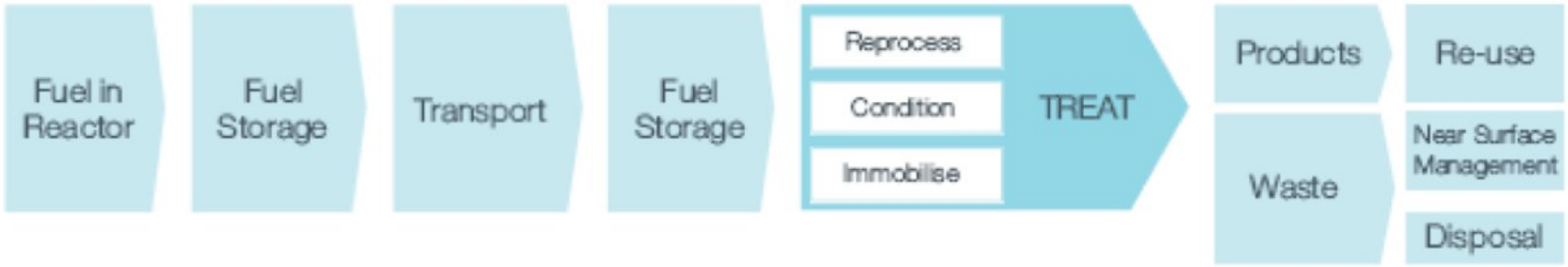
Ref: NDA Strategy II (effective April 2011), www.nda.gov.uk

NDA and its Spent Fuel Inventory

The **Nuclear Decommissioning Authority** (NDA) reports to the Department of Energy and Climate Change (DECC), and is responsible for clean-up of UK's historic civil nuclear legacy.

NDA's Spent Fuel Inventory is **diverse** and consists of:

- large quantities of Magnox fuel (metallic)
- large quantities of **oxide fuel** (dominated by AGR fuel)
- smaller quantities of non-standard fuel types or 'exotic fuels' (including oxides, e.g. WAGR, SGHWR, MOX)



NDA's Value chain for spent fuel management from reactor to final re-use, near surface management or disposal. (courtesy of NDA)

Oxide Fuel Management Objective

Objectives:

- **To ensure receipt, safe management and ultimate disposition of UK owned oxide fuel and**
- **To optimise the management of overseas owned oxide fuel held in the UK.**

NDA are contracted to:

- receive and manage all spent AGR fuel arisings

  Approx half of AGR fuel is under contract for reprocessing; while it is the NDA's decision to reprocess or directly dispose of the remainder.

- reprocess overseas LWR fuel received and stored at Sellafield, returning products and any associated wastes to customers

Ref: NDA Strategy II (effective April 2011), www.nda.gov.uk

NDA Oxide Fuel Strategy

Strategy:

To complete the LWR and AGR reprocessing contracts as soon as reasonably practicable and cease reprocessing at THORP.

and…

NDA plan to place into *long-term storage* at Sellafield any fuel not reprocessed pending disposal, including future arisings of AGR fuel.

NDA expect **storage to be needed for many decades** before the fuel can be packaged and sent to a Geological Disposal Facility (GDF).

NDA consider that placing fuel into long-term storage will **not foreclose future options** for managing spent fuel, including the option to reprocess.

Ref: NDA Strategy II (effective April 2011), www.nda.gov.uk

NDA Oxide Fuel Strategy Development

Development of NDA's oxide fuel strategy is ongoing:

- To enable a transition away from reprocessing to wet storage in due course
  - To determine how much AGR fuel should be reprocessed
  - To determine the most appropriate time to stop oxide fuel reprocessing
- To transition from interim wet storage to long term storage

Ref: NDA Strategy II (effective April 2011), www.nda.gov.uk

NDA Oxide Fuel Strategy Development

Using R&D the NDA and SLCs (e.g. Sellafield Ltd) will:

- Develop storage options
- Evaluate how spent fuel should be safely and cost-effectively stored in the long-term at Sellafield

NDA plan to complete Credible Options study in 2011, and identify preferred strategic option by end 2012.

Ref: NDA Strategy II (effective April 2011), www.nda.gov.uk

Long Term Storage of AGR - Options

Wet storage in Sellafield ponds

(Sellafield Ltd Baseline Plan)

Dry storage in new vault store

(previously investigated by SNL in 1980s-90s, and again by SL in 2009)

Dry storage in casks

(previously investigated by SL in 2009)

What influence will lifetime extensions, fuel integrity, disposability, cost, transportation, etc. have?

AGR Fuel: Expected Issues for Wet Storage

- **Corrosion of sensitised cladding**
- **Drying of graphite sleeves**
- **SCC of sensitised cladding**
- **Clad creep rupture (intact pins)**
- **Fuel pellet oxidation (failed pins)**
- **Treatment of Experimental fuel pins**

Long Term Storage of AGR – R&D areas

Current areas of work:

- Review of the effectiveness of pond storage chemistry
- Assessment of best dry storage environments and conditions
- Assessment of drying technologies and dry storage capacities
- Comparison of wet and dry storage options for new/replacement storage capacity
- Impact of storage conditions on fuel disposability
- Management of non-standard fuels

Summary

- In UK spent fuel management is a matter for the commercial judgement of its owners
- NDA Strategy is to complete the LWR and AGR reprocessing contracts as soon as reasonably practicable and cease reprocessing at THORP …
- … and to place into *long-term storage* at Sellafield any fuel not reprocessed pending disposal, including future arisings of AGR fuel
- With an emphasis on AGR fuel, R&D has started to support developing NDA strategy and associated issues
- R&D continues to support interim storage of UK oxide fuel

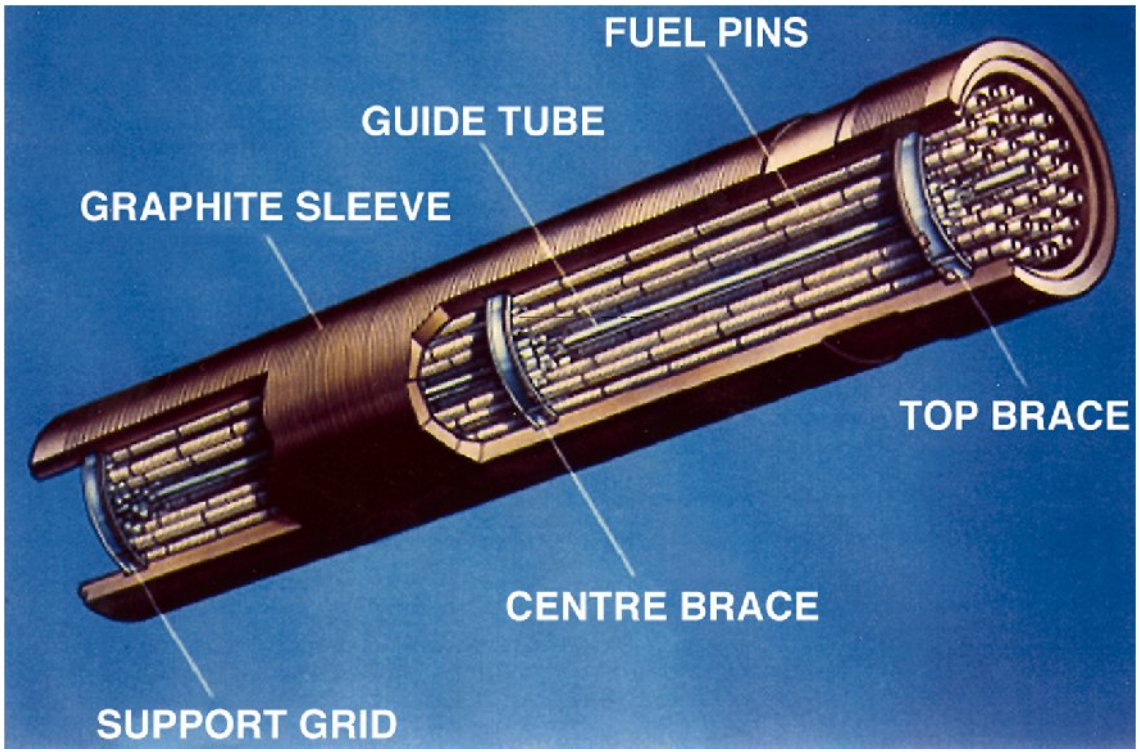
Acknowledgments

NNL would like to acknowledge Danny Fox and Darrell Morris of the NDA for funding R&D on the topic of long term storage of AGR.

NNL would like to acknowledge Mark Cowper of the NDA RWMD for funding R&D on the topic of disposal of AGR

Advanced Gas-cooled Reactor (AGR) Fuel

- **Geometry:** 36 pins per element, 8 elements per stringer
- **Fuel pellets:** UO_2, annular, ~50kgU/element
- **Cladding:** 20/25/Nb stainless steel with ribs
- **Free volume**: mainly pellet bore
- **In-reactor environment:**
  CO_2
  1-1.5% CO
  160-400 vpm CH_4
- **Burnup:**
  typically 20-30 GWd/tU
  max element limit
  = 43 GWd/tU



Dismantled AGR in Slotted Can