

NDA PhD Bursary Spent Fuel Theme

2017

Magnox, Oxide and Exotic Fuels



Over 96% of the lifetime arisings of Magnox fuel have already been reprocessed.

Inventory of non-standard fuels, 'exotics'



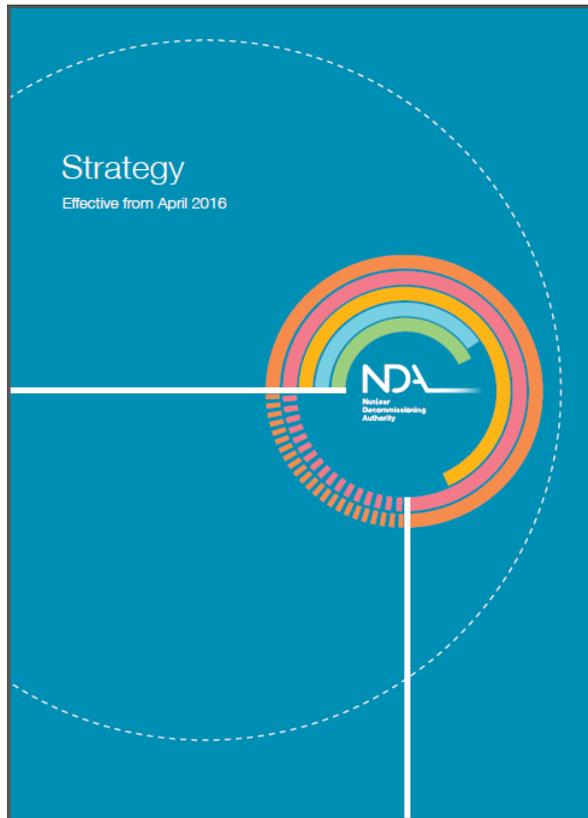
includes metal, oxide and carbide materials. Legacy from development of research, experimental and prototype fuels and reactors.



THORP expected to complete reprocessing 2018. Remaining oxide fuels and future arisings of AGR will be interim stored.

NDA Spent Fuel Strategies

NDA Strategy 2016



NDA strategy is to reprocess all Magnox fuel in line with the MOP.

After THORP has finished reprocessing, AGR and other spent oxide fuels will be interim stored, pending a future decision on whether to declare them as waste for disposal in a GDF.

Specific exotic fuels will be reprocessed alongside with bulk fuels which have common characteristics. In some other cases, fuel will be stored alongside AGR fuel.

Spent fuel strategy development



We are working on alternative options to treat possible remnant **Magnox** spent fuel so that any remaining fuel can be safely and cost-effectively managed.

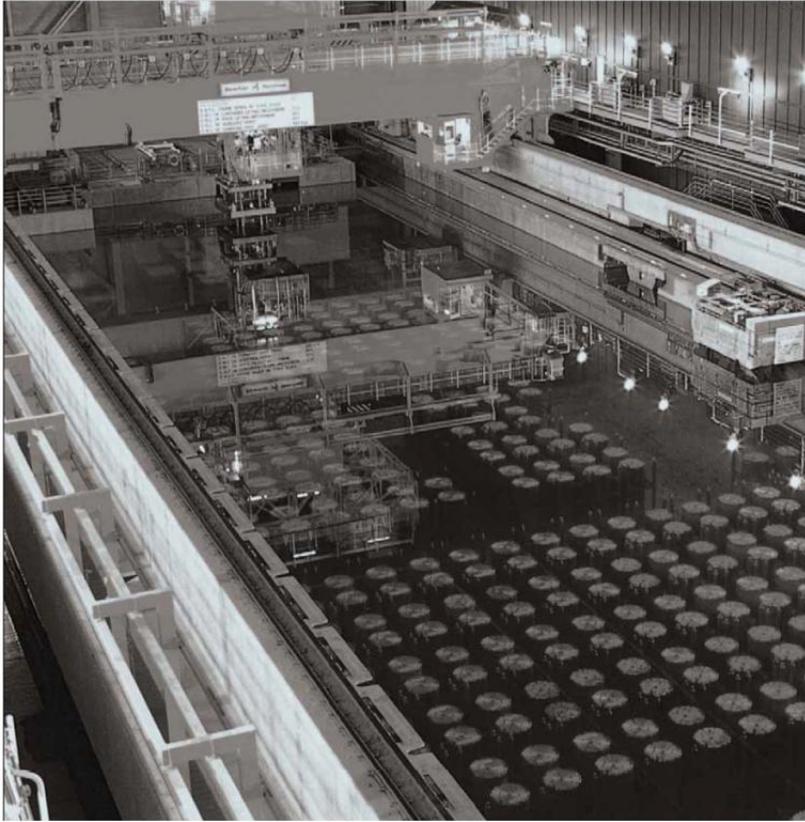
We will continue to work on the storage, packaging and disposal of **oxide** fuels, including work on dry storage as an alternative to wet storage.

Not all **exotic** fuels can be reprocessed, and alternative management options for their storage, treatment and disposal need to be developed.

Spent fuel R&D needs

- **Strategies for the management of spent fuels exist, together with plans for their implementation and appropriate contingency measures.**
- **There is a requirement for R&D that can help to underpin strategies, improve confidence in managing contingencies and enhance the understanding of alternative options for storage and pre-treatment for disposal.**

Monitoring in spent fuel storage ponds

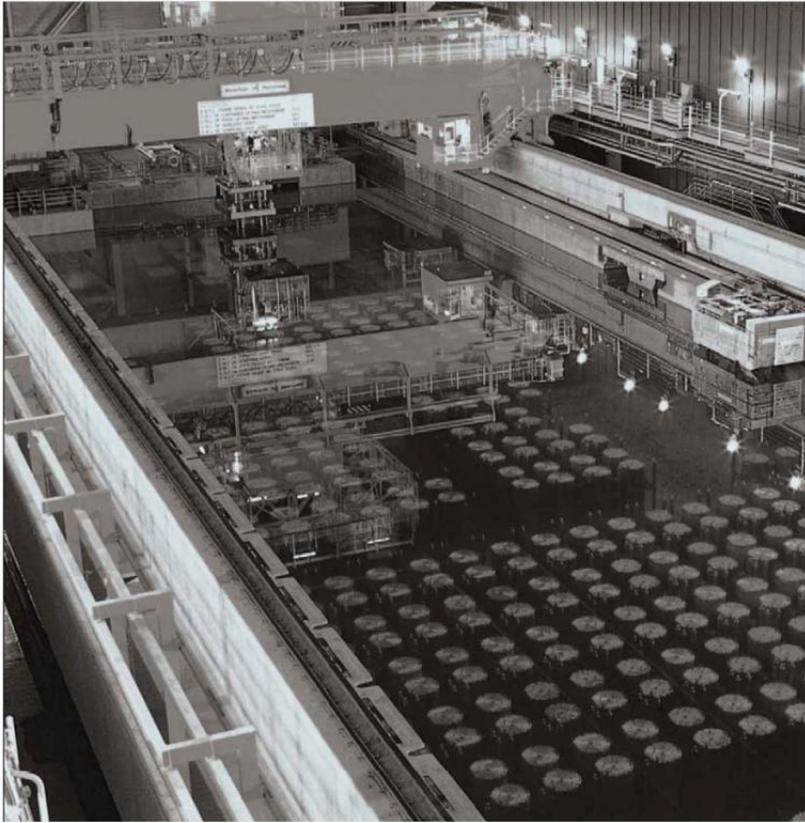


- AGR and some exotic spent fuels will be put into pond storage at pH 11.4 to control cladding corrosion.
- Any corrosion of cladding or other fuel containment would result in release of soluble radionuclides (e.g. Cs-137) to pond water.
- Routine off-line analysis of bulk pond water will detect any loss of containment, but will not give any early warnings, and tracing releases of soluble radionuclides to their source may be difficult and time-consuming.
- Leaching of pre-existing inventories from pond structures may confuse early detection of any fuel leakage.

PhD call spent fuel topics

- **Monitoring in spent fuel storage ponds**
 - Research into novel techniques which could support detection, (3D) mapping or tracing of very low level radionuclide releases in spent fuel storage ponds.
 - Research into potential novel approaches which may detect at an early stage the onset of general or local conditions which might promote corrosion of cladding or other fuel containment in fuel storage ponds.

AGR cladding behaviour in wet and dry storage



- Sustainability of wet storage of AGR fuel until GDF disposal (after circa 2075) is of great strategic importance.
- Operational experience underpins wet storage of AGR fuel at pH11.4, but fundamental mechanisms of corrosion and inhibition of irradiated AGR cladding are not fully understood.
- Dry storage is a potential alternative for AGR fuel, in the event that wet storage is not sustainable.
- There is considerable worldwide experience of dry storage of Zircaloy clad LWR fuels, but there is no equivalent experience of dry storage of stainless steel clad AGR fuel.

PhD call spent fuel topics

- **AGR cladding behaviour in wet and dry storage**
 - Research to determine the fundamental mechanisms of the corrosion and corrosion inhibition of irradiation sensitised AGR fuel cladding under pond storage conditions.
 - Research into the behaviours of irradiation sensitised AGR fuel cladding under moist and dry storage conditions, including the potential impact of stress and microstructure of the cladding.
 - Research to demonstrate methods which could replicate the metallurgy of neutron irradiated stainless steel to provide representative simulant materials which could be used to examine the behaviour of neutron irradiated sensitised stainless steel in various wet, moist or dry storage environments.

Damaged and degraded fuel



- Exotic fuels inventory includes a variety of damaged and degraded metal or oxide fuel material (e.g. PIE debris).
- Potentially need to condition/stabilise and package materials for interim storage and/or final disposal.
- Indicative challenges include presence of water and organic materials, which may cause further degradation, material swelling or radiolytic gas generation.

PhD call spent fuel topics

- **Damaged and degraded fuel**
 - Research into potential methods of treating damaged and degraded spent fuel materials to stabilise and immobilise them in a form suitable for long-term storage and/or final disposal.
 - Research into methods of improving performance of containment packages for intact or damaged, degraded spent oxide and/or metal fuels to facilitate long-term interim storage and/or final disposal.