



Management of Nuclear Fuel in the UK: Past, Present and Future

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WM2017

- UK power programme
- UK strategy for spent fuel management
- Future spent fuel storage requirements
- Current issues in spent fuel management
- R&D requirements

- Magnox Reactors

- ❖ 26 reactors build between 1956 and 1971
- ❖ total nominal output 4.4 GWe
- ❖ design life 20 years
- ❖ most operated > 40 years, max 47 years

- ❖ natural Uranium fuel
- ❖ ~50,000 te fuel reprocessed
- ❖ < 2,00 te fuel to be reprocessed

- ❖ Reactors closed 1989 - 2015



Current UK Nuclear Fleet

- AGR
 - 6 stations, 880 – 1230 MWe
 - total output 8.2 Gwe
 - started operation 1976-1989
 - scheduled closure 2023-2030



- PWR
 - 1 station, Sizewell B
 - 1198 MWe
 - started operation 1995
 - scheduled closure 2035
 - expect 20 years extension



New Build (1)

- EDF & CGN
 - Hinkley Point C,
 - 3.2 GWe capacity (2 EPR)
 - **approved September 2016**
 - earliest operation 2026
 - Sizewell C,
 - 3.2 GWe capacity (2 EPR)
 - Stage 2 consultation
Nov 2016-Feb 2017
 - Bradwell B
 - Pre-planning stage



New Build (2)

➤ Horizon

- Wylfa, 2.7 GWe (2 ABWR)
 - Stage 2 consultation complete
 - Site investigation underway
 - Earliest operation 2026

- Oldbury, 2.7 GWe (2 ABWR)
 - Pre-planning stage

➤ NuGen

- Moorside, 3.4 GWe (3 AP1000)
 - stage 2 consultation complete
 - site investigation underway
 - Final Investment Decision 2018



- Strategy has been reprocessing of Magnox and AGR fuel
 - Low corrosion resistance of Magnox fuel
 - Initial issues with corrosion of AGR fuel
 - Energy security
 - Preparation for transition to fast reactor fuel cycle
 - International business
- Disposition (approximate quantities)
 - Magnox ~50,000 te reprocessed
 - AGR ~6,000 te reprocessed <6,000 te to be stored
 - SZB <2,000 te to be stored
- Strategic change due to
 - Reduced international business
 - No immediate prospect of fast reactor deployment
 - Mismatch between capacity and need
 - Good storage performance over > 20 years
 - Refurbishment costs

“Spent fuel management is a matter for the commercial judgement of its owners, subject to meeting the necessary regulatory requirements.”

Spent Fuel Management for Gas Cooled Reactors

Current strategy for Magnox fuel:

- Interim stored and reprocessed
 - *Reprocessing contracts expected to be complete by end 2020*

Current strategy for AGR fuel:

- Interim stored and reprocessed
 - *Reprocessing contracts expected to be complete by end 2018*
- Long term stored pending geological disposal
 - *Centralised (“Away from Reactor”) storage*
 - *Transition from interim to long term storage*
 - *Use of existing storage infrastructure*



Spent Fuel Management for Sizewell B

- Option of reprocessing contract not exercised
- Strategy is long term stored pending geological disposal
- Reactor pool reaching capacity in 2016
- Dry storage facility commissioned 2016
 - *Vertical concrete canister system*



Images
courtesy of
EdF

Challenges for SF Management

- AGR fuel – underpinning long term wet storage
- LWR fuel – underpinning long term performance of canisters
- Re-use of separated Pu as MOX or fast reactor fuel (or disposal)
- Consequential challenges
 - Optimising back end: storage-transport-disposal
 - Incentivising centralised storage
 - Managing knowledge and maintaining skills and capability across long period of minimal SF activity

- Historically UK has reprocessed its spent fuel from power reactors
 - 50,000 tHM of Magnox fuel
 - 10,000 tHM of oxide fuel (AGR, SGHWR & overseas LWR)
- Vitrified HLW is stored in air-cooled vault stores pending geological disposal
- Vitrified HLW is a core part of the GDF baseline inventory



- Fuel evolution over decades-centuries
- Monitoring of fuel condition and local environment
- Contingencies and severe accidents
- Ageing management of SF pools
- Drying behaviour of defective spent fuel
- Degradation mechanisms and ageing management plans for cask storage
- Post storage transportation

- UK is building a new generation of LWRs
- Strategy has moved to open 'cycle', with option for future return to closed cycle if needed
- Disposal facility programme under way
- Existing storage technology and infrastructure to meet SF management need for current reactors
- 10 year decision making period for new capacity
- Focus on knowledge, skills and capability maintenance

Sound position for long term SF management