

# Reprocessing in the UK: why adopted and why soon to be abandoned?

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May 2012

# The start of reprocessing

- Original motivation was to produce plutonium (Pu) for weapons – reprocessing spent fuel from Windscale ‘piles’ and early Magnox-type reactors in 1950s
- A large reprocessing facility was completed in 1962 (B205) to reprocess metallic Magnox fuel, primarily for civilian purposes – the Pu was to feed future fast neutron reactors
- When it became clear that Pu was not needed for fast reactors, B205 continued because no dry store route was developed, and metallic fuel corrodes quickly in ponds
- B205 has been frequently refurbished, but is to be closed by 2016/7 after all metallic Magnox fuel has been reprocessed

# The second generation of reprocessing - THORP

- By 1960s it was clear that new reactors would use low enriched uranium oxide fuel
- BNFL was formed in 1971 (separated from R&D and military activity) to be a 'commercial' but state-owned company to provide fuel cycle services in UK and internationally – mainly reprocessing
- Early experiments in using B205 to reprocess oxide fuel failed, and BNFL developed plans to build a large new oxide fuel reprocessing plant – THORP
- Main immediate motivation for THORP was desire of Japanese utilities to have reprocessing done in other countries – there was limited UK demand but some from Germany
- Japanese utilities largely paid for THORP - it was commissioned in 1994 but has been unreliable, though currently operational

# THORP contracts (1)

- Most of fuel reprocessed at THORP has been from overseas sources, almost 40% of total from Japan
- UK utilities became unenthusiastic about reprocessing at THORP in 1980s on cost grounds: this intensified in 1990s.
- In 1994 UK abandoned funding fast reactors and accepted that they would be unlikely to be needed for indefinite future: there was therefore no clear rationale to reprocess UK fuel
- After privatisation of British Energy (1996) reprocessing contract re-negotiated in 1997: future spent fuel would be reprocessed *or* indefinitely stored – and prices for spent fuel contracts were reduced as storage would be much cheaper

# THORP Contracts (2)

- British Energy (now taken over by EDF – French state-owned utility) owns all oxide-fuel producing reactors in UK
- It has consistently argued that reprocessing is much more expensive than storage and has tried to end reprocessing of its spent fuel – advocating interim storage
- In 2001, British Energy (pre-EDF takeover) stated to the UK Parliament:

“BE has never re-used any of the material produced by reprocessing because it would be uneconomic to do so.....Reprocessing ...is an unnecessary and expensive exercise that BE cannot afford. Reprocessing produces materials that have no current economic value....BNFL could provide storage-only management at a fraction of the cost” (Memorandum to Select Committee on Environment Food and Rural Affairs, November 2001)
- In 2007, Royal Society (UK academy of science) advocated end to reprocessing on grounds that Pu was unnecessary

# Why the Nuclear Decommissioning Authority?

- NDA set up in 2005: a state-owned body with primary mission to achieve focus on more rapid and cost-effective clean-up
- It took over from the state-owned BNFL, which was wound up
- Problems with BNFL
  - Technically and financially unsuccessful: THORP erratic; MOX plant a complete failure; data falsification over MOX for Japan
  - Paid very little attention to serious waste hazards at Sellafield
  - World market for reprocessing drying up
  - The UKAEA (former R&D agency) provided a contracting-out model for focus on clean-up activities

NDA given responsibility for reprocessing and MOX plants because Sellafield site complex/integrated

## THORP contracts (3)

- THORP now has c. 400 tU of foreign fuel to reprocess under contract, and c. 2000 tU of UK AGR fuel contracted to reprocess as well
- If technology holds up, this will be complete in late 2018
- This leaves c. 4000 tU of AGR fuel for which management route will now be long-term (initially wet) storage
- There will be further AGR fuel to manage as AGRs get further lifetime extensions - this will certainly be via storage not reprocessing

# THORP closure

Review by NDA in November 2011 concluded:

- Least-cost option is to complete reprocessing contracts, but no more – expected closure in late 2018
- Life extension of THORP would cost several billion \$: no visible UK or foreign demand for further reprocessing contracts
- Major risk is that THORP and/or associated plants (e.g. evaporators, HASTs) will fail, so that reprocessing may stop sooner than 2018
- A risk exists, if reprocessing has to end before 2018, of too little fuel storage capacity at Sellafield and a consequent risk of halting some/all AGR operation

# How to manage UK plutonium stockpile?

- After reprocessing ends, UK will have over 100 t separated Pu in UK ownership
- Current policy is storage at Sellafield but Government regards this as temporary and unsatisfactory
- Government is currently considering Pu strategy
- NDA study in 2010 suggested 10 credible options, including 5 immobilisation and 3 re-use in MOX
- Government's current inclination is to re-cycle Pu in MOX for UK future reactors on cost grounds
- But costs are uncertain and disputed (immobilisation via low-spec MOX probably cheaper) and UK re-use depends on future reactor build

# Fuel cycle for future reactors

- UK Government is hoping for c. 16 GW of new reactors
- EDF the lead contender for reactor construction
- Government's published expectation since 2007 is that no operator will want to reprocess - and therefore sites for future reactors must have spent fuel storage capacity for 120-160 years
- All potential future reactor operators including EDF are content with this – none of them wants to reprocess, and this is for straight economic reasons
- No future reactor operator will choose to use MOX (derived from UK's Pu stockpile) unless subsidised to do so

# Conclusion

- Reprocessing now being brought to an end in UK – all reprocessing will end by 2018, and possibly sooner depending on reliability of technology or (less likely) policy change
- Official studies show that completion of existing contracts for THORP are just worth doing on economic grounds, but only because of sunk costs. Analysis not publicly available, so cannot be independently checked
- Refurbishment of THORP would be grossly uneconomic – very costly, and no visible demand, either from UK (if new reactors or built) or from any other country