Decommissioning vs New Build:
Can the UK Nuclear Sector Expand While Dismantling Its Past?

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THE BIG PICTURE

The UK is dismantling its nuclear past while simultaneously building its nuclear future.

The Magnox fleet was among the world's first generation of nuclear power stations. Designed in the 1950s, these reactors prioritised safe operation and electricity generation with dismantling being a distant problem of the future.

Years on, features that served their operational purpose, such as graphite cores and difficult access internal structures, now contribute to the complexity and cost of decommissioning

The UK is currently investing in new nuclear capabilities to deliver long-term energy stability. These reactors will eventually also require decommissioning.

This creates an opportunity:
Today's challenges can become design data for the future of nuclear reactors.

1950s – 1960s
MAGNOX

Operations Design

- Reactors built for electricity
- Graphite moderated cores
- Limited consideration of dismantling

TODAY
DECOMMISSION

Lessons Learnt

- Complex dismantling of reactors not designed to come apart
- £15 billion estimated cost to decommission the Magnox estate [1]
- Significant technical challenges

FUTURE
NEW NUCLEAR

Lifecycle Designing

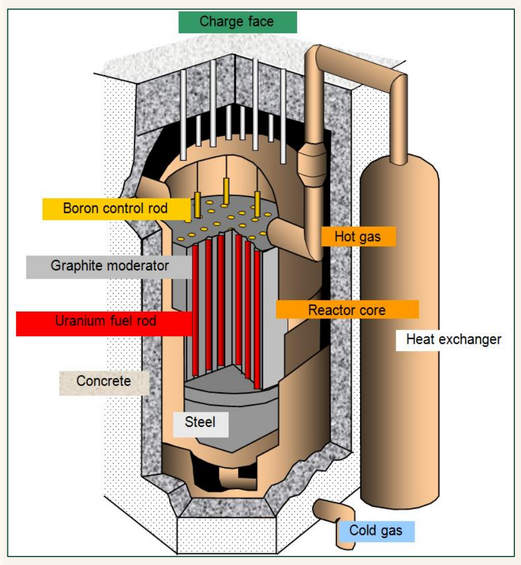
- New capacity to support the UK's path to net zero
- Will require dismantling
- Opportunity to design differently from the start

RESEARCH QUESTION: *How can lessons from **Magnox decommissioning** inform a **dismantle-first, design-backwards approach** for the future of UK reactors design?*

MAGNOX LESSON 1

Graphite Moderator

Built for operations transforms into an end-of-life challenge



OPERATIONS DESIGN

Graphite provides neutron moderation and forms a major structural component of the core.
It was originally selected for its effectiveness and long-term stability in service.

LEGACY CHALLENGE

- Large graphite inventory within the core
- Irradiation and oxidation change properties over time
- Difficult characterisation, retrieval and waste management
- Significant volumes of radioactive waste

DESIGN LESSON Material choices should be evaluated throughout lifecycle including how they will eventually be removed.

MAGNOX LESSON 2

Inaccessible Internal Structures

Degradation becomes a design constraint

OPERATIONS DESIGN

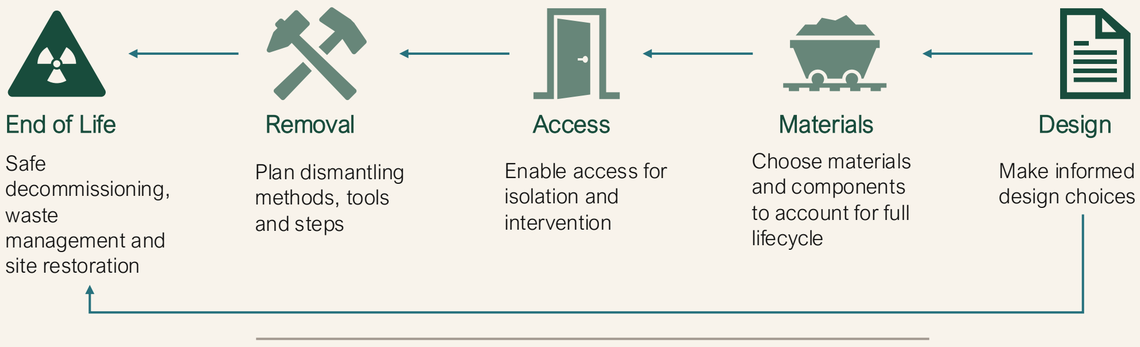
- CO_2 cooled reactor system
- Low-alloy steels used in structural components
- Magnesium alloy fuel cladding selected for favourable neutronic properties

LEGACY CHALLENGE

- Oxidation affected internal steel components, contributing to derating
- Magnesium-alloys low melting point (450 °C) restricted operating temperature
- Degradation and inaccessibility can limit inspection, maintenance and intervention

DESIGN LESSON Design for degradation, inspection and replacement especially where components could become inaccessible or irreplaceable

DESIGN BACKWARDS



KEY PRINCIPLES

Accessible Provide physical and geometric access
Modular Use modularity to allow replacement
Manageable Enable knowledge of materials for handling, treatment and disposal

Define dismantling requirements before design decisions make them too complex to change.

THE FRENCH LESSON

Graphite Reactor Decommissioning Demonstrator - France

France developed a full-scale demonstrator to test and qualify dismantling technologies for its UNGG reactors. Testing since 2022 has supported graphite-brick recovery tools and robotic arms for remote dismantling, with lessons intended to inform the first-of-a-kind Chinon A2 project and subsequent reactors. [3]

REHEARSING DISMANTLING
Test and improve techniques at full scale

TEST TOOLS & ACCESS
Understand constraints and optimise solutions

REDUCE UNCERTAINTY
Build confidence and improve safety

If dismantling must be rehearsed at full scale, could those requirements be considered before a reactor is built?

WHY ISN'T THIS ALREADY STANDARD?

DELIVERY PRESSURE

- Focus on speed to build and deploy capacity
- Previous Magnox strategy deferred reactor decommissioning for approx. 85 years [2] after shutdown

UPFRONT COST

- Access, modularity and materials increase cost
- Benefits are realised in the future while costs are immediate

DESIGN PRIORITIES

- Operational performance and safety dominate early decisions
- Dismantling requirements are often not visible in trade-offs

CONCLUSION

The challenge is not whether designing for dismantling is desirable. It is making end-of-life requirements visible enough to influence design decisions.

[1] Nuclear Decommissioning Authority (2016). *Annual Report and Accounts 2015/16*.
[2] Nuclear Decommissioning Authority (2021). *Timing of the Magnox Reactor Decommissioning Strategy*.
[3] EDF (2025). *Universal Registration Document 2024*.