UK regulatory expectations for management of HTGR spent fuel

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IAEA- Technical Meeting on the Management of Spent Fuel (Pebbles and Compacts) from High Temperature Reactors
7 – 11th July 2025

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Nuclear regulation in the UK

ONR Office for Nuclear Regulation

Environmental regulation- Devolved Administrations

Radioactive waste disposals (inc. to air, land and water)

Abstraction & discharges to controlled waters

Conventional waste disposal

Conventional chemical / combustion

Safety, Security & Safeguards- Great Britain

Nuclear safety

Nuclear site health and safety (conventional health and safety)

Nuclear security

Nuclear safeguards

Transport of radioactive materials

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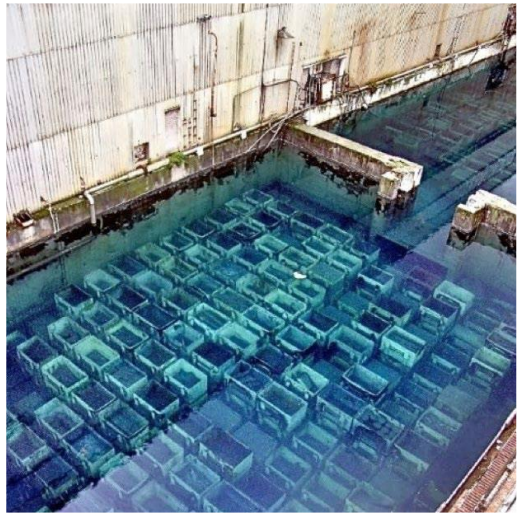
Waste management in the UK

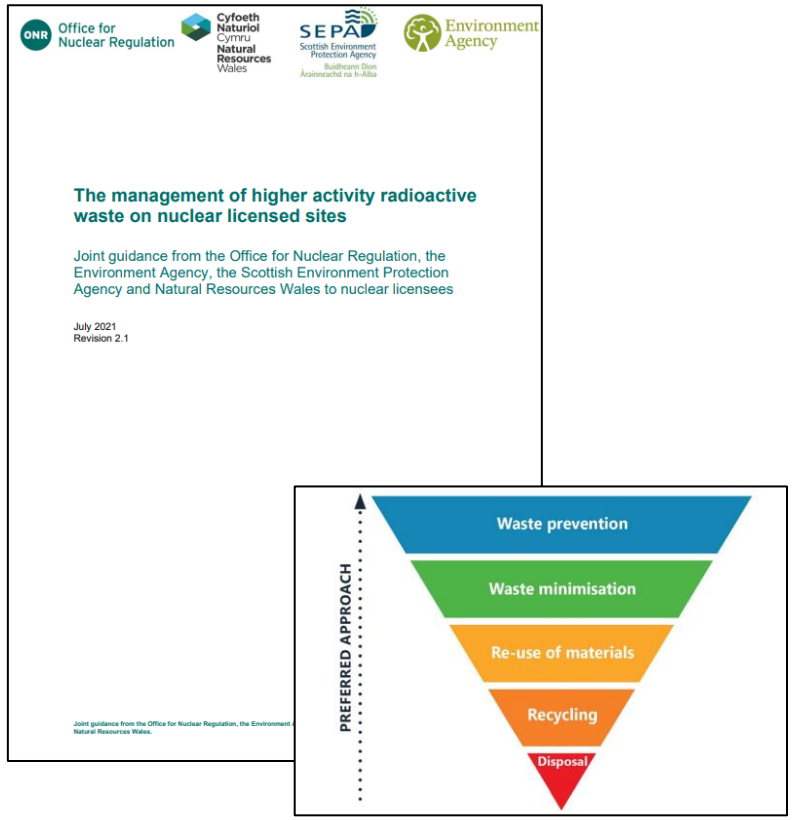
Waste producers

- Manage, treat and package wastes



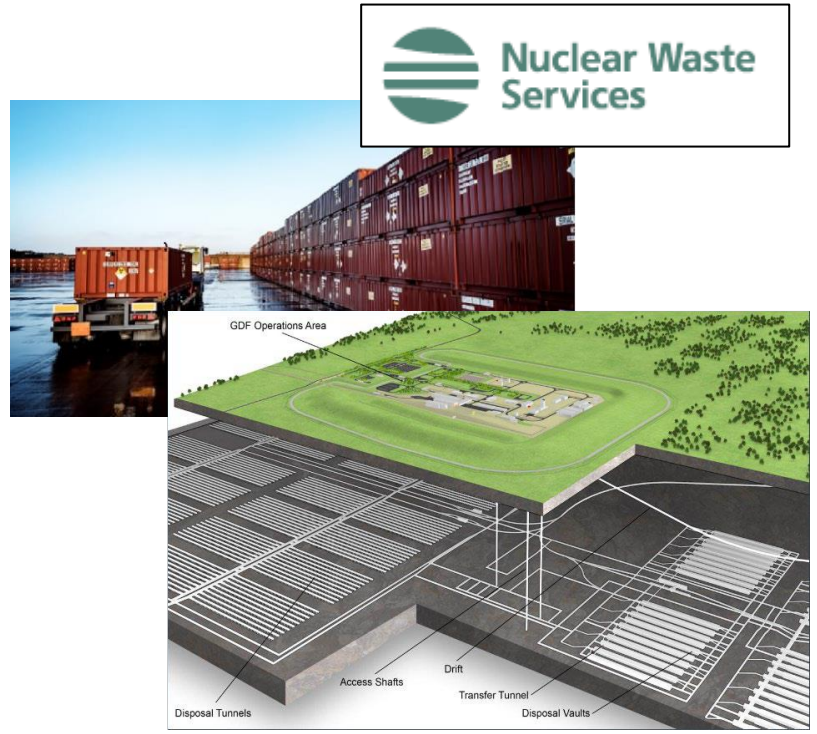
Regulators & Government

- Establish policy and framework
- Produce guidance



Repository operators

- Set Waste Acceptance Criteria (WAC)
- Assess suitability of wastes



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Regulatory approach

- Principle based, non-prescriptive regulatory framework
- Regulators set principles and operators must demonstrate how they will comply
- Allows flexibility, innovation and is technology neutral
- Key principle is optimisation to achieve ALARA through application of Best Available Techniques (BAT) and Waste Management Hierarchy (WMH)
- Regulatory effort is proportionate to hazard and risk
- Repository operators must be engaged and response will be scrutinised by the regulators
  - Nuclear Waste Services (NWS) provide staged level of scrutiny which allows designers/developers to engage as their designs mature
- UK Government requires operators to demonstrate can fund decommissioning and waste management
  - Future operator is responsible for interim storage until repository are available

Radioactive substances regulation (RSR): objective and principles - GOV.UK (www.gov.uk)

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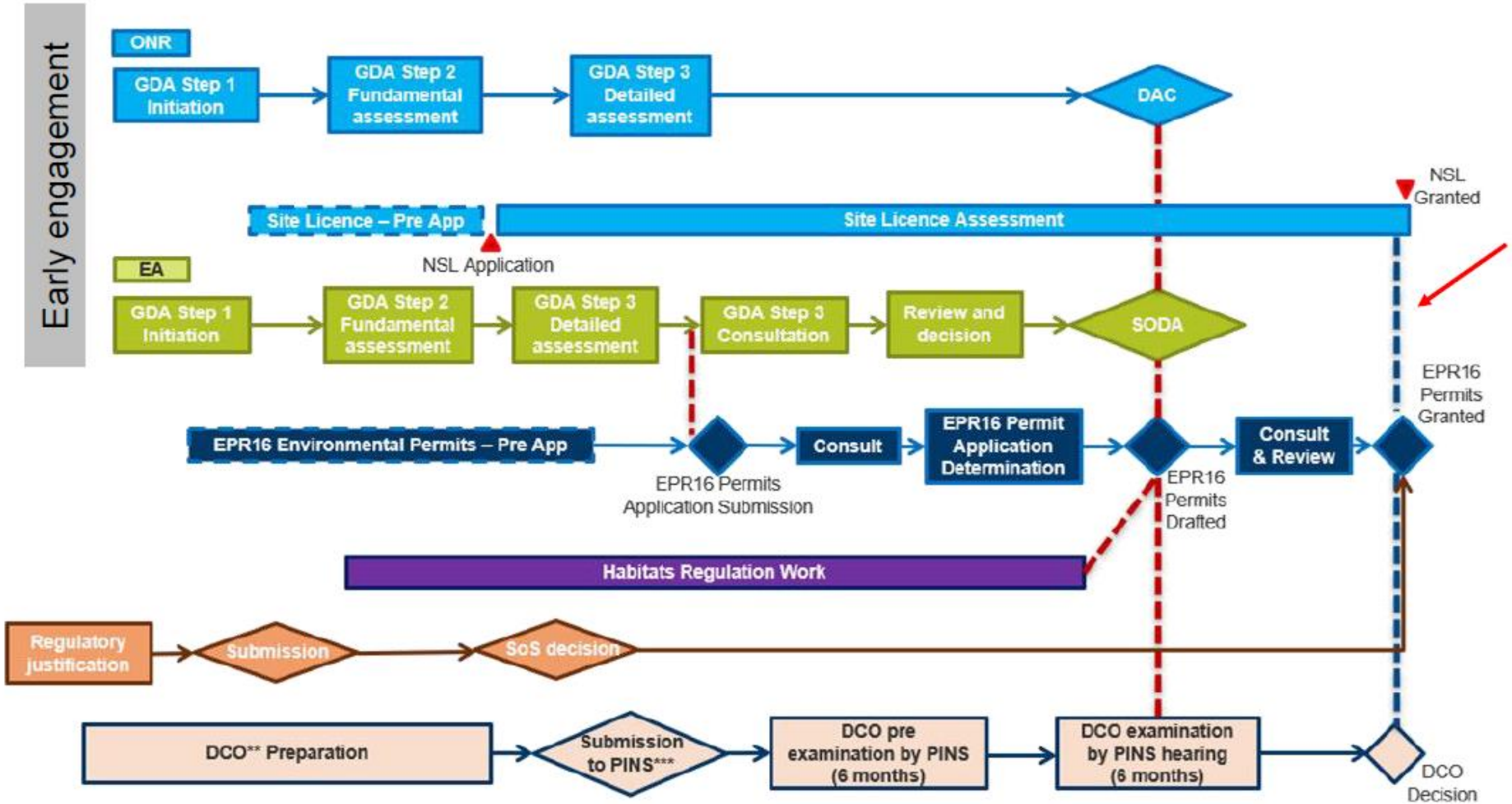
UK nuclear new build approval route



- ✓ Demonstrated approach is safe, secure and minimises impact to people and the environment
- ✓ Known waste volumes and inventories
- ✓ Credible disposal routes
- ✓ Interim storage
- ✓ Confidence from repository operators that wastes will be accepted
- ✓ Funded Decommissioning Plan

*Please note that there are also construction permits and marine licence applications.
**DCO – Development Consent Order
***PINS – Planning Inspectorate

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UK legacy graphite waste inventory

Magnox, AGR and research reactors:

- UK has predominately used graphite reactors for research and power production
- All Magnox and research reactors are shutdown, all operating AGRs will be shutdown in 2030s
- Resulted in a significant graphite legacy
- Majority of legacy graphite is stored within the de-fuelled reactors

DRAGON:

- Prototype high temperature helium cooled
- Project involving 13 countries
- Built 1960 – 1964
- Ceased operation: 1975
- Experimental operations and testing of TRISO fuel
- Being decommissioned and wastes being interim stored before final disposal
- Relatively small quantities of wastes – low burnup
- Useful learning for an HTGR fleet, but gaps remain

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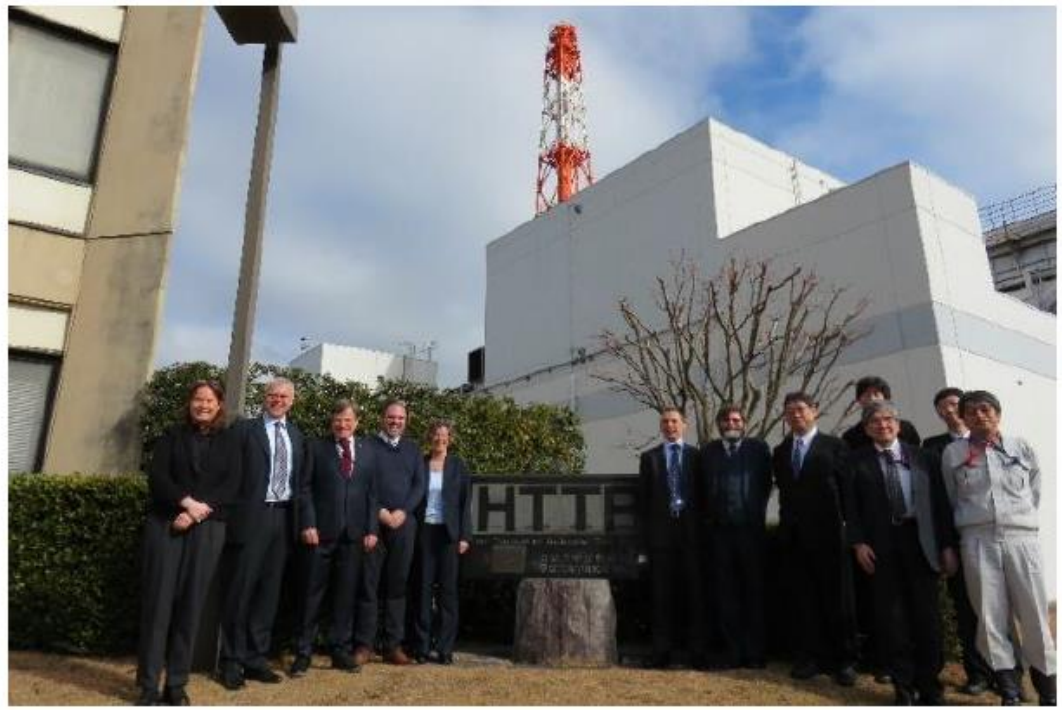
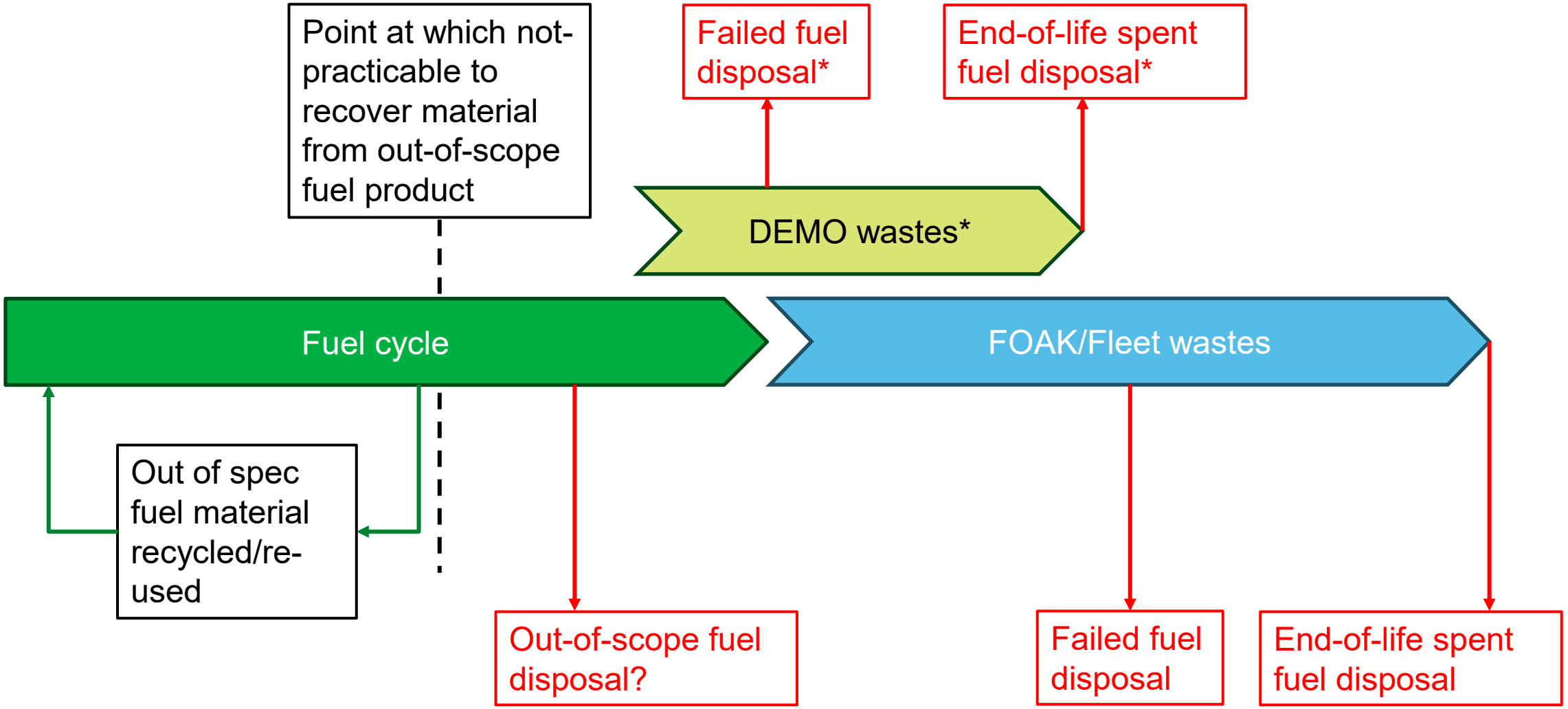
Advanced Modular Reactor Research, Development & Demonstration Programme

- **Phase A**: 2022-2023 funded 4 reactor and 2 fuel projects and to develop designs, £2.5m
- **Phase B**: 2023-2025 funding 2 reactor projects. Develop designs to Generic Design Assessment (GDA) level 2 design maturity, £31m
- **Coated Particle Fuel STEP 1**: 2023-2025 to develop CPF capability, £16m



Advanced Modular Reactor (AMR) Research, Development and Demonstration Programme: Phase B competition (closed to applications) - GOV.UK

Expected HTGR fuel waste arisings



*DEMO wastes may be different, e.g. lower/higher enrichment, to FOAK/Fleet

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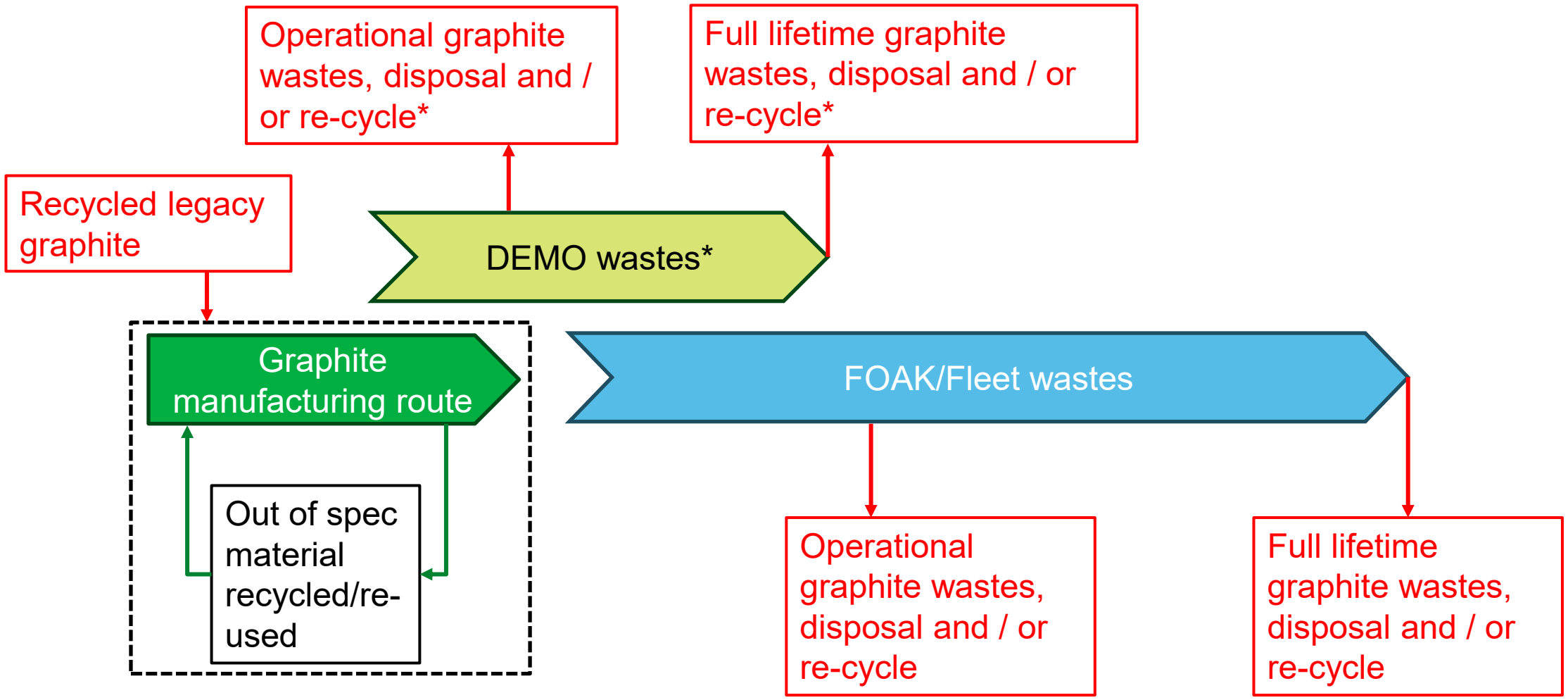
Expected HTGR graphite waste arisings



*DEMO wastes may be different, e.g. grade, dose, to FOAK/Fleet

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HTGR waste challenges

Novel wastes:

- No route yet for HTGR fuel & reactor graphite disposal in the UK, although similar legacy wastes
- Final fuel disposal form not know e.g. retain/remove block-graphite?
- Expect operational graphite wastes- must demonstrate as ALARA
- Potential re-use/recycle of legacy graphite and HTGR fuel and graphite
- Must demonstrate that there is a credible plan for future disposal of all wastes
- Must avoid wastes with no UK disposal route (i.e. problematic wastes)

Demo:

- Same principles applied to Demonstrator reactor, FOAK and fleet
- Recognise that Demo operator more likely to change material, operating environment etc
- Therefore, wastes produced may be more diverse, but likely smaller overall volumes
- No Demo specific guidance proposed, but UK regulatory approach allows flexibility
- For example, Demo operator may produce more waste per MW than fleet to generate OPEX

Failed fuel:

- ALARA/WMH seek to avoid failed fuel (and associated secondary wastes and potential releases)
- However, failed fuel is generated, managed and disposed of in the UK from existing reactors
- How will failed fuel be detected and managed in HTGR lifecycle?

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International engagement

- Engaging with international groups, IAEA, NEA etc and overseas regulators to share learning, influence standards and learn from others experience
- Where a design has been assessed elsewhere this could inform the UK regulatory assessment – may reduce time and effort
- May be possible to align assessment activities with other regulators- align expectations and guidance
- Opportunities will depend on regime, assessment undertaken and gap analysis between UK and other regime expectations

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