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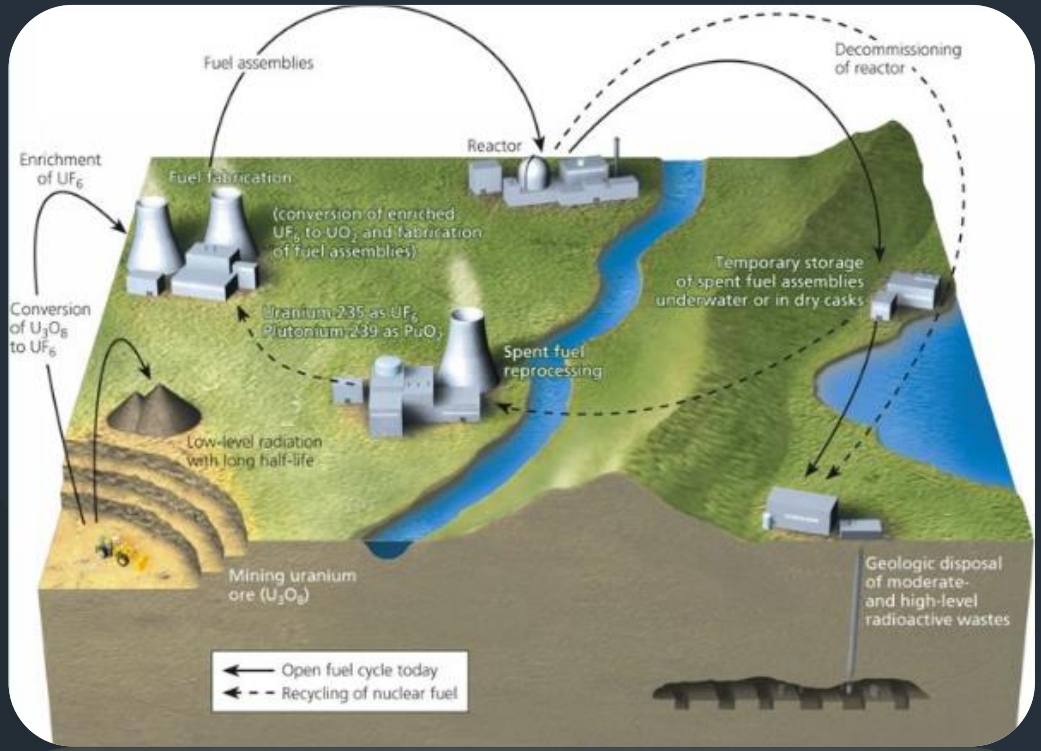
Nuclear Transport Solutions

Transport Considerations for SMR Fuel Cycle and TNPPs

George Burnett
Strategy and Security Advisor
Nuclear Transport Solutions, United Kingdom

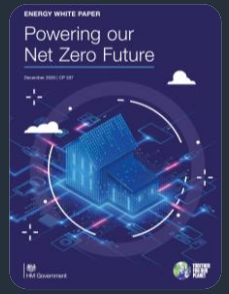
Nuclear Transport Overview



- Transport connects the nuclear fuel cycle
- Transport faces distinct challenges to that of a site
- Case by case approach is often necessary accounting for:
  - Safety
  - Security

UK Overview

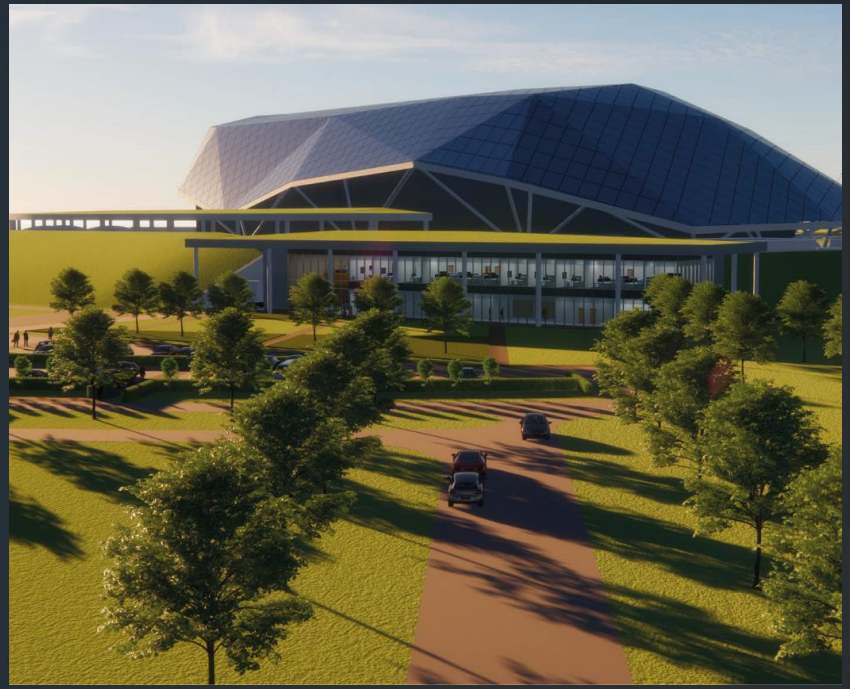
- Approval of 1 new reactor per year until 2030



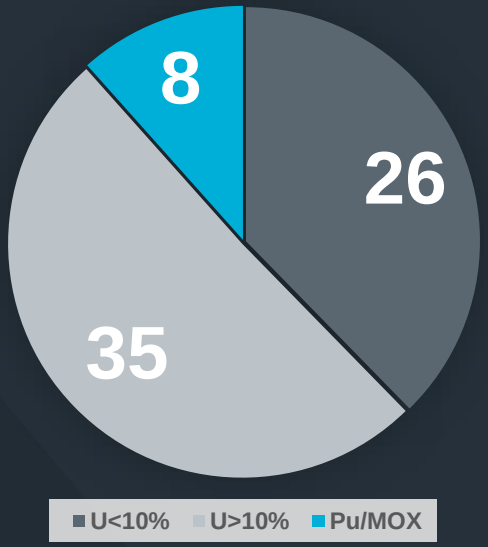
- UK SMR expected early 2030s

Power Output (MWe)	**470**
Fuel Type	UO2 pellet
Fuel Enrichment	4.95% (max)
Refuelling Cycle (months)	18-24

- Potentially more licensed sites across UK (UK SMR looking to deploy on previously licensed sites)



International insight from SMR fuel data…



*land based

Energy Well

- UO2 Triso (15%)
- **Spent fuel transported loaded in reactor container**

MicroURANUS

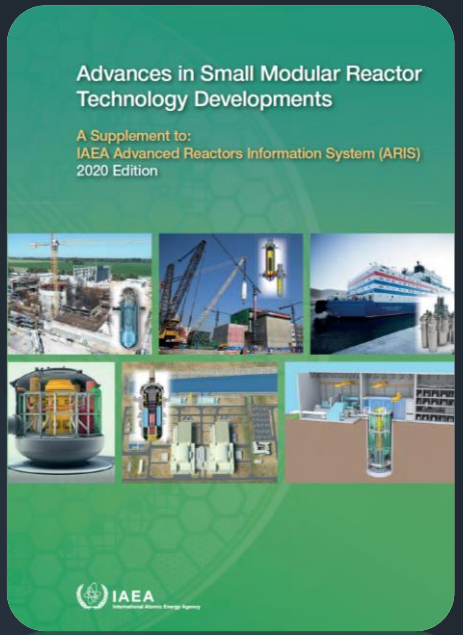
- UO2 (12%)
- **Transported encapsulated with spent fuel after lifecycle**

ELENA

- UO2 (15.2%) / MOX
- **Transported loaded with fuel**

eVinci

- UO2 Triso (up to 19.75%)
- **Module transported loaded with fuel**



Safety Approach - SMR Applicability

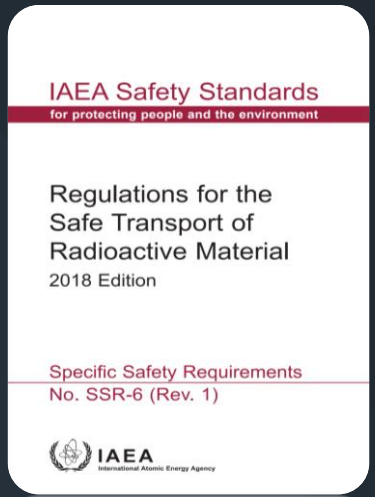
Assess the contents of SMR Spent Fuel i.e. <5% enriched UO_2, TRISO, HALEU etc.

Using the IAEA SSR-6 Regulations determine the type of package required, i.e. Type B package

Determine if a new package or repurposing of an existing package is required. This package requires a Package Design Safety Report (PDSR)

Package Design Safety Report (PDSR)

Licensing | Design and Analysis | Shielding | Criticality



Transport Security Approach - SMR Applicability

- Categorise material (type, form and quantity) adopt the Graded Approach.
- Sabotage considerations (especially for back-end)
- Incorporate Design Basis Threat (DBT) / Threat Assessment
- Implement Defence in Depth
- **<u>Remote transport and siting:</u>**

Deter → Detect → Delay → Respond

Delay Time > Response Time

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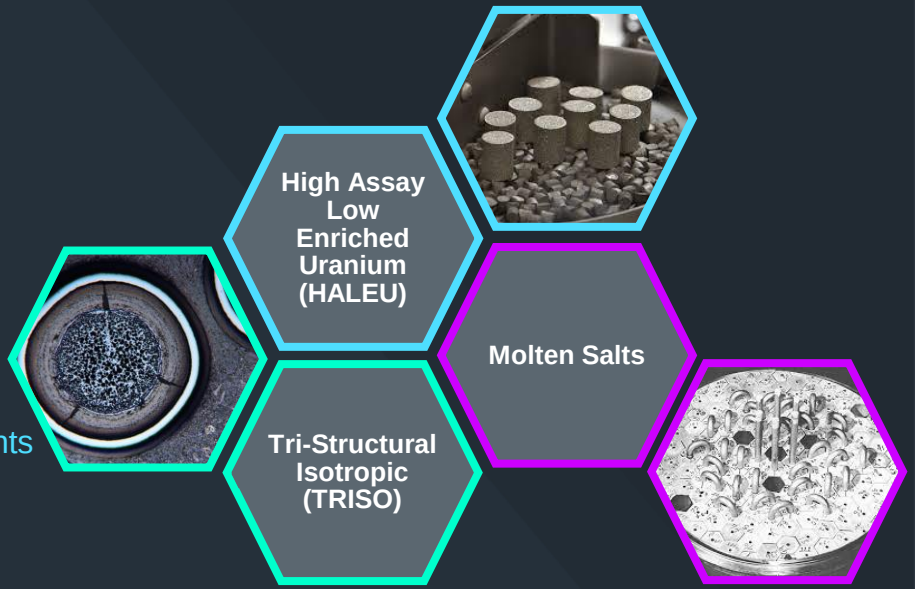
Transport Gaps

- Transport safety substantiation of fuel characteristics:
  - SSR-6 Normal Conditions of Transport
  - Accident Conditions of Transport
- Data availability
  - Package Design Safety Report requirements
  - Package availability unknown



- Inherent security characteristics? **Theft** vs **Sabotage**

How recoverable is the fissile material within the fuel type?

How attractive is this material to a malicious actor?

Potential to cause URCs?

How dispersible is this material?

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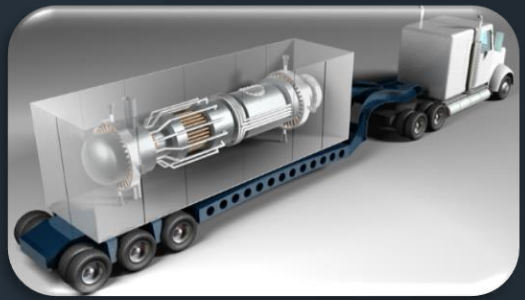
Transportable Nuclear Power Plants (TNPPs)

Safety	Security
Applicability of safety assurances designed in module (+25yr lifecycle)	Fissile content i.e. categorisation, drives security requirement
Assurances of subcriticality safety features in transport	Sabotage vulnerability (use of Vital Area Identification (VAI) analysis for transport)
Testing against Accident Conditions of Transport (ACTs) – SSR 6	International transports will need appropriate security handovers
Regulatory changes over the core lifecycle	
Type R licensing for land transport?	

Vs



Thank you.

George Burnett
Strategy and Security Advisor, Nuclear Transport Solutions
George.burnett@ntsglobal.uk