

Overview of BEIS Advanced Fuels National Programme

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Background to Advanced Nuclear Fuel National Programme

HM Government

Industrial strategy: government and industry in partnership

The UK's Nuclear Future



- UK Government's Nuclear Strategy was published in 2013
- Nuclear Innovation Research Advisory Board (NIRAB) established to advise Government on implementation of long term R&D programmes
- In 2016 NIRAB published reports on Recommendations (March) & Prioritisation (Nov). Fuels recognised as a key area.
- October 2016 – ITT's issued for National Programmes in a number of areas including Fuels, Reactors & Recycle
- June 2017 – NNL successfully awarded the Advanced Nuclear Fuel and the Recycle programmes

UK Nuclear Fuels Reputation

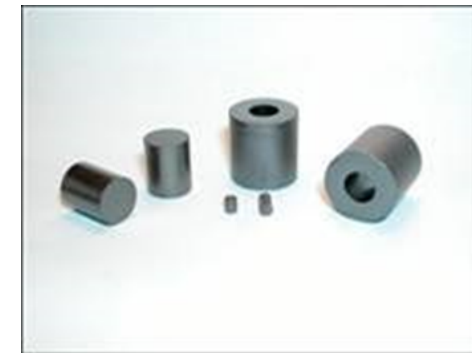
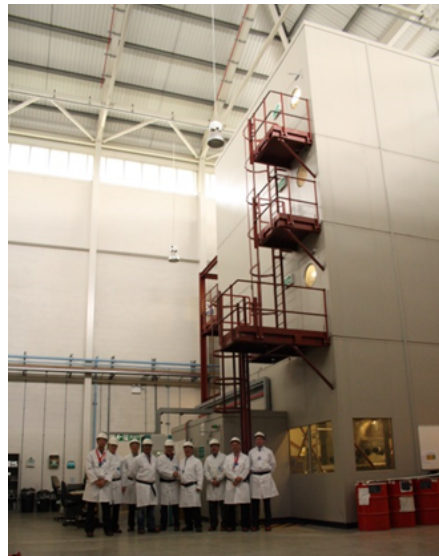


Magnox fuel elements



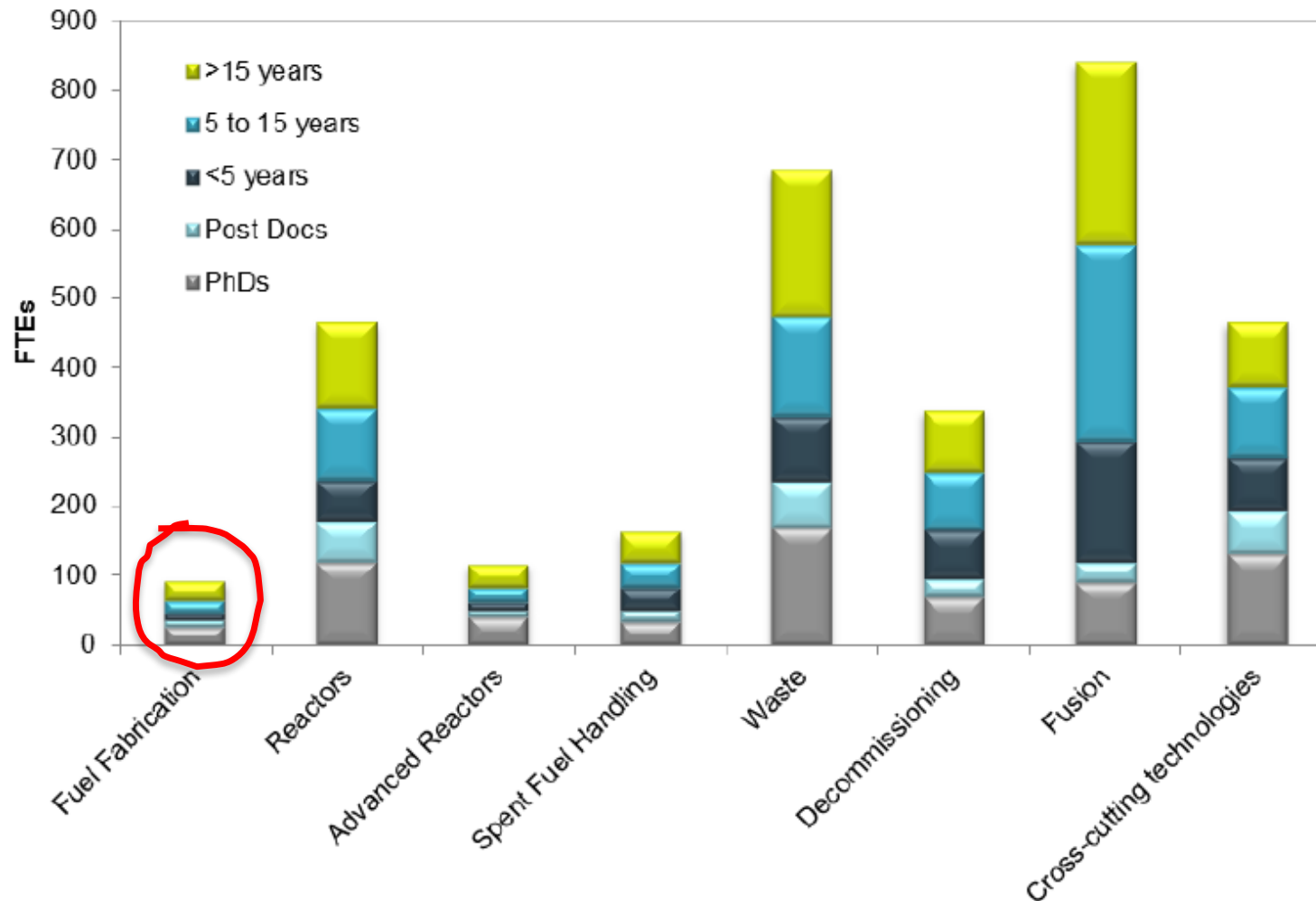
Integrated Dry Route Oxide Fuels at Springfields

Short Binderless
Route for MOX fuel



Fuel pellets for AGR and PWR

Civil Nuclear R&D Skill Base in 2015/6



Taken from “The UK Civil Nuclear R&D Landscape Survey”, Feb 2017

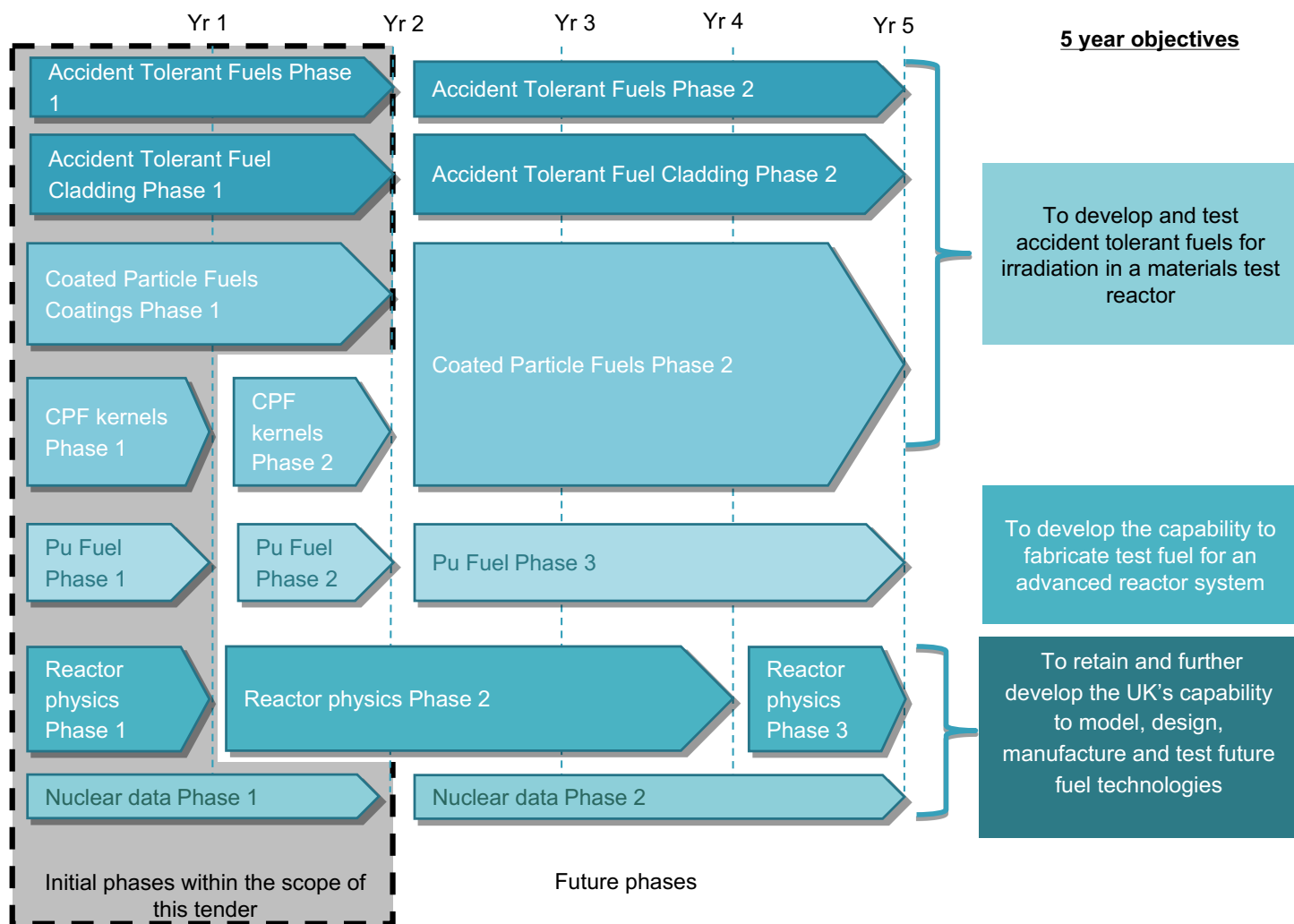
The overall aims are:

- By 2020 to have established a strong nuclear fuels R&D base that attracts international investment, supports retention of the UK's fuel manufacturing capability and underpins subsequent delivery of nuclear fuels to the domestic and international markets
- By 2030 for the UK to be engaged in national and international R&D programmes providing 'proof of concept' for future fuel cycles and reactors
- By 2050 for the UK to be supplying the fuel needs of Gen-III+ and any Gen-IV and small modular reactors (SMRs)

To deliver the following benefits:

- a UK capability and subject matter expertise in advanced nuclear fuels research
- international collaborations in accident tolerant fuel (ATF) development, fast reactor fuels and nuclear data development programmes
- establish the UK as a key contributor experience and world-class expertise in fuel fabrication
- industry co-investment in research programmes and subsequent industrial deployment

Advanced Nuclear Fuel programme



Task 1 - Accident Tolerant Fuel

Specific outputs :

- Small scale trials to develop manufacturing routes for high density fuels (uranium silicides and nitrides)
- Engagement with international programmes to test fuels (from rodlets through to Lead Test Rods)
- Collaboration with fuel vendors to scale-up technology

Partners :

- University of Manchester
- University of Bristol
- Imperial College



U₃Si₂ pellet
fabricated at
NNL Preston
Lab.

Task 2 - Accident Tolerant Fuel Cladding

Specific outputs :

- Development of manufacturing and joining technologies for ATF cladding options
 - (1) Coated Zr alloys (focusing on metallic coatings e.g. Cr)
 - (2) SiC-SiC composites (focusing on joining technologies)
- Testing of ATF cladding under normal PWR/BWR coolant conditions and also high temperature steam
- Use of DCF to subject samples to ion beam/gamma irradiation
- Collaborations with international partners (e.g. Il Trovatore) and fuel vendors leading to test irradiations



Cr-coated Zr alloy



SiC-SiC composite

Partners :

- University of Manchester
- Manchester Metropolitan University
- Amec Foster Wheeler
- Nuclear Advanced Manufacturing Research Centre

Task 3 – Coated Particle Fuels

Specific outputs :

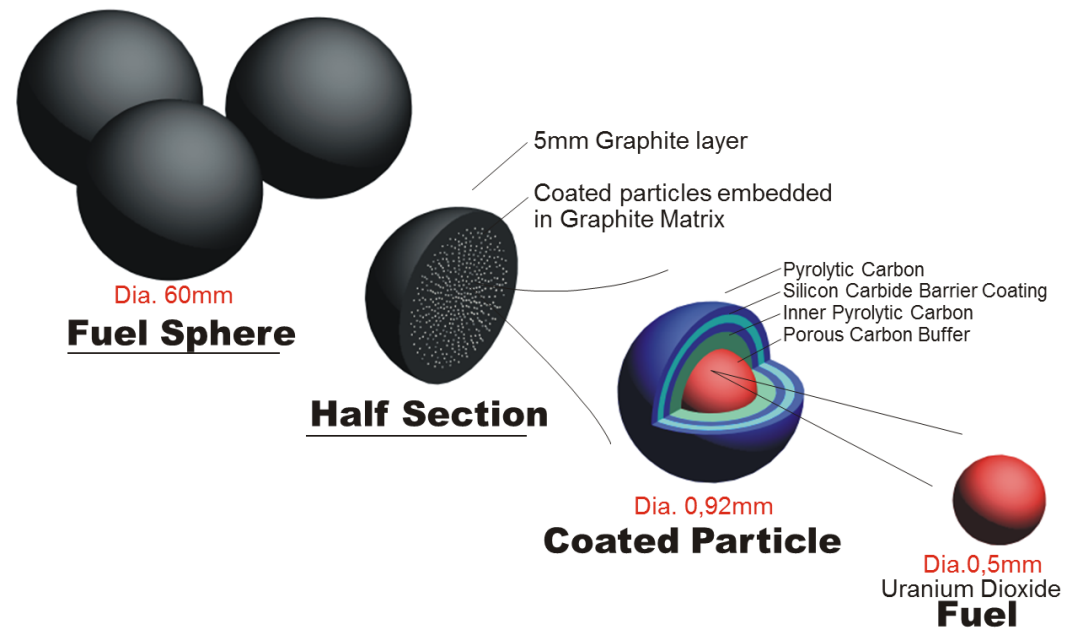
- Review of UK capability for manufacture of coated particle fuels
- Produce costed recommendations for Phase 2 programme to re-establish a capability for CPF production including both kernel and coatings

Partners :

- University of Manchester



Kernel production rig at
NNL Preston Lab.



Task 4 – Pu Fuels

Specific outputs :

- Develop a strategy to procure, install and commission the equipment necessary to establish a UK capability for fast reactor Pu fuels
- Ensure synergy with NDA plans for Pu disposition programmes

Partners :

- University of Leicester

MOX fuel line at
NNL Central Lab.



Tasks 5 – Reactor Physics Modelling

Specific outputs :

- Requirements capture exercise for advanced physics modelling needed to analyse advanced reactor types that may be deployed within the UK
- Costed plan for the development of one or more models for advanced reactors / fuels to be incorporated into a whole reactor modelling capability which integrates new fuel and core models with thermal hydraulics models
- One or more preliminary reactor models developed as far as practicable using existing tools

Partners :

- Amec Foster Wheeler
- University of Manchester
- Imperial College
- University of Liverpool

Tasks 6 – Nuclear Data

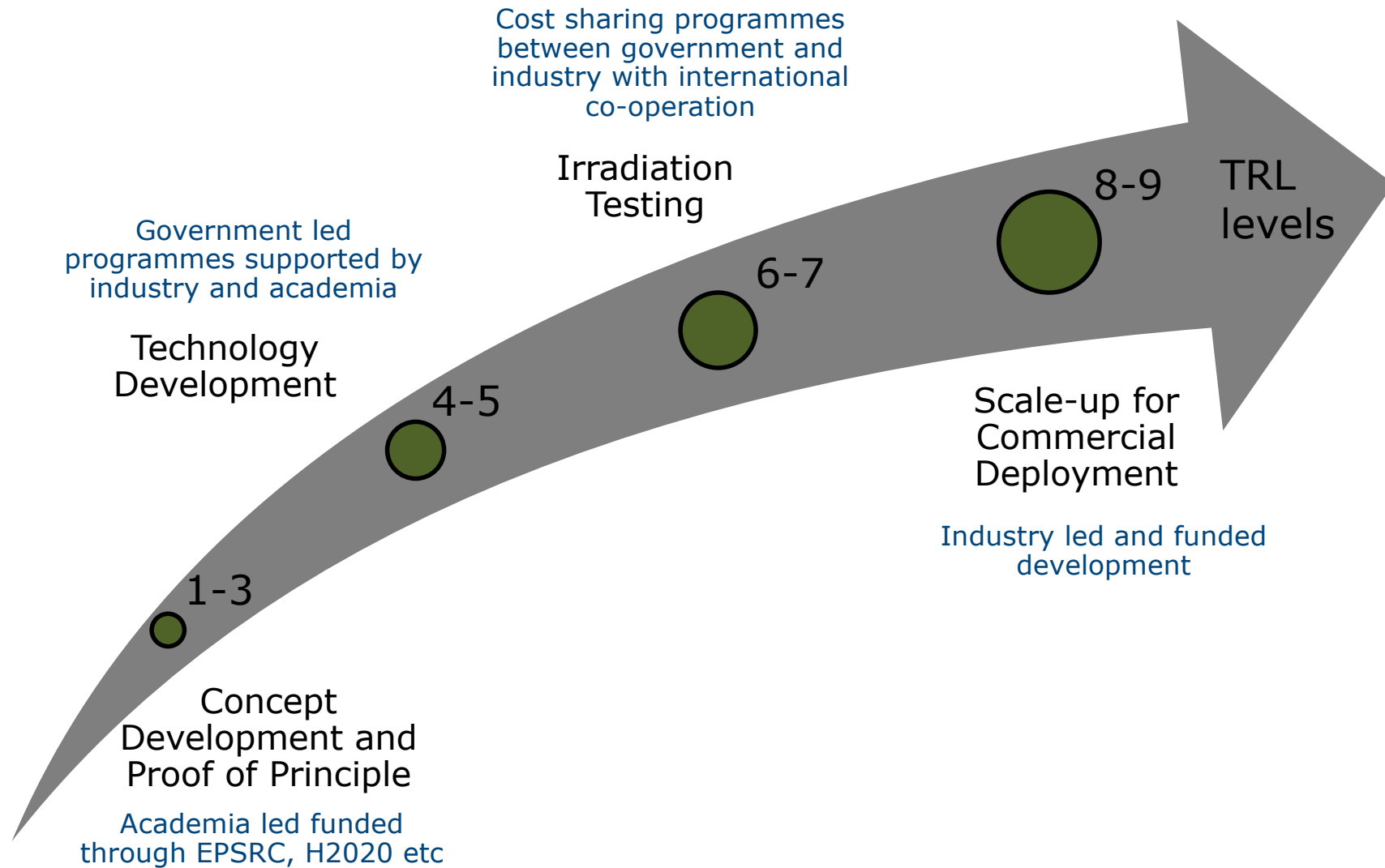
Specific outputs :

- Develop a strategy for the UK to re-engage with the international nuclear data community
- Identify gaps in the nuclear data required to develop advanced fuels or reactors
- Prioritise and justify UK needs for new nuclear data and ensure that these priorities are reflected in international programmes

Partners :

- Amec Foster Wheeler
- University of Manchester
- University of Surrey
- University of York
- Culham Centre for Fusion Energy
- National Physical Laboratory

Route to Market



NATIONAL NUCLEAR LABORATORY

