

Nuclear Engineering and Skills

Presentation to EPC Annual
Congress March 2007

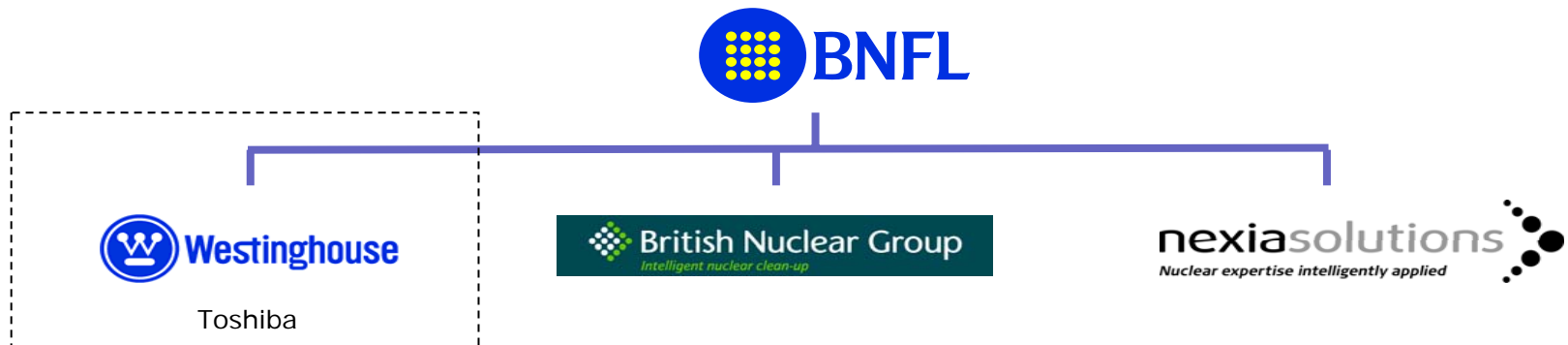
Dr Graham Fairhall

Scope

- Background to Nexia Solutions
- National Nuclear laboratory
- Academia and the nuclear industry
- Nuclear skills for sustainability
- Summary

Background to Nexia Solutions

- BNFL was restructured as a result of the formation of the Nuclear Decommissioning Authority (NDA) leading to the creation of holding company with three principal subsidiaries:



Nexia Solutions

- Approximately 750 staff
- Covers range of nuclear skills
 - Experimental
 - Modelling
 - Laboratory
 - Pilot plant
- Provides R&D services to UK nuclear industry, Government, Regulators and overseas

In the Safety spotlight

We operate in a heavily regulated high hazard industry. Success depends on a world class EH&S performance.

- Safety is everyone's business
- Zero Accidents and incidents target
- Encourage and reward
- Behavioural challenge
- Avoidance of loss through learning
- Engage the workforce

Nexia Solutions Committed to Excellence

- RoSPA Research and Development Sector Award
 - **Winners 2004, 2005, 2006**
- RoSPA Sir George Earle Trophy
 - **Nominated 2006**

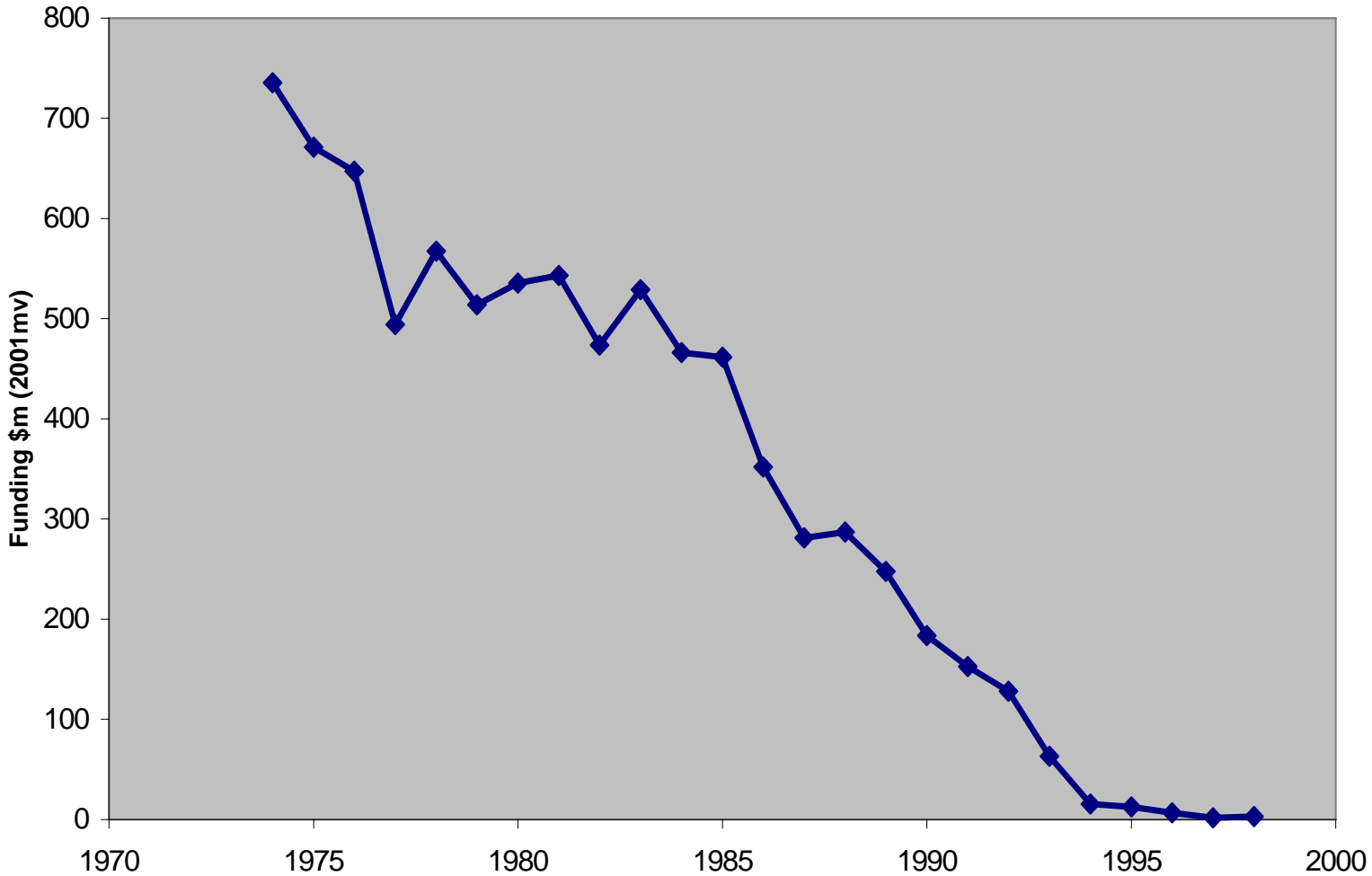


Certified to:

- ISO 14001 Environmental Management
- ISO 9001 Quality Management



UK Public Sector Nuclear Fission R&D Funding



Development of University Research Alliances

Radiochemistry

MANCHESTER
1824

Launched June
1999
University of
Manchester

**Particle
Technology**



Launched May
2000
University of
Leeds

**Waste
Immobilisation**



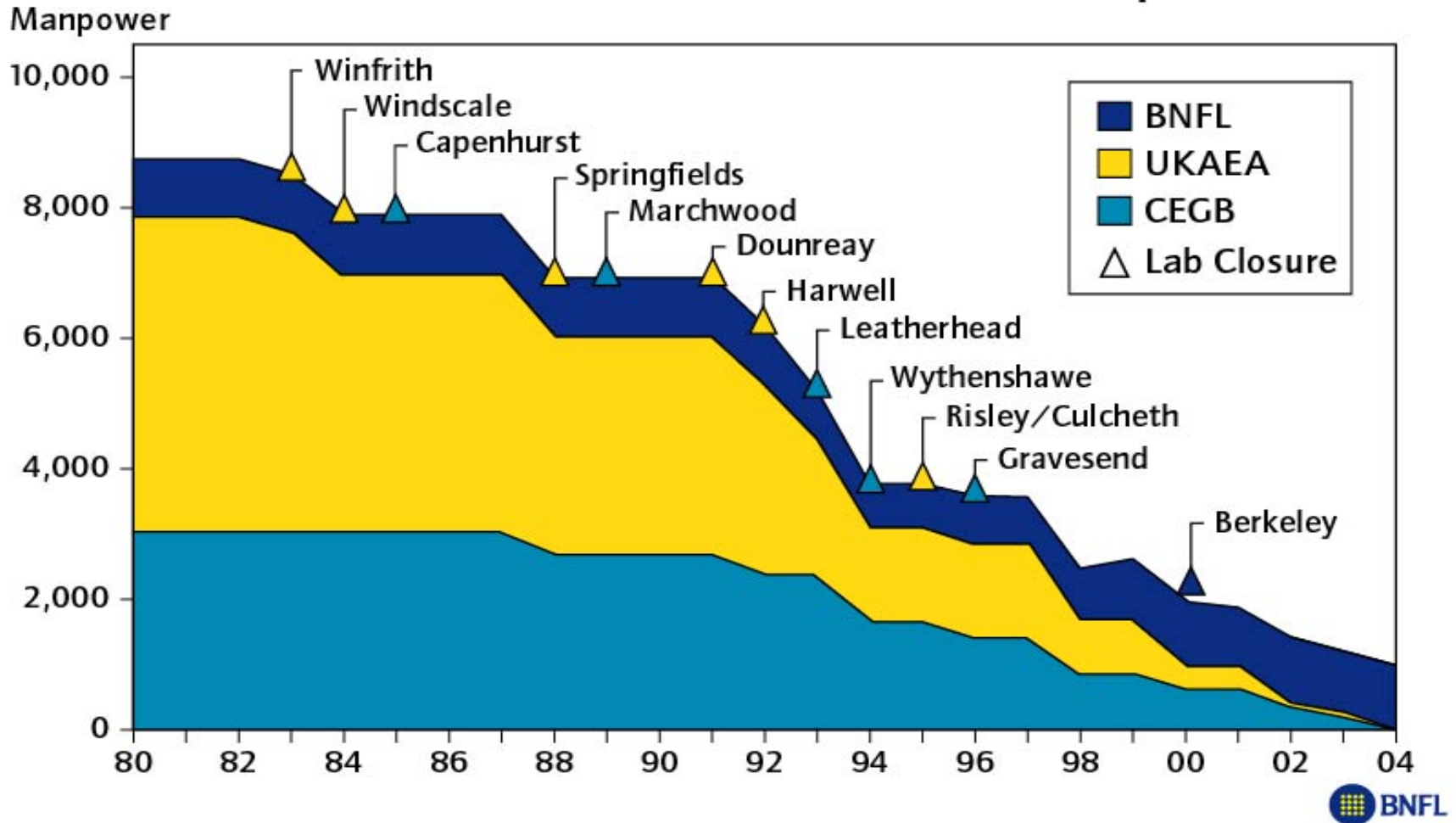
Launched Aug
2001
University of
Sheffield

**Materials
Performance**

MANCHESTER
1824

Launched Nov
2002
University of
Manchester

Best Estimate in Decline in UK R&D Manpower



UK National Nuclear Laboratory

Statement by Alistair Darling

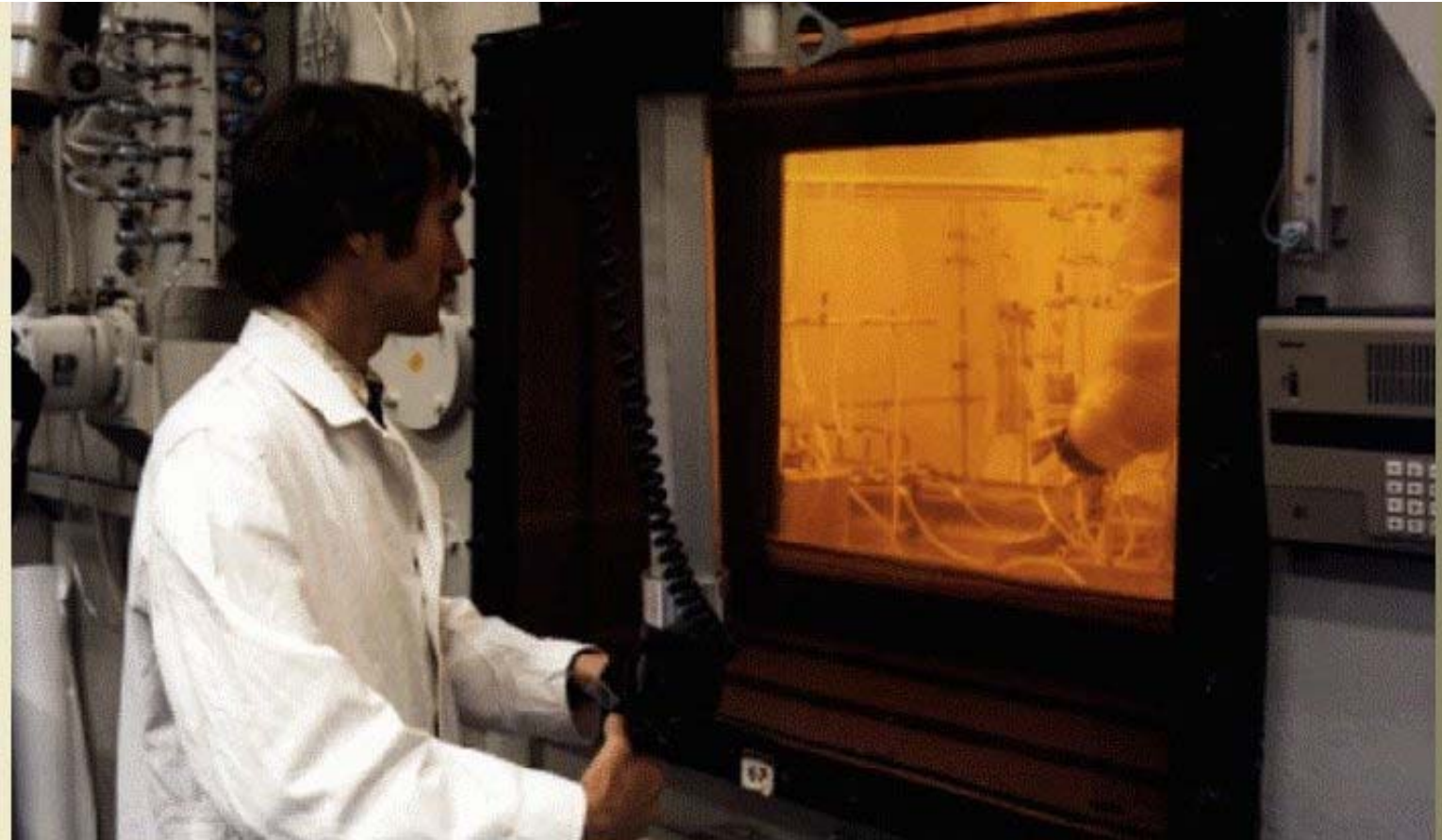
Secretary of State for Trade and Industry
24th October 2006:

“Ministers have also announced the intention to establish a new National Nuclear Laboratory, to be formed out of the British Technology Centre at Sellafield and Nexia Solutions, the research company currently owned by BNFL. The Laboratory will play a central part in safeguarding the necessary skills for the UK’s Civil nuclear industry.

British Technology Centre



Post Irradiation Examination Facility



UK National Nuclear Laboratory

Nexia Solutions will be the foundation of the UK NNL

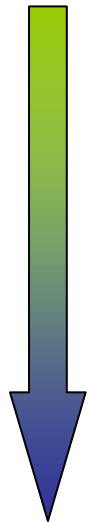
- Will safeguard and develop the key nuclear technology skills not reliably supplied by the marketplace
- Operate world class facilities
- Lead/integrate strategic technology programmes
- Support technology needs (customers/national/international)
- Apply results to deliver benefits to customers and society
- Trusted technical advice to Government
- Collaborate nationally/internationally with industry/academia/ other NNLs to lever investment and knowledge
- Socio-economic focus

Universities and the Nuclear Industry

- Importance of undergraduate and postgraduate education and training
- NTEC / Engineering Doctorate schemes
- University Alliances
 - Nexia Solutions
 - British Energy etc
- NNL links to Universities
- Skills pipeline concept
- Access to NNL facilities for collaborative research

Seamless Team – Example Materials

**PRIMARILY
NON ACTIVE**



**ACTIVE &
CONTAMINATED
MATERIAL**

Underpinning Science
e.g. diffusion of atomic species in
nuclear materials
Initially strongly academically biased
but with clear path to the application



Specific to a key degradation mechanism
e.g. developing a mechanistic model of
environmentally assisted cracking



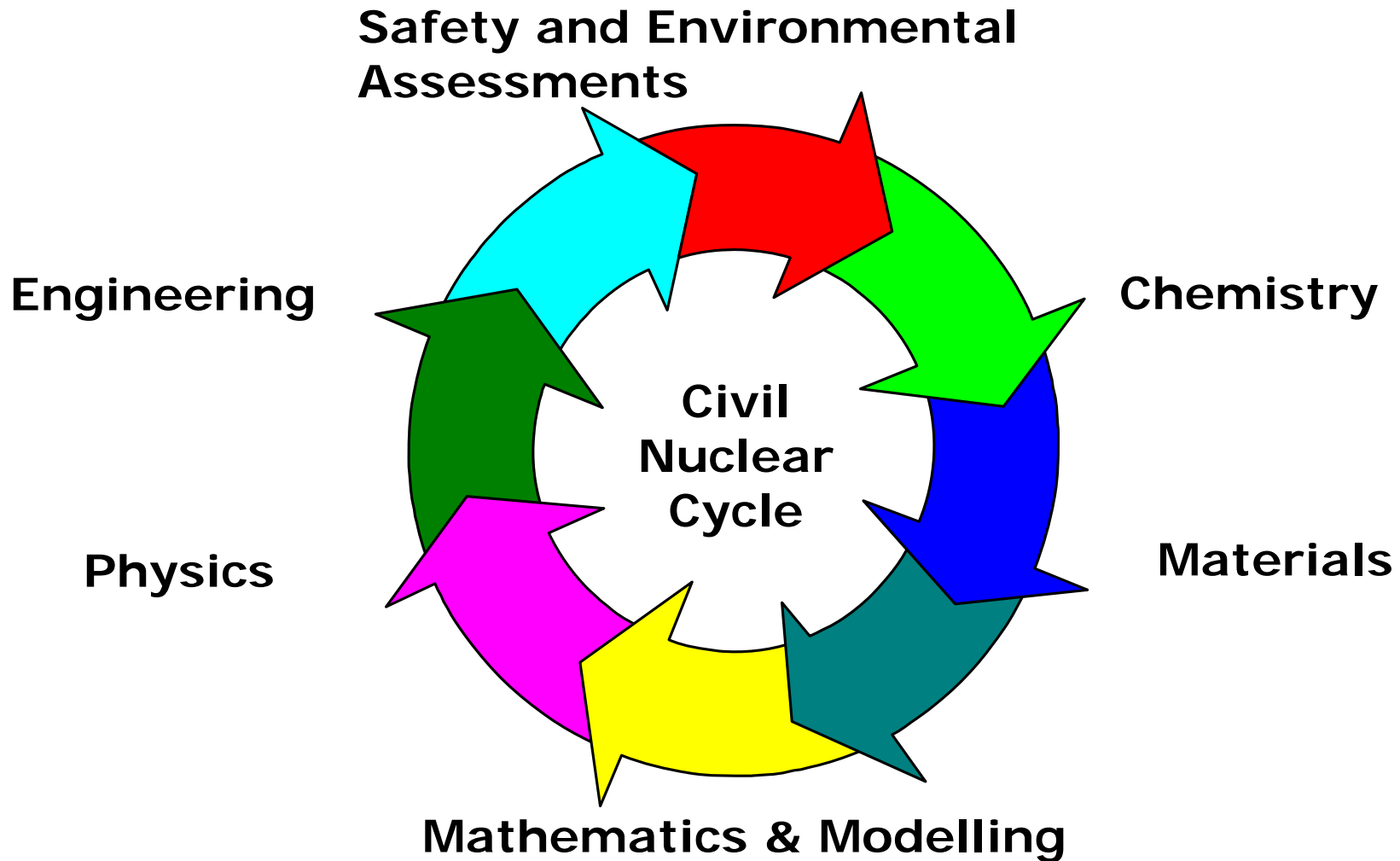
Application orientated project
e.g. specific aspect of reactor pressure
embrittlement relevant to a given customer
Led by Nexia but making use
of academic expertise

**ACADEMIC
LED**

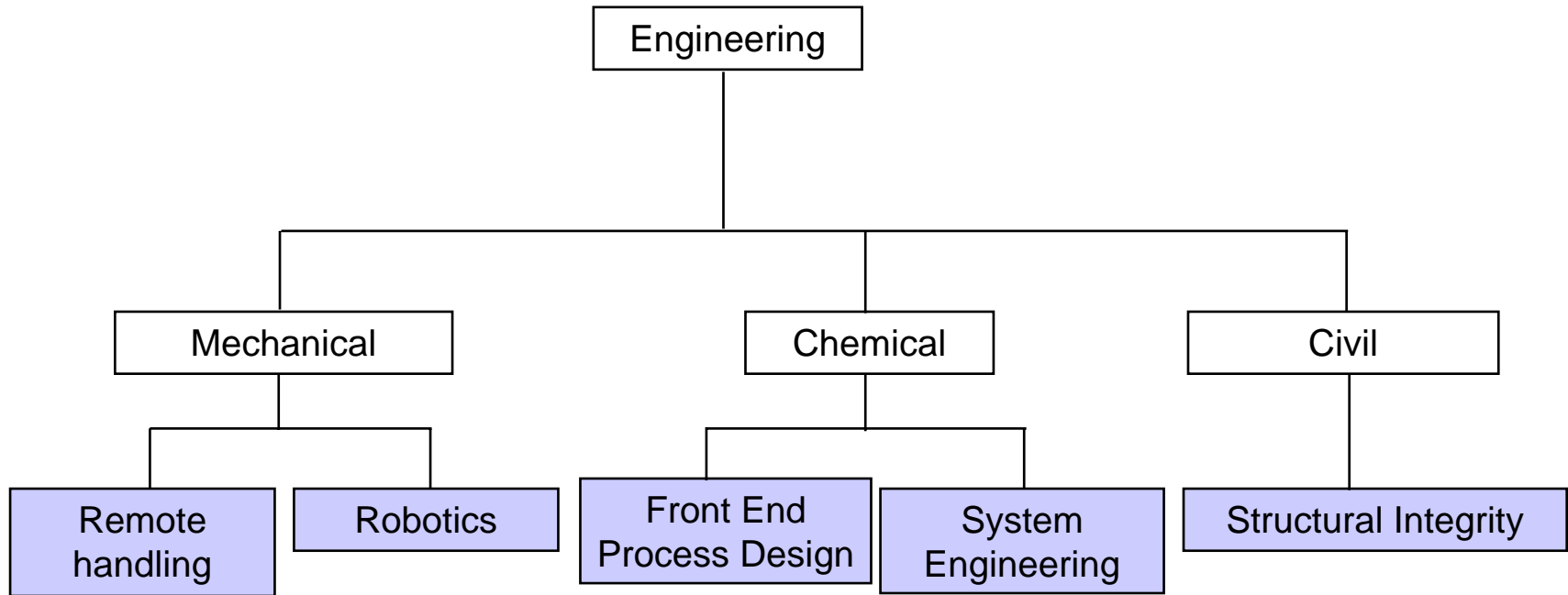


**NEXIA
LED**

Nuclear Capabilities



Examples of Nuclear Engineering capability



Generations of nuclear energy systems

Generation I



Early Prototype Reactors

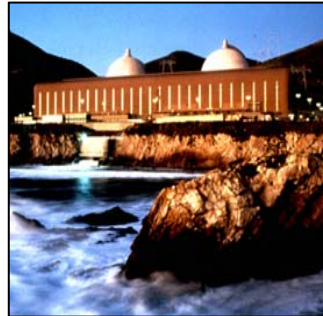


- Magnox
- Shippingport
- Dresden

Generation II



Commercial Power Reactors



- LWRs: PWR, BWR
- CANDU
- AGR

Generation III



Advanced LWRs



- ABWR
- AP600/AP1000
- EPR

Generation III+



Evolutionary Designs

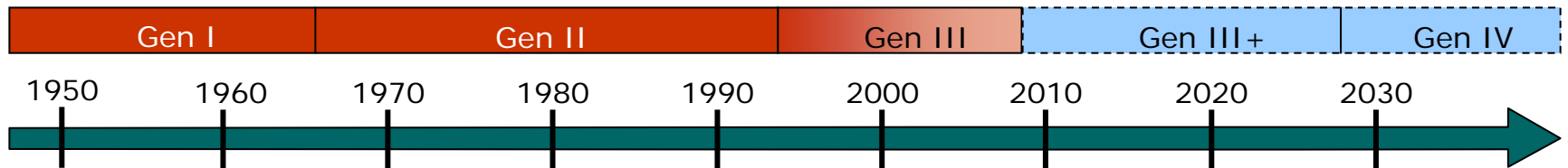


- PBMR
- IRIS

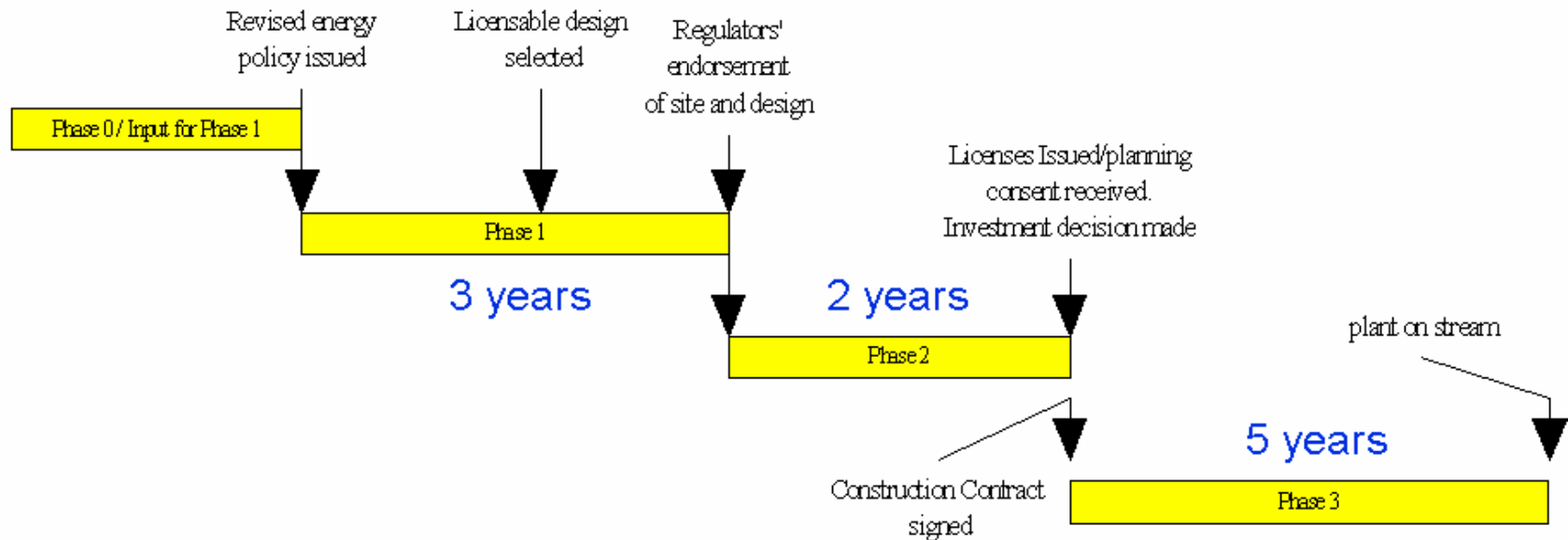
Generation IV



- Highly Economical
- Enhanced Safety
- Minimize Wastes
- Proliferation Resistant



Timeline for Replacement Nuclear Build



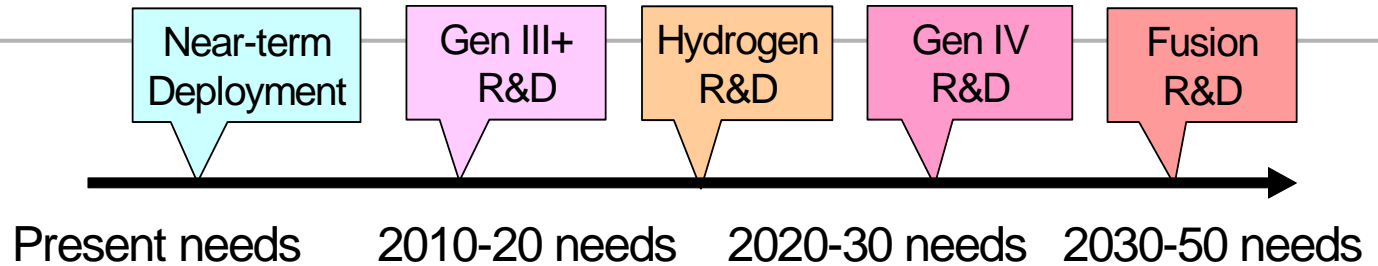
- Possible timeline for replacement new nuclear build in the UK.
- Key activities involve licensing in the UK of existing reactor technology
- Research is not required on advanced systems themselves.
- Research needed for UK to retain the critical skills required

R&D skills for New Build

- **If UK commits to new build R&D activities would be required to underpin licensing including:**
 - Safety Case Assessment
 - Performance Assessment
 - Socio-economic studies
 - Security & safeguards
 - Reactor systems information
 - Materials performance
 - Thermal Hydraulics
 - Nuclear physics / engineering
 - Waste Management

Technology Development

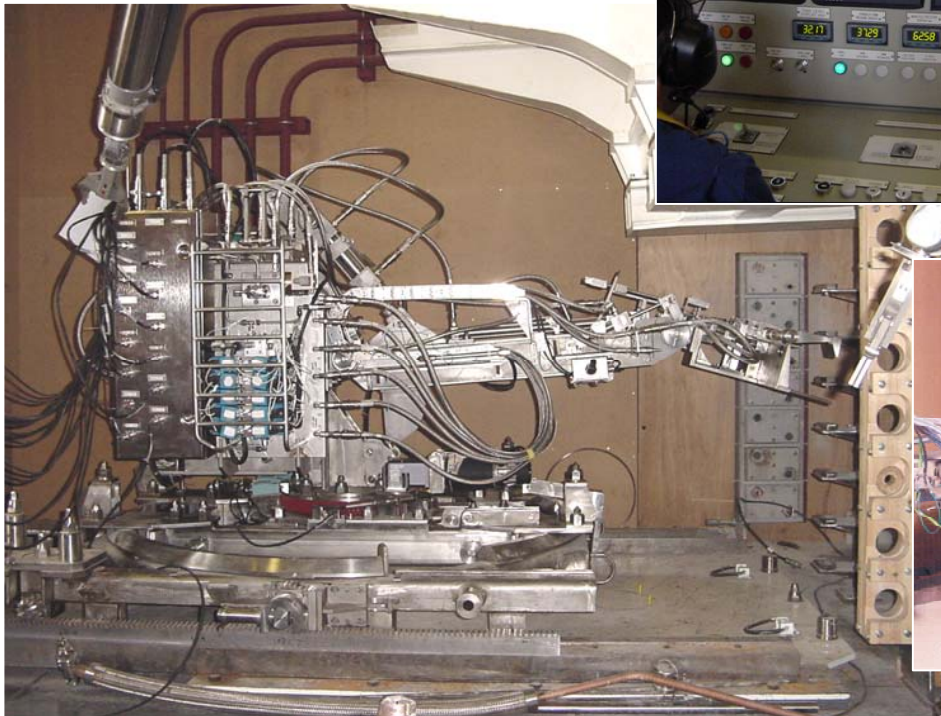
Timeline



Programme	Near-term Deployment	PBMR	IRIS	H2	VHTR	GFR	SFR
Fuels Research & Core Design	✓		✓		✓	✓	✓
Fuel Cycle					✓	✓	✓
Systems Engineering	✓	✓	✓	✓	✓	✓	✓
Materials	✓	✓	✓	✓	✓	✓	✓
Water Chemistry	✓		✓				
Thermal Hydraulics	✓		✓	✓	✓	✓	✓
Safety Performance	✓	✓	✓	✓	✓	✓	✓
Criticality & Shielding	✓		✓			✓	✓
Waste Disposal	✓	✓			✓	✓	✓
Regulation	✓	✓	✓	✓	✓	✓	✓
Socio-economic	✓	✓	✓	✓	✓	✓	✓
Economic / financial	✓	✓	✓	✓	✓	✓	✓

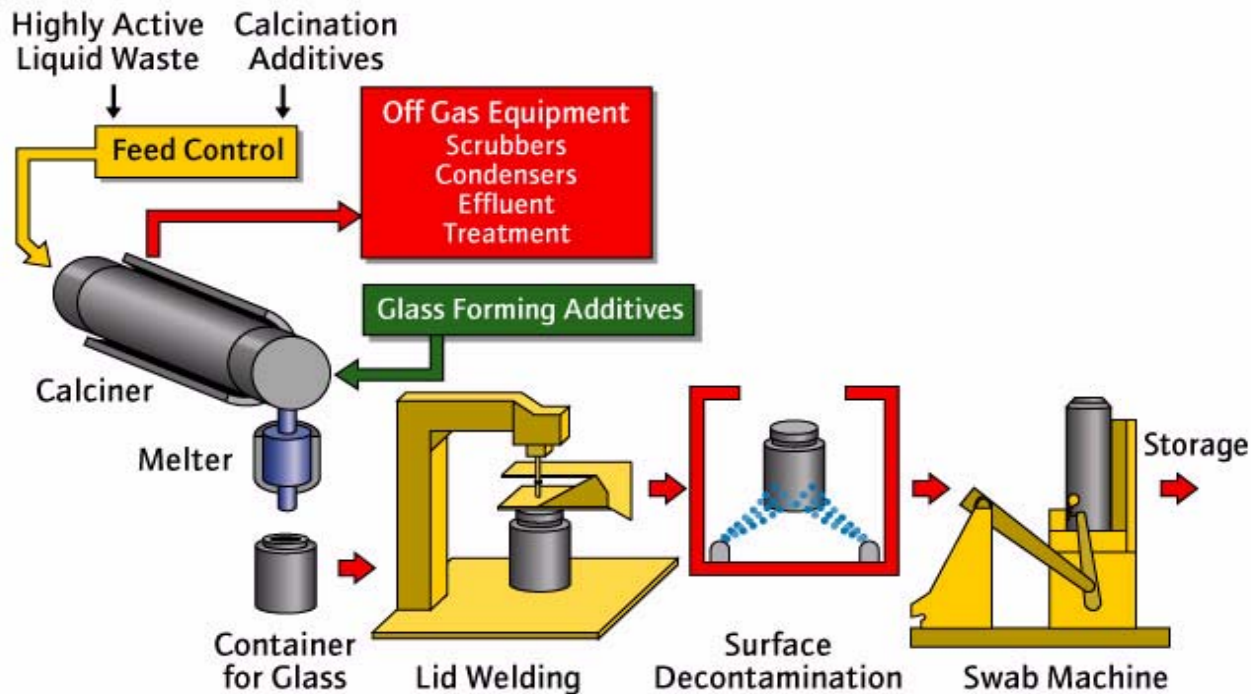


Melter Power Supplies



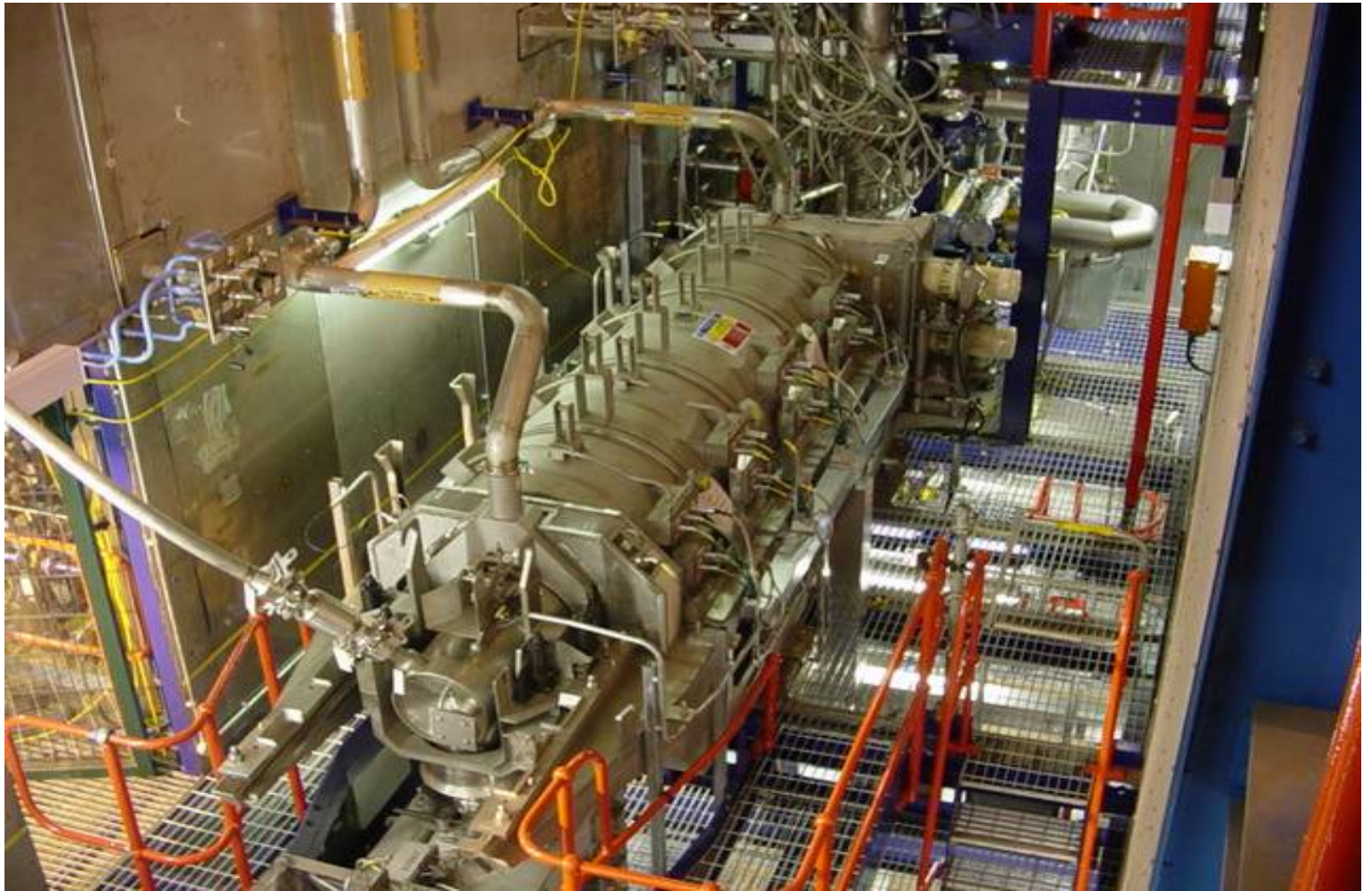
The Vitrification Process

Continuous Vitrification Process



FS1.14

Vitrification Test Rig



Summary

- Maintaining nuclear skills is essential to underpin the industry over next century
- Formation of NNL will provide foundation for skills development and protection
- Important role of University education and research to support nuclear sector