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NUCLEAR INNOVATION
AND RESEARCH OFFICE

Nuclear Research & Innovation - a Helicopter View

Simon Franklin, NIRO Director of Nuclear Innovation and Research
September 2022



NIRO

Nuclear Innovation & Research Office (NIRO)

Main activities

- Support to BEIS in management of the variety of funded R&D and enabling programmes
- Work with NIRAB to formulate advice to HMG on HTGRs
- Support to BEIS on technical aspects of nuclear policy
- Support to BEIS in response to Minister & parliamentary enquiries



How do we connect with nuclear academia ?

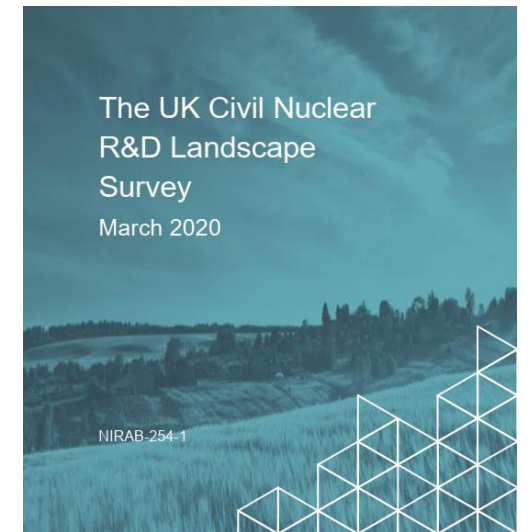
- **Facilitating national & international collaboration**

- GIF, OECD-NEA, Bilateral etc collaborations
- facilities strategy & promotion

- **Via BEIS**

- supporting BEIS activities in R&D
- technical monitoring
- supporting identifying priority areas in R&D

- **NIRAB membership**





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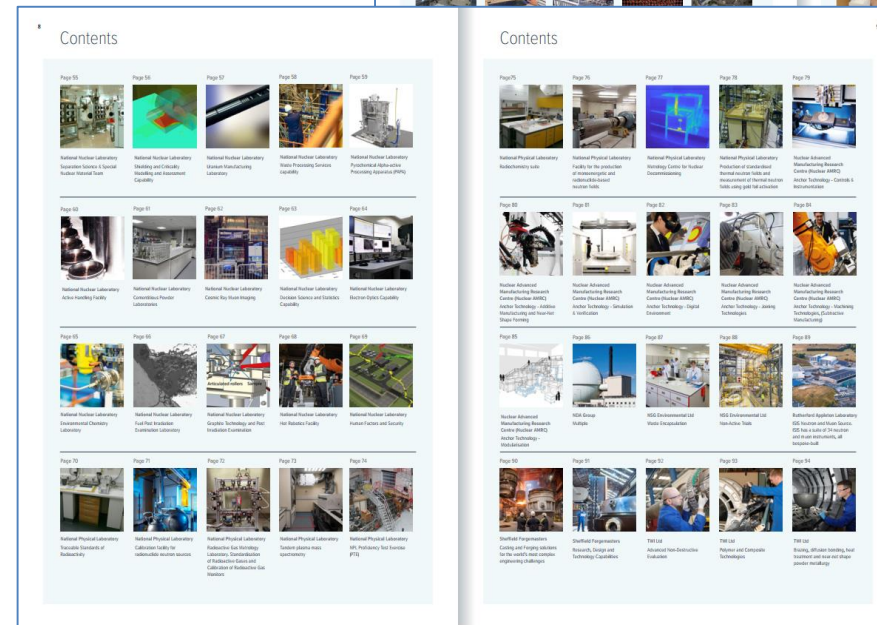
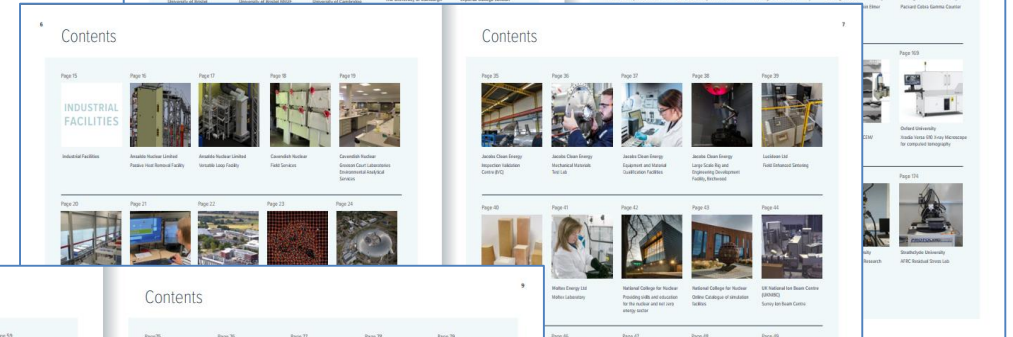
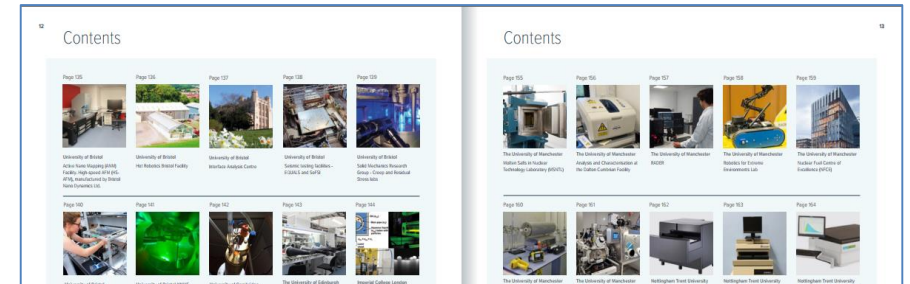


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UK Nuclear Fission R&D Catalogue:
Facilities, Equipment and Capabilities

SECOND EDITION - JULY 2022

Fission R&D Catalogue



https://www.nirab.org.uk/cdn/uploads/attachments/UK_Fission_RD_NIRO_CATALOGUE_ONLINE.pdf




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NUCLEAR INNOVATION
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Nuclear Innovation Programme Brochure

FIRST EDITION



Department for
Business, Energy
& Industrial Strategy

BEIS Nuclear Innovation Programme (NIP) Summary Brochure



NanoStructured Steels to Extend Operational Performance for Nuclear Reactors


Lead: The University of Sheffield

Project background

The major innovation in the project is adaptation of the state of the art laboratory conceptualised nanostructured steels towards industrial scale production. The main objectives of the project were:

1. Developing new nanostructured steels (NSS) that mitigate materials degradation and enhance operation under contained high temperature, corrosion and high irradiation environments, which are relevant to all energy sectors but particularly Generation IV and small modular nuclear reactors. The ultimate aim of the work is to develop a material with 30,000 hours creep lifetime at 650°C and 200 MPa and a 100,000 hours lifetime at 650°C and 150 MPa, which is twice the life in comparison with the same steel matrix without a strengthening nanostructure.
2. Developing and optimising manufacturing routes using advanced thermodynamic and thermomechanical processing modelling combined with state-of-the-art laboratory experimentation, enabling industrial production of NSS using existing industrial infrastructure.
3. Utilising advanced microstructure and mechanical property testing to develop a mechanistic understanding of the role of nanostructure in the material behaviour during manufacturing, and under simulated in-service environments (high temperature, irradiation, corrosion).

Organisations involved (Click on logo to view website)



Key outcomes from project

This project developed a new heat treatment strategy for a commercial alloy which resulted in superior mechanical properties with no difference in corrosion behaviour. Additionally, a new reduced activation alloy was developed with very good mechanical properties and corrosion behaviour, making it a likely possible candidate, with small changes to the existing chemistry, for use in fusion reactors.

The work has successfully demonstrated that the ferritic steel compositions (Jellyco 603 and 656) are viable competitors to the existing commercial grade P91, exhibiting higher levels of strength at room and elevated temperatures, albeit with a lower degree of stable ductility and impact fracture energy. The lower fracture energy, specifically the upper shelf energy is further complicated from a high amount of data scatter. This scatter in turn is directly related to the inhomogeneity associated with the alloy itself. This inhomogeneity has originated in the casting process, resulting in some alloy segregation which further elongates during the tempering process. Additionally, the lower fracture energy is also associated with a higher level of internal porosity, which often difficult to control in smaller castings. It is anticipated that improvements in fracture behaviour will result in these, or similar alloy compositions with larger scale castings and better steel development practices.

Key reports / presentations

No public documents released from this work

Key websites

Programme website:

Key project contact:

Name: For further information of this project please contact NIRO
Email: info@nirab.org.uk

Project Faith (Fuel Assembly Incorporating Thermal Hydraulics)

Lead: Cammell Laird


Project background

Project FAITH (Fuel Assembly Incorporating Thermal Hydraulics) builds on the FAIR Modules project. This created a roadmap for developing "plug and play" modules for nuclear plant in the UK. The aim for project FAITH is to show how modular builds can deliver solutions for new nuclear and address the roadmap developed during FAIR Modules.

In the development phase of the new nuclear reactor designs, the design of fuel assemblies must be optimised, with thermal hydraulics capable of testing fuel assemblies in the UK, project FAITH will deliver a solution capable for both water and sodium cooled reactors using modular designs.

The production of the rig will be a baseline for future projects and applications, with its strong transport integrity plan reducing cost of module commissioning and the use of cutting-edge technologies to monitor the health of rig in transportation and through-life.

Organisations involved (Click on logo to view website)



Key outcomes from project

Demonstrating, using the build of a thermal hydraulics rig, the effectiveness of off-site modular manufacturing.

The capturing and exploration of the technologies that are best applied to the nuclear industry.

Core Completed:

Shipbuilding Process Capture, Rig 1 design, Rig 1 production, Rig 1 Commissioning at Cammell Laird, Rig 1 Delivery, Rig 1 Commissioning at NN.

Auxiliary Completed:

Transport integrity plan and analysis, laser scanning, VR training

Outstanding: Rig 2 design, lessons learnt, final process capture

Key reports / presentations



Cammell Laird Collaborates with University of Liverpool to Keep Nuclear Energy Project On Track (Cammell Laird)

Key websites

News article: Virtual Engineering Centre
Cammell Laird Collaborates with University of Liverpool to Keep Nuclear Energy Project On Track
Cammell Laird (cammell-laird.co.uk)

Key project contact:

Name: Lorian Roberts
Email: l.roberts@cammell-laird.co.uk
Tel: 01747 087768

Manufacturing & Materials

Rig delivered to NN, Harington, UK, 8th March



Technology next steps

The design of Rig 2 a sodium rig, will be ready to go into a safety case and ultimately production in future work.

The process and technology aspects of this project should be applied to larger production projects and tested with repeatability, a larger rig or similar would be a suitable next step and test.

Other key project information

Phase 1	Phase 2
Investment BEIS: £750,072	Investment BEIS: £1,560,000 (70%)
Match Funding: N/A	Match Funding: £1,250,000
	Total: £7,400,000

Phase 1
Project Start Date: March 17
Completion Date: September 18

Phase 2
Project Start Date: June 19
Completion Date: January 22

Multiple collaboration events with NN/EC through NN.

- Specialised employees in different software's such as: 3D Inventor, AutoCAD, SolidWorks (scanning) & PDM review (virtual reality)
- 3 journal papers
- Used significant experience in structural & mechanical engineering to build rig.

Key project contact:

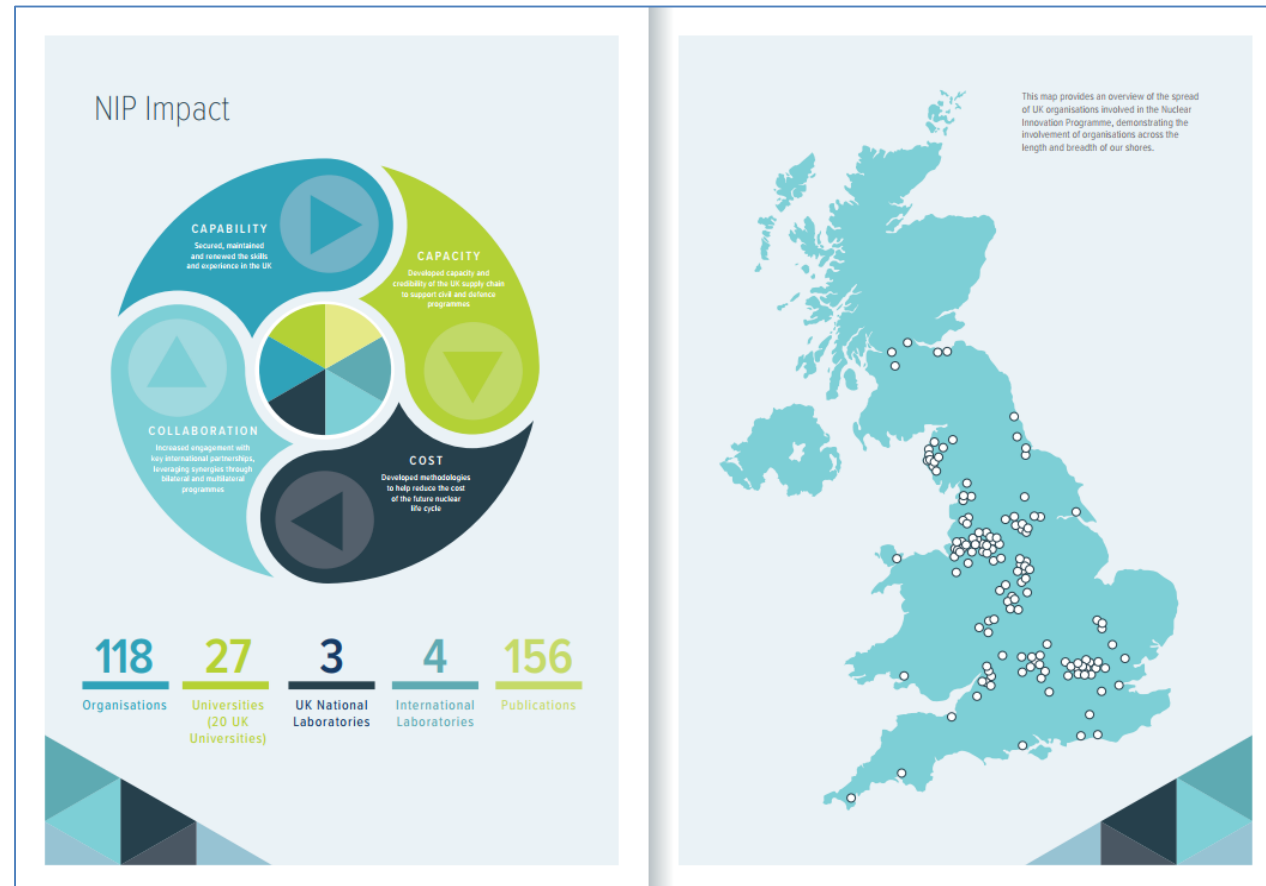
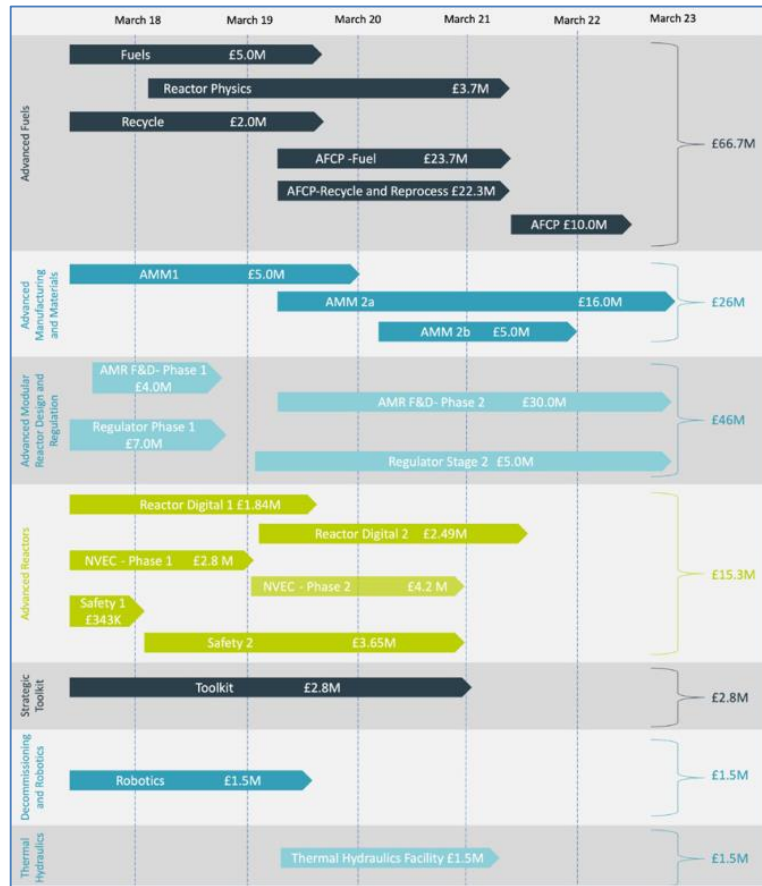
Name: Lorian Roberts
Email: l.roberts@cammell-laird.co.uk
Tel: 01747 087768



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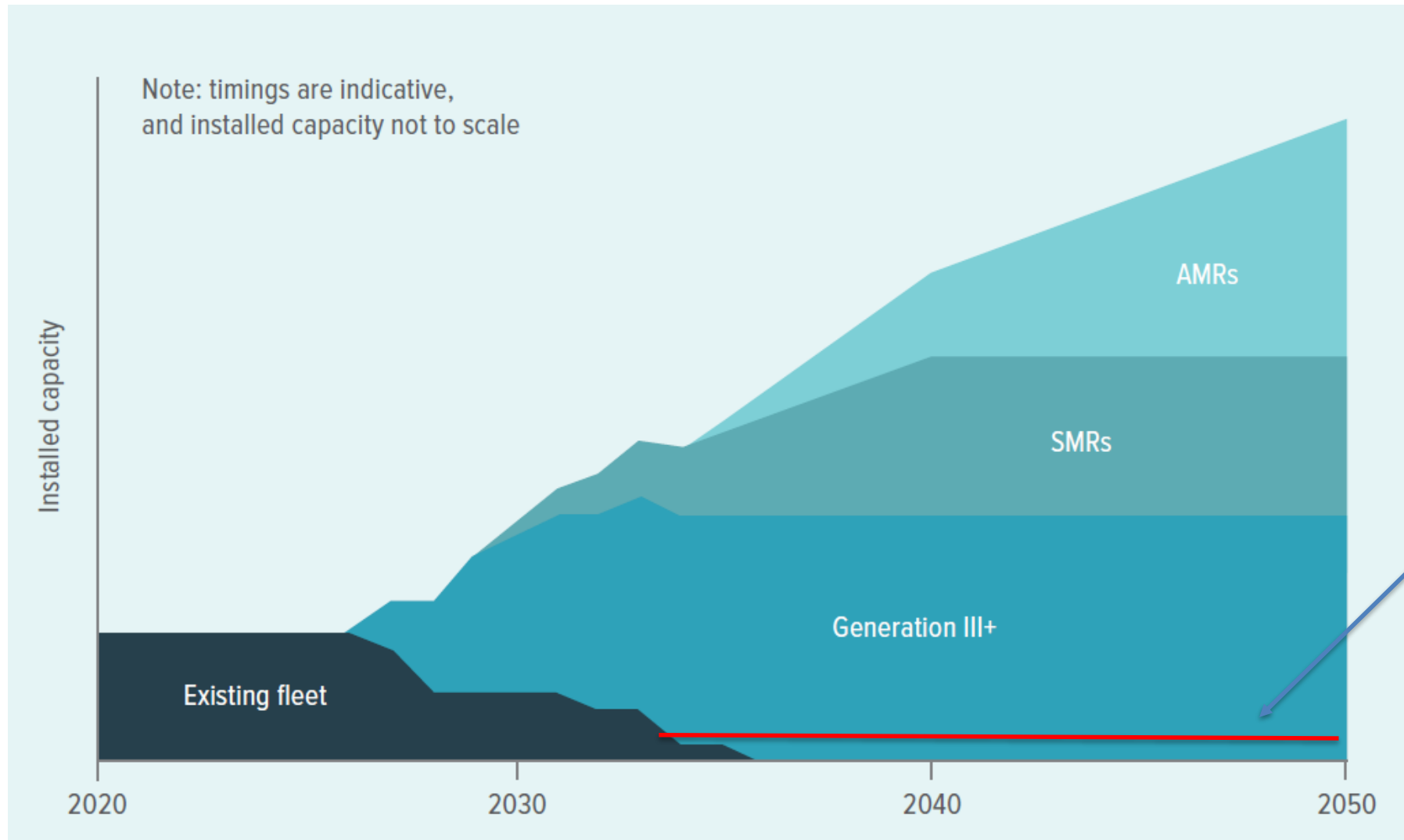
Nuclear Innovation Programme Brochure



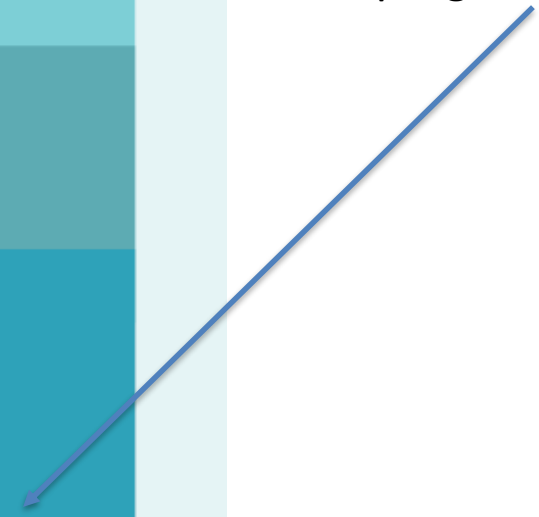
[Nuclear Innovation Programme Brochure.pdf \(nirab.org.uk\)](https://nirab.org.uk)

Department for
Business, Energy
& Industrial Strategy

The Future Nuclear Programme ?



No new nuclear
programmes



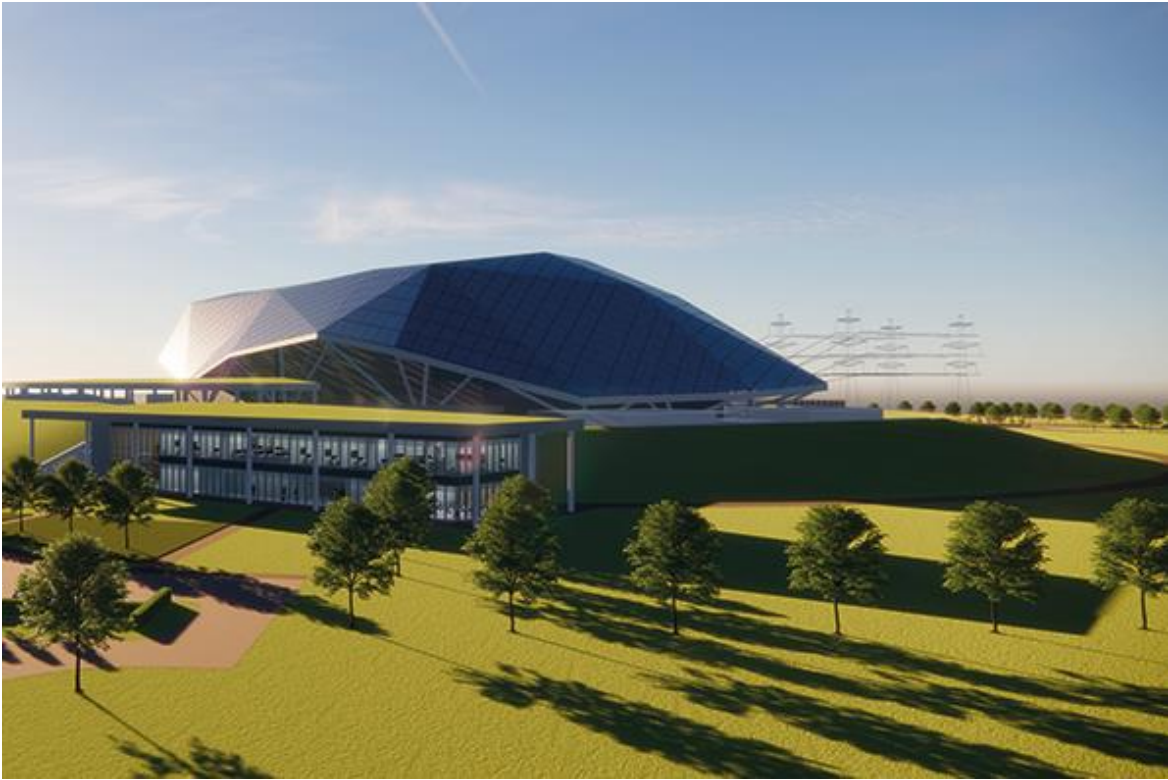
UK SMR funding and Progress

Small Modular Reactors (SMRs) are a type of nuclear reactor that are designed to be smaller, safer, and more flexible than traditional large-scale reactors. They are typically designed to be built in factories and then transported to the site, which can significantly reduce costs and construction time. SMRs are being developed by a variety of companies around the world, including Rolls-Royce, NuScale, and Westinghouse.

The UK government has committed to supporting the development of SMRs as part of its nuclear strategy. In 2019, the government announced that it would provide £1.2 billion in funding to support the development of SMRs. This funding is being used to support a variety of activities, including research and development, design, and construction.

One of the main challenges facing the development of SMRs is the need for a regulatory framework that is tailored to their unique characteristics. The UK government is currently working on developing a regulatory framework for SMRs, which is expected to be completed by 2025. This framework will provide a clear path for the development and deployment of SMRs in the UK.

The UK government is also supporting the development of SMRs through a variety of other measures. For example, it has established the Small Modular Reactor Development Fund, which provides funding for the development of SMRs. It has also established the Small Modular Reactor Design Competition, which is open to all UK-based companies. This competition is designed to encourage innovation and competition in the development of SMRs.



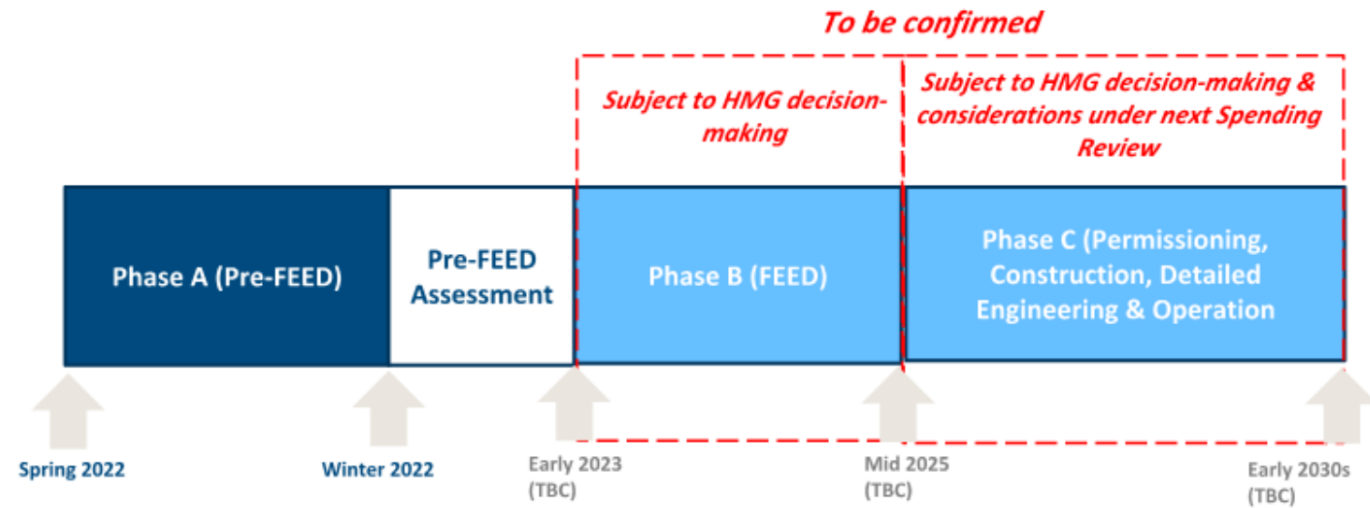
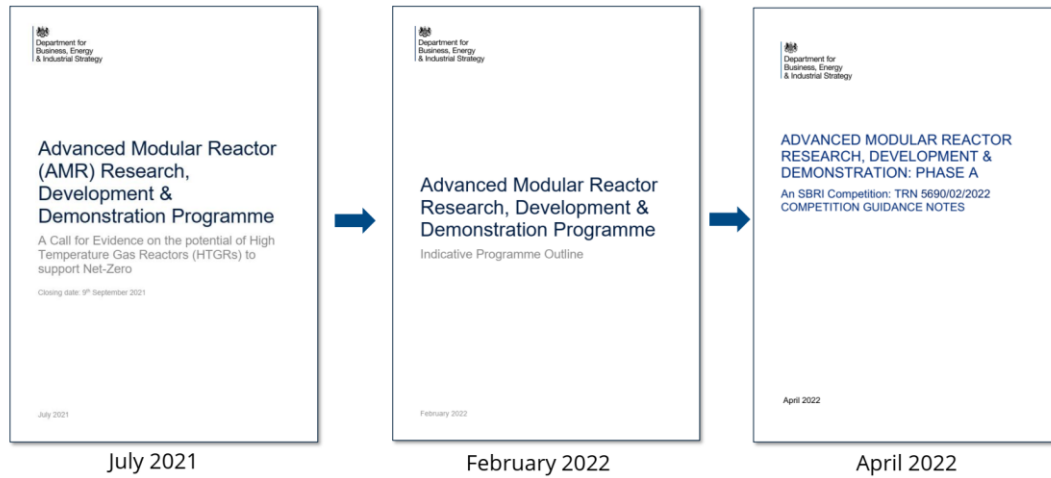
Rolls-Royce SMR design, credit: Rolls-Royce



**UK Research
and Innovation**

1. [Industrial Strategy Challenge Fund](#)

Current AMR R&DD Programme



How can we engage further ?

We all need to work together to provide nuclear energy security through innovation to meet net zero by 2050

We would love to hear from you !

Please email simon.franklin@niro.org.uk to inform NIRO R&D thinking

Example areas of interest we would like your feedback on include:

- **R&D priorities for the next 5-10 years ? R&D academic led vs commercially led ?**
- **Are there cross-sector innovations we might be missing ? What enablers you see ?**
- **What capability areas are more / less important ?**
- **What facility access concerns you have ? What funding challenges you have ?**
- **How could we improve our reports ?**
- **Would you support R&D landscape workshops?**





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Q&A

info@niro.org.uk

Fostering greater coordination of research across the sector

Drawing on the knowledge and experience of sectorial experts

Providing independent strategic and technical advice to Government that will de-risk investment, inform policy and enable maximum value for money to the UK taxpayer

Providing advice on opportunities for engaging with international partners

Supporting the growth of the wider nuclear R&D landscape, including the supply chain.