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Multilateral and Bilateral Nuclear Research Collaborations

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Multilaterals

- Generation IV International Forum (GIF)
- Second Framework for Irradiation Experiments (FIDES-II)
- Halden Human Technology Organisation (HTO)
- Jules Horowitz Reactor (JHR)

Bilaterals

- US-UK Nuclear Energy R&D Cooperative Action Plan

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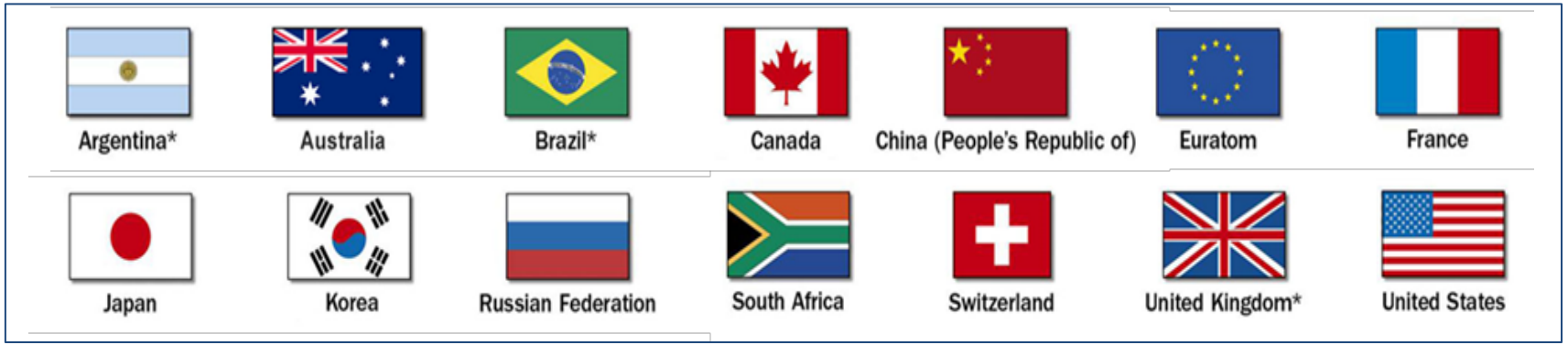
GIF: a framework for international co-operation in research and development for the next generation of nuclear energy systems, launched in 2001



13 Member Countries + the EU

Key theme through 2024: Accelerating the Readiness of Gen IV Systems to Meet Net Zero Goals:

1. Strengthening Gen IV system features for combatting climate change (e.g., flexible operations and non-electric applications)
2. Supporting transition from R&D to demonstration and deployment through technical readiness, regulatory readiness and improved economics
3. Strengthening GIF relevance to industry
4. Supporting the Gen IV talent pipeline

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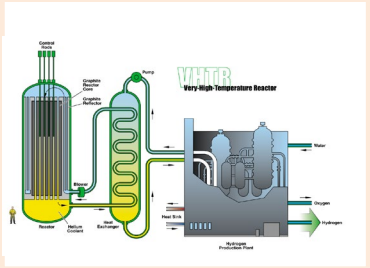
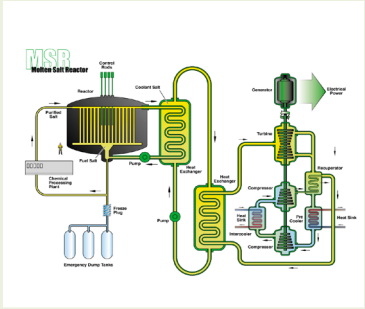
Six Generation IV Reactor Technologies

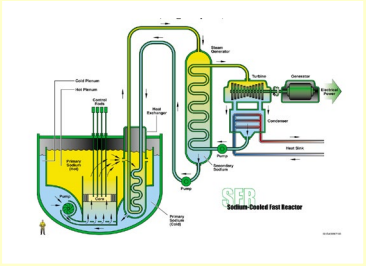
Very High Temperature Reactor (VHTR)



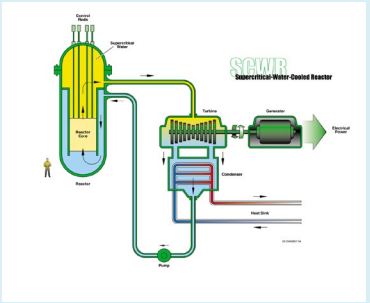
Molten Salt Reactor (MSR)



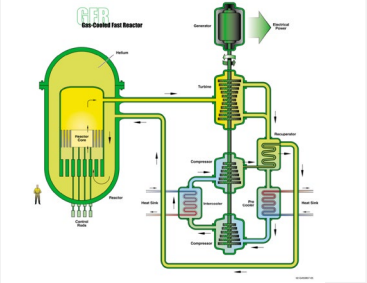
Sodium-cooled Fast Reactor (SFR)



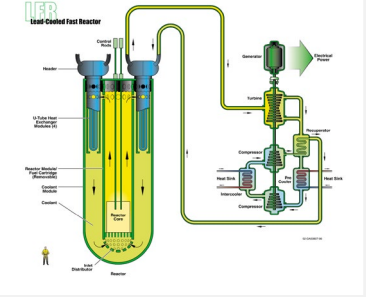
Supercritical Water-cooled Reactor (SCWR)



Gas-cooled Fast Reactor (GFR)



Lead-cooled Fast Reactor (LFR)



Cross-cutting Collaborations

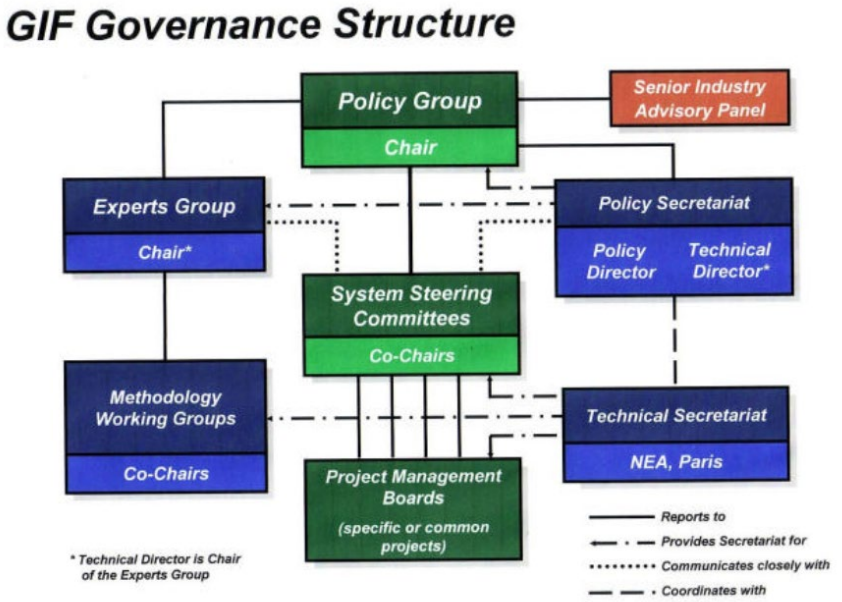
- Economics & Modelling
- Education & Training
- Proliferation Resistance & Physical Protection
- Risk & Safety
- Safety Design Criteria
- Non-Electric Applications of Nuclear Heat
- Advanced Manufacturing & Materials Engineering

To achieve goals in four areas:

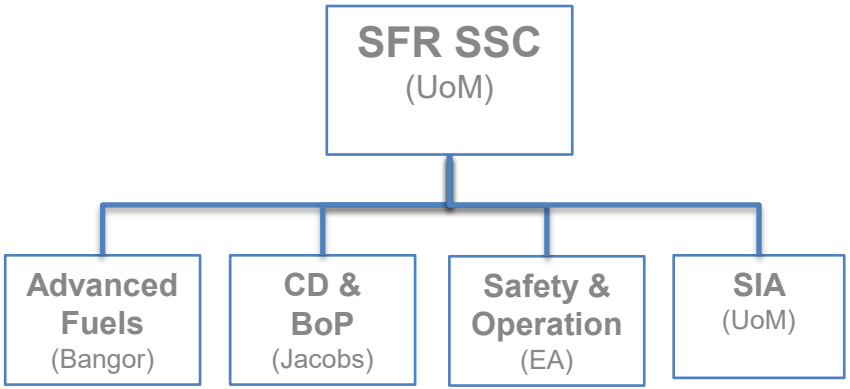
1. Sustainable energy with minimum waste
2. Life cycle cost advantages
3. Safety and reliability
4. Proliferation resistance & physical

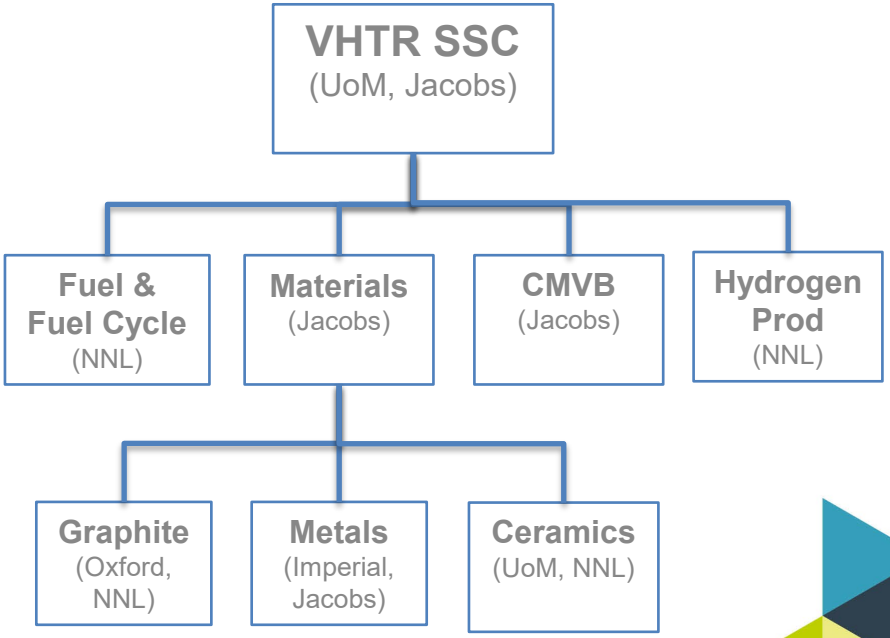
GIF Operation

- Policy Group/ Leadership Team
- US, France, Japan, Korea, Canada, UK
- UK was early signatory to original Framework Agreement (International Treaty), then withdrew and rejoined in 2018
- Early 2024 – UK received unanimous approval to join VHTR SSC (observing since 2018)
- UK observer on SFR
- In 2023 UK led the development of an Industry Engagement Policy Statement (theme of current leadership team)
- 2 x PGEG meetings per year



UK Involvement in VHTR and SFR Arrangements





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UK Involvement in Other Groups

Governance Groups

- Policy Group (UoM, DESNZ)
- Expert Group (NIRO, DESNZ)
- Senior Industry Advisory Panel (Jacobs, Rolls-Royce SMR)

Working Groups

- Proliferation Resistance & Physical Protection (NNL)
- Education and Training (Cambridge, EA, Jacobs)
- Risk & Safety (ONR, EA)
- Advanced Manufacturing & Materials Engineering (Nuclear AMRC)

Task Forces

- Non-Electric Applications of Nuclear Heat (NNL)

~ 30 UK GIF Representatives

Second Framework for Irradiation Experiments (FIDES-II)

- Permanent closure of the Halden Reactor in Norway in June 2018
- International community identified the need to strengthen the network of international test facilities with the ability to perform neutron irradiation
- FIDES emerged from these discussions
- UK joined towards the end of the first triennial 2021-24
- NNL is the UK Party to the FIDES-II Agreement
  - UK 3rd Parties – ONR, UKAEA, EDF Energy UK, Jacobs, Rolls-Royce, and Bangor, Imperial, Manchester and Oxford
- UK has recently committed to the second triennial 2024-27

Participants

Belgium, Czechia, Finland, France, Germany, Hungary, Japan, Korea, Netherlands, Spain, Sweden, Switzerland, United Kingdom, United States, European Commission (EC)

Project period

2024-2027

Budget

Member contributions to FIDES fees: EUR 13 Million

Work scope value: Approximately EUR 30 Million

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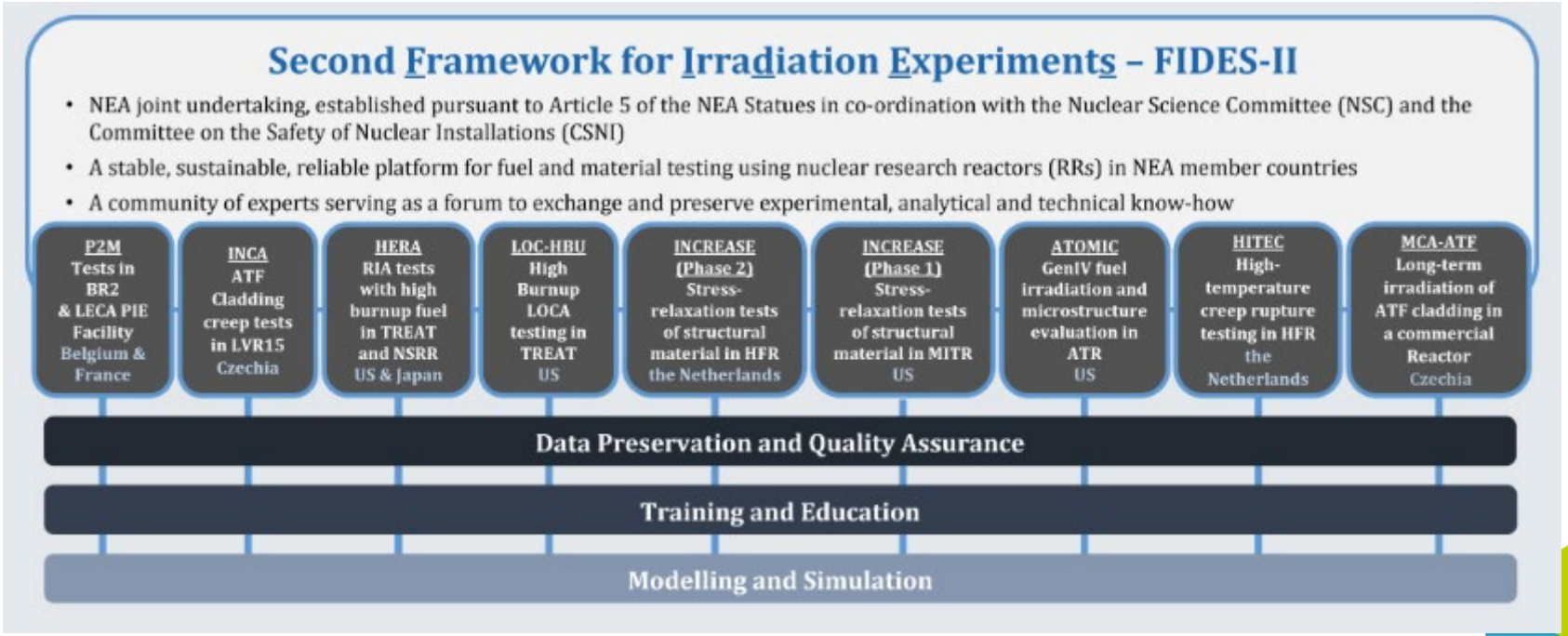
FIDES-II 2024-27



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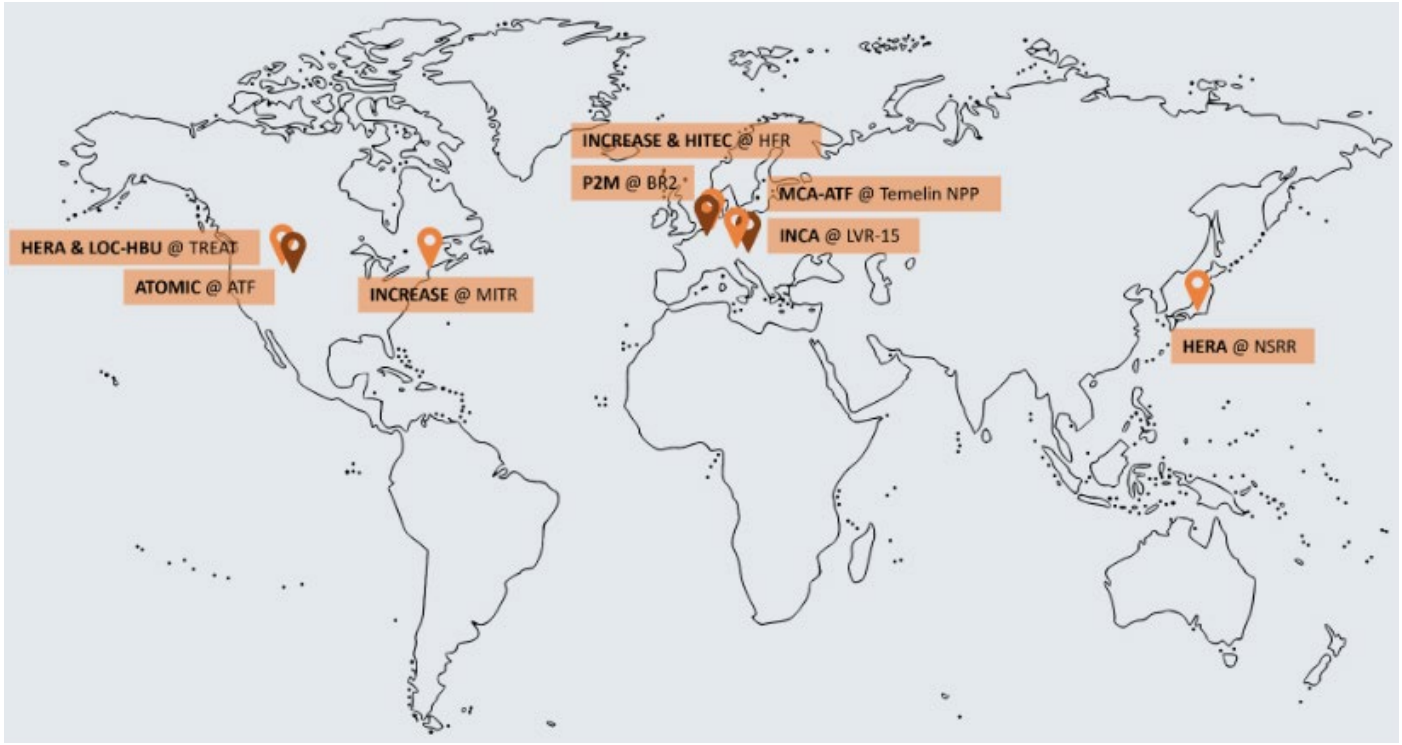
FIDES-II Research Reactors



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Halden Human Technology Organisation

- Research consists of seven topics of prioritised Human Factors and Digital Systems Research for existing and new reactors including SMRs.
- NNL is the signatory to the Halden HTO Agreement
  - UK 3rd Parties – ONR, EDF, FNC, Jacobs, Rolls-Royce, Rolls-Royce SMR, Sellafield Ltd, UKAEA
- Research performed by Institute for Energy Technology (IFE), Norway
- NNL deliver an annual UK Members group meeting
- UK Representative (NNL) elected Chair of the Halden Programme Review Group 2024

Participants

Canada, China, Czechia, Germany, Japan, Korea, Netherlands, Norway, Sweden, United Arab Emirates, United Kingdom, United States

Project period

Current mandate: January 2024 - December 2026

Budget

EUR 14.58 million

01	Human Performance
02	Digital I&C - Safety Assurance
03	Control Room Design & Evaluation
04	Human-Automation Collaboration and Multi-Unit Operation
05	Digital Systems for Operations and Maintenance
06	Sustainable Decommissioning and Asset Lifecycle Management
07	Cyber Security for Main Control Rooms

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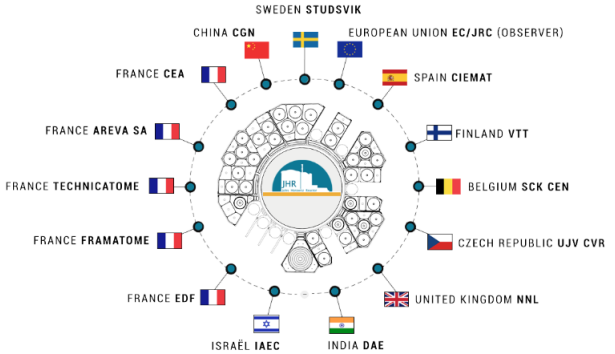
HAMMLAB simulator laboratory (Halden human-Machine LABoratory)

In 2023 seven crews participated in studies at HAMMLAB and three crews participated in studies at training simulators at nuclear power plants.

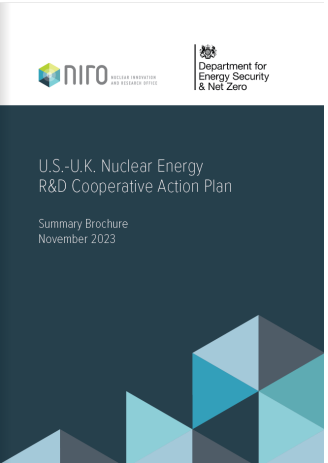
Jules Horowitz Reactor

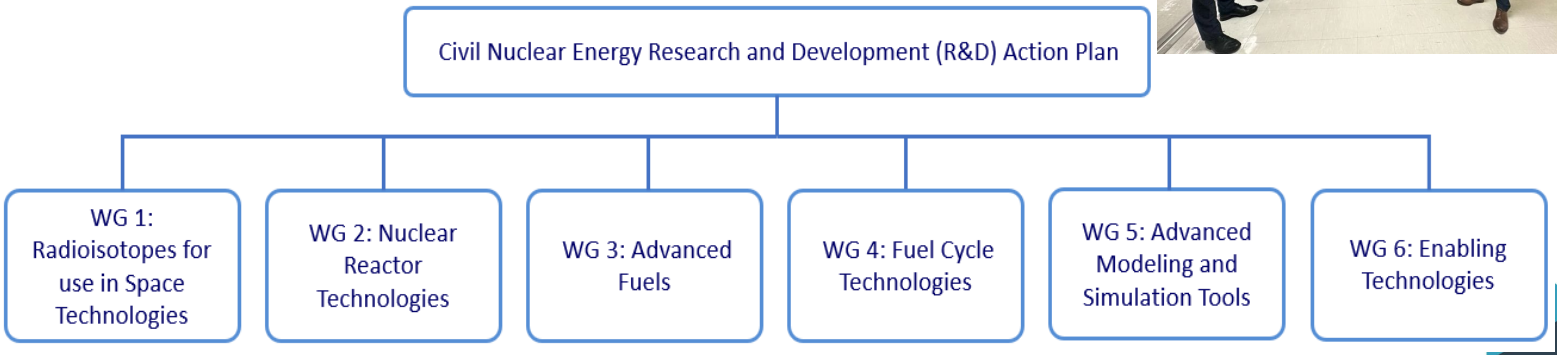
- JHR is a new Materials Test Reactor under construction at CEA Cadarache
- JHR will be operated as an international user-facility with the 15 partners (including UK) forming an international consortium
- Evolution of the reactor design (to address changes in safety standards) and scope (to provide a more flexible experimental capability) have impacted cost and schedule
- Current schedule has reactor operation 2032-34
- UK Representative (NNL) appointed Chair of the Governing Board 2024 to 2028



US-UK Action Plan

- Civil Nuclear Energy R&D Action Plan signed at the British Embassy in Washington, D.C. in September 2018
- Action Plan seeks to facilitate cooperation in R&D for advanced civilian nuclear energy technologies between the two countries.





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Any Questions?