



Department for
Business, Energy
& Industrial Strategy

Advanced Modular Reactor Research, Development & Demonstration Programme

Indicative Programme Outline

February 2022



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1. Purpose

This document provides an indication of the proposed Advanced Modular Reactor Research, Development & Demonstration (RD&D) Programme and builds on BEIS' December 2021 confirmation of High Temperature Gas Reactor (HTGR) technology as the focus for this Programme.

It aims to inform stakeholders with an interest in the development of HTGRs including materials, fuels, supply chain, manufacturing & construction processes, innovation in the nuclear sector more generally, and potential end-users of high-temperature heat. This information aims to gather feedback from the Sector ahead of a formal Invitation To Tender (ITT) for Phase A of the Programme which is anticipated for launch in Spring 2022.

Details presented in this document are subject to change and may not reflect the final, published ITT for Phase A of the Programme.

How to provide feedback:

There are a number of questions related to the Programme which BEIS would welcome feedback on by Friday 4th March 2022 via the survey link [here](#). There is also the opportunity to provide general feedback or information via this link. Individual responses to feedback will not be provided.

If you have additional information that you would like to share, there is limited availability for engagement with BEIS which you can request via the survey.

For any general questions related to this document please email:
nuclearinnovation@beis.gov.uk

2. Programme Overview

The Prime Minister's Ten Point plan for a Green Industrial Revolution [\[1\]](#), the Energy White Paper: Powering our net zero future [\[2\]](#) & the Net Zero Strategy [\[3\]](#) recognise the role of large (GW scale) reactor nuclear technology, Small Modular Reactors (SMRs) and Advanced Modular Reactors (AMRs) in supporting Net Zero by 2050. On AMRs, a commitment was made to develop an AMR R&D Programme with the aim of enabling a demonstration by the early 2030s, to understand the potential of the technology.

An "Advanced Modular Reactor" is a UK term for the next generation of nuclear reactors. They use novel coolants and/or fuels and typically have higher temperature outputs (in the range of 500-950°C, compared to around 300°C for Light Water Reactors (LWRs) or 600°C for Advanced Gas Reactors (AGRs)). Based on current technology development certain AMRs could generate high temperature heat to potentially help displace fossil fuels in industrial processes and support more efficient low-carbon hydrogen and synthetic fuel production.

In December 2021, following underpinning analysis and a Call for Evidence, the technology focus for the Programme was confirmed as High Temperature Gas Reactor (HTGR) technology. As a result, going forward the Programme will focus on HTGR technology with the ambition for this to lead to a HTGR demonstration by the early 2030s.

The aim of the Programme is to demonstrate that HTGRs can produce high temperature heat which could be used for low-carbon hydrogen production, process heat for industrial and domestic use and cost-competitive electricity generation, in time for any potential commercial AMRs to support Net Zero by 2050.

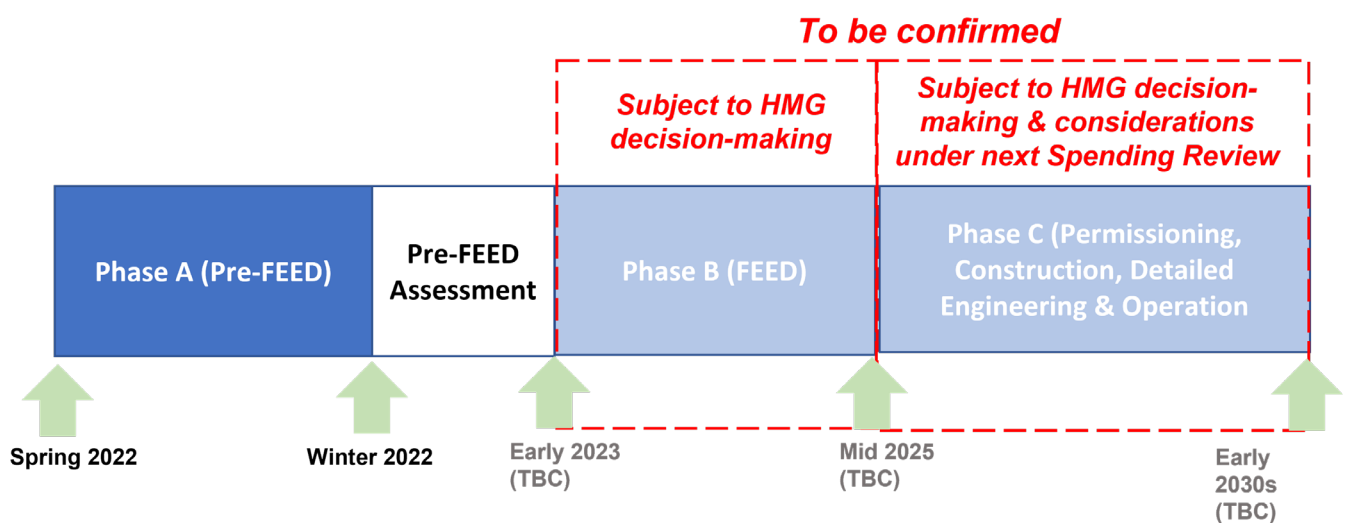
Certain HTGR designs have been demonstrated which highlight the early stages of technology feasibility. BEIS would like the sector to demonstrate a HTGR, to be sited in the UK, which has innovation at the centre of its design, build and application– with the ambition for this to result in the most cost-effective solution shaped by end-user requirements and delivered by the early 2030s.

This document sets out an indicative outline for the Programme to inform and gain feedback from interested stakeholders and to enable the sector to prepare for Phase A. Feedback on the indicative structure set out for the Programme can be submitted to BEIS via the survey in section 1.

3. Indicative Programme Structure

The potential three phase structure for the AMR RD&D Programme is shown below. Phase A aims to understand the potential size, type, cost and delivery method for a HTGR demonstration by allowing industry to propose options against the overarching Programme aim.

Phase B is subject to HMG decision-making and Phase C is subject to HMG decision-making and considerations under the next Spending review. They have been shared as an illustration only to provide stakeholders with an overall view of the potential structure of the Programme. This structure is subject to change.



3.1. Phase A: Pre-FEED

There will be a share of up to £2.5 million for up to 5 Feasibility or Preliminary Front End Engineering Design (Pre-FEED) studies over a potential 6–9-month period. We are considering costs to be between £300k -500k for each project. Applicants will be required to submit the Pre-FEED study at the end of Phase A. Further details for Phase A will be shared as part of the ITT.

To note: For Phase A any criteria for the HTGR demonstration would likely be intentionally broad – for example the type of demonstration or the potential heat output, this is to allow the sector to inform BEIS of the most cost-effective solution which could support Net Zero by 2050, pushes the boundaries of science, technology & innovation and can be delivered by the early 2030s.

Potential applicants should note that the likely expected outputs from Phase A would be:

- An outline design of the HTGR demonstration concept, technical feasibility, a roadmap/ schedule for delivery of the demonstration by the early 2030s, regulatory considerations,

generic site requirements, high-level cost-estimation, and an outline of full lifecycle activities.

- Considerations of the multi-disciplinary team and skills that would deliver the HTGR demonstration including potential commercial stakeholders, delivery authority, operator & end-user. There should be an appraisal of the specific capability and programme management that will be leveraged to ensure a successful HTGR demonstration.
- Outline how the proposed project would seek to maximise UK participation and increase capacity in the supply chain.
- It should identify the R&D/ technical challenges key to realising the HTGR demonstration concept in the early 2030s and how they will be overcome.
- Highlight how the proposed project will utilise new, innovative processes to drive down costs associated with the HTGR demonstration.
- As the overarching aim of the Programme is for AMRs to support Net Zero by 2050 also through the decarbonisation of heat, the Pre-FEED should also outline how heat will be extracted from the concept and thereafter utilised by potential end users. There should also be an appraisal of how these end users will be engaged.
- A consideration of the current market failures for commercial deployment of HTGRs and how the proposal will aim to address these will also be expected.
- The Pre-FEED study will be used as a basis for BEIS to develop the scope of Phase B: FEED (which is currently to be confirmed & subject to HMG approval) and to inform associated policy developments. It is anticipated at this stage that Phase B will not be a down selection of successful Phase A applicants. Phase B will likely be open to all applicants (this includes those who were successful in Phase A, those who were unsuccessful in Phase A and new proposals). New proposals into Phase B would need to provide a detailed appraisal on the feasibility of their proposal or equivalent.

3.1.1 Eligibility for Phase A and contracting approach

- It is anticipated that Phase A funding will be awarded using the [Small Business Research Initiative \(SBRI\)](#). SBRI is a well-established pre-commercial procurement process that enables the development of innovative products and services in response to specific challenges faced by government departments and public-sector bodies. The SBRI approach is not limited to small and medium sized organisations.
- An SBRI will fund 100% of eligible costs.
- For an SBRI the permitted arrangement for collaborative bids are lead/ main contractor and other partners supporting as sub-contractors.

The sharing of risks and benefits is an important aspect to the SBRI approach. Projects receive financial support and retain any intellectual property generated, with certain rights of use retained by BEIS. Project outputs are also expected to be shared widely and publicly and project teams are not permitted to include profit and contingency sums in the eligible project costs.

- Prospective bids will need to demonstrate they have a UK lead organisation who is positioned as the main contractor. Organisations from the UK nuclear industry can lead a collaborative bid or put forward a solo-bid.
- UK academic institutions and National Laboratories can only lead a collaborative bid - they will require the support of organisations from the nuclear industry as part of their bid.
- International organisations can support a bid as a sub-contractor only, and not lead.
- Organisations are permitted to be a main contractor on one bid and a sub-contractor to another or multiple bids. Multiple bids which have the same UK main contractor will not be considered.
- To be eligible for Phase A, bids must agree to the BEIS standard terms and conditions of contract. This is non-negotiable.

3.2. Phase B: FEED

Similar to large-scale engineering projects this Phase, still subject to approvals, would see successful applicants undertaking a detailed assessment of their HTGR concept over a longer period of time to enable a Front End Engineering Design (FEED) output study.

- Outputs: A FEED study to be used as a basis of the detailed design and engineering and include accurate total investment & lifecycle cost, how this would be sited and include overall project delivery planning.
- Contracting approach: We anticipate utilising a grant-based approach to engage any successful bidder(s). This would therefore require matched funding from industry. Similar to Phase A, applicants will need to consider how the proposal will maximise benefits to the UK, for example through IP, Supply Chain, Jobs, Fuel.
- Down selection: It is anticipated at this stage that Phase B will not be a down selection of successful Phase A applicants. Phase B will likely be open to all applicants (this includes those who were successful in Phase A, those who were unsuccessful in Phase A and entirely new bids).

3.3. Phase C: Permissioning, Construction, Detailed Engineering & Operation

This is an indicative phase only, subject to HMG approval and decision making as part of the next Spending review. This Phase could see a successful proposal from Phase B undertake detailed site-specific design, planning permissions, environmental permitting, Nuclear site licensing, construction, commissioning and initial operation of the HTGR demonstration.

This publication is available from: www.gov.uk/government/publications/advanced-modular-reactor-amr-research-development-and-demonstration-programme

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