Overview of BEIS Thermal Hydraulics Project

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SYSTEMS AND ENGINEERING TECHNOLOGY

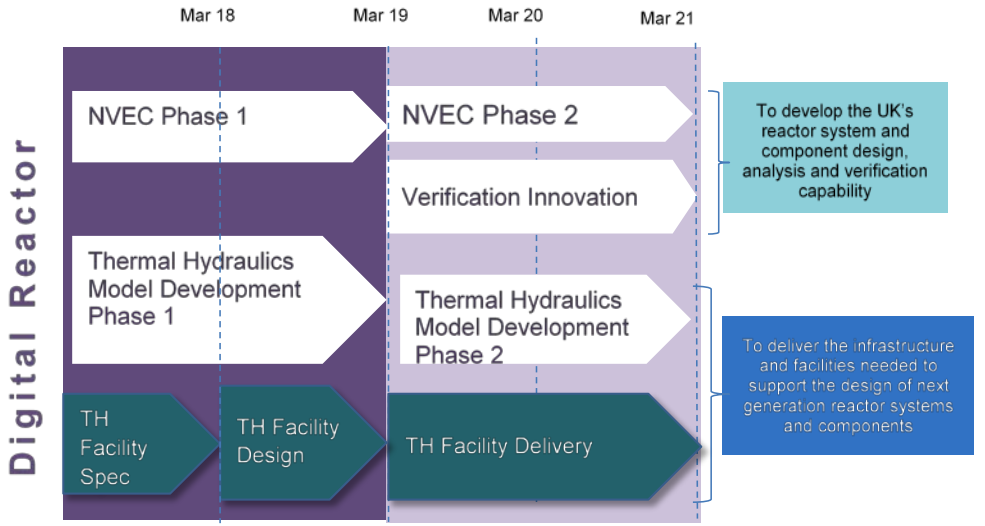
FRAZER-NASH CONSULTANCY

Nuclear Innovation Programme (NIP)

The UK Government Department for Business, Energy & Industrial Strategy (BEIS) launched the 'Nuclear Innovation Programme' (NIP) in 2016

This is a phased programme, aiming primarily to:

- Upskill the UK nuclear community in emerging nuclear technologies
- Make the UK an international 'partner of choice' for emerging nuclear technology development



The Nuclear Thermal Hydraulics (NTH) programme forms part of the 'Digital Reactor' research defined within the NIP

We are in 'Phase 2' of the programme, working in parallel with:

- Jacobs (Wood): Nuclear Virtual Engineering Capability (NVEC) development
- UKAEA: Nuclear Thermal Hydraulics Facility delivery (NTHF)

Nuclear Thermal Hydraulics (NTH) Phase 2

Phase 2 NTH is a 2-year programme, primarily aiming to:

- Deliver open source **Technical Volumes** that define good practice methodologies for NTH modelling
- Demonstrate good practice through a number of **Case Studies**, based on emerging nuclear technologies
- Establish and expand the limit of NTH modelling knowledge, through focused **Research & Development**

In parallel, the Phase 2 NTH programme aims to:

- Collaborate and integrate with other NIP programmes and international research activities
- Hold dissemination events to promote the uptake of programme outputs

Project website https://www.innovationfornuclear.co.uk/nuclearthermalhydraulics.html

Our Team

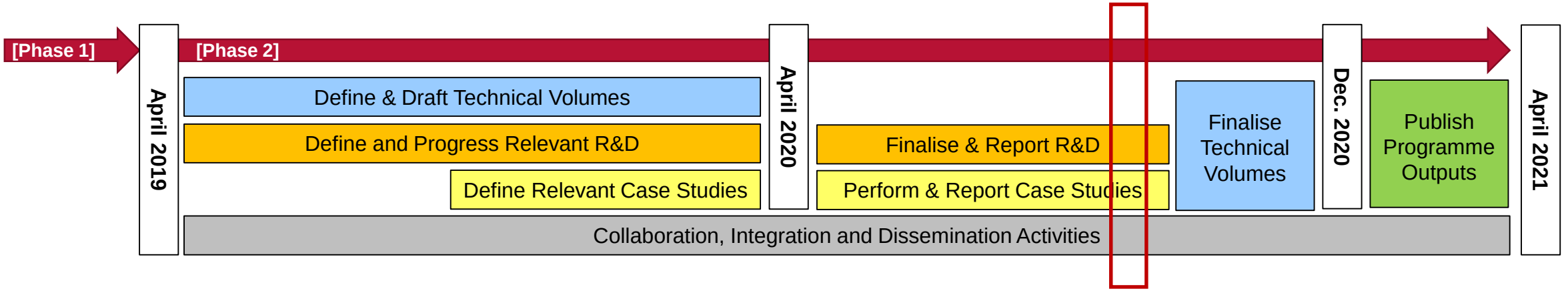
- **The team aims to combine relevant expertise and services from:**
  - **Industry and Academia** *(Technology Developers, Technical Service Providers, Research Institutions)*
  - **International Organisations** (*UK, US, Canada, Europe*)
  - **Multiple Nuclear Technology Developers** (*LWR SMR, MSR, LMFR, HTGR*)

Nuclear Thermal Hydraulics (NTH) Phase 2

The Phase 2 NTH Programme focusses on the **industrial application and commercialisation of:**

- Predictive capability for passive safety arguments
- Single phase heat transfer and natural convection
- Upskill UK in modern digital methods
- Relevant to all advanced nuclear technologies (water, high temperature gas, liquid metal and molten salt)

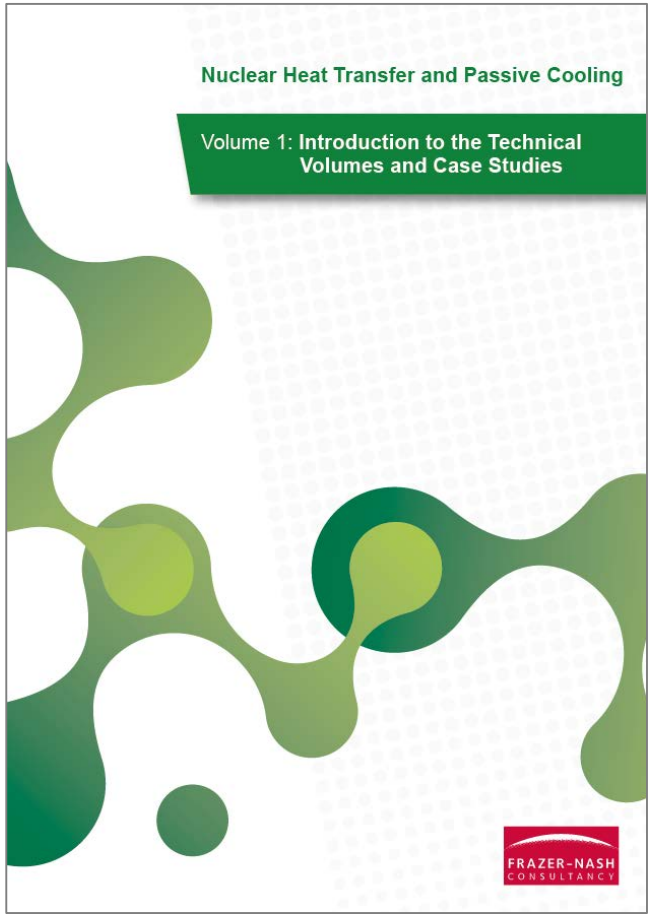
Programme timeline:



Technical Volumes

- The six technical volumes are intended to provide a **clear, concise and useful technical overview** of relevant phenomena and analysis methods within a civil nuclear context, to assist engineers in performing **good quality analysis**.

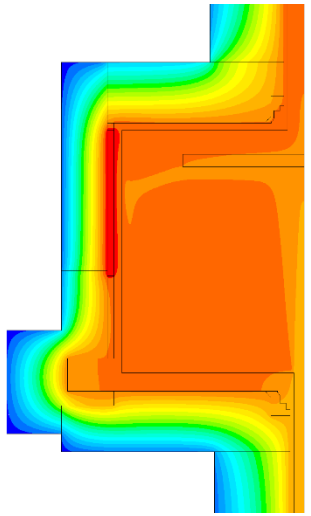
- Volume 1: Introduction to the Technical Volumes and Case Studies
- Volume 2: Conjugate Heat Transfer
- Volume 3: Natural Convection and Passive Cooling
- Volume 4: Confidence, Uncertainty and Model Reduction
- Volume 5: Liquid Metal Thermal Hydraulics
- Volume 6: Molten Salt Thermal Hydraulics



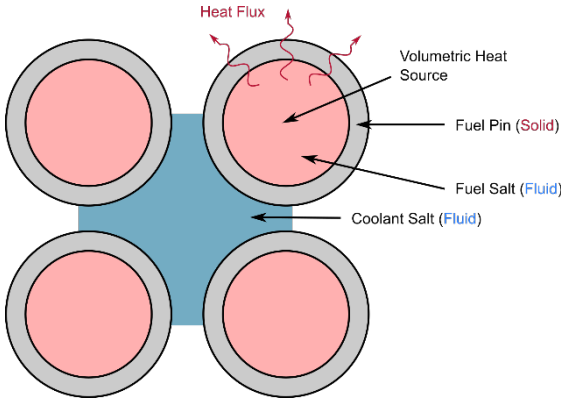
Case Studies

- The four case studies provide **‘worked examples’** of specific modelling tasks and **demonstrate the modelling approaches** described in the technical volumes.

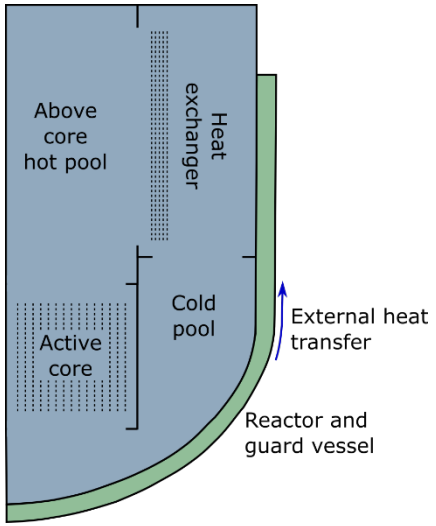
Case Study A: Liquid Metal CFD Modelling of the TALL3D Test Facility



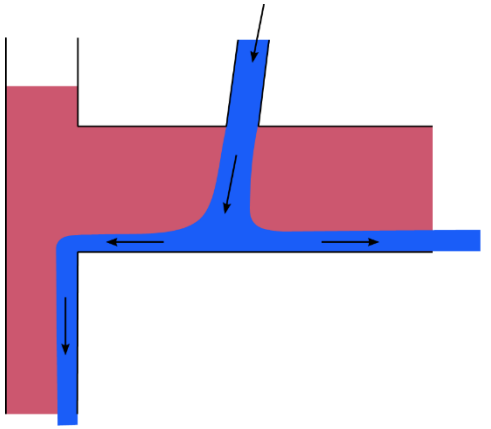
Case Study B: Fuel Assembly CFD and Uncertainty Quantification in a MSR



Case Study C: Reactor-Scale CFD for Decay Heat Removal in a LFR



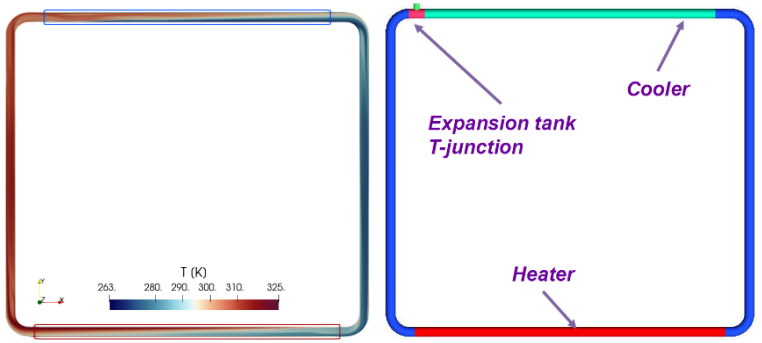
Case Study D: System Code and CFD Analysis for a Light Water SMR



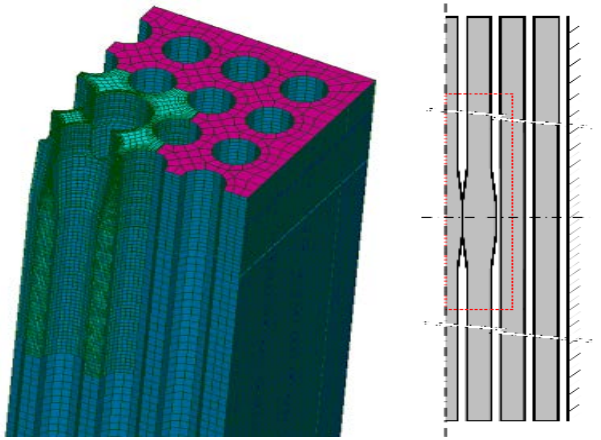
Focused R&D

- This R&D is intended to **address gaps in knowledge** to support the technical volumes and case studies, and to focus on areas of industrial interest applicable to different reactor technologies.
- This continues some of the Phase 1 research at the University of Manchester and Sheffield.

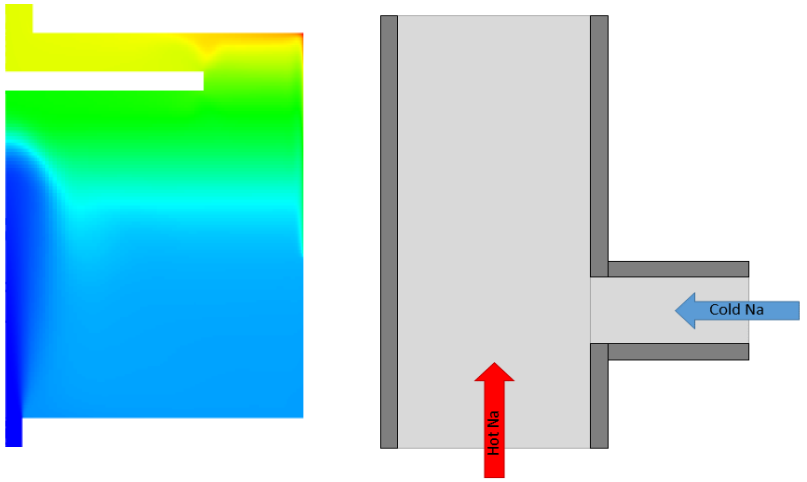
Natural Circulation Loops
University of Manchester



Coarse Grid CFD
University of Sheffield



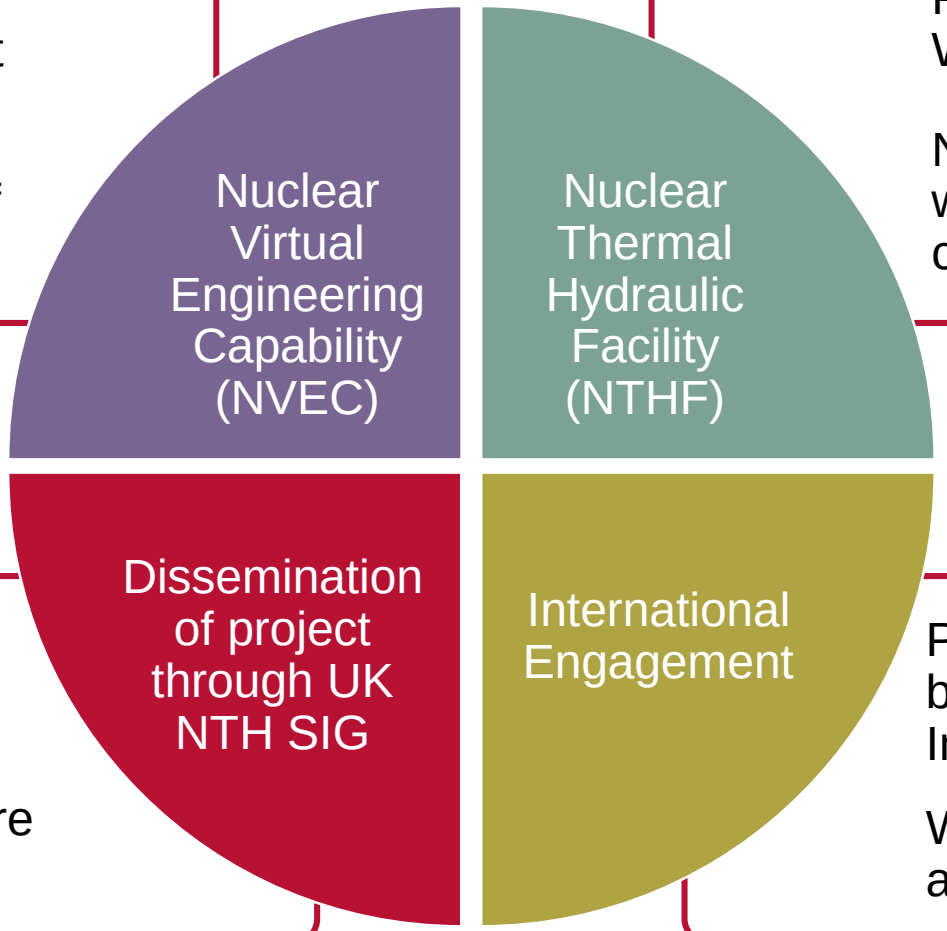
Liquid Metal Heat Transfer
University of Sheffield



Integration and Dissemination

Need to integrate model development with NVEC toolset

Working with Jacobs to include thermal hydraulics within one of their case studies



Proposed £40m test facility in North Wales being led by UKAEA

Need to align model development with facility to deliver integrated UK capability

UK Nuclear Thermal Hydraulic Special Interest Group meetings being held regularly

Two-day training seminar to share the project outcomes

Participating in next NEA CFD benchmark on Fluid-Structure Interaction

Working with international developers and supporting UK-US engagement

Summary

Thermal hydraulics underpins the performance and safety of all SMR and AMR technologies

Phase 1: Model development and facility specification with initial innovative new methods

Phase 2: Developing advanced modelling practices for SMR and AMR technologies

Increased confidence in thermal hydraulic modelling tools and understanding will lead to:

- Reduced costs
- Better efficiency
- Simpler designs

- Thermal hydraulics is key to meeting cost reduction target
- Project focused on industrial applications for SMR and AMR developers
- Upskilling UK workforce and disseminating knowledge to UK community
- Providing route to international collaboration and commercialisation

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Contact me if you want to find out more about our research

www.innovationfornuclear.co.uk

Thermal hydraulics

Securing skills and developing models through Nuclear Thermal Hydraulics research and innovation in the UK for SMR and AMR technologies.

Advanced Manufacturing and Materials

Developing understanding in advanced joining techniques for nuclear applications. Helping to unlock the blockers for the adoption of new technologies in nuclear new build

Safety & Security

Researching new techniques and methods that provide engineers with a greater insight into their reactor technology’s safety and security performance, empowering them to make risk informed decisions that drive cost reduction.