Advanced Nuclear Skills Innovation Campus

GAMECHANGERS
DELIVERING NUCLEAR INNOVATION

Department for Business, Energy & Industrial Strategy

Call for Proposals: Industrial Innovator Research and Development Projects

On behalf of the Department for Business, Energy and Industrial Strategy (BEIS) and the National Nuclear Laboratory (NNL), Game Changers are inviting proposals from businesses for access to facilities at NNL's Preston Laboratory to undertake research and development projects focussing on advanced nuclear technology.

The projects must be undertaken between 15th November 2021 and 25th March 2022.

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NATIONAL NUCLEAR LABORATORY

This funding call is part of a short pilot of the Advanced Nuclear Skills and Innovation Campus (ANSIC), delivered by NNL on behalf of BEIS, and will provide innovation grants of up to £135k per project. It is intended that two innovation projects will be funded. The cost of instrument and facility access at NNL's Preston Laboratory and support from NNL experts will be covered by ANSIC, and therefore free at point of use for the successful applicants. Full details of the opportunity are provided below.

An online briefing event will take place at 1pm on 15th September 2021 to provide an overview of ANSIC and further information about this call. The application process will be explained in detail and attendees will have an opportunity to take part in a Q & A session.

Proposals must be submitted using the Game Changers online application system. The deadline for applications is 12 noon on Thursday 7th October 2021.

Summary

This call is part of a short pilot of the Advanced Nuclear Skills and Innovation Campus (ANSIC), delivered by NNL on behalf of BEIS, as part of the UK Government's commitment to the continued development of advanced nuclear technology to help the UK reach net zero emissions by 2050.

The pilot campus, located near Preston on the Springfields nuclear licensed site, will serve as a research and innovation hub, bringing together industry and academia to collaborate on projects designed to help accelerate the deployment of advanced nuclear technology. Integrated with NNL's Preston Laboratory, a state-of-the-art nuclear research facility, ANSIC will allow researchers and innovators to access some of the world's most advanced nuclear facilities and receive support from technical and operational subject matter experts.

The pilot programme will help to build an informed, reliable evidence base to:

- establish future demand and scope for future initiatives
- help determine the future direction of a campus programme which could help to ensure the UK has the skills needed to remain at the forefront of ground-breaking nuclear research and development
- identify opportunities for industry collaboration and the practical challenges of delivering campus activities on a nuclear licensed site

Scope

The purpose of this call is to fund innovation projects aimed at harnessing the potential of advanced nuclear technologies to accelerate decarbonisation.

The UK Government has committed to significant investment in the development of small modular reactors (SMRs) and advanced modular reactors (AMRs) as part of the transition to a low carbon economy. In July 2021, the Government announced plans to explore the potential of High Temperature Gas Reactors (HTGRs) to enable an AMR demonstration by the early 2030s, to support net zero by 2050. This funding call is open to all potential technologies.

Innovation and specialist skills and expertise are recognised as fundamental to maximising the potential of advanced nuclear technologies to support decarbonisation and are a key focus of the ANSIC pilot programme.

In this call, proposals for innovation projects that explore all potential uses of nuclear technology as part of a low carbon economy are invited. This includes, but is not limited to, innovation projects investigating:

- The use of nuclear technologies in hydrogen production, direct heat for industrial or domestic use, energy storage, chemical synthesis and production of medical isotopes
- Technologies that enable the recovery and reuse of radioactive waste material for energy and non-energy use
- Technologies that reduce the cost of advanced nuclear systems
- Mechanisms of enabling licensing and validation of new technologies
- Opportunities to derive additional value from advanced nuclear systems

Eligibility and funding

Applications are invited from businesses of any size from any sector. Submissions are welcome from organisations not already considered to be part of the nuclear supply chain.

Collaborative applications may be submitted, but contracts will be awarded to a single lead organisation.

All projects should make use of equipment located within ANSIC at NNL's Preston Laboratory on the Springfields nuclear site. A list of equipment available is given in the appendix. If the proposed innovation project requires access to other nuclear facilities available at alternative NNL sites, such access may be negotiated if sufficient need and benefit can be demonstrated. A full list of these facilities can be found in the UK Nuclear Fission R&D Catalogue: Facilities, Equipment and Capabilities from NIRO, under National Nuclear Laboratory (pages 38-60).

There are three potential modes of access to ANSIC and these are detailed below. For the modes which entail applicants being on-site at ANSIC, they will only be given access subject to achieving appropriate levels of security clearance for the work being proposed. Details of the security process are provided as an addendum to this document.

It is expected that as well as clearly outlining technical goals, successful applications will promote skills development, knowledge sharing and IP generation.

Projects will start on 8th November 2021 and finish on 25th March 2022.

Terms and conditions will be provided by Game Changers and can be viewed on request ahead of submitting a proposal.

Funding will be awarded on a match-funded basis with the level of funding varying according to the size and nature of organisation (please refer to company accounts guidance on GOV.UK to establish the size of your organisation). Allowable costs are those incurred as a direct consequence of delivering the project (either monetary or in-kind).

	ANSIC contribution	Applicant contribution
Micro company	70%	30%
Small company	70%	30%
Medium company	60%	40%
Large company	50%	50%
Research and Technology Organisation	100%	0%

The following ANSIC access and support costs will be covered by NNL and should not be included in funding applications:

Access costs:

- security clearance
- drug and alcohol testing
- training courses
- COVID testing as and when required at the time of access

Support costs:

- translation of the experimental requirements to enable production and approval of the written schemes of work to permission the experiment
- support completing the required access forms
- support preparing collaborative and acceptable risk assessments
- guidance in writing experimental methodology
- NNL technical leadership (particularly for applicants from a non-nuclear discipline)
- provision of required personal protective equipment
- supervision of experiments by NNL staff
- NNL operators to perform experiments as required
- adequate arrangements for the transportation of samples to/from the NNL facility
- disposal costs
- support from NNL scientists on the production of experimental reports

Modes of access to ANSIC

Recognising the challenges of performing experimental work on radioactive materials, and on nuclear licensed sites, three possible modes of access should be considered under this call. In consultation with NNL, applicants should consider carefully which is the most suitable and timely mode of access to apply for, with consideration for how the chosen mode of access will achieve the required results and outcomes and how it will facilitate collaboration.

The three modes of access will be as follows:

I. 'Hands On' – Work is performed by the applicant(s) at ANSIC with on-site NNL technical input and supervision

II. 'Hands in Pockets' - The experimental work at ANSIC is performed by NNL staff with the applicant(s) present to oversee the work within the agreed scope

III. 'Remote' – The experimental work at ANSIC is performed by NNL staff with the applicant(s) providing input remotely.

Different levels of security clearance will be required for the different modes of access. The 'Hands in Pockets' and 'Remote' approaches will necessitate applicants having or obtaining Government baseline personnel security standard (BPSS), whilst 'Hands On' access will require Security Check (SC). It must be noted that the SC process takes several weeks to complete (likely to be a minimum of 4 – 6 weeks), therefore it may be advantageous if applicants for 'Hands On' access already hold SC clearance.

If applicants don't already possess the required level of clearance for 'Hands On' access, then the 'Hands in Pockets' or 'Remote' approach may need to be considered to complete the proposed project work. Applicants requesting 'Hands On' access should consider these as contingency options.

How to apply

Applicants should state an initial expression of interest by contacting the Game Changers team (apply@gamechangers.technology) with a very short summary of the research they'd like to undertake (up to one page of A4). This summary should provide a brief background to the intended research, a brief overview of research aims, the intended mode of access and the ANSIC equipment of interest. Project costings are not expected at this stage.

Expressions of interest should be submitted as early as possible.

Game Changers will facilitate engagement between the applicant and NNL staff who will confirm the technical feasibility of the proposed research in respect of the availability of appropriate levels of facility access and support.

Once NNL have confirmed that the required access to facilities and support can be provided, applications must be submitted using the Game Changers online application portal.

In addition to completing the form, applicants need to upload a PDF (maximum four A4 pages long) which clearly demonstrates how their project fits with the defined scope of the call.

The PDF must also outline:

- the proposed research and its scientific basis, including details of proposed experiments
- the nature of access required to ANSIC ('Hands On', 'Hands in Pockets' or 'Remote') and how the chosen mode of access will achieve the required results and outcomes
- the anticipated collaboration with NNL and how this will support the delivery of the project
- equipment for which access will be required to undertake the research
- materials required (outlining the provenance of the samples, location and plans for transportation to (and from) ANSIC)
- the impacts that the funding and access to ANSIC facilities will have on the applicant's wider business development goals
- why the project team is well placed to deliver
- the wider impacts of the proposed research (for example on society and the UK's net zero goals)
- project risks and mitigations
- safety, security and nuclear safeguarding risks and mitigations

A template PDF document is available on the Game Changers website.

All individuals who plan to contribute to the proposed research and experiments should be clearly identified including their names, affiliations, short CV statements (maximum one page) and

any existing security clearance. This information can be submitted as an annexe to the PDF and can be additional to the four page limit.

The PDF can contain images and diagrams and be up to four A4 pages long. Files must be smaller than 10MB.

Applications must be accompanied by a detailed project plan with clearly defined work packages, tasks and timescales to achieve the proposed project outcomes within the given timescales. The work packages should be costed individually. The project plan should be completed using the template provided on the Game Changers website and uploaded in addition to the PDF document via the Game Changers online application portal.

Assessment of applications

Submissions will be assessed by a panel and written feedback will be provided by Game Changers for all applications, whether or not successful. The panel will comprise members of the ANSIC Steering Group, which includes representatives from NNL, BEIS and the Nuclear Innovation and Research Office (NIRO).

Applications will be assessed consistently and transparently using the following criteria (weightings shown in brackets):

1. Clarity of project aims and alignment to the scope of the call, e.g. in harnessing the potential of advanced nuclear technologies as part of a low carbon economy (10%)
2. The level of proposed collaboration (between the applicant's team and NNL) including how well the project will make use of materials, equipment, and technical expertise available at ANSIC (15%)
3. The level of impact that access to ANSIC will have on the applicant's broader business development goals (15%)
4. The level of technical innovation involved in the proposed work (10%)
5. The potential impact of the project, including but not limited to societal, environmental and economic impacts (10%)
6. The skills, capability and capacity of the applicant team to deliver the proposed project (10%)
7. Value for money (including the cost to ANSIC and the value of applicant contributions) (10%)
8. The likelihood of the proposed project work meeting the pilot end date (10%)
9. Identification of key project risks with credible mitigation proposals (10%)

Successful applicants will be asked to enter into a contract with NNL to deliver the proposed research. NNL will place direct fixed priced contracts with successful applicants and at the outset of projects, applicants will agree a project payment profile with NNL.

As soon as successful applicants are notified, they and their organisations must be ready to work closely with NNL to sign contracts, commence any necessary security clearance processes, prepare for the experiments and undertake relevant training. A two week period has been allocated to achieve contract signing.

Scheduling of access to ANSIC facilities will be agreed by the NNL User Access Leader with the applicant. An NNL lead scientist will work closely with the applicant and provide technical support for the experiments and subsequent analysis.

It is a requirement of any granted access that following project completion, a short case study is prepared jointly, which may be used to support subsequent ANSIC and NNL user access calls.

All users of ANSIC facilities will need to comply with prevailing COVID guidance and NNL's COVID policy. Dates noted within this call are all subject to the condition that any planned access must be possible within prevailing government imposed restrictions on work or travel, any imposed restrictions by the site licensor and within any operating procedures put in place by NNL to ensure the continued safety and health of their workforce and any other visitors to their facilities.

More information

A briefing webinar will take place at 1pm on Wednesday 15th September 2021. Registration for the webinar is via Eventbrite.

If you would like to discuss any aspect of this call, please email apply@gamechangers.technology.

Date	Activity	Notes
2nd September 2021	Call opens	Briefing webinar will be held on 15th September at 1pm. Registration via Eventbrite.
September 2021	Proposal preparation period for applicants	Applicant contacts Game Changers team to express interest as soon as possible (not later than 28th September) and begins dialogue with relevant NNL technical staff to test the technical feasibility of the proposal and ensure availability of equipment and facilities.
7th October 2021	**Call closes (12 noon)**	
18th - 22nd October 2021	Panel assessment of the proposals	A panel review of all proposals is planned to be held during the week 18th - 22nd October
25th – 29th October 2021	Notification of the panel decisions	Applicants will be notified of the panel's decisions. Feedback will follow. Successful applicants will receive contract paperwork that includes additional details to be completed by the applicant. Signed contracts to be in place by 15th November 2021*
1st November 2021	Security clearance process commences	NNL will advise successful applicants of the requirements and support them in completing the process.*
w/c 15th November 2021	Kick-off meetings held	Meetings will be attended by applicants, NNL technical staff and representatives of the Game Changers team.
November 2021	Preparation and planning for experiments and access	
Dec 2021 – Mar 2022	User Access for 'Hands in Pockets' and 'Hands On' experiments, or supply of materials for 'Remote' work	The specific timing of user access will be notified by the NNL User Access Leader and is subject to security approval. Experimental work, completion of close-out reports using provided templates and preparation of case studies by March 25th 2022

***The schedule of this call requires security clearances and contractual arrangements to be in place without delay, so agreement to process all necessary paperwork as quickly as possible to meet these requirements is a pre-requisite to participation in this time-limited pilot scheme.**

Addendum: security clearance

For ‘Hands in Pockets’ and ‘Remote’ access, applicants will have to obtain Baseline Personnel Security Standard (BPSS) clearance. This will include a check that any required ‘Right to Work’ documentation is in place.

If applicants have resided or worked in any one country for more than 6 months (broken or unbroken) in total, within the last 3 years, they will need to obtain and provide an original National Police Certificate from that country.

To obtain Security Check (SC) clearance for ‘Hands On’ access at NNL’s active facilities, applicants will need a minimum of 5 years UK residency.

The SC process includes a background check, criminal record check, check of credit and financial history and it may also include an interview which applicants must be willing to undertake.

References are required so applicants will need to seek agreement from the referees they intend to elect that they are willing to provide a reference.

More information on the security vetting process can be found on https://www.gov.uk/government/organisations/united-kingdom-security-vetting and applicants are advised to read this information.

Appendix: Facilities, equipment and capability at NNL's Preston Laboratory

Uranium Manufacturing Capability

Summary of capability / facility

The key skills in the Reactor Core Technology Team are fundamentally powder and fuel pellet processing and micro analysis of the associated material. The pellet processing capability involves milling fuel feedstocks of specific customer specifications and then pressing the powder into pellets prior to sintering and analysis to compare to the original customer specification.

The team also has an experimental rig to manufacture novel coated fuel particles and works with universities on National Programmes looking at new accident tolerant fuels.

The SEM capability can analyse materials at the micro-structure level and gather structural and corrosion information together with an EDX detector to determine the elemental composition of a sample.

Nuclear material capabilities (i.e. activity limits)

Limited to uranium active materials or Pu surrogates (e.g. Ce)

Specification of relevant instruments and equipment available within ANSIC

- Electric arc furnace (arc melter), for the production of metallic uranium alloys.
- Uranium hexafluoride reaction rig to investigate the fabrication of advanced nuclear fuels, such as silicide and nitrides directly from UF6)
- Coated particle fuel rig (the UK's only capability to make fuel kernels is currently being developed)
- Pelleting equipment (crusher and mills, pellet presses, sintering furnaces, centreless grinder) housed in inert gloveboxes, which can be used to produce pellets from raw material, such as that produced from the arc melter/ UF6 reaction rig
- Microscope sample preparation facility (mounting and subsequent grinding & polishing of both active and non-active samples from throughout the nuclear industry, including ceramics, metals, cements, and grouts)
- Optical microscopes, and scanning electron microscopes (SEM)
- Laser flash analyser for the measurement of thermal diffusivity and calculation of thermal conductivity

Measurement and Analysis Capability

Summary of capability / facility

Staff within the NNL Preston Measurement and Analysis (M & A) capability undertake routine analysis of active materials and R & D activities concerned with new analytical techniques and instrumentation, within its Measurement & Analysis Preston Laboratory (M&A-PL) - an ISO 17025 accredited laboratory where analysis of a wide range of active materials is undertaken. The lab provides UKAS accredited radiochemical, physical, and chemical data to UK civil and defence customers. M&A-PL can support front-end fuel cycle processes involving uranium metal, oxide, UNL, silicide and carbide, and back-end activities utilising fission, activation, and trans-U radionuclides.

M&A-PL also has the capability to allow users to perform R & D trials, analytical method development, small scale ion-exchange/column trials, decontamination trials utilising similar apparatus, and techniques involving fission, activation and trans-U radionuclides.

Specification of relevant instruments and equipment available within ANSIC

Low active laboratory comprising several fume hoods including some with acid gas scrubbing functionality and high active laboratory including glovebox and shielded cell suite; air-conditioned counting room.

Approved transport containers for IP1/2/3 and Type A radioactive materials

Nuclear material capabilities (i.e. activity limits)

Safety case supports both uranic and non-uranic active operations with supporting infrastructure including waste routes.

Uranium: 15 g fissile or fissionable (note that the wider facility can handle greater amounts)

Fission/activation/trans-U.

Safety case limits:

- 5.0E+07 Bq alpha per sample
- 2.5E+09 Bq beta per sample

Note that lower limits may apply depending on the nature of the materials (dry, wet), and operations (bench, low/high active fume hood or those likely to generate airborne activity).

Radiation:

- Low active laboratory: 1 mSv/hr gamma
- High active laboratory: 20 mSv/hr gamma

High active laboratory including glovebox and shielded cell suite; air-conditioned counting room.

Approved transport containers for IP1/2/3 and Type A radioactive materials

Radiometric capability:

- 2 x 8 channel Ortec Octete alpha spectrometers
- 5 x liquid scintillation counters, 2 with alpha beta discrimination
- 6 x HPGe photon detectors
- 2 x Raddec Pyrolysers
- Standard lab equipment to facilitate radionuclide separation procedures: ion-exchange, extraction chromatography, solvent extraction

Chemical analysis capability:

- Perkin elmer Elan DRC-e Inductively Coupled Plasma – Mass Spectrometer
- Agilent 725 Inductively Coupled Plasma Optical Emission Spectrometer
- Thermo Dionex ion chromatograph
- Fisons Carlo-Erba CHONS analyser for small volume samples (<10 mg)
- pH, conductivity

Physical analysis capability:

- Density, settling behaviour and wet dry determinations

Shielding and Criticality Modelling and Assessment Capability

Summary of capability / facility

Criticality expertise

NNL has extensive experience in producing criticality safety assessments for nuclear facilities and transport packages. Added to this, our team is experienced in hazard identification processes.

They have all the expertise needed to carry out nuclear criticality safety analyses using criticality data handbooks, hand methods of calculation and Monte Carlo techniques.

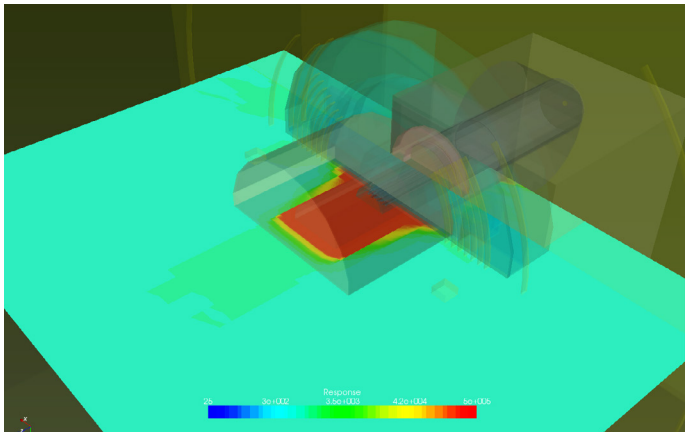
Shielding

NNL provides quality radiation shielding and dose rate assessments for its own facilities and for both UK and international customers. Our radiation shielding capability has a wide range of applications and covers the complete fuel cycle. This capability is enhanced with the latest nuclear codes capability, with nuclear codes such as MCBEND, MCNP® and ATTILA®, all of which can be run in parallel to aid enhanced quality of service to our customers in shorter timescales. In addition to these complex codes we can offer fit for purpose simplistic hand calculations or simple calculations using MICROSHIELD® and RANKERN for gamma radiation.

In addition, combined with other technical capabilities, such as criticality, reactor and nuclear physics within NNL, we can offer a complete integrated service. For example, fuel depletion calculations can be carried out in our FISPIN code or ORIGEN which can then feed directly into the above shielding codes.

NNL has the capability to produce criticality incident detection (CID) system omission cases and CID system placement assessments. Our assessors provide specialist input into emergency planning work and guidance through out-of-hours plant support and participation in criticality emergency exercises.

The team has access to specialist computational codes, including MONK, MCBEND, MCNP® and ATTILA® running on the Gemstone cluster (and standalone machines).



Specification of relevant instruments and equipment available within ANSIC

Bulk shielding assessments for neutron (spontaneous fission + alpha n), gamma and capture gamma sources

- Localised (penetration) shielding assessments for neutron (spontaneous fission + alpha n), gamma and capture gamma sources
- Skyshine calculations
- Radiation protection plans and ALARP assessments
- Classification of areas and dose uptake assessments
- Shielding design basis
- Dose/shielding assessments for transportation of radioactive material in flasks/ships both in the UK and internationally (Japan, USA)
- CIDAS placement assessment
- Emergency planning criticality dose contours
- Source inference calculations (adjoint calculations)

Waste Processing Services capability

Summary of capability / facility

The NNL Waste Processing Services team supports waste treatment from VLLW through to HLW. This is a combination of real waste treatment or treatment optimisation R & D on behalf of customers. The capability area supports all aspects of current and future waste and residue processing, dealing with a wide variety of uranic waste streams including:

- Characterising and assessing wastes and residues
- Improvement of existing chemical processes and invention of new uranic fuel cycle and waste and residue processes
- Laboratory testing and development of uranic fuel cycle and waste and residue processes
- Process flow sheeting
- Plant design, commissioning, and operation
- Plant support
- Waste and residue processing (> 3000 drums processed)

The team utilises a “phased” methodology by which materials are assessed and a solution that creates waste products which minimise environmental impact and taxpayer spend is presented. This has been successfully used in support of both operating plants and as part of the UK government funded (BEIS) Advanced Fuel Cycle Programme (AFCP)

The Waste & Residue Processing team operate a suite of medium active laboratories as well as standard laboratory equipment.

Specification of relevant instruments and equipment available within ANSIC

- X-Ray diffraction (XRD)
- Scanning electron microscope-energy dispersive X-Ray (SEM-EDX)
- X-Ray fluorescence (XRF)
- Mass spectrometry (MS)
- Thermo-gravimetric Analysis / differential scanning calorimetry (TGA/DSC)
- Liquid scintillation counting equipment

Flexible processing plant containing easily re-configured “modular” items including:

- Stirred vessels from 25 dm^3 to 10,000 dm^3 to act as dissolver/leach vessels, contactors, precipitators, settling tanks, blending tanks etc
- Various filters and-centrifuges
- Solvent extraction purification equipment
- A total enclosure
- An industrial washing machine configured to run cycles using detergent or nitric acid
- A large and very flexible off-gas scrubber

Active Robotic Laser Cutting Facility

Summary of capability / facility

NNL's Active Robotic Laser Cutting facility comprises equipment and flexible floorspace to develop, test, and demonstrate robotic and artificial intelligence (RAI) solutions for the nuclear industry. We also perform a significant proportion of our RAI programmes using our digital infrastructure for simulation, virtual reality (VR), and software development.

The research test rigs available at NNL are on an experimental and industrial scale. We act as a link between the small-scale, low TRL (1-4) robotics research and the full-scale demonstrator facilities to progress technology up to TRL 9.

NNL have a National Nuclear User Facility (NNUF) for Robotics. This is an EPSRC-funded facility to support UK academia and industry to deliver research in robotics and artificial intelligence for application in extreme and challenging nuclear environments.

Nuclear material capabilities (i.e. activity limits)

Uranium Active and Non-Active

Specification of relevant instruments and equipment available within ANSIC

Active semi-autonomous robot / robot laser cutting facility

- Industrial KR30 KUKA robot
- Semi-automated system
- Point cloud data acquisition
- Active hot cell with variable ventilation to align with nuclear facilities/ degraded buildings under decommissioning
- Automated tool changing
- Regulator approved safety case

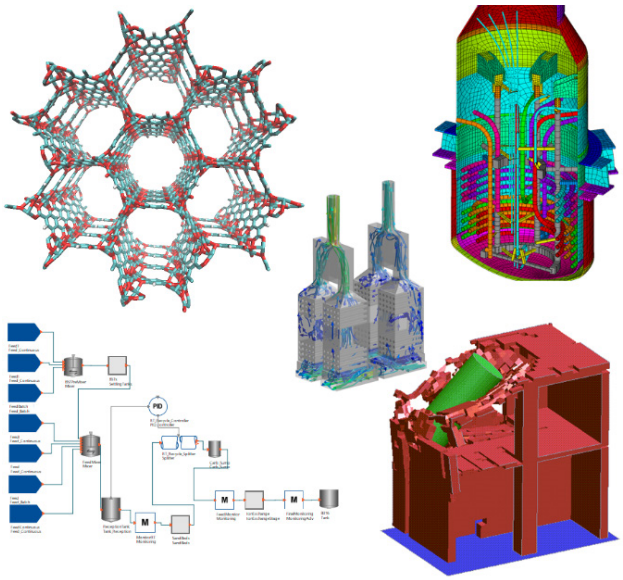
Nuclear & Reactor Physics Modelling Capability

Summary of capability / facility

The Nuclear & Reactor Physics Team are primarily all desk-based modellers all of whom own and understand a component of the overall team capability and who overlap and support each other across 3 primary capability areas - namely, nuclear physics, reactor physics and fuel performance.

An understanding of the underlying nuclear physics and underpinning reactor neutronics is a fundamental base upon which the other skills and knowledge is built upon.

The Preston team use a combination of bespoke and off-the-shelf codes to undertake their work – primarily utilising the ANSWERS code-suite for the majority of their activities.



Specification of relevant NNL software codes available within ANSIC

ANSWERS Software – including WIMS-TRAIL – Reactor Neutronics Modelling Code

- ORION (Fuel Cycle Modelling Tool)
- ENIGMA (Fuel Performance Modelling Software)
- FISPIN (Reactor Inventory Calculation Software)

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