Nuclear Innovation Programme – Safety and Security

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SYSTEMS AND ENGINEERING TECHNOLOGY

FRAZER-NASH CONSULTANCY

Introduction

"Developing digital tools and fundamental scientific understanding needed to design and build future generations of reactors in an accelerated and cost effective way, with emphasis on ever increasing safety"

NIRAB Reactor Design Recommendation – Final Report 2017

Accelerated

Reduced Costs

Increased Safety and Security Performance

- How have we got here?
- Our research and vision
- Research across four key themes
- Our research's impact

How we got here

01

2016

NIRAB Report

High-level work-stream research recommendation
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02

2017

Landscape Review

Detailed review of UK's current research base.

03

2017

Idea Generation

Eliciting challenges and idea generation by engaging with academia and industry.

04

2018

Research Topics

Detailed research topic proposals as part of an integrated project.

05

2020

Research complete

Scope of original research topics completed creating a lasting capability.

06

Beyond 2020

Dissemination & Adoption

Helping end users embed our research into their organisations to drive benefits.

At a glance

Research 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.**

3.95 million

Delivering new unique capability for UK export.

3 years

Phased research topics informed by an initial scoping investigation.

9 delivery partners

Frazer-Nash Consultancy, National Nuclear Laboratory, Jacobsen Analytics, Rolls-Royce, EDF energy, Context IS, University of York, University of Bristol, Lancaster University.

25 engineers and researchers

From academia and industry.

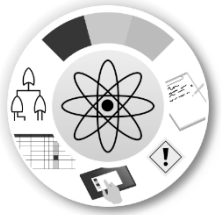
20 research topics

Spread over four different work streams.

Research themes

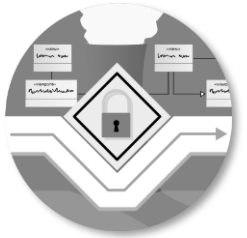
Advanced safety case methodologies

Develop a tool kit of advanced safety case methodologies that can drive down costs and support the adoption of novel nuclear technologies as a source of low carbon power.



Reactor design for safety & security

Investigating how safety and security can be optimised in facility design – augmenting the UK's skill base and developing fresh talent.



Security modelling and simulation assessment

Exploring novel security assessment and modelling methodologies that improve the integration of nuclear security with safety.

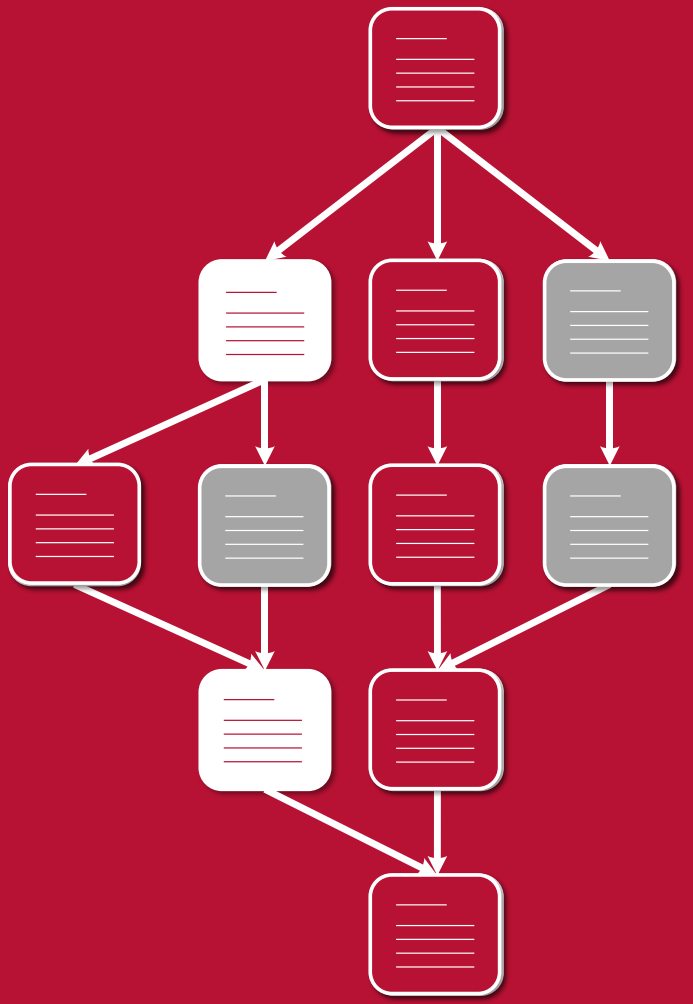
C&I safety and security design capability

Enabling modern, off-the-shelf C&I to be used in nuclear installations by developing key safety justifications, including a framework for justifying programmable elements.

Our vision

Our vision is to develop our research into an integrated safety and security development process for advanced reactor technologies. Accessible via our online portal, the process will reduce barriers to adoption of such technologies in the UK.

www.innovationfornuclear.co.uk



Concept

Preliminary

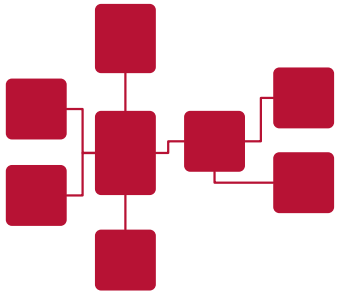
Detailed

Build & Commissioning

Operation

Advanced safety case methodologies

Providing a safety case architecture for advanced technologies



Safety Case Data Model

Template Safety cases

AMR / SMR Safety Road map

Accreditation & Training

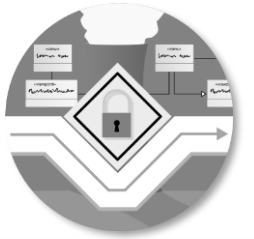
Focus on specific areas with big opportunities for improvement

Uncertainty in PSA

Extreme Hazards

- Reducing costs for advanced technologies by providing an outline safety case framework that can be used by their technology
- Building a consensus across industry for professional recognition, helping maintain the UK skill base
- Providing new approaches to specific “difficult” topics to de-risk licencing

Reactor design for safety & security



Providing the architecture and tools to enable seamless integration of safety and security for advanced technologies

Model-Based Systems Engineering template for Nuclear Systems

Practical implementation of ALARP for Security

Flexible methodologies for the security categorisation and classification of plant

Security modelling approaches for multiple SMRs

The future system architectures to enable safe penetration testing

Framework to enable knowledge transfer

+ Demonstrating how our industry can leverage technologies from other sectors to reduce costs

+ Developing approaches that enable nuclear security to transition from a discipline based on assertion to based on risk, facilitating improved outcomes

+ Addressing security issues that are unique to advanced nuclear technologies

Security modelling and simulation assessment

Building a framework that integrates best practice with regulatory expectations

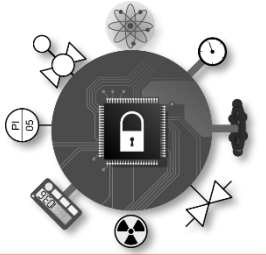
What does secure by design mean when developing nuclear technologies?

Practical guidance of how to use modelling to demonstrate compliance with SyAps

Tools and approaches for making cost / benefit decisions to support risk base approaches

- Providing engineers with an understanding of how they should implement “secure by design” to improve security performance while reducing costs.
- Giving security professionals the tools they need to demonstrate a justified risk-based approach.

C&I safety and security design capability



Developing the safety case framework to enable programmable devices

Explore new options for justifying the use of programmable control and protection systems and developing new evidence to challenge current assumptions.

Mitigating potential threats the introduction of programmable devices will bring

Supply chain road map

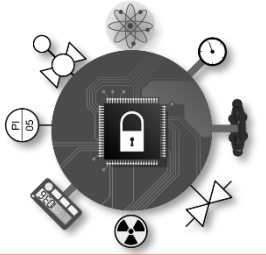
Recovering nuclear control systems

Identify and characterising the SMR control room human factor issues to inform future research

Enabling significant cost savings by providing the evidence base for reactor designs to rely on programmable systems to ensure their safety

Identifying both safety, security and commercial risks behind the adoption of programmable devices to enable reactor vendors to take early action and direct future research

C&I safety and security design capability



Delivering new techniques and facilities to enhance the testability of programmable devices to support safety justifications

Learn from other safety critical industries to establish alternative techniques for testing new nuclear C&I.

A facility that can undertake statistical testing and qualification of devices for nuclear safety systems.

Promoting testability through identifying appropriate requirements for platform and device development.

Providing a UK capability that can be exported worldwide to support nuclear programmable device manufacturers

Helping device manufacturers to understand the unique needs of the nuclear industry, increasing access for novel technologies and approaches

The impact

> Our research has given us and our delivery partners the unique opportunity to foster relationships and explore international opportunities that we would of not been able to without it. And we are not done yet!

I am a security professional

Educating safety and security professionals about their respective disciplines

International Influence

Driving engagement with several international bodies and prospective international end users

Collaborations

Engagement with three SMR & AMR reactor vendors as well as existing nuclear generators

2 conference papers

And counting…

Summary

- The Safety and Security landscape is challenged by speed, cost and requirement.
- Our research is focused on four key themes seeks to help address this issue by providing practical guidance and tools to support advanced nuclear technologies.
- Our vision is to develop our research into an integrated safety and security development process for advanced reactor technologies, accessible via our online portal.
- Our research has given us and our delivery partners the unique opportunity to foster relationships and explore international opportunities.

Don’t want to ask your question now? Come and find out more about our research and how you can be involved at stand 11, in the exhibition room.

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.