Developing a Regulatory Framework for Fusion Energy Systems

NRC Public Meeting

September 16, 2021

U.S.NRC

United States Nuclear Regulatory Commission

Protecting People and the Environment

Agenda

Time	Speaker	Topic
10:00-10:15am	NRC	Welcome/Introductions/Opening Remarks
10:15-10:20am	United Kingdom Atomic Energy Authority (UKAEA) *Dr. Sally Forbes*	Introduction: The regulatory journey for future fusion power reactors in the UK
10:20-10:35am	UKAEA *Dr. Sally Forbes*	Fusion technologies being developed in the UK and accident scenario studies
10:35-10:50am	Health & Safety Executive (HSE) *James Taylor*	HSE and the regulation of fusion
10:50-11:05am	Environment Agency (EA) *Ian Streatfield*	EA and the regulation of fusion
11:05-11:20am	Regulatory Horizons Council (RHC) *Parag Vyas*	RHCs Report on Fusion Energy Regulation
11:20-11:35am	Department of Business, Energy & Industrial Strategy (BEIS) *Edward Lewis-Smith*	Government consultation on fusion regulation
11:35-11:50am	All	General Discussion – Insights on Regulatory Approaches
11:50-12:00pm	Break	
12:00-12:15pm	NRC	Status of Recent Activities and Insights on Regulatory Approaches
12:15-12:30pm	All	Questions/Closing Remarks/Next Steps

UK Atomic Energy Authority

NRC Public Meeting on Fusion Regulation September 2021:

The Regulatory Journey for Future Fusion Power Reactors in the UK

Dr Sally Forbes

Fusion Safety Authority

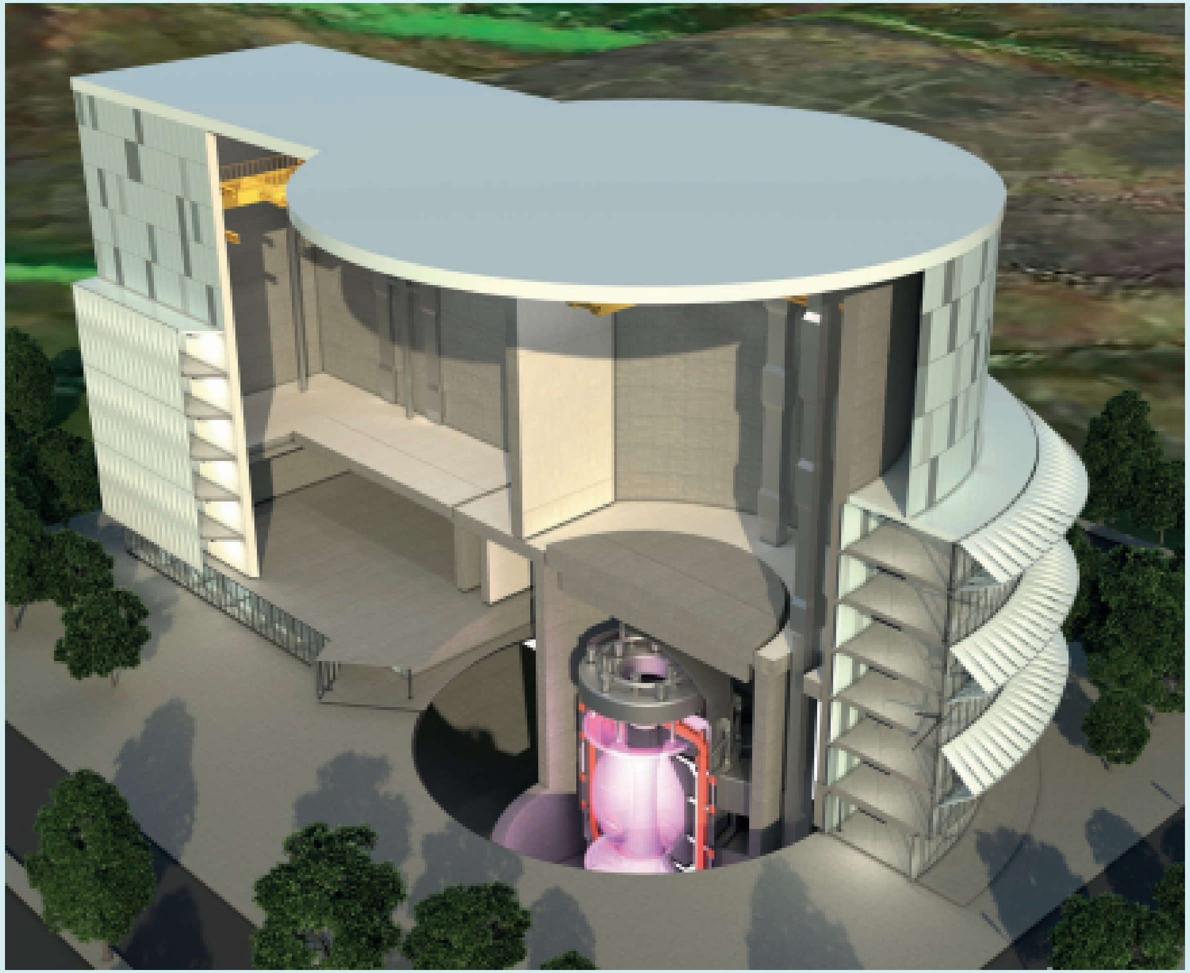
Introduction

UK Atomic Energy Authority

- Fusion technologies - Current developments in the UK
- Fusion hazards - Radiological accident scenarios
- Health & Safety Executive (HSE) – Regulation of fusion
- Environment Agency (EA) – Regulation of fusion
- Regulatory Horizons Council (HSE) – Report on Fusion Energy
- Dept of Business, Energy & Industrial Strategy (BEIS) – Government consultation

Spherical Tokamak for Energy Production

UK Atomic Energy Authority



World's first, fully-integrated fusion energy plant

Phase 1

- Develop concept design
- Select a site

Phase 2

- Detailed engineering design
- Permissions and consents
- Pre-construction works

Phase 3

- Manufacturing
- Construction

UK Atomic Energy Authority

STEP high-level schedule

2021 | 2025 | 2030 | 2035 | 2040

Concept (till 3/24)

- Concept / Reference Plant Design
- Programme Development
- Site selection
- Transition to Target Operating Model

Detailed Design and Mobilisation

- Engineering Design
- Long lead procurement
- Early Manufacture
- Site development

Main Construction

- Full plant manufacture and assembly
- Full site development
- Equipment and system testing

Commissioning and Operations

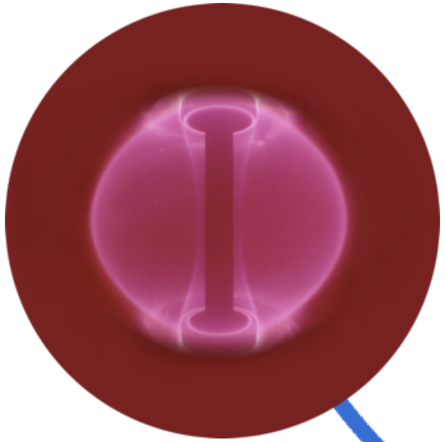
- Non-active and active commissioning
- Prototype ops

Two technologies unlock Commercial Fusion

tokamak energy
a faster way to fusion

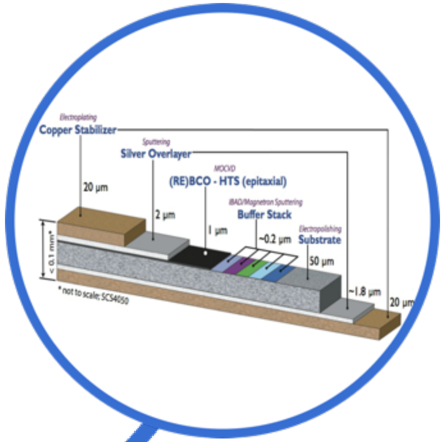
Spherical Tokamak

Squashed shape, highly efficient



High Temperature Superconductors

High magnetic fields

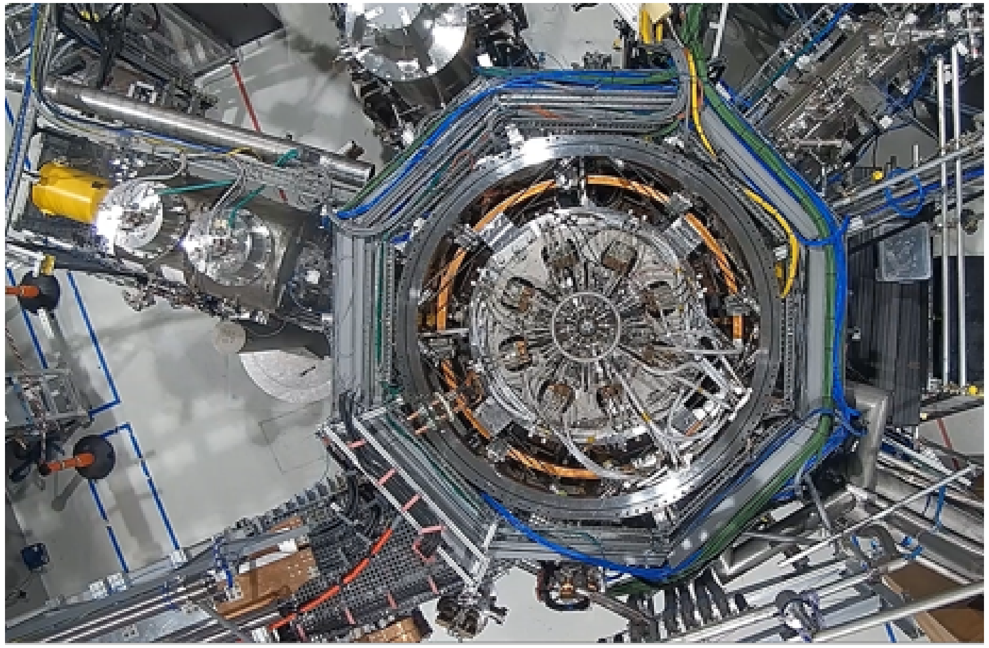


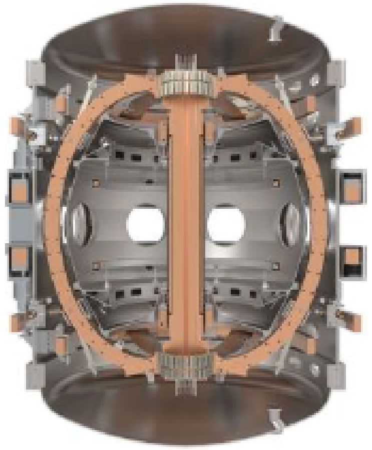
Commercial Fusion Power

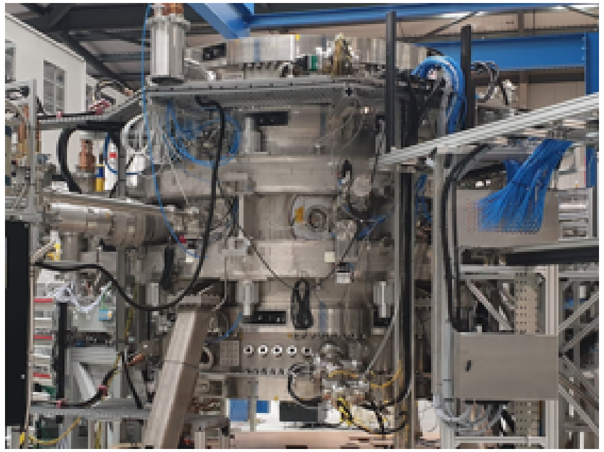
Smaller, cheaper, faster...... with strong competitive advantage

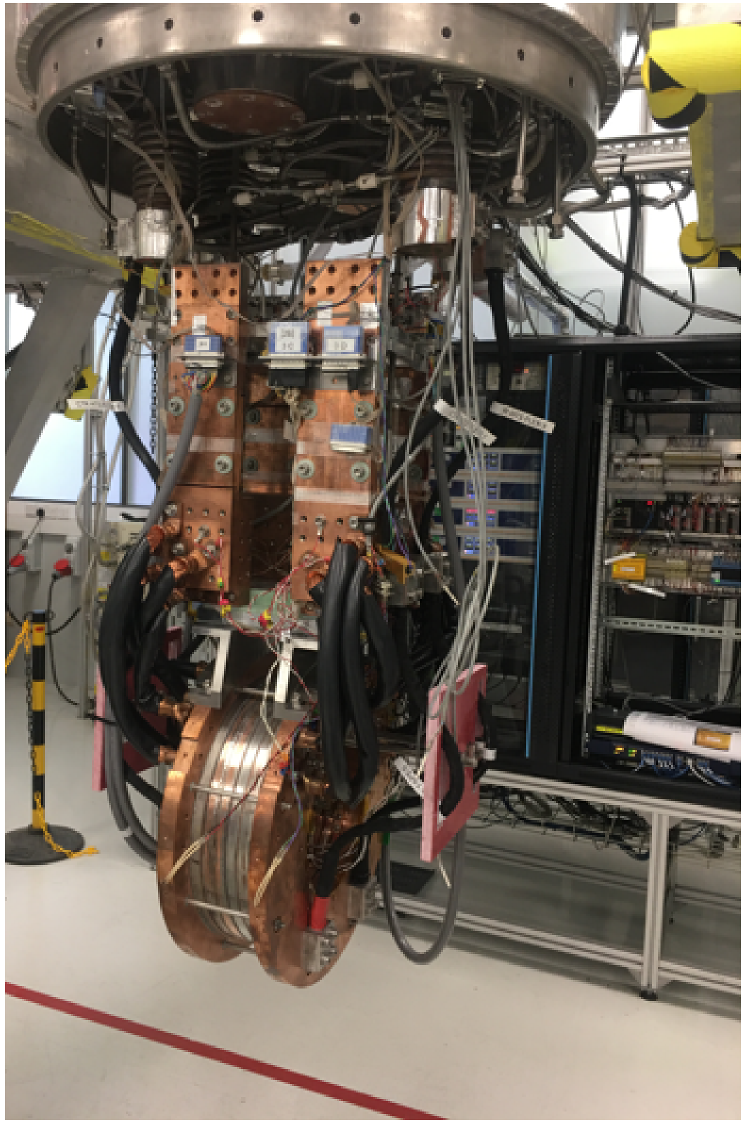
ST40 Device and Powerful Magnets

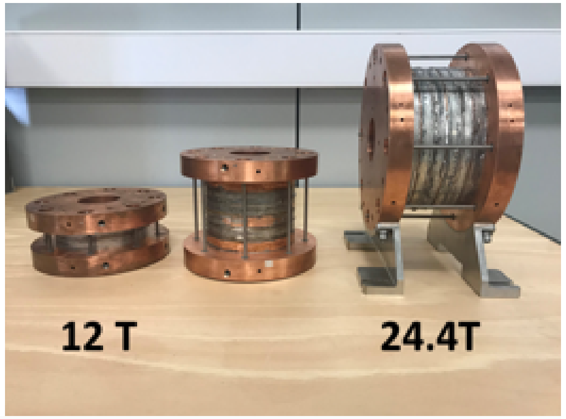
tokamak energy
a faster way to fusion

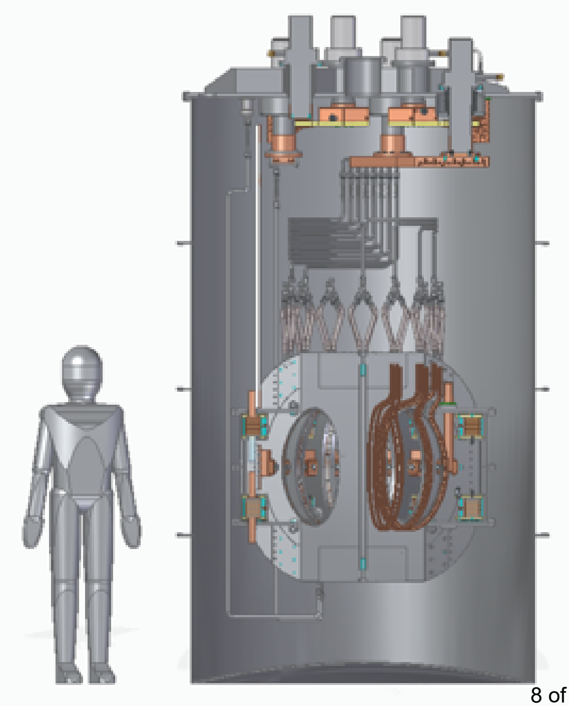






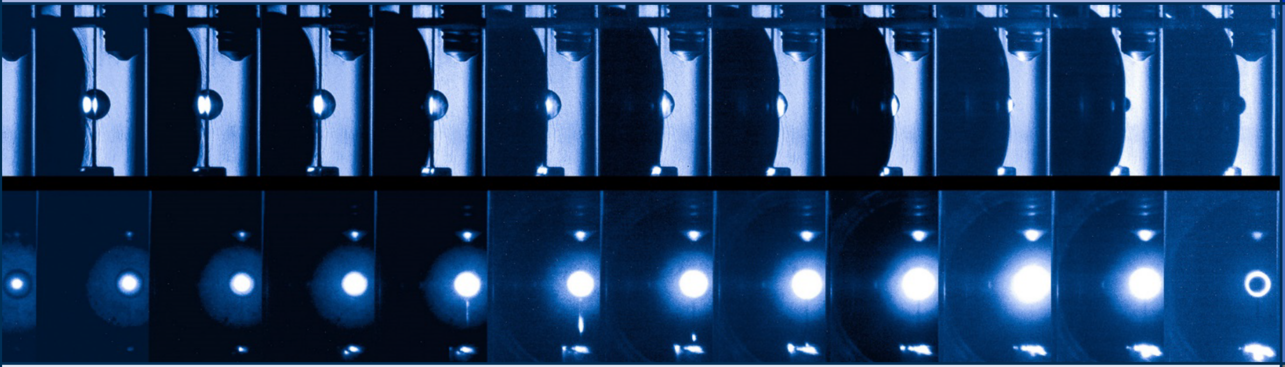






First Light Fusion

- University of Oxford spin-out, fusion energy pioneer
- Ground breaking R&D in many areas including: pulsed power; simulation; and fusion plant engineering
- $25m of funding in 2020 from both specialised cleantech and global institutions



Projectile-driven inertial fusion

- Sidesteps major known challenges of fusion engineering
- Offers a simpler route to a commercial power plant
- Has the potential to generate energy at very competitive LCOE

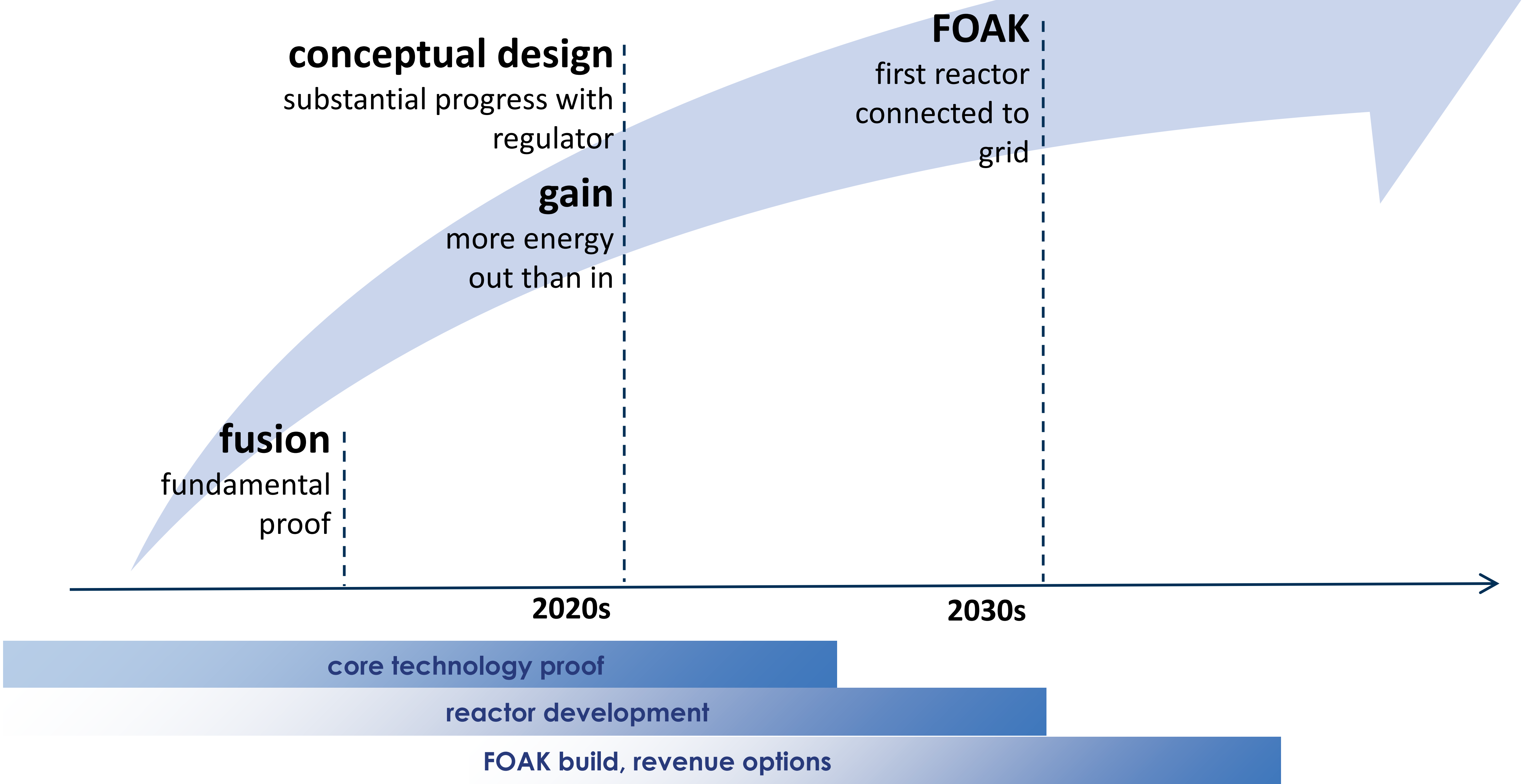
Advanced capabilities

- World-class plasma simulation tools that are regularly validated against boundary-pushing experiments
- Machine 3's advanced engineering accelerates our projectile from zero to >15 km/s in less than 1 cm.

Cooperation is key

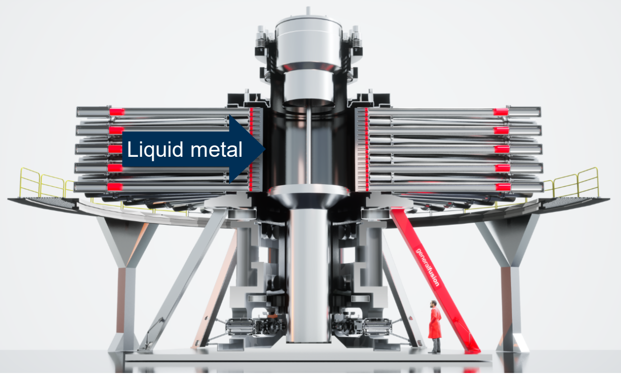
- Collaborating with UKAEA, academia and power plant engineering consultants
- Unique opportunities for collaboration in balance of plant and fusion island development

our simpler technology enables a realistic faster timeline



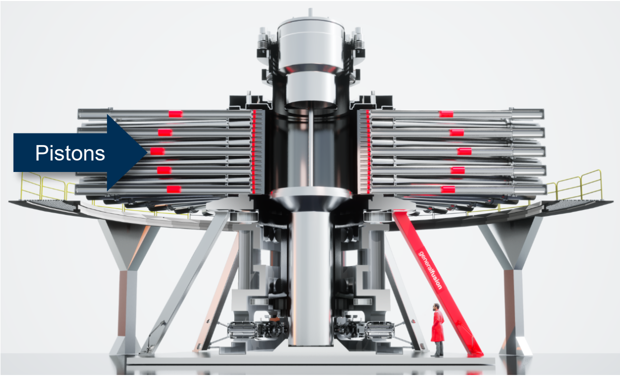
General Fusion's Magnetized Target Fusion technology

Set up



An inner chamber cavity of approximately four meters in diameter is formed by rotated liquid metal inside the fusion vessel, surrounded by a phased array of several hundred pistons.

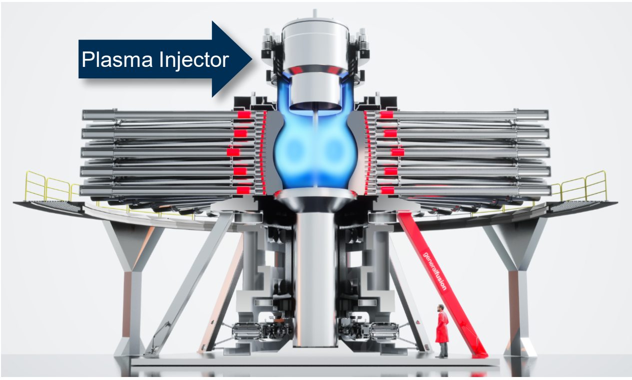
Compression system launch



The inner chamber cavity is quickly pushed inwards by the precisely synchronized pistons.

Timing and pressure variations in the pistons pushes the liquid metal from a cylinder into a spherical cavity to compress the plasma.

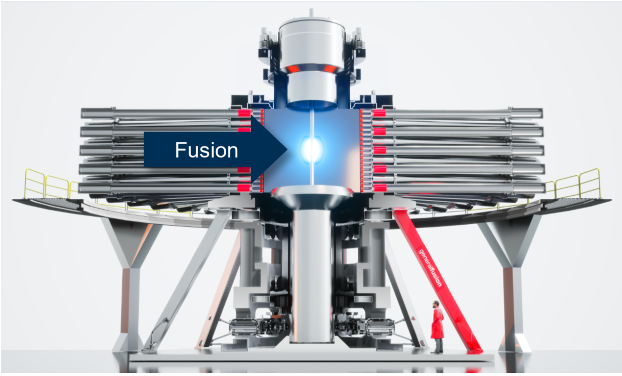
Plasma injection



Simultaneously, a hot magnetized plasma at 5 million degrees Celsius is formed by a plasma injector and inserted into the chamber cavity.

Confined within the collapsing metal cavity, the plasma is compressed and heated to over 100 million degrees Celsius, creating fusion conditions.

Fusion and energy conversion



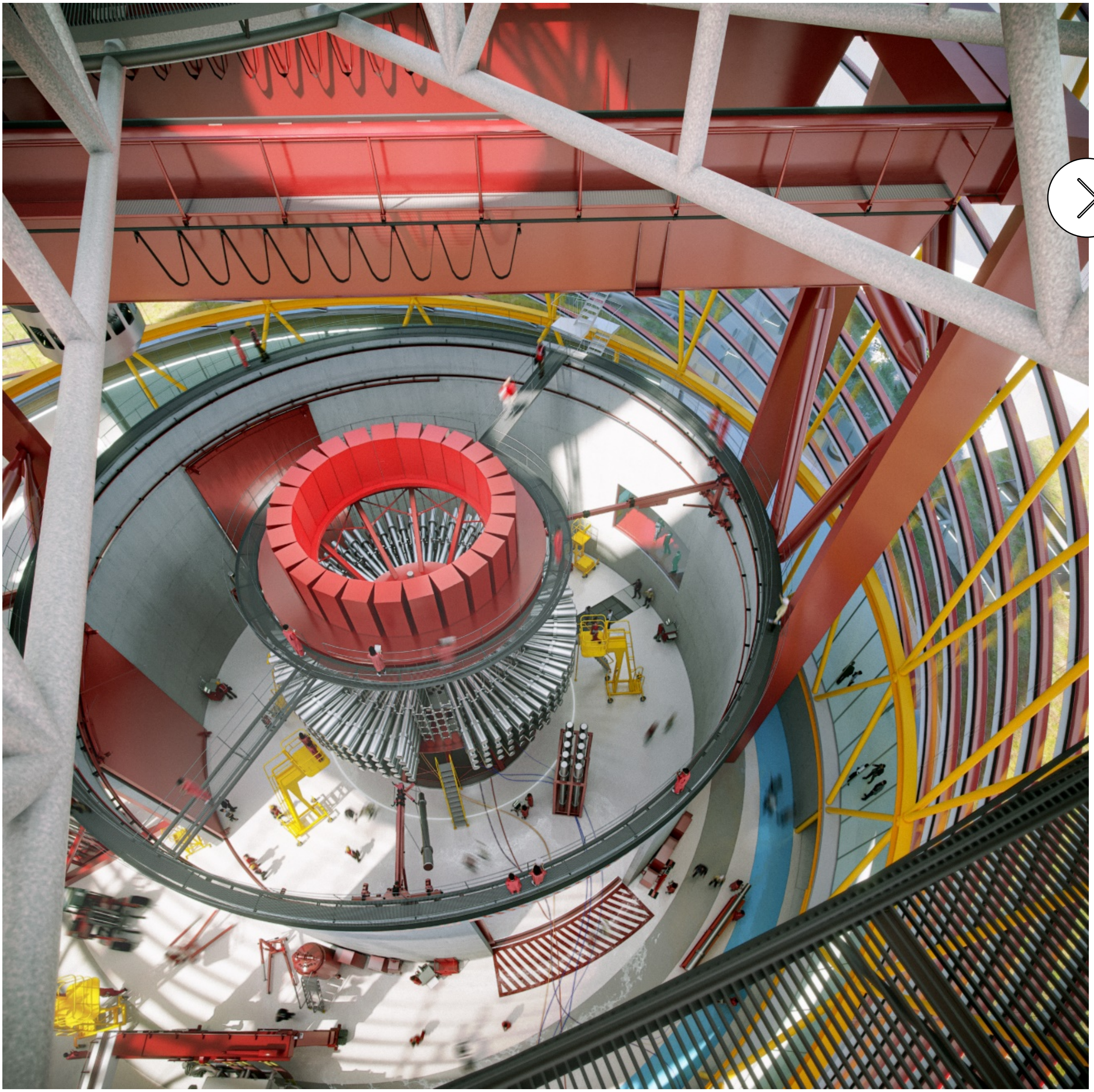
Fusion energy is released and absorbed into the surrounding liquid metal, heating it to about 500 degrees Celsius.

Hot liquid metal is extracted and converted to steam. The steam drives a turbine to produce electricity and recharges the pistons for the next cycle.

Then, the cavity reopens, pistons reset, and cycle repeats one time per second.

The fusion equivalent of a diesel engine: practical, durable, cost-effective

The Fusion Demonstration Plant



70% scale
of commercial power plant

1 pulse per day
repetition rate

Off-grid
demonstration prototype

The FDP has 2 key goals:

- Demonstrate, at power plant-scale, that **fusion conditions can be practically achieved** using General Fusion’s technology
- Refine **commercial fusion power plant economics**, based on actual FDP performance

Commercializing Magnetized Target Fusion

- **The Fusion Demonstration Plant will confirm the performance and economics of Magnetized Target Fusion**
- **The next step will be a full-scale Commercial Pilot Plant (CPP) that will generate electricity**

2021 – 2025

Commence design and build of the **Fusion Demonstration Plant** at UKAEA's Culham Campus

Initiate the design of the **CPP**

Outreach in key markets to engage with **potential customers** to gain insight into the **deliverables** required of General Fusion's technology

Engagement with **governments** for **funding** and **regulation** of fusion energy

2025 – 2030

- **Fusion Demonstration Plant** starts operations and evaluation in 2025
- General Fusion engages with early **customers**
- Continue to evolve the design and technology of the **CPP**
- Ongoing engagement with **governments** to build out the **regulatory framework**
- Start of **construction** on the first **CPP**

2030 – 2035

- **CPP** commences **operations**

Fusion Hazards – Radiological Accident Scenarios

Dr Sally Forbes
Fusion Safety Authority

Radiological accident scenarios

- UKAEA has been providing technical expertise in the areas of fusion safety, security, environment and waste
- Collated information from published safety studies into early concept designs for fusion power plant *
- These have estimated potential public doses in bounding and hypothetical worst case scenarios (eg. loss of coolant accidents with breach of confinement barriers, resulting in release of tritium and activated dust to the environment)
- Show that potential public doses in these scenarios are much less than for the worst case fission power station accidents (ie. Chernobyl / Fukushima)
- Supports a hazard / risk based approach to a proportionate regulatory framework for fusion

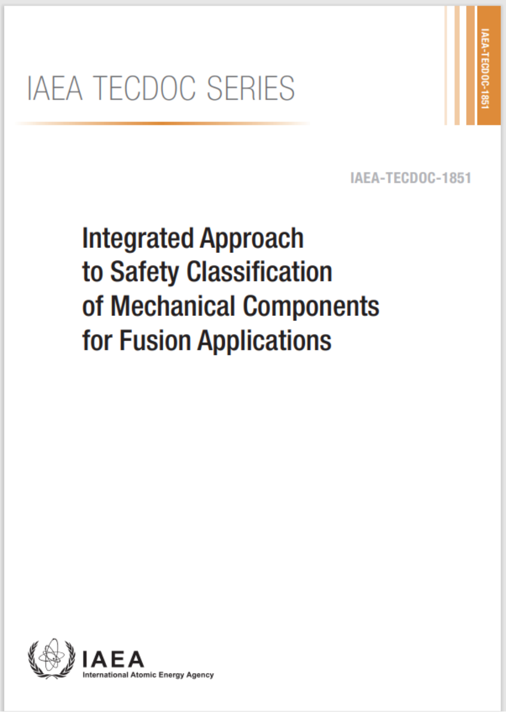
* eg. European Safety and Environmental Assessment of Fusion Power (SEAFP)/Power Plant Conceptual Study (PPCS)

eg. also HYLIFE & SOMBRERO inertial fusion design, ARIES stellerator design

International Atomic Energy Agency

UK Atomic Energy Authority

- Series of IAEA Technical Meetings on Safety for Fusion
- Published TECDOC on Safety Classification of Mechanical Components for Fusion Applications
- Next step is to produce TECDOCs on:
  - Fusion Power Plant Regulation (led by UKAEA)
  - Safety Assessment and Design Guidelines for Fusion Power Plant (led by ITER)



HSE and the Regulation of Fusion

James Taylor

Principal Specialist Inspector (Radiation)

HSE Aims

As a regulator, we aim to prevent workplace death, injury or ill health by:

- providing advice, information and guidance
- raising awareness in workplaces by influencing and engaging
- operating permissioning and licensing activities in major hazard industries
- carrying out targeted inspections and investigations
- taking enforcement action to prevent harm and hold those who break the law to account

How HSE Operates

HSE applies these principles when conducting its activities:

- Prioritise according to risk
- Proportionality in how we apply the law and secure compliance
- Targeting of our enforcement action
- Consistency of our approach
- Transparency about how we operate and what an employer can expect
- Accountability for our actions

Fusion: Hazard and Risk

- Low general risk compared to other activities regulated by HSE e.g.
  - Oil and gas
  - Petrochemicals
- Similar or lower risk to other HSE regulated radiation practices such as
  - Cyclotrons used for radioisotope production
  - Betatrons used for industrial radiography
  - Large scale industrial sterilisation plants

Fusion: Hazard and Risk

- No runaway reactions
- No very long-lived radioactive waste
- Small external dose rates
    - Aim for <1mSv h^{-1} outside biological shielding
- Tritium characteristics
    - 12.3 y half-life
    - 10 day biological half-life
    - Low radiotoxicity

The Regulation of Fusion Technology: Legislation (1)

General Duties:

<u>Primary Legislation:</u>

The Health and Safety at Work etc Act 1974 (HSWA)

- Duty to control risk so far as is reasonably practicable

<u>Secondary Legislation</u>

The Management of Health and Safety at Work Regulations 1999 (Management Regs)

- Duty to carry out a risk assessment to reduce risks as low as reasonably practicable

The Regulation of Fusion Technology: Legislation (2)

The Radiation Hazard:

Ionising radiation:

The Ionising Radiation Regulations 2017 (IRR 17)

- relevant because of the use of tritium, the generation of neutrons and the likely production of radioactive activation products

The Radiation (Emergency Preparedness and Public Information) Regulations 2019 (REPPIR 19)

- relevant because of the storage of tritium on site

Non-ionising radiation

The Control of Electromagnetic Fields at Work Regulations 2016

- controls the risks associated with the high magnetic fields in and around a fusion reactor

The Control of Artificial Optical Radiation at Work Regulations 2010

- Controls the risks associated with the use of lasers for fusion purposes

Regulatory Approach

- Primary responsibility for managing workplace risks lies with the business or person that creates the risk.

- As a regulator, HSE's role is to determine that businesses are *effectively* and *proportionately* managing their health and safety risks to workers and others

- The general duties require risks to workers and others health and safety are controlled so far as is reasonably practicable.

- HSWA is firmly goal-setting and outcome focussed establishing goals to be achieved rather than absolute standards to be met and approaches to be followed.

- Employers are encouraged to be active managers of their risks rather than passive recipients of instruction.

Future Fusion

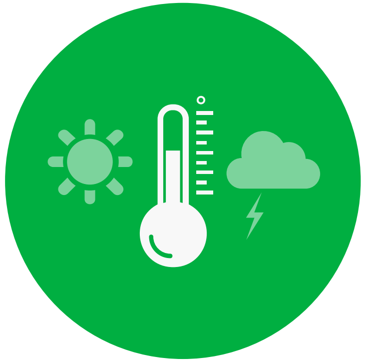
- HSE considers current goal setting regulatory regime is adequate (and has been successful in regulating experimental fusion reactors)
- The IRR17, REPPIR19 and the regulations applicable to non-ionising radiation have been and will be adequate to control any radiological risks
- A new proposed consent system will add an additional layer of reassurance – the submission of a safety assessment(s) and its review by HSE is likely to be required
- HSE will work closely with operators and other regulators to further define standards and assist operators during the design, operation and decommissioning phases.

Environment Agency regulation of fusion

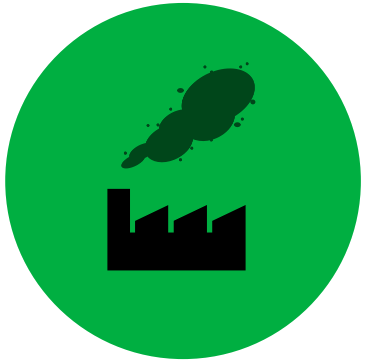
Ian Streatfield
Manager, Advanced Nuclear Technologies
16 September 2021

Environment Agency

What we do: We protect and improve the environment



We help people and wildlife adapt to climate change and reduce its impacts.



We improve the quality of our water, land and air by tackling pollution.

We work as part of the Defra group to create a better place for people and wildlife.

Environment Agency

Our principles: how we make choices

Focus on the **20%** that makes **80%** of the difference.

Support local priorities.

Put people and wildlife first.

Environment Agency

Environmental regulators

NIEA Northern Ireland Environment Agency
www.ni-environment.gov.uk

SEPA Scottish Environment Protection Agency

Environment Agency

Cyfoeth Naturiol Cymru
Natural Resources Wales

Our Role

Environmental and security regulator for non-nuclear radioactive substances users in England

- We permit keeping and use of radioactive substances and accumulation and disposal of radioactive waste

Environmental regulator for the nuclear industry in England

- We permit disposal of radioactive waste from nuclear power station including the waste arising from decommissioning

Environment Agency

BEIS Advanced Modular Reactor (AMR) Competition

- **Phase 1 (Feasibility Study)**: Up to £4 million funding to carry out a series of feasibility studies for AMR designs (to January 2019)

High temperature reactor

Sodium-cooled fast reactor

Molten Salt Reactor

High temperature reactor

Lead-cooled fast reactor

Fusion Reactor

High temperature reactor

Lead-cooled fast reactor

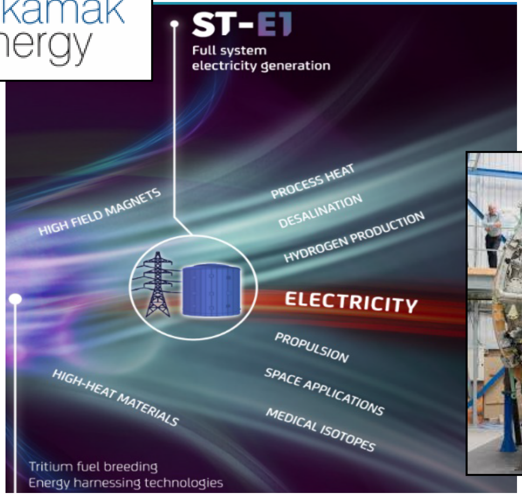
- **Phase 2 (Design Development)**: a share of up to £40 million was available for selected projects from phase 1 to undertake development activities. A further £5 million may also be made available for regulators to support

Future fusion in the UK

UK Atomic Energy Authority

generalfusion

tokamak energy



first light

Current and future initiatives related to fusion

- Reviewed existing regulatory framework
- Review charging (consultation to move to time and materials basis)
- Continue to build capacity and capability
- Review and revise guidance
- Review how to enable innovation through regulation and influence

Environment Agency

Working with others (1)

Regulators

- Long established working relationships with both HSE and ONR, underpinned by Memoranda of Understanding
- Clear responsibilities
- Coordinated engagement with Operators where appropriate
- Consider joint guidance where appropriate

Environment Agency

Working with others (2)

Operators

- Significant experience regulating Culham Centre for Fusion Energy
- Early engagement / pre-permitting is key
- Enabling, “Yes if” approach, clarifying regulatory expectations
- Learning from wider regulation of other industrial sectors

Other stakeholders

- Experience of regulating sites of high public interest
- Public consultation is a key aspect of environmental permitting regulations

Environment Agency

Environment Agency

REGULATORY HORIZONS COUNCIL

NRC Public Meeting on Fusion Regulation

16 September 2021

About the RHC

RHC Charter

- The Regulatory Horizons Council (RHC) is **an independent expert committee** that identifies the implications of technological innovation, and provides government with impartial, expert advice on the regulatory reform required to support its **rapid and safe** introduction.
- "In developing ideas and recommendations, the Council will engage openly and transparently with research institutions, business, civil society, policymakers, regulators and other contributors as appropriate. It will draw on a broad range of expertise, help build consensus and ensure recommendations are sufficiently contextualised."
- "The government will … [publish] a formal response to all the recommendations contained in the Council's reports**, stating clearly whether the government accepts or rejects the recommendations**; giving reasons where it disagrees with the Council's recommendations, and where appropriate presenting an alternative proposal for enabling the proposed innovation; and providing timelines for implementation where it agrees with the Council's recommendations, and making clear which commitments are new policies."

RHC Charter: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/881237/RHC_Charter.pdf

About the RHC

- Newly constituted body, one year old
- Five council members plus Chair, drawn from diverse industrial, academic and public backgrounds
- Agile and cross-disciplinary
- Report on Fusion Energy, 31st May 2021

https://www.gov.uk/government/groups/regulatory-horizons-council-rhc

Exam Question

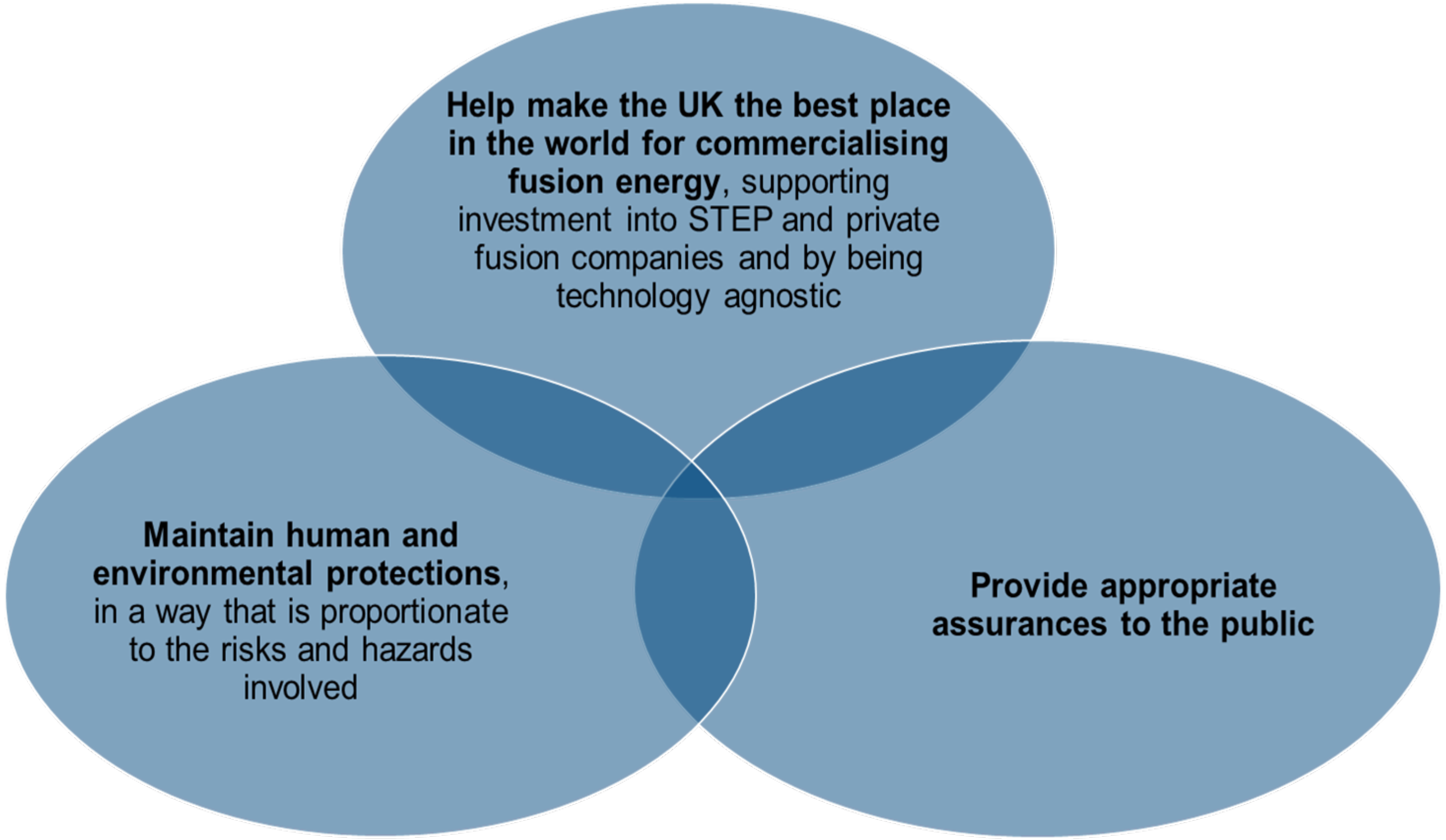
Overarching Exam Question
How can the UK continue to move towards an innovation friendly, long-term regulatory framework for fusion?

First Deliverable
Through participatory engagement the RHC will produce a report to influence on the decision to select a Fusion Regulator for STEP (Spherical Tokamak for Energy Production).

Secondary Deliverable
The RHC to produce a report on the broader topic of what a fusion regulatory framework should look like, particularly on a commercial basis. This report will build on and complement work done on the STEP question.

Supplementary Question (Ongoing)
How can the RHC contribute towards promoting an international regulatory framework that facilitates the long-term future trade of fusion energy?

Objectives


Help make the UK the best place in the world for commercialising fusion energy, supporting investment into STEP and private fusion companies and by being technology agnostic
Maintain human and environmental protections, in a way that is proportionate to the risks and hazards involved
Provide appropriate assurances to the public

Key criteria

1. **Proportionate and agile**
2. **Perception and trust**
3. **Lessons learnt and understanding**
4. **Experimentation and forward-looking**
5. **Support and collaboration**

Recommendations

Main Recommendation

The RHC recommends that the UK champions the way for a non-fission approach, by setting out and consulting on a bold, forward-looking vision of how the Health and Safety Executive (HSE) and Environment Agency (EA) could lead and evolve the regulatory approach for STEP.

- The RHC found that although changes, potentially including legislation, will be needed, STEP does not require a different regulatory approach from that which has worked well for fusion in the UK to date. The EA and HSE provide the proportionate framework for regulation of STEP commensurate with the hazards presented by the technology.

Second Recommendation

Guidance on the EA and HSE regulatory approach to fusion should be produced to explain to stakeholders and the public how this works in practice. The guidance would help provide both clarity and reassurance concerning the UK's regulatory approach for STEP.

https://www.gov.uk/government/publications/regulatory-horizons-council-report-on-fusion-energy-regulation

Government Response

Department for Business, Energy & Industrial Strategy

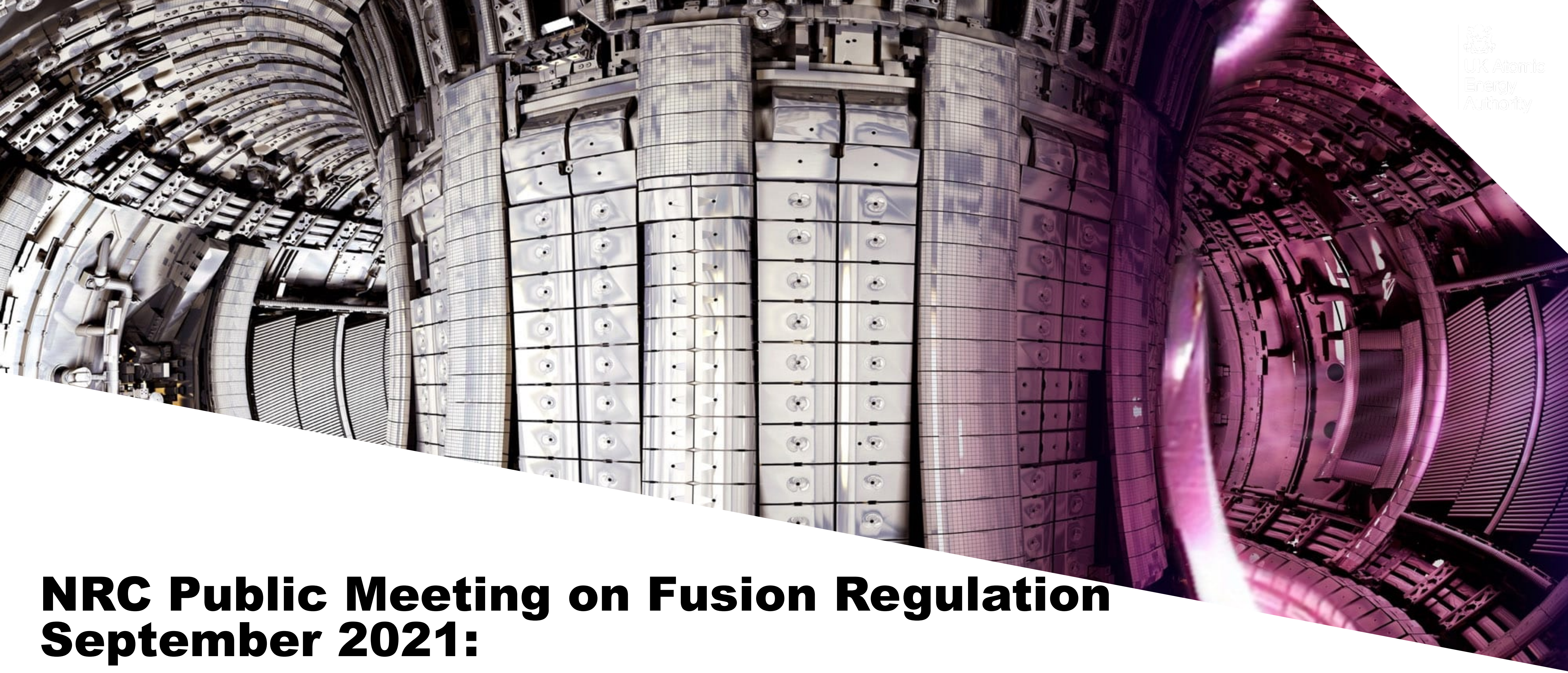
"The Government agrees with the RHC that the lower intrinsic hazard of the fusion process when compared to fission is an incredibly important factor in considering the regulatory framework for fusion. It is also important to recognise the hazards in the fusion process and the overall technical uncertainty given that fusion is still a developing technology. The complexity of this issue means that the Government cannot yet take a firm view on the RHC's recommendations. However, BEIS commits to respond fully, in line with the RHC Charter, once it has considered responses to the forthcoming consultation in early 2022.

I am very grateful to the Regulatory Horizons Council for their important and valued contribution to the subject of fusion regulation, and for helping to show that the UK is serious about fusion and unleashing innovation across the UK."

AMANDA SOLLOWAY MP

Parliamentary Under Secretary of State - Minister for Science, Research and Innovation

https://www.gov.uk/government/publications/government-response-to-the-regulatory-horizons-councils-report-on-fusion-energy



NRC Public Meeting on Fusion Regulation September 2021:

The Regulatory Journey for Future Fusion Power Reactors

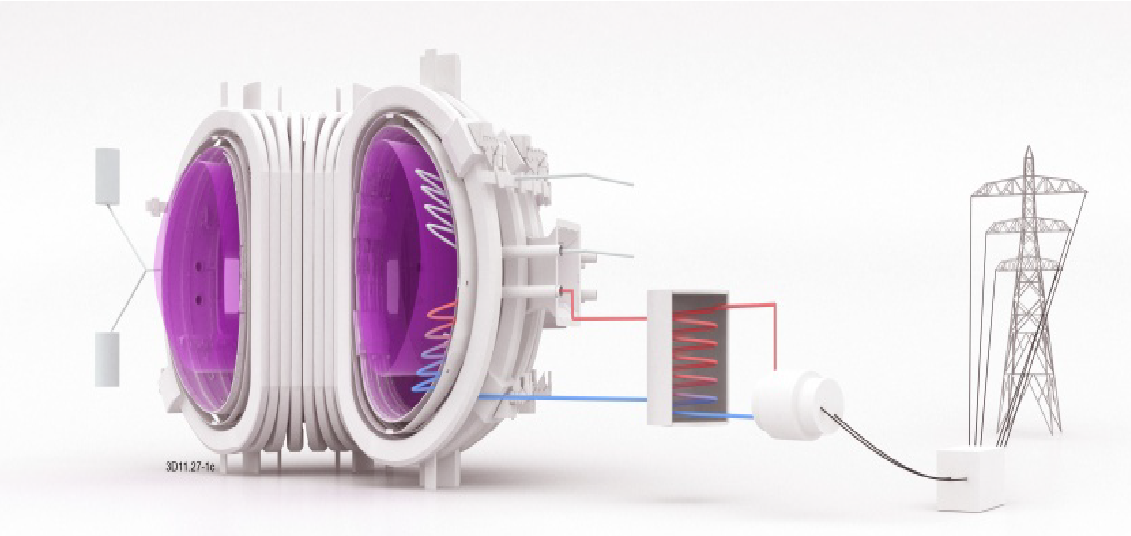
- Edward Lewis-Smith
- BEIS - Domestic Fusion Policy

BEIS review of the regulatory framework 2

- Undertaking a review of the current fusion regulatory framework in the UK, to consider how best to support innovation in fusion

- Supported by UKAEA's Fusion Safety Authority and the regulators

- As progress from experimental facilities to demonstration facilities on the path to commercial fusion power reactors, level of hazard will change - tritium inventory, activated materials, radioactive waste



euro-fusion.org

Government response to RHC

3

- The Government agrees with the RHC that the lower intrinsic hazard of the fusion process when compared to fission is an incredibly important factor in considering the regulatory framework for fusion.
- It is also important to recognise the hazards in the fusion process and the overall technical uncertainty given that fusion is still a developing technology.
- The Government plans to publish a full consultation on Fusion Regulation later this year, enabling all stakeholders and the public the chance to have their say.

Importance of Engagement

- Regulatory harmonisation will be essential for global development and deployment of fusion – this requires sustained engagement

- To successfully commercialise fusion, public understanding of and support for fusion energy is crucial. Trust in regulatory measures will be a key factor in that support.

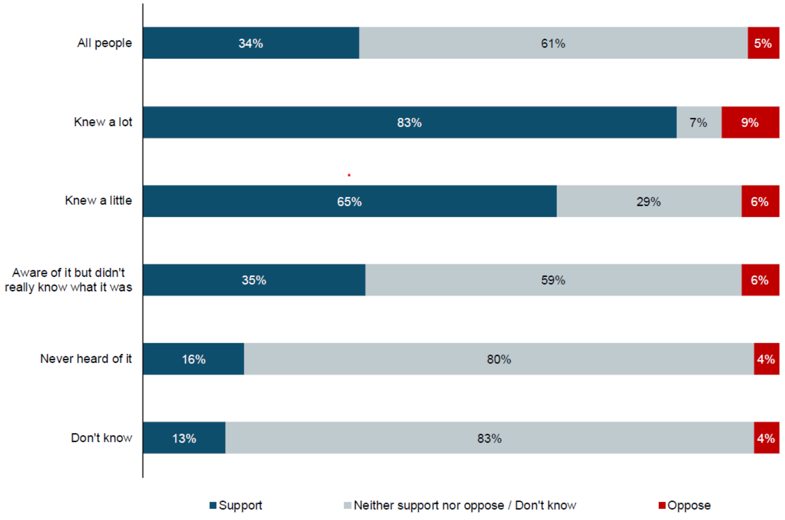
Current Engagement

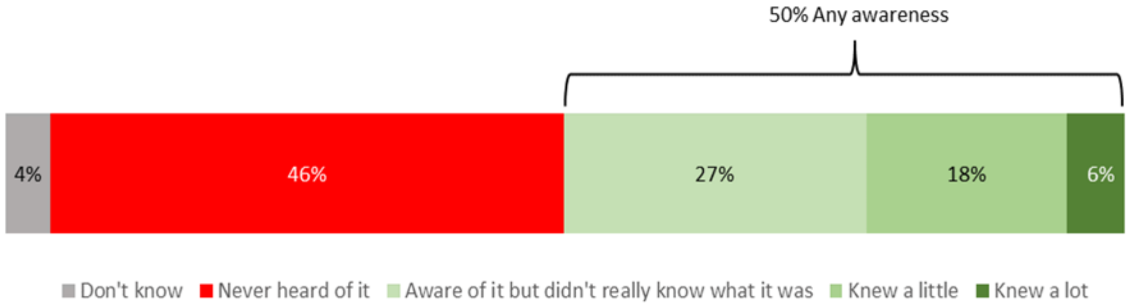
5

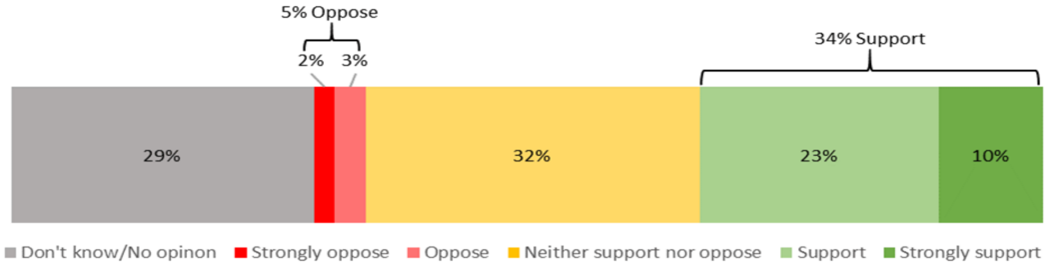
- BEIS operates a Public Attitudes Tracker to gauge UK public opinion on a range of issues. Fusion was included for first time in Septembe 2020 (next in September 2021)

- Opposition to fusion is very low (5%), but knowledge of fusion is relatively low too (24%)

- Increased awareness and knowledge of fusion strongly correlates with increased support







Q230. Before today, how much did you know about fusion energy?

Summary

UK Atomic Energy Authority

- We thank the NRC reaching out to the UK to share its regulatory journey for fusion
- It has come at the right time as the fusion community is rapidly mobilising to move from R&D facilities to the development of prototype / demonstration fusion power reactors on the path to commercialisation
- Having a proportionate and enabling regulatory framework is a key part of this journey
- We have a growing international fusion regulatory community - the work being undertaken by the IAEA in these areas will hopefully provide an international platform for ongoing collaboration and harmonisation

Thank you !

Discussion – International Perspectives

United States Nuclear Regulatory Commission
Protecting People and the Environment

September 16, 2021

Developing a Fusion Framework:
Recent Activities and Insights on Regulatory Approaches.

Agenda

1. Overview of white paper: “*Preliminary Options for a Regulatory Framework for Fusion Systems*.”

2. Insights into Decision-Making Graded Criteria.

3. Next Steps/Future Activities.

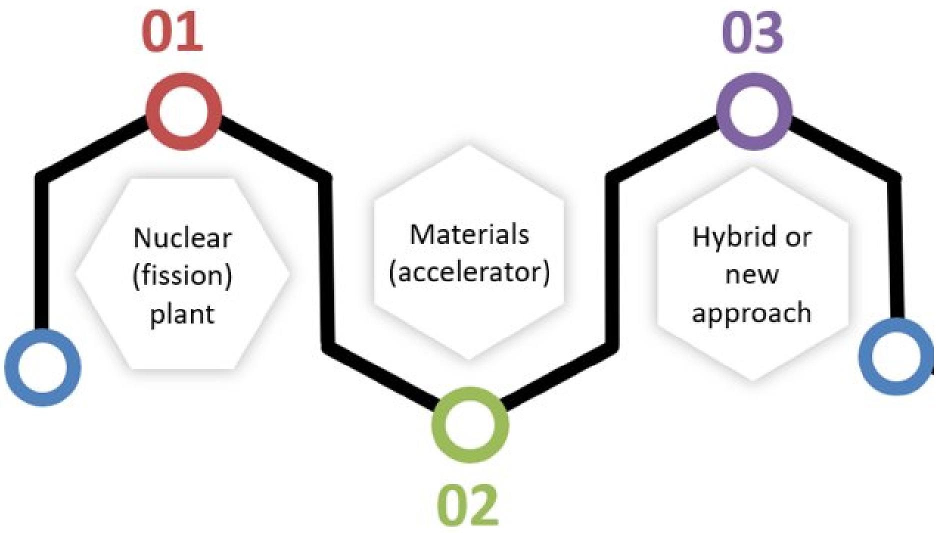
White Paper: Preliminary Options for a Regulatory Framework for Fusion Systems[1]

- Issued April 21, 2021, to support interactions with the Advisory Committee on Reactor Safeguards (ACRS).
- ACRS reviews and advises the Commission on technical and policy issues related to Advanced Nuclear Reactors (among other things).
- Per NEIMA[2] definition, Advanced Nuclear Reactor means a nuclear fission or **fusion** reactor.

[1] White Paper: "Preliminary Options for a Regulatory Framework for Fusion Systems" is available at Agencywide Document Access and Management System (ADAMS) Accession No. ML21118A081
[2] Nuclear Energy Innovation and Modernization Act (NEIMA) - PUBLIC LAW 115–439—JAN. 14, 2019

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

White Paper: Preliminary Options for a Regulatory Framework for Fusion Systems



- White paper reflects preliminary options for the regulatory treatment of fusion systems being considered by the NRC.
- Concepts and high-level regulatory options have been previously shared with stakeholders during public meetings and will continue to be developed.
- White paper reflects input received from external stakeholders via letters and public forums. This will be critical in informing the final regulatory options SECY paper.

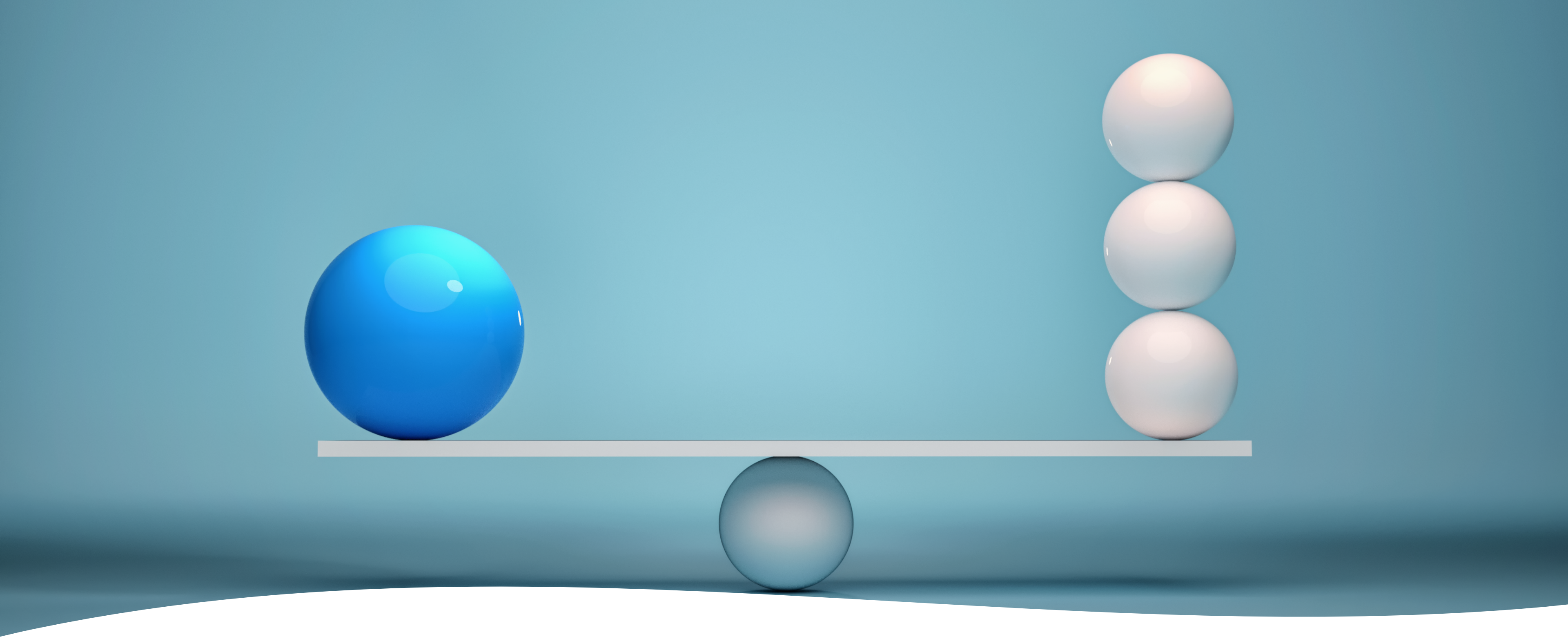
White Paper: Preliminary Options for a Regulatory Framework for Fusion Systems

White paper reflects the challenges associated with developing possible options for a regulatory framework for fusion energy systems.

- Notable ***Legal*** Challenges:
  - Are fusion systems of significance to the common defense and security, or could affect the health and safety of the public?
  - Does the current definition of "Utilization Facility" in Section 11 of the Atomic Energy Act (AEA) of 1954, as amended, support inclusion of fusion systems?
  - Does the current definition of "Byproduct Material" in Section 11 of the AEA, as amended, support inclusion of fusion systems?

White Paper: Preliminary Options for a Regulatory Framework for Fusion Systems

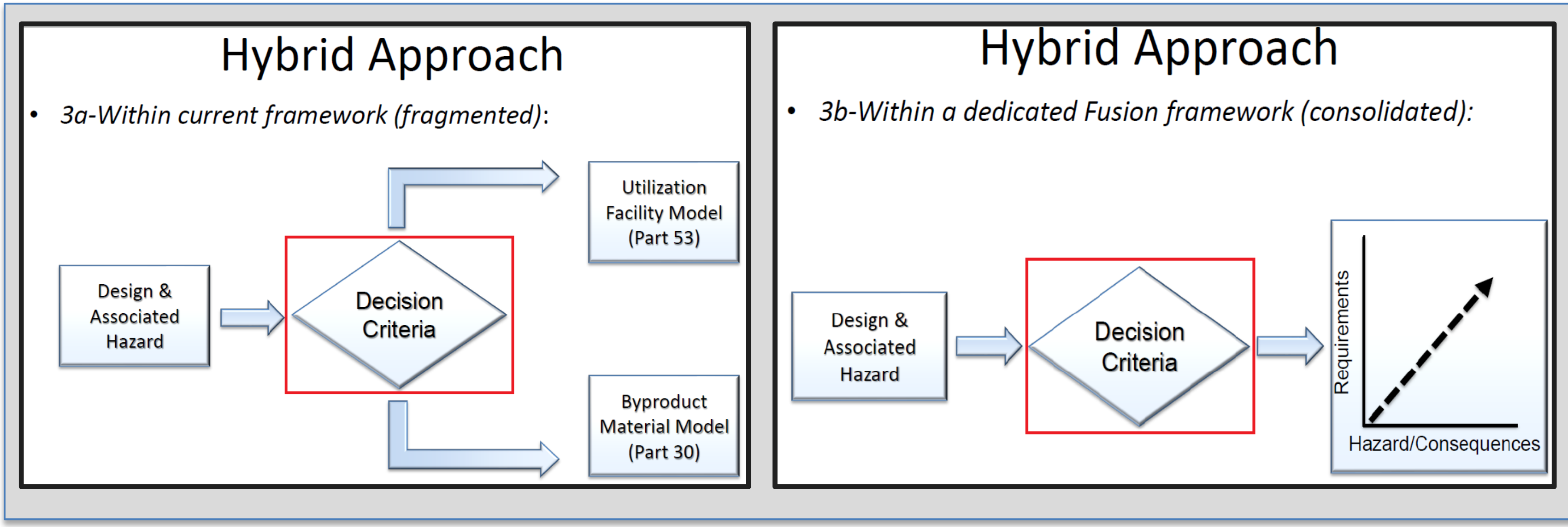
- Notable ***Technical*** Challenges:
  - ➢ Fusion Confinement Approach (i.e.: Magneto, Inertial, Magneto-Inertial).
  - ➢ Fuel Type (neutronic [DT, DD, TT] or aneutronic [DHe3, pLi6, pB11]).
  - ➢ Understanding Offsite Dose Consequence scenarios.
  - ➢ Understanding limits/targets on byproduct material types and quantities.
  - ➢ Understanding required safety systems and potential accident scenarios to ensure reasonable assurance of adequate protection.



Graded Approach

What insights can we use and leverage such that all the regulatory options presented are commensurate with the anticipated risk/hazards of fusion system facilities?

Insights into a Graded Approach



- Although there are some differences in the regulatory processes associated with utilization facilities and byproduct materials, the **technical bases for assessing fusion energy systems are expected to be similar in both approaches**.

- For example, in either approach the design and hazard analysis will determine the **scope of requirements** needed for a license for the safe use of radioactive materials and similar information will be needed to evaluate the design and radiological hazards associated with a particular commercial fusion facility.

Insights into a Graded Approach

- A scalable approach could be developed from an existing regulatory framework, or entirely new. For example:
  - *Elements of a utilization facility approach under 10 CFR Part 50, 52 or 53 could be scaled down.*
  - *Elements of a byproduct approach under 10 CFR Part 30 could be scaled up.*
  - *A hybrid approach (fragmented or consolidated) needs to be scalable to balance regulatory requirements against a wide variety of designs. (i.e: aneutronic system (2MWe) and neutronic system 300 MWe or beyond).*

- Any scalable approach needs clear and predictable decision-making criteria to ensure consistency and regulatory certainty.

Insights into a Graded Approach

In the context of having a technology-inclusive, regulatory framework that is graded such that regulatory compliance is commensurate with associated risk:

- What advantages/disadvantages would stem from categorizing fusion systems based on estimated offsite consequences as one of the many different decision-making criteria tiers? What are examples of potential tiers based on estimated offsite consequence for staff consideration?

- What advantages/disadvantages would stem from categorizing fusion systems based on inventory limits of byproduct material (such as tritium) as one of the many different decision-making criteria tiers? What are examples of potential tiers based on inventory limits of byproduct material for staff consideration?

- What advantages/disadvantages would stem from categorizing fusion systems based on power output (MWe) as one of the many different decision-making criteria tiers? What are examples of potential tiers based on power output for staff consideration?

- What advantages/disadvantages would stem from categorizing fusion systems based on the fusion reaction being applied (neutronic [DT, DD, TT] or aneutronic [DHe3, pLi6, pB11]) as one of the many different decision-making criteria tiers? What would be the expected difference in the level of safety systems between fusion facilities for these two types of fusion reactions?

Insights into a Graded Approach

- The questions shown on the previous slide are meant to enhance the discussion of future meetings. The NRC is not seeking formal responses to these questions from stakeholders. (Paperwork Reduction Act)

- NRC staff will continue to engage stakeholders via public meetings and any other regulatory vehicles to better understand concepts for decision-making criteria.

- External stakeholders can provide valuable insights and feedback to allow for a better understanding of:
  - The fusion technologies and their risks,
  - Insights into methodical and risk informed approaches commensurate with fusion technologies.

Stakeholder Comments

You may submit any comments and feedback related to fusion by any of the following methods:

- Federal Rulemaking Website: Go to https://www.regulations.gov and search for Docket ID NRC-2019-0062. Address questions about NRC dockets to Dawn Forder; telephone: 301-415-3407; email: Dawn.Forder@nrc.gov

- Email comments to: Rulemaking.Comments@nrc.gov If you do not receive an automatic email reply confirming receipt, then contact 301-415-1677.

Next Steps and Future Activities

- Continue stakeholder interactions to better inform the development of the SECY paper. Fusion public meeting tentatively planned for mid to late October.

- NRC staff is assessing the current SECY paper completion schedule of May 2022 and evaluating the impacts of a potential extension.

- Additional information: https://www.nrc.gov/reactors/new-reactors/advanced/fusion-energy.html

Discussion – Insights on Regulatory Approaches

THANK YOU!

Questions/Closing Remarks