



Proportionate Regulation for Fusion

IAEA Fusion Enterprises, 12th June 2022

Dr. Sally Forbes (Fusion Safety Authority)

Contents

- Introduction
- IAEA – Developing TECDOCs on Fusion Safety and Regulation
- Case Study: Developing a Regulatory Framework for Fusion in the UK

Introduction

- One of the future considerations for the commercialisation of fusion energy:
 - the establishment of a proportionate and enabling regulatory framework
 - to provide public assurances on protection of people and the environment
- A number of countries have experience in operating experimental fusion facilities
 - most regulate experimental fusion facilities as “radiation sources”
- Many future fusion facilities on the path to commercialisation are expected to use larger inventories of radioactive materials (ie. tritium)
 - acknowledged that the existing regulatory framework should be reviewed and updated for the regulation of demonstration and prototype, and eventually commercial fusion power plant

Fusion Safety Authority at UKAEA

Established to provide BEIS with technical expertise and advice regarding fusion regulation

- Produced a Technology Report in support of the Government's consultation on a regulatory framework for fusion energy

Based on published studies for concept designs of fusion power plant with different technologies

Identify the main hazards associated with fusion (focus on radiological aspects)

Discuss the magnitude and nature of these hazards (inherently different to fission)

- Supporting the work with the International Atomic Energy Agency (IAEA) to develop TECDOCs on fusion power plant regulation and safety



IAEA: Developing TECDOCs on Fusion Safety and Regulation

Introduction – Technical Documents on Fusion

Development of TECDOC 1 on Regulation and TECDOC 2 on Design Safety

Development of a third **document** that lists and explains general principles for the design safety and regulation of FPP (based on information gathered in TECDOCs 1 and 2, and a potential review of the applicability of the safety standards)

This document could provide the basis for international fusion safety standards



TECDOCs on Fusion Regulation and Design Safety

TECDOC 1

International Experience
in the Regulation of
Fusion Facilities

TECDOC 2

A review and collation
of current Safety
Assessment and Safety
Design Practices
for Fusion
Power Plant (FPP)

The purpose of the two TECDOCs is to collect an accurate snapshot of the current status of fusion facility regulation and safety design practices.

TECDOC 1 - Collection of Regulatory Information

- Scope of regulatory framework (focusing on safety related to radiation risks as the first step)
- Technical capability to assess and regulate fusion
- Further details about regulatory regime, as applicable to fusion
 - Site selection
 - Early Engagement
 - Design Assessment
 - Pre-operations permissioning
 - Permissioning, compliance and enforcement during operations
 - Decommissioning and delicensing
- Current level of regulatory interaction and engagement with dutyholders

Experience collected in relation to existing and shutdown fusion devices, future experimental, demonstration and FPP projects

QUESTIONNAIRE

- **Aim**
- **Regulations**
- **Processes**
 - **Engagement**
 - **Dutyholder submission**
 - **Review Process (document review, inspection activities and frequency of inspections)**
 - **Regulatory outcome**
- **Public engagement and consultation**
- **Regulatory capability and capacity (define size and skills of team)**
- **Guidance**
- **Dutyholder documentation – requirements and update process**
- **Regulatory cost recovery**

TECDOC 1 - Preliminary Findings

- Experimental fusion facilities (no / limited tritium) regulated under radiation protection legislation (radiation generator devices)
- Countries with future fusion projects may adopt **different approach** for fusion reactors with significant inventory of tritium, options under consideration by countries include:
 - ✓ Proportionate application of regulatory framework for fission
 - ✓ Development of bespoke fusion regulation
- Key challenges:
 - ✓ Development of detailed regulatory guidance
 - ✓ Development of technical capability of regulators
 - ✓ Lack of international safety standards
- Developing strong international cooperation and sufficient understanding of **fusion safety aspects** is key to overcome these challenges



TECDOC 2 – Collection of Safety Design Information

Questionnaire

Part 1 General Safety Design Approach for FPPs in view
of their Safety Characteristics

Part 2 Specific Design Safety Aspects and Safety
Analysis Relevant to FPPs Planned and Under
Development in both the Public and Private Sectors

Overall Safety Assessment Context

TECDOC 2 – Questionnaire Part 1

Part 1 General Safety Design Approach for FPPs in view of the Safety Characteristics

Q1 Does IAEA Document SF-1 Apply?

Q2 Use of Quantitative Acceptance Criteria?

Q3 Approaches to Identifying Main and Supporting Safety Functions?

Q4 Views on the Categorization of Plant States?

Q5 Views inherent safety of the FPP fusion reaction in the context of the design of confinement barriers ?

Q6 Application of the IAEA concept of Practical Elimination to FPP design?

Q7 Application of Defence in Depth to FPP?

Q8 Views on Applying General Design Requirements to FPP?

Q9 Approach to Qualifying Items Important to Safety?

Q10 Consideration of External Hazards in the Design of FPP?

Questionnaire Part 1

Progress to Date & Next Steps



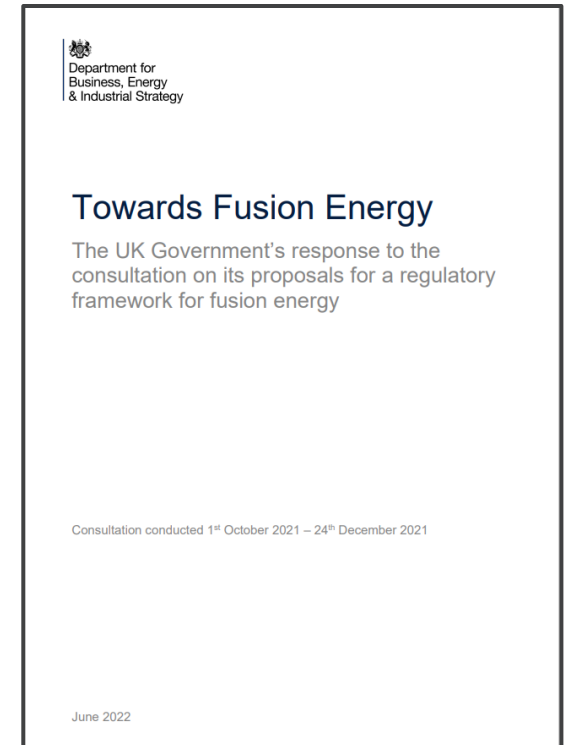
- First drafts of the contents of the TECDOCs were produced ahead of the questionnaire, the contents helped to formulate the questions in the questionnaire
- For TECDOC 2, the contents of this first draft were largely based on ITER, as there is a lot of existing information can be from ITER's experience of safety and design assessment. Further information from other devices are being collected through the circulated questionnaire and will be incorporated to the final version of the document
- Consultancy and Technical Meetings taking place this year to analyse the responses collected from the questionnaires already circulated
- The information will be populated into the TECDOCs, with a summary of common issues and approaches
- TECDOCs 1 and 2 constitute the starting point for developing a path towards internationally harmonized framework for the safety of FPPs

Case Study:

Developing a Regulatory Framework for Fusion in the UK

“The UK Government’s response to the consultation on its proposal for a regulatory framework for fusion energy”

- The UK is helping to lead the global field on regulation for rapidly evolving, cutting-edge fusion technology
- Fusion energy facilities will need to be regulated appropriately and proportionately to maintain public and environmental protection
- Consultation in Oct-Dec 2021 on proposals for regulating fusion energy in the UK
 - responses received from the public, industry, academia & other fusion stakeholders around the world
 - input from UK and international fusion experts has been invaluable in helping reach a decision on how to regulate (nearly 60 respondents)



Decisions on Fusion Regulation

1. Current UK regulators of fusion R&D facilities will retain responsibility for fusion
 - Health & Safety Executive and Environment Agency / Devolved Regulators
 - Based on the assessment of the hazard of fusion energy (as projected by existing studies) & inherent differences between fission and fusion
 - Build regulatory capability on fusion, to supplement existing approach to regulating complex, higher hazard industrial facilities

Decisions on Fusion Regulation

2. This regulatory approach will apply to all currently planned fusion prototype energy facilities in the UK
- Recognise the changing nature of the fusion sector, but action needed now to clarify how fusion energy facilities will be regulated
- Reflect diversity of fusion technologies in the regulatory framework

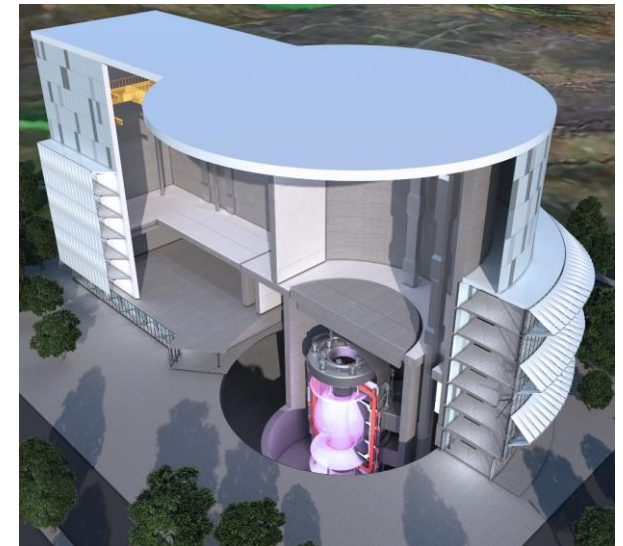


Illustration of STEP prototype power plant facility. © UKAEA

Decisions on Fusion Regulation

3. The Government will legislate to make clear in law the regulatory treatment of fusion energy
- Amend the Nuclear installations Act (1965) to explicitly exclude fusion facilities from the regulatory and licensing requirements under the Act



Illustration of UKAEA fusion scientists and engineers. © UKAEA

Summary of Proposals

- Justification of Practices Involving Ionising Radiation – for fusion power plants
- National Policy Statement for Fusion – align the planning process for fusion power plants with other significant infrastructure projects
- Third Party Liabilities – consider whether and how to introduce an appropriate regime, proportionate to the liabilities
- Regulatory engagement – consider options for formalised engagement in the design phase between developers and regulators

Summary of Proposals

- Public engagement – consider additional opportunities for the public to be consulted during the regulatory process
- Security, Export Controls & Safeguards – consider proportionate and appropriate arrangements to ensure safe and secure operation of fusion power plant
- Radioactive Waste – no major changes to policy expected, but ensure that decommissioning and waste management is undertaken safely and effectively
- Regulatory capacity & capability – build technical capability and increase capability in line with the growth of the fusion sector

Analysis of Consultation Responses

- See the Consultation Response document for further details:
- [Towards fusion energy: proposals for a regulatory framework - GOV.UK \(www.gov.uk\)](https://www.gov.uk/towards-fusion-energy-proposals-for-a-regulatory-framework)
 - breakdown numbers of responses to each question (agree / disagree / don't know)
 - presentation of a range of views from respondents
 - Government's response and intended next steps

BEIS issue an invitation to contact them for more information or to share your views at: fusionregulation@beis.gov.uk



Illustration of UKAEA fusion scientists and engineers. © UKAEA

Summary

Summary

- At a relatively early stage in the commercial fusion energy development process – start to develop regulatory framework and guidance now
- Regulatory harmonisation will be essential for global development and deployment of fusion – this requires sustained international 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
- Good community forming for fusion safety & regulation - continue to grow and utilise this network to seek international harmonisation

Contact: FusionSafetyAuthority@ukaea.uk