REGULATORY FRAMEWORK TOWARDS FUSION ENERGY IN GERMANY
Principles and Open Issues

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1. INTRODUCTION

Germany has a strong track record in research and application regarding nuclear fusion power plant. With the ASDEX Upgrade tokamak at Garching, the world leading stellarator Wendelstein 7-X at Greifswald, and relevant participation in further international fusion projects such as ITER and EU DEMO, significant contributions have been made in research activities worldwide. Furthermore, for a few years now, a very active community of startups and industrial partners has been growing in Germany, which initiates support programmes, cf. [1, 2]. However, beyond research and technological issues, a key question is how to license fusion facilities ensuring the necessary level of safety and equally supporting the flexibility and openness in a rapidly evolving field. Our research project ReFus on the future regulation of fusion facilities in Germany is dedicated to this topic.

2. REFUS PROGRESS

The project on the regulation of fusion facilities in Germany is progressed based on the atomic energy act [3] and radiation protection act [4] to systematically analyse German regulations for readiness in terms of an effective and reliable licensing process of nuclear fusion power plants. Therefore, as a first pillar, the existing national and international legal frameworks (atomic law, radiation protection law and subordinate regulations) were evaluated including:

- Overview of the Legal Landscape

A comprehensive review of existing laws and regulations applicable to nuclear fusion technology, both domestically and internationally, was conducted. Hereby areas of application, interfacing points, and how they interact with state-level laws in Germany were mapped out.

- International Developments and Harmonization with national regulation

Impacts of international and European laws together with treaties on German legislation pertaining to nuclear fusion were identified. Also, areas for a potential harmonization of the German legal and regulatory framework with relevant international standards to ensure compliance and facilitate international cooperation on fusion projects were sketched out.

- Gap Analysis

A detailed gap analysis was performed to identify potential deficiencies or missing components in the current legal and regulatory framework that may hinder the development of fusion technology as well as safe operation. Specific areas such as licensing, operational safety, waste management, public and environmental protection, and liability were addressed.

In parallel, as a second pillar, technical regulations were analysed with the objective to develop a long-term concept for fusion power plants, ensuring safe and efficient operation throughout their lifecycle. It focused specially on hazard potential together with safety and radiation protection implications and considerations. This involved:

- Regulatory Evolution

Elements for a future regulatory framework that must adapt over time in response to scientific advancements and operational experiences gained from existing and future fusion projects.

- International and National Standards Integration

Integration of existing technical rules and standards and experiences from international and national regulations tailored to projects such as ITER and Wendelstein 7-X.

- Hazard and Protection Goal Assessment

Hazard potential in fusion facilities was comprehensively assessed with different parameters, and it was preliminary determined, if current radiation protection requirements need adjustments to suit the specific challenges of fusion technology.

- Evidence for Safety

Preliminary overarching requirements that can be adapted to various fusion facility designs were derived, and draft concept for standardized methods to provide clear and concrete evidence of safety for licensing processes was proposed.

3. PRELIMINARY RESULTS

National and international laws and regulations applicable to fusion technology will be outlined, along with the identification of the relevant sections of the atomic and radiation protection law applicable for fusion facilities. This will include the results of an analysis of how international treaties and agreements influence German fusion regulations. As a result of this work, gaps in the current framework that could impact the development and operation of fusion facilities will be identified. Preliminary recommendations for harmonizing German laws with international standards to facilitate global collaboration and proposals for bridging gaps with either adjustments to existing laws or new regulatory measures tailored for fusion requirements will be discussed.

Results of a comprehensive review of past and current licensing processes for major fusion projects like Wendelstein 7-X and ITER will be presented based on lessons learned and best practices documented to inform future regulatory frameworks. Preliminary analysis results of the fusion specific hazard potentials in comparison with other nuclear and radiation facilities will be presented. A graded approach based on hazard considerations will be discussed.

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