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Strategic Approach to Codes and Standards for the Structural Integrity of STEP

Codes, standards and structural integrity are multidisciplinary fields in which UKAEA has a distinguished history of groundbreaking research and innovation, delivering significant economic benefits and enhancing energy security for the UK. After decades of worldwide research and development including recent world records for inertial and magnetic fusion energy, fusion is progressing steadily from experiment and concepts towards prototype and commercial fusion power plants. Over the next decade, the focus in the fusion is expected to be shifting from plasma physics to addressing technology and engineering challenges, from the conceptual design phase to engineering design and construction, concurrently transitioning from purely publicly funded effort to private-public partnerships. This transition necessitates overcoming highly complex engineering challenges across all the technology readiness levels and significantly increasing the scale of engineering delivery systems, on the scale from millions to billion pounds of investment. A critical step to enable this transition is to develop a fusion codes and standards solution for future prototype fusion power plants, ensuring high standards of public, environmental, and investment protection while maximising economic benefits.

This work reviews the needs for codes and standards for STEP and outlines a strategy aimed at providing effective solutions to enhance confidence that the STEP programme objectives can be achieved. The strategy is based on STEP's objectives, baseline design, operational philosophy, and the current global fusion codes and standards landscape. The STEP-driven strategy identifies critical gaps and challenges that must be addressed, proposing clear priorities and plans to tackle them. The scope of codes and standards is considerable in breadth, must covering the entire STEP plant. It also demands significant depth to address fusion-specific research and development gaps, as well as the complexity necessary to define and manage interfaces, ensuring both horizontal and vertical integration across the whole STEP plant. It also requires knowledge in depth to address significant research and development gaps in fusion-specific systems, as well as the complexity needed to define and manage interfaces between codes, striving towards horizontal and vertical integration across the STEP whole plant. This underscores the necessity of a holistic and coordinated approach and strategy.

This strategy will not only support the realisation of STEP with the highest safety standards and ensure structural integrity but also safeguard investments and strengthen the fusion

ecosystem. It marks a significant new chapter in shaping the future of fusion, with STEP serving as the vehicle driving progress and innovation. By integrating other ongoing efforts from UKAEA's contributions to AFCEN, ASME, EUROfusion and IAEA, the UKAEA working group aims to establish a comprehensive pathway to address engineering challenges, develop fusion codes and standards, and ensure regulatory compliance, thereby ultimately advancing the path toward commercial fusion energy.

Technical Categories Addressed

Other Systems

Speaker's title

Mr

Speaker's email address

yiqiang.wang@ukaea.uk

Country/Int. organization

United Kingdom of Great Britain and Northern Ireland

Affiliation/Organization

United Kingdom Atomic Energy Authority

Author: WANG, Yiqiang (UKAEA)

Co-authors: Mr HELLEND, Alex (UKIFS); Mr WALDON, Chris (UKIFS); Mr SHANNON, Mark (UKAEA); Mr BARRETT, Thomas (UKAEA)

Presenter: WANG, Yiqiang (UKAEA)