Overview of the UKAEA Neutronics Research Programme

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The Applied Radiation Technology group at the United Kingdom Atomic Energy Authority (UKAEA) comprises a group of experts in neutronics and radiometrics to support the delivery of fusion energy. The group has expanded significantly in recent years, driven by unprecedented investment in the UK fusion programme and the rapid growth of the international private fusion sector. This growth is underpinned by decades of cumulative expertise in the development and application of advanced methods for modelling and measurement of radiation fields.

This presentation provides an overview of the group's broad research portfolio, with particular focus on recent developments and applications in neutronics. A major challenge in radiation transport analysis lies in the defeaturing, simplification, and conversion of CAD models. To address this, UKAEA has developed **MCIO**, a tool for conversion of CAD geometry to constructive solid geometry (CSG), currently supporting MCNP, OpenMC and Serpent. As well as the underlying conversion algorithms, the development has focused on optimized void generation and conversion performance gains for large-scale models achieved through multi-processing. Through collaboration with EUROfusion partners, UKAEA continues to advance the modelling of fluid activation. The **GammaFlow** code is being extended to incorporate aspects of CFD, enabling more accurate prediction of fluid flow and thereby the gamma source terms from activated fluids. A further research area addresses the modelling of Activated Corrosion Products (ACPs). Recognising both the safety significance of this phenomenon and the lack of suitable tools worldwide, UKAEA is developing **TRACTOR**, a new code designed to model pipe corrosion and the transport of activated particulates.

Ensuring the credibility of nuclear analysis remains a core priority, with substantial effort devoted to validation and verification (V&V) of radiation transport codes and nuclear data. In collaboration with F4E, UKAEA is developing the open-source tool **JADE**, with a strong focus on OpenMC integration. The automated V&V datasets enabled by JADE will contribute to unifying ongoing international benchmarking activities and the broader adoption of this code. As fusion approaches deployment, robust neutronics-based technical evidence is needed to support safety, security, and non-proliferation policy, building on ongoing and recent UKAEA engagement with international partners, including through secondments to the IAEA. The presentation concludes with examples of nuclear analysis supporting private fusion, demonstrating applications to stellarators, inertial confinement, and magneto-inertial fusion concepts, often requiring advanced or novel extensions to core tools and methods.

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