Evaluation of SRO mode-0 conditions and TSSI design

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The Start of Research Operation (SRO) is the first nuclear operational phase of ITER, as defined in the ITER baseline research plan. During this phase, hydrogen and deuterium plasmas are operated at full magnetic field and plasma current, but with limited neutron production, with the primary objective of demonstrating machine integrity and nuclear safety prior to deuterium–tritium operation. The machine configuration and associated systems during SRO differ significantly from those of subsequent operational phases.

Fusion for Energy (F4E) has performed preliminary engineering assessments to evaluate radiation conditions during SRO. The objective of these studies is to establish shielding design requirements for the Structures, Systems and Components (SSCs) present during operation, with particular focus on the Temporary SRO Shielding Items (TSSI). These shielding provisions must ensure compliance with occupational dose limits and support safe assembly operations.

The production of these neutronics assessments is technically challenging due to the complexity of the computational models, the deep-penetration nature of the problem, and the extent of modifications required with respect to the reference models. These assessments were performed using the novel Gitronics methodology to track the changes required and the different configurations.

Neutron fields were initially calculated inside the bioshield using an ad hoc modified version of the E-Lite model. In addition to implementing the SRO-specific configuration changes, the model was reduced to sectors 1, 2, and 3 to improve computational efficiency. The in-bioshield simulation provided neutron fluxes and energy spectra at the TSSI locations in the ports and top lid. Responses were subsequently used as source terms in simplified one-dimensional models to perform a scoping study aimed at identifying optimal port TSSI thicknesses and material compositions to feed the mechanical design. In parallel, a surface source (RSSA) was generated at the bioshield boundary and employed as input to a second simulation based on a modified Tokamak Complex model using the SRCUNED code. Also in this case, the Neutral Beam (NB) cell was adapted to reflect the SRO configuration, and neutron fluxes and spectra were recorded at the North Wall TSSI locations to conduct an additional scoping study for those items.

Once the optimal TSSI designs were identified, they were implemented in both the in-bioshield and Tokamak Complex models. Then assessments were reperformed with both models to confirm the expected radiation conditions for the SRO configuration. To conclude, final comprehensive full sectors simulations are planned along the summer.

Type of contribution:	Poster session	☐
	Oral Contribution	☒