

Testing Needs for the Development and Qualification of Fusion Breeding Blankets

Monday 28 July 2025 15:10 (40 minutes)

Achieving tritium self-sustainment in the breeding blanket will require a form of breeder within the engineering design of the machine which must produce an acceptable ratio of tritium to fusion neutrons to allow for a closed fuel cycle, with surplus to start up subsequent power plants. The design of the breeder and associated tritium plant must be maintainable and must be demonstrably safe with regards to the release of tritium into the environment. However, no fusion blanket has ever been built or tested. Hence, its crucial integrated functions and reliability in DEMO and future power plants are by no means assured.

Large feasibility concerns and performance uncertainties exist for all the concepts investigated to date. A vigorous research, development, and demonstration programme is urgently needed to fill the remaining outstanding gaps. This includes the accomplishment of a nuclear qualification programme involving the use of relevant new n-irradiation testing facilities or some other means, where developers will need to be able to test breeding blanket components in a neutron flux like what would be present in the fusion reactor itself.

Currently, focus is on define the testing requirements and the testing and qualification strategy to increase the maturity level of this critical component. Validating and qualifying an essential fusion core component, like the breeding blanket, requires adequate facilities which are yet to be developed and cannot occur as part of the testing and development of pilot plants or first-of-a-kind facility. Just as wind tunnels for airplanes, launch pads for space rockets or test tracks for new railroad locomotives have been built and used to confirm the performance of the tested solutions, to determine their reliability and correct possible design faults, advancing the development and qualification of the breeding blanket would need adequate testing capabilities and facilities.

The testing issues together with the options being considered for possible qualification facilities are discussed in this talk.

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Session Classification: Session 2