Contribution ID: **17** Type: **Oral**

STANDARDS REQUIREMENT AND DEVELOPMENT IN MANUFACTURING OF WATER-COOLANT TRITIUM BREEDING BLANKET COMPONENT

Tritium breeding blanket is the core component in the future fusion power plants, which is responsible for tritium breeding, neutron shielding and heat extraction. In order to realize these functions, the blanket component usually is designed as a box-structure modular made of steel plates, into which the tritium breeding materials and neutron multiplying materials were filled. To exhaust the nuclear heat in the blanket, a serial of cooling channels was installed in the steel plates. In the operation of the fusion reactor, the high-pressure coolant will be injected into the cooling channels. Therefore, the blanket component usually is considered as a pressure vessel. In addition, the blanket component is working under high energy neutron irradiation. To ensure the cleanliness of the fusion device, the reduced-activation ferritic-martensitic steel (RAFM steel) has been chosen as the structure materials. Therefore, in the design and manufacturing process of the blanket module, we not only need to carry out the development of manufacturing technology, but also simultaneously consider the safety issues during the component's usage, as well as the relevant material technology requirements and manufacturing technology specifications.
In this report, some recent research progress in the manufacturing technology of blanket module will be presented firstly, including the development and batch production of RAFM steel plates and tubes, as well as the research on forming and inspection technologies for internal coolant channels. Then, we will show the standardization efforts in blanket module manufacturing technology. In the R&D of CFETR-WCCB module manufacturing technology, we have collaborated with participating enterprises to establish a group standard for the manufacturing and inspection technologies of water-cooled blanket modules. This standard primarily specifies the structural composition, manufacturing techniques, technical requirements, inspection methods, inspection rules and reporting for WCCB module. Notably, it introduces, for the first time, a classification management system for welding-related processes in the fabrication and assembly of WCCB module. Additionally, we are conducting research on the development of manufacturing technologies for the BEST-TBM blanket module and its operational scenarios in fusion reactor facilities. The most significant challenge currently faced is the standardized management of manufacturing and inspection technologies. For instance, as a pressure vessel, each weld in the blanket module development process requires process qualification and inspection technology development. However, RAFM steel, being a novel material, is not covered by existing pressure vessel standards, necessitating their extension and updating.

Furthermore, we are advancing additive manufacturing technologies for blanket modules, which raises the issue of establishing technical specifications for additively manufactured RAFM steel in fusion reactors. A critical first step involves accumulating mechanical property data and neutron irradiation resistance data for additively manufactured RAFM steel.

Technical Categories Addressed

Structural materials

Speaker's title

Mr

Speaker's email address

wjwang@ipp.ac.cn

Country/Int. organization

China

Affiliation/Organization

Author: Prof. WANG, Wanjing (Institute of Plasma Physics, Chinese Academy of Sciences (ASIPP))

Co-authors: Prof. LIU, S (Institute of Plasma Physics, Chinese Academy of Sciences (ASIPP)); Mr SHI, Y (Advanced Technology & Materials Co., Ltd (AT&M))

Presenter: Prof. WANG, Wanjing (Institute of Plasma Physics, Chinese Academy of Sciences (ASIPP))

Session Classification: Tritium Breeding Systems