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P2.148 Development of bore welding tools for ITER blanket remote maintenance

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Remote welding of cooling water pipes is one of the technological challenges for maintenance of nuclear fusion reactor. In ITER, more than 1,000 in-vessel welds are performed for the installation of First Wall (FW) and Shield Block (SB), of which failures during D-T operation require complete remote handling of these pipes due to irradiation environment in the vacuum vessel. The welds in FW and SB require two separate bore welding tools, i.e. (a) FW pipe welding tool and (b) SB coaxial connector welding tool, for different bore diameter of 42.7 mm and 100 mm, respectively. This paper presents development of these in-vessel bore welding tools.
In order to accommodate with possible positional error of FW and SB, FW pipe welding tool is integrated with the weld groove alignment tool for achieving precise groove alignment before weld operation. In addition to successful welding test of prototype welding tool, the performance test of pipe alignment tool is reported, by which gap and lateral misalignment between pipes were aligned within 0.3 mm, satisfying required precision to achieve good weld quality.
The SB coaxial connector welding tool is not required to adapt with misalignment between weld grooves due to SB's guiding features. On the other hand, the SB's geometry requires this tool to go through 80 mm diameter opening and to expand to 100 mm diameter for welding operation. This tool is integrated with visual observation tool with infrared ray camera for visual inspection of welds. The design of newly manufactured prototype tool and performance test results are presented.

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