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Development of reliable tooling and processes for remote maintenance of ITER cooling water connections

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The high neutron flux inherent in fusion reactors creates high heat loads in the components surrounding the plasma. These heat load needs to be managed through active cooling. These components also become highly activated so require remote maintenance, hence the connection and disconnection of these cooling systems becomes an important functionality of these maintenance activities. The integrity of these connections is also of critical importance both to the operation of the components and to maintain the confinement of the activated effluent they contain; therefore, it is imperative that a reliable system of connection and disconnection is established.

TIG welding is a process that is recognised within nuclear design standards as a reliable technique that can be used for connections on confinement barriers. RACE has performed extensive work across a range of applications in ITER such as the diverter, diagnostic port plugs and neutral beam vessel, and pipe sizes varying from DIN 25 to DIN 200 to develop tooling and processes to ensure that high quality TIG welding can be conducted remotely.

This work shows that autogenous TIG welding is an appropriate technology to conduct this maintenance activity. It also notes that for this technology the pipe thickness joint thickness must be restricted to a maximum of 3mm and that the sulphur content of the stainless-steel material must be closely controlled with smaller tolerances that anticipated by the industrial codes. The use of filler inserts to supplement material is also discussed. It concludes that the control of the alignment of the tooling is critical to success and suggests design solutions that can achieve these requirements.

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