

# In-bore robotic laser cutting and welding tools for nuclear fusion reactors

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The installation and decommissioning of components in nuclear fusion reactors will require quick, and reliable, cutting and welding of hundreds of thick-walled steel cooling pipes. To this end, laser cutting and welding techniques have been investigated and prototype in-bore robotic tools have been developed to apply these laser process within a pipe. The prototype laser tools include a novel miniaturised laser head design to fit within the confines of the pipe and apply the laser processes with a short standoff distance. The novel laser heads and prototype tools were manufactured and used for a series of demonstration trials at a high-power laser facility. Samples from these trials were analysed with optical microscopy, surface profilometry, transmission radiography and x-ray computed tomography to assess the quality of the welds and cuts produced. Here, we will present the design of the laser optics heads and prototype tools, results of the high-power laser trials, analysis of the demonstration cuts and welds produced, laser process issues discovered during the trials and the design modifications made to overcome them.