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Optimization of a welding procedure for making critical aluminum welds on the LBNF absorber core block

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The LBNF Absorber consists of thirteen 6061-T6 aluminum core blocks. The core blocks are water cooled with de-ionized (DI) water which becomes radioactive during beam operations. The cooling water flows through gun-drilled channels in the core blocks. A weld quality optimization was performed to produce National Aeronautical Standard (NAS) 1514 Class I [1] quality welds on the aluminum core blocks. This was not successful in all cases. An existing Gas Tungsten Arc Welding (GTAW) Welding Procedure Specification (WPS) was fine tuned to minimize, in most cases, and eliminate detectable tungsten inclusions in the welds. All the weld coupons, how-ever passed welding inspection as per the piping code: ASME B31.3 Normal Fluid Service [2]. Tungsten electrode diameter, type, and manufacturer were varied. Some of the samples were pre-heated and others were not. It was observed that larger diameter electrodes, 5/32 in., with pre-heated joints resulted in welds with the least number of tungsten inclusions. It is hypothesized that thinner electrodes breakdown easily and get lodged into the weld pool during the welding process. This breakdown is further enhanced by the large temperature differential be-tween the un-preheated sample and the hot electrode.

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