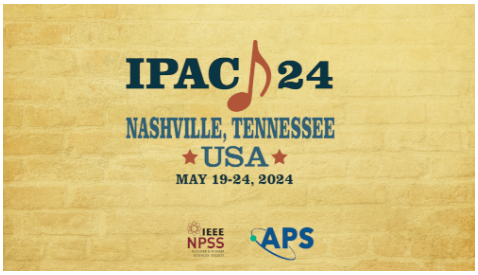

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Pressure spike in the LBNF absorber core's gun drilled cooling channel from an accident beam pulse

Thursday, 23 May 2024 16:00 (2 hours)

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. The cooling water is supplied by the LBNF Absorber Radioactive Water (RAW) cooling system which is designed as per ASME B31.3 Normal Fluid Service [1]. An uninhibited beam accident pulse striking the water channels was identified as a credible accident scenario. In this study, it is assumed that the beam pulse hits the Absorber directly without interacting with any of the other upstream beamline components. The beam parameters used for the LBNF beam are 120 GeV, 2.4 MW with a 1.2 s cycle time. The accident pulse lasts for 10 μs. The maximum energy is deposited in the 3rd aluminum core block. For the sake of simplicity, it is assumed that the accident pulse strikes the 1 in. ID water channel directly. The analysis here simulates the pressure rise in the water during and after the beam pulse and its effects on the aluminum piping components that deliver water to the core blocks. The weld strengths as determined by the Load and Resistance Factor Design (LRDF) and the Allowable Strength Design (ASD) are compared to the forces generated in the weld owing to the pressure spike. A transient structural analysis was used to determine the equivalent membrane, peak, and bending stresses and they were compared to allowable limits.

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