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Seat leak tests and commissioning of control valves in the cryogenic distribution system of the ESS superconducting linac

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The European Spallation Source (ESS) is a neutron-scattering facility which will use a pulsed 2.0 GeV proton beam generated in the linear accelerator (LINAC) for releasing high-energy neutrons in the ESS target station. The 2K superconducting linac comprises 13 spoke and 30 elliptical cryomodules. The cryogenic distribution system (CDS) connects the cryogenic plant with the 43 cryomodules through a 400 meters long cryogenic multi-transfer, 43 valve boxes and an endbox.

The CDS consists of 373 control valves in total. There are 8 and 10 control valves in each elliptical and spoke valve boxes, respectively, and 3 valves in the end box. The control valves are used for regulating or blocking the process helium flows. The seat tightness of the CDS valves is crucial especially for warming up individual cryomodules, which is required for potential short-term maintenance or repair activities in the cryomodule while keeping the others in cryogenic conditions. What is more, leaks over valve seats might cause moisture or ice formation on room temperature uninsulated pipes for warmup and cooldown valves or add heat load to the cryogenic system. Valve initialization and leak tightness tests were firstly performed with warm helium in the second half of 2022 before the first CDS cooldown. The tests revealed many leaks above the specified acceptable leak rate of 10E-4 mbar.l/s with several of them reaching even 10E2 mbarl/s. The major bulk of those leaks were fixed before and after the 2nd CDS cooldown that followed in 2023. This paper describes the seat leak test method and results, as well as the possible causes of the observed leaks and the taken solutions for repairing the insufficiently tight valves.

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