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Cryogenic Distribution System for the ESS Superconducting Proton Linac

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The European Spallation Source is a 5 MW, 2.0 GeV long pulse proton machine, currently under construction in Lund, Sweden. Its superconducting linear accelerator will use three types of cavities, i.e. double-spoke resonator cavities, medium- β and high- β elliptical cavities. The superconducting section of the ESS linac will be composed of 13 spoke cryomodules (each with 2 spoke cavities), 9 medium- β cryomodules and 21 high- β cryomodules (each with 4 elliptical cavities). The nominal operation temperature for the cavities is 2 K, with 40/50 K thermal shielding. The total heat loads to both the cavity cooling loops and thermal shields are estimated as 2.3 kW and 8.5 kW, respectively. The required cooling powers will be provided by the linac cryoplant and delivered in two temperature levels: 4.5 K and 40/50 K. Then, the 2 K temperature level will be produced in each cryomodule by precooling and throttling the 4.5 K helium.

The linac cryomodules will be connected with the cryoplant by a dedicated cryogenic distribution system. The system will include a number of valve boxes, which will allow for warming up and cooling down one or more cryomodules without affecting the others. The installation and commissioning are scheduled for the beginning of 2017 and mid of 2018. This paper describes the functional requirements, general layouts and the in-house conceptual design of the cryogenic distribution system.

Author: FYDRYCH, Jaroslaw (European Spallation Source ESS AB)

Co-authors: WEISEND, John (SLAC); ARNOLD, Philipp (European Spallation Source ESS AB); Mr TERESZKOWSKI, Piotr (European Spallation Source ESS AB); Mr HEES, Wolfgang (ESS); WANG, xilong (European Spallation Source ESS AB)

Presenter: FYDRYCH, Jaroslaw (European Spallation Source ESS AB)

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