



Contribution ID: 812

Type: **Contributed Oral Presentation**

C2Or1A-04: Options for the PolFEL Cryogenic System

Tuesday, July 23, 2019 11:45 AM (15 minutes)

The Polish Free Electron Laser facility (PolFEL) is currently under development at the National Center for Nuclear Research in Swierk, Poland, by consortium of eight Polish scientific institutions and two industrial partners. In the first stage, this fully superconducting linear electron accelerator will consist of an electron gun and four RI-HZDR type cryomodules, each housing two 9-cell superconducting TESLA RF cavities. Such a configuration allows the generation of a continuous wave and long pulse beam with 5-50 MeV of energy and a coherent radiation length of 6 μm . In the second stage, the PolFEL will be extended with two cryomodules, which will increase the beam energy up to 800 MeV and reduce the coherent radiation length to less than 10 nm.

At the current phase of the project, two operation temperatures of the RF cavities are considered: 2.0K and 1.8K. For both of the operation temperature cases, static and dynamic loads to the linac are estimated to be 40W and 180W for the 1st stage, while for the 2nd stage, 52W and 260W, respectively. The cooling power will be generated by the TCF50 Liner helium plant, which was donated by the STFC in Daresbury, UK, after the ERP project was shut down. This helium plant has a liquefaction capacity of 6 g/s and 118W@4.5K of cooling power. During the beam-on operation mode of the linac a shortage of cooling power will be compensated by liquid helium from an external dewar, while the warm helium gas stream exceeding the liquefaction capacity will be collected in pressurized storage tanks. During the beam-off mode, the helium gas will be recovered from the storage tanks and re-liquefied to the external dewar.

This paper presents a detailed description of the PolFEL cryogenic system and provides calculations for the sizing of the system's components for two options in the temperature of operation.

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Session Classification: C2Or1A - Large Scale Systems III