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RF heat load compensation with electrical heater for XFEL accelerator - measurements at CMTB, AMTF and FLASH

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Since 2007, the European X-ray Free Electron Laser (XFEL) is being constructed at DESY, Germany. 800 superconducting niobium 1.3 GHz nine cell cavities and 100 superconducting magnet packages will be operated in a liquid helium II bath at 2K. The static and dynamic heat loads at 2K result in a vapour mass flow up to 96 g/s at 3100 Pa. A four stage cold compressor system is used to return the vapour to the XFEL helium refrigerator. Relative pressure oscillations of the helium II bath should be kept below 1% for stable RF operation of the cavities. In addition, fast changes of vapour pressure and mass flow at the inlet of the cold compressors must be avoided during variation of RF load, e.g. due to switching on/off of RF power or due to cavity quenches. Electrical heaters in the helium II bath of the XFEL linac will be used to compensate the RF load changes. The concept and results of measurements performed at Cryo Module Test Bench (CMTB), Accelerator Module Test Facility (AMTF) and FLASH accelerator are reported.

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