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14 kA HTS Current Leads with one 4.8 K Helium Stream for the Prototype Test Facility at GSI

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The key part of the international FAIR project in Darmstadt, Germany, is the synchrotron SIS100, for which superconducting magnets are employed. For the First of Series Dipole a pair of HTS current leads with a nominal current of 14 kA DC were specified, manufactured and successfully tested. The motivation for these current leads was a high operation current and the liquefaction limit of 1 g/s of the cooling plant. In the design it has to be taken into account that per lead only one helium stream is available for the entirely inner cooling. For I=0 (8 kA DC) only 0.25 g/s/lead (0.38) were necessary to be compared to 0.365 (0.51) specified. Slow ramping with 50 A/s up to 17 kA was accomplished. Triangular cycles with 27 kA/s up to 14 kA were achieved. The current leads withstood the test voltage of 3 kV between two leads and between lead and ground. The one stream helium flow is regulated by the temperature at the warm end of the HTS to be 50 K. The reliability of the first pair, especially of the cold terminal, is a clear go for the series of HTS current leads needed for the Series Test Facility, the String Test and the SIS100 ring. There is a separate 50 K helium gas supply which allows a significant reduction of cooling requirements. These 19 pairs in total shall have a common design which will be slightly different to that of the first pair for the Prototype Test Facility.

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