

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

Henning Raach, Claus H. Schroeder, Eric Floch, Alexander Bleile, Pierre Schnizer (GSI Helmholtzzentrum, Darmstadt, Germany)
Torben P. Andersen (Mark & Wedell, Kvistgaard, Denmark)

Introduction

In the next years the Facility for Antiproton and Ion Research (FAIR) will be built at Darmstadt, Germany. The heart is the heavy ion synchrotron SIS100 where superconducting magnets will be employed. For the test of the First of Series Dipole a pair of current leads are needed. On account of the cooling capacity of the Prototype Test Facility and the high current the colder part of the conductor shall be made of high temperature superconductor (HTS).

Requirements

- **Only one cooling stream**
- nominal current 14 kA_{DC}
- slow ramping to 17 kA (50 A/s)
- triangular cycles 14 kA peak (27 kA/s)
- **DN 100 CF flange**
- maximal length 2.2 m
- mass flow rate in steady operation not higher than **0.5 g/s/lead** (higher flow rates possible for 10 to 20 minutes)
- maximal pressure 5 bar(a)
- operating pressures: 1.3 bar(a) supply, 1.1 bar(a) return
- test voltage 3000 V (life circuit – ground, helium circuit – life circuit), 2 minutes
- electrical insulation shall hold for vacuum between 10⁻⁸ mbar to 10⁻⁴ mbar
- leakage rate below 10⁻⁸ mbar*l/s

Factory Acceptance Test

- Leak tightness
- HV tests: leakage current in the order of 1 nA
- continuity tests
- dimensional control
- all tests performed at room temperature

Site Acceptance Test

- Repetition of Factory Acceptance Test
- Mounting of current leads in feedbox
- no cold leaks
- DC currents up to 14 kA, mass flow rates: see table
- slow ramping up to 17 kA, no quench
- triangular fast cycles, test passed
- contact resistance of cold terminal below 4 nΩ

I _{DC} /kA	actual mass flow per lead/ g/s	specified mass flow per lead/ g/s
0	0.25	0.365
8 ***	0.38	0.51
13.5	0.625	0.67

*** relates to a triangular cycle with 14 kA peak

Summary and Outlook

The first pair of HTS current leads for the Prototype Test Facility passed all tests and is in operation. A second pair of the same design has been delivered and the cold tests are still to be performed. The good quality so far is a clear go for the series. 19 pairs shall be manufactured for the Series Test Facility, the String Test and the SIS100 ring. There will be a separate 50 K helium supply which allows a significant reduction of cooling requirements. These 19 pairs shall have a common design slightly different to the first pair.

