

TCC Meeting 02/11/2017 Powering of 11 T Trim

A. Ballarino

With contributions from/discussions with R. Betemps, Ph. Denis, H. Prin, D. Ramos, M. Gonzalez, S. Yammine, J. P. Burnet



Presented at the WP6a Meeting on 24/10/2017

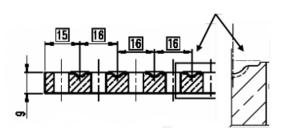
Introduction

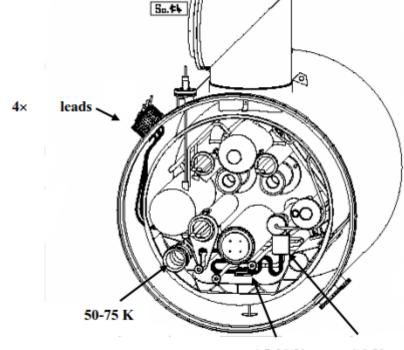
- Following recommendation from circuits review (March 2017): use trim circuit to compensate difference in transfer function between the 11 T and the main LHC dipoles
- Design of leads with CMI. Conceptual study of gascooled leads able to meet the HV insulation requirements (3.1 kV to ground in cryogenic conditions - trim on MB dipole circuit, EDMS 90327) and preliminary integration study of conduction-cooled leads
- In October 2017: decision to use conduction-cooled leads LHC-type under the responsibility of SCD



LHC 120 A Conduction-cooled leads







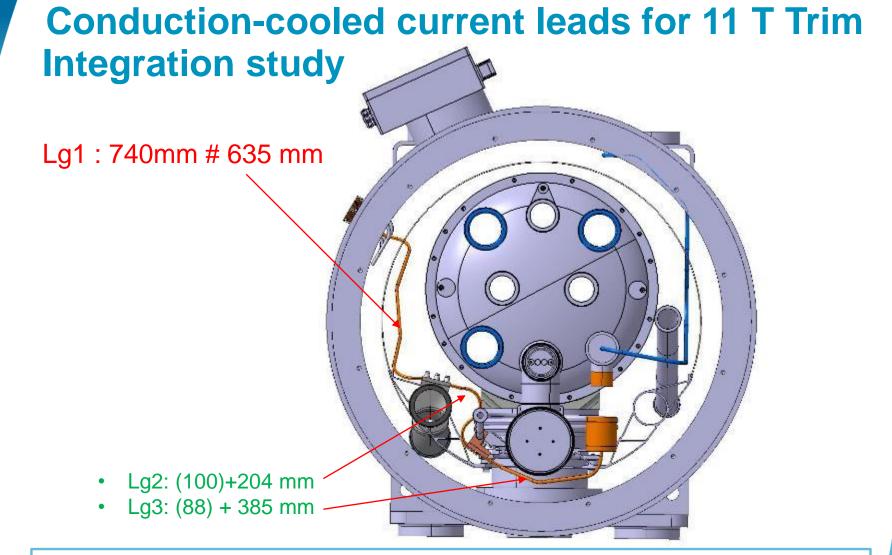
4.5-20 K 1.9 K



- Reviewed integration study (for enabling use of LHC design and associated technologies)
- Performed electrical insulation tests on LHC conduction-cooled 120 A leads (Vins > 5 kV in He gas, RT, atmospheric pressure)
- Proposed the use of two current leads per polarity (one assembly of four leads per circuit)
- Discussed with EPC:

Protection of the leads (voltage signal to power converter) – slow power abort (~10 s) when voltage across individual lead exceeds ~ 100 mV;





Integration preserves LHC lengths: <u>same design</u> and <u>same</u> <u>components/parts</u> as for LHC. <u>Same integration</u> as for LHC (by adding a slit on the thermal shield). <u>Different shape</u> of current leads.



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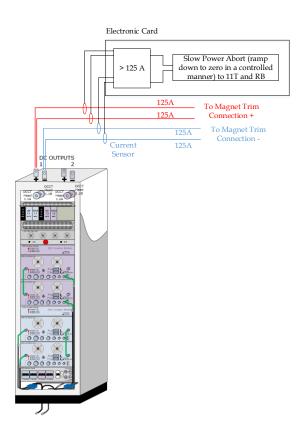


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Protection



- 2x70mm² DC cables (identical) per polarity. The resistance of the cables will naturally balance the current in both leads.
- **Current sensors on the DC cables** to be added to be able to protect from overcurrent (>125 A).
- A new R2E card (logic to be determined) should be developed to generate an abort signal when the limit current in surpassed.
- WP6b was asked to follow up this subject, and to report back to the MCF.

S. Yammine, TE-EPC



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Detection of un-equal ($\Delta I > 10 \text{ A}$) current distribution between conductors

 To be verified: routing of RT cables (four instead of two - not considered to be a challenge)



Tentative schedule

Nine months project timeline

Start Date:	02/10/2017									
Desired end date:	30/06/2017									
	2017			2018						
	Oct	Nov	Dec	Jan	Febr	March	April	Мау	June	Responsibility
Integration study - to make design feasible and "LHC like"										EN-EDM plus SCD, CMI, LMF
Procurement of raw materials										SCD, Main Workshop ?
Detailed drawings of leads, Implementation of design changes										SCD, EN-EDM
Shaping trials (Cu)										SCD
Drawings of thermalization blocks					\wedge					SCD, CMI, EN-EDM
Design and drawings of tooling for shaping										EN-EDM, SCD, Main Workshop
Manufacturing of tooling for shaping										LMF ?
Manufacturing of thermalization blocks										LMF ?
Laser welding qualification and procedures										Main Workshop
Production of sub-components										SCD
Shaping, welding, assembly, RT tests of one prototype										SCD, Main Workshop
Availability of one prototype assembly										SCD
Procedure for mechanical integration			-	+						СМІ
Procedure for in-situ electr. connections				-	+					SCD
Specification for powering and protection			-	+						SCD
Protection									+	EN-EL in iterface with SCD

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