



Changes of SPS extraction interlock strategy for TED beam stoppers with LIU beams

Functional specification sent for approval

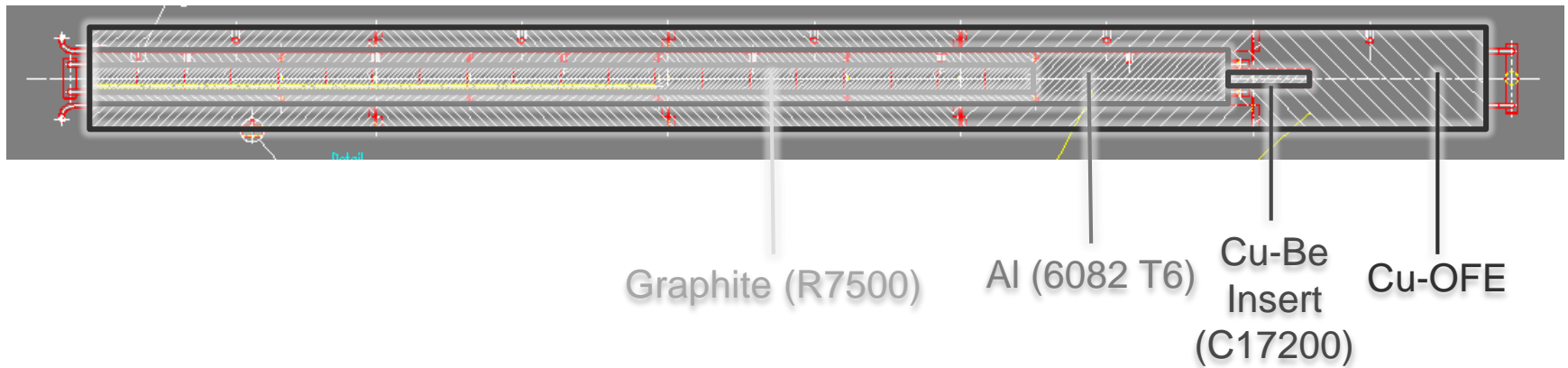
- Deadline for comments
8th of September 2017

CERN CH-1211 Geneva 23 Switzerland	EDMS NO. 1839530	REV. 0.1	VALIDITY DRAFT
 	REFERENCE SPS-OTH-ES0001		
Date: 2017-08-25			
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ABSTRACT:			
<p>FLUKA and ANSYS simulations of LIU beams impacting the TED beam stoppers in the SPS to LHC transfer lines have shown that the stresses reached in some of the TED materials will be beyond the predicted material strength. The intensity on the TEDs with LIU beams therefore has to be limited and the SPS extraction interlocking strategy modified. This document summarizes briefly the simulation results and defines the new interlocking strategy.</p>			
DOCUMENT PREPARED BY:	DOCUMENT TO BE CHECKED BY:	DOCUMENT TO BE APPROVED BY:	
V. Kain M. Donze A. Masi S. Gabourin	M. Zerlauth J. Uythoven D. Wollmann S. Gilardoni M. Fraser A. Perillo Marcone R. Esposito J. Wenninger I. Romera Ramirez K. Cornelis S. Cettour Cave K. Li F. Velotti	M. Meddahi B. Goddard G. Rumolo E. Shaposhnikova	
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Introduction (1)

- TED: transfer line beam stopper
 - Designed to absorb ultimate beam
 - In air

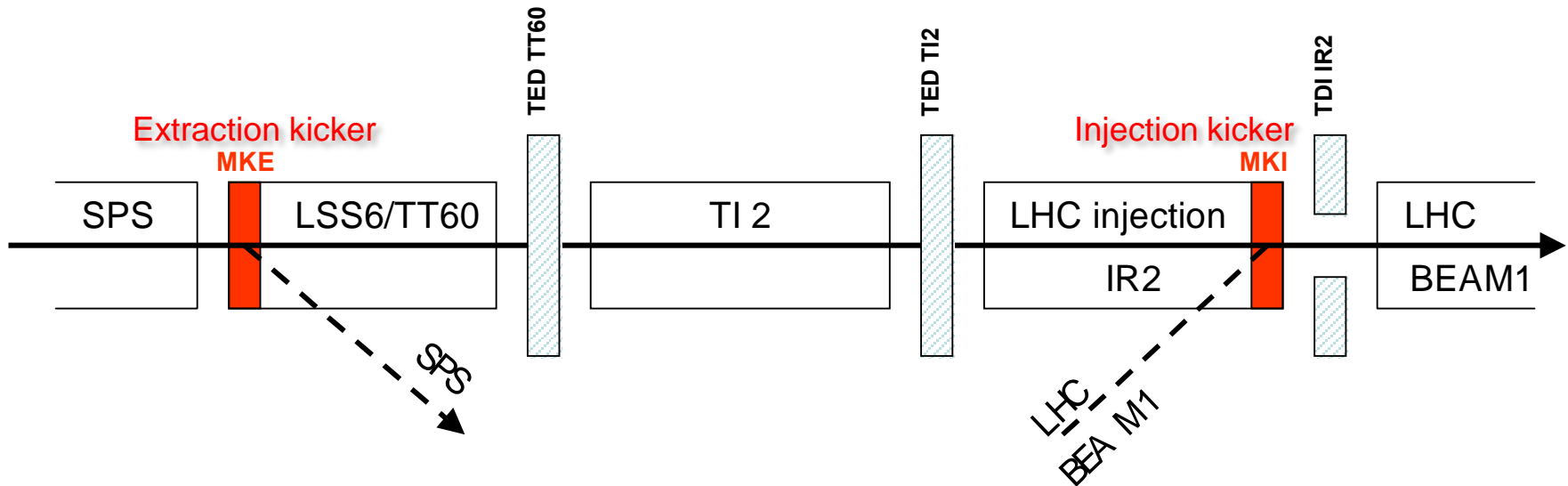
4.3 m TED connected to Y-chamber. Can be moved into beam.



- Two TEDs per 3 km LHC transfer line.
 - One shortly after the SPS extraction point. One close to the LHC injection point.

Introduction (2)

- With the TEDs part of the line only can be studied without the downstream part necessarily available



- Interlocking philosophy: If a TED is in beam the interlocks of the downstream equipment are ignored.
- If TEDs are moving, extraction is never permitted. Only if **in** or **out**
- This is true for any intensity to be extracted from the SPS

Proposed interlocking change

	p^+ / bunch	ε [μm]	brightness [$\frac{10^{11}}{\mu\text{m}}$]	N_b
Standard	1.2×10^{11}	2.6	0.46	288
Ultimate	1.7×10^{11}	3.5	0.49	288
HL-LHC	2.32×10^{11}	2.1	1.1	288
BCMS LIU	2.0×10^{11}	1.3	1.54	288

- The current TED design cannot withstand more than 144 LIU intensity bunches.
 - Graphite goes beyond service stress
- Proposal:
 - Keep current design
 - Limit intensity to max. 144 LIU bunches to be extracted from the SPS with TEDs in the line

Proposed implementation

- New Safe Machine Parameter Flag in the SPS: **SPS TED BEAM FLAG A and B**
 - **SPS_TBF**

- The new flag is taken into account in the user permit of the TEDs, where it is checked whether it is moving or not.
 - The logic will be completed to take into account the SPS_TBF as follows:
User Permit = TRUE when ((TED_IN \cap SPS_TBF=TRUE) \cup TED_OUT)
else User Permit = FALSE

- The affected BICs
 - input 1 of the slave BIC TT60B (in BA6) for Extraction 1
 - input 1 of the slave BIC TT40B (in BA4) for Extraction 2
 - input 1 of the slave BIC TI2D (in SR2) for Extraction 1
 - input 1 of the slave BIC TI8D (in SR8) for Extraction 2