

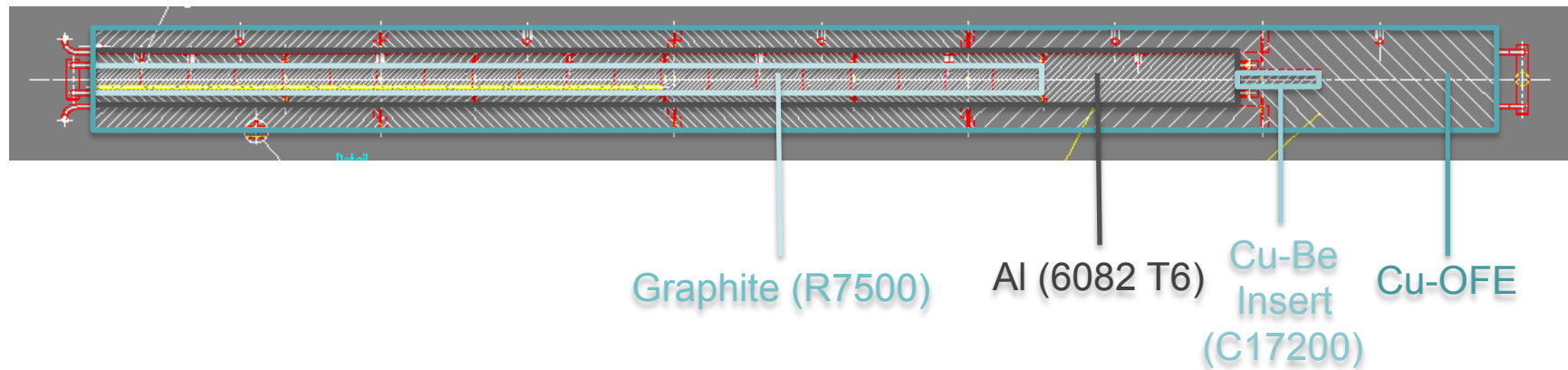
# **Changes of SPS extraction interlock strategy for LIU beams TEDs cannot take LIU beams**

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# The role of the TEDs in the SPS Extraction Interlock System (1)

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

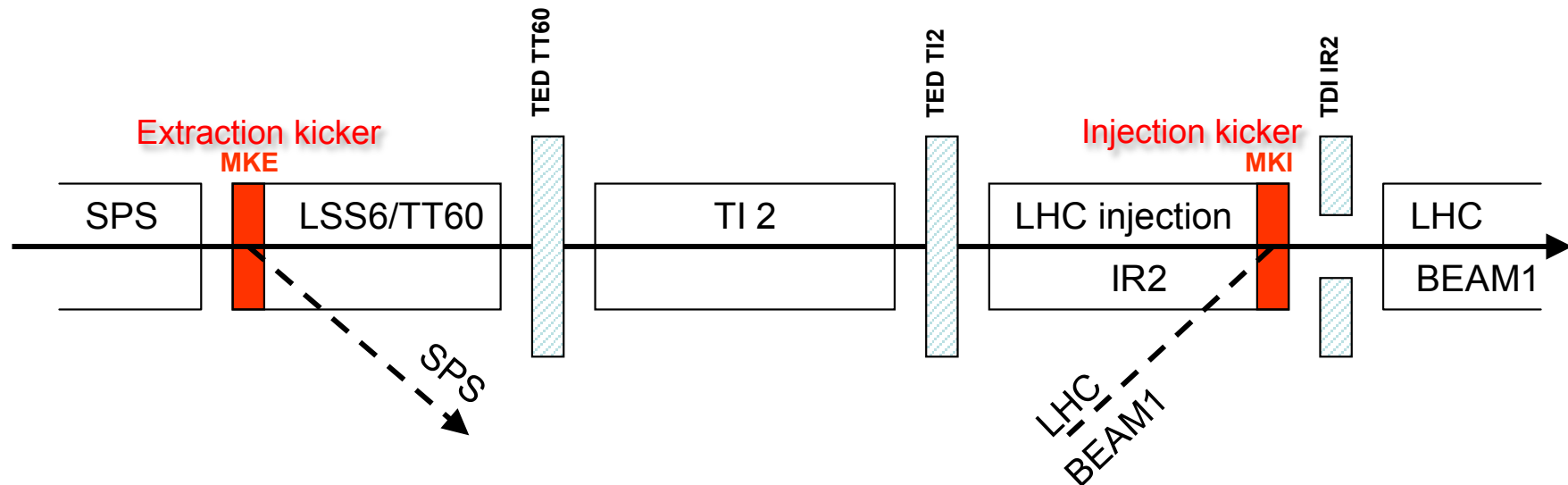
4.3 m TED connected to Y-chamber. Can be moved into beam.



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

## The role of the TEDs in the SPS Extraction Interlock System (2)

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

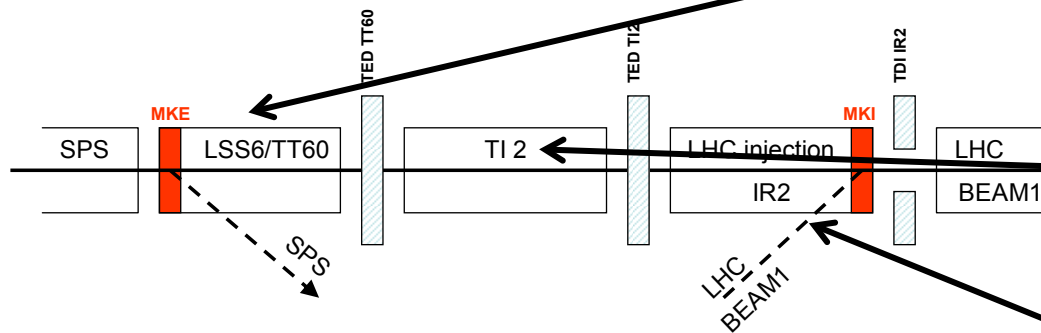


- Interlocking philosophy: If a TED is in beam the interlocks of the downstream equipment are ignored.
- This is true for any intensity to be extracted from the SPS

# The role of the TEDs in the SPS Extraction Interlock System (3)

- The position IN/OUT of the TEDs is input to the definition of the Extraction Permit in the Extraction Master BIC

- IN = green
- OUT = red



	INPUT	
SOFTWARE	TRUE	
INIT	TRUE	
1	not used	
2	not used	
3	TT60-A	FALSE
4	TT60-B	FALSE
5	TED-in TT60	TRUE
6	not used	
7	not used	
8	TI2 Upstream	FALSE
9	TI2 Downst...	FALSE
10	TED-in TI2	TRUE
11	INJ Beam-1	TRUE
12	Probe Beam...	FALSE
13	BPF-1	FALSE
14	SBF-1	FALSE

= Extraction Permit

- The same is true for extraction in LSS4

# TED specific interlocking in “slave” Beam Interlock Controller

- If TED is moving extraction is inhibited
  - Interlock TRUE if IN or OUT
  - Interlock FALSE if TED is moving

	INPUT
TED TT40	TRUE
not used	TRUE
not used	TRUE
not used	
not used	
not used	
not used	
not used	
not used	
Screens TT40	TRUE
BLM TT40	FALSE
BPM LSS4	FALSE
BCT	FALSE
MSE Converter Sum Fa...	FALSE
not used	

# Status of Simulations

## Summary 1<sup>st</sup> pulse

R. Esposito

Material	Graphite	Aluminum	Cu-Be	Cu-OFE
RUN 2 Standard	621*	132	157	51
RUN 2 BCMS	560*	84	99	38
RUN 3 HL-LHC	1150*	230**	276**	77**
RUN 3 BCMS 2e11	1303*	205**	244**	70**
RUN 3 BCMS 2.32e11	1460*	232**	276**	78**
RUN 3 HL-LHC 154b	701*	136	163	52
RUN 3 BCMS 2e11 144b	752*	115	137	46
RUN 3 BCMS 2.32e11 144b	845*	130	155	50

\*Acceptable with Ti mask. Not acceptable without Ti mask.

Is it possible not to hit TED in TI2 LHC side with full intensity pulses until the next technical stop?  
(144 bunch pulses will be fine)

\*\* After one or many pulses it can go beyond service temperature or recrystallization temperature.

# Conclusions of Simulations

- Ti window on TED guarantees “no” fire risk

R. Esposito

Simulations also done for continuous extractions over 30 minutes

## Conclusions

All the beams, half intensity (144 bunches):

**ACCEPTABLE**

HL-LHC  $2.32e11$  ppb \* 288 bunches:

**RISK OF CRACKS IN GRAPHITE FOR A SINGLE PULSE**

BCMS  $2e11$  ppb \* 288 bunches:

**HIGH RISK OF CRACKS IN GRAPHITE FOR A SINGLE PULSE**

BCMS  $2.32e11$  ppb \* 288 bunches:

**HIGH RISK OF CRACKS IN GRAPHITE FOR A SINGLE PULSE**

# Proposal

- ❑ No budget and space for new LIU TEDs
- ❑ High intensity extraction on TED only needed during setting up with high intensity
  - To check of delay settings for beam on kicker length settings
  - A few times per year

## **THEREFORE:**

- propose to keep current TEDs
- modify interlocking for TEDs accordingly\*
- Setting up not impacted: can set up with 50 ns
- TT60 TED older, less performing version, to be replaced by new design
  - EN/STI looking into it
- HiRadMat TED to be studied



## \*...modify interlocking for TEDs accordingly

- ❑ Will have to prepare new SPS flag: TED safe beam flag
  - = 144 LIU BCMS bunches
  - Required reliability of flag still needs discussion with EN/STI
  
- ❑ Master BIC logic will not be modified
  
  
- ❑ Modify the slave BIC logic to which TED “moving” is connected
  - Add logic: `OUT == TRUE || TED safe beam flag == TRUE`
  
  - Either change the TED MOVING interlock to add this
  - OR add another non-maskable interlock with this logic

# TED specific interlocking in “slave” Beam Interlock Controller

- If TED is moving extraction is inhibited
  - Interlock TRUE if IN or OUT
  - Interlock FALSE if TED is moving
- Here the additional interlock would be added. BIC TT40B and TT60B

The screenshot shows a control panel with a list of interlocks on the left and their status on the right. The status is indicated by colored buttons: green for TRUE and red for FALSE. The 'TED TT40' interlock is circled in red.

Interlock Name	Status
TED TT40	TRUE
not used	
not used	
not used	
not used	
not used	
not used	
not used	
not used	
Screens TT40	TRUE
BLM TT40	FALSE
BPM LSS4	FALSE
BCT	FALSE
MSE Converter Sum Fa...	FALSE
not used	