CONS and HL-LHC day
26 September 2017
Analysis of needs from EN-STI

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CONS and HL-CONS approved requests
(for HL-CONS except spares)

- S. Redaelli's talk will cover LHC collimators **spares**, part of which will be EN/STI LS2 collimator production (e.g. TCPPM) and respective control system upgrade
- **Not treated here**

New requests for conversion of LHC into HL-LHC

Item n.	Description	Budget request	Budget to be allocated in years (from-to)	Priority (1-3) 1 top 3 low
1	**Construction of new LHC external dumps** (HCTDE__XX)	3.8 MCHF	2021-2026	1
2	**Construction of upgraded TED/TBSE cores** (including mechanics & control)	2.2 MCHF	2022-2026	2

TDE = Target Dump External
TED = Target Extraction Dump
TBSE = Target Beam Stopper Extraction

ITEM: 1 (LHC external dumps)

Rational of the request			
Current TDE windows are – at this stage – not capable of resisting a dilution failure and are with limited safety margin for nominal dumps. Dump sector has demonstrated weaknesses during operation (N_2 leaks). No instrumentation available on the dump for performance evaluation.			
Total Budget request	**3.8 MCHF** (2x dump sectors + 4x cores)	Budget to be allocated in years (from-to)	2021-2025
Material budget request	2.8 MCHF	Personnel available [y/n] in addition to personnel budget request	YES
Personnel budget request	1.0 MCHF – FELL/PJAS + students		
Consequences of suppression of request on HL performance			
Risks of damaging core (oxidation) and create leaks in the primary beam vacuum			
Consequences of delay of request to LS4 or later			
Beam availability and machine protection			

ITEM: 1 (LHC external dumps)

- Upstream stainless steel window (separating UHV from N_2 sector) as well as downstream TiGr2 (separating N_2 from air) will not be capable of sustaining a dilution failure during HL-LHC era
- Safety factor is ~1 even for nominal dump
  - Cannot reliably ensure reliability
  - Studies ongoing – dynamical effects dominating
- Potential consolidation that might be implemented in current spares for the downstream window not possible on operational devices (2x)

ITEM: 1 (LHC external dumps)

- Current design of the dump N_2 sector is prone to leak of N_2 to air
  - LHC dump currently operating in “degraded” mode, with UD62 graphite core at atmospheric pressure w/ minimal N_2 flow
- Not considered in original design: extreme large vibration (1.5 mm p2p at 200 Hz w/ current beams) inducing stresses on the entire assembly (will get worse w/ HL beams)

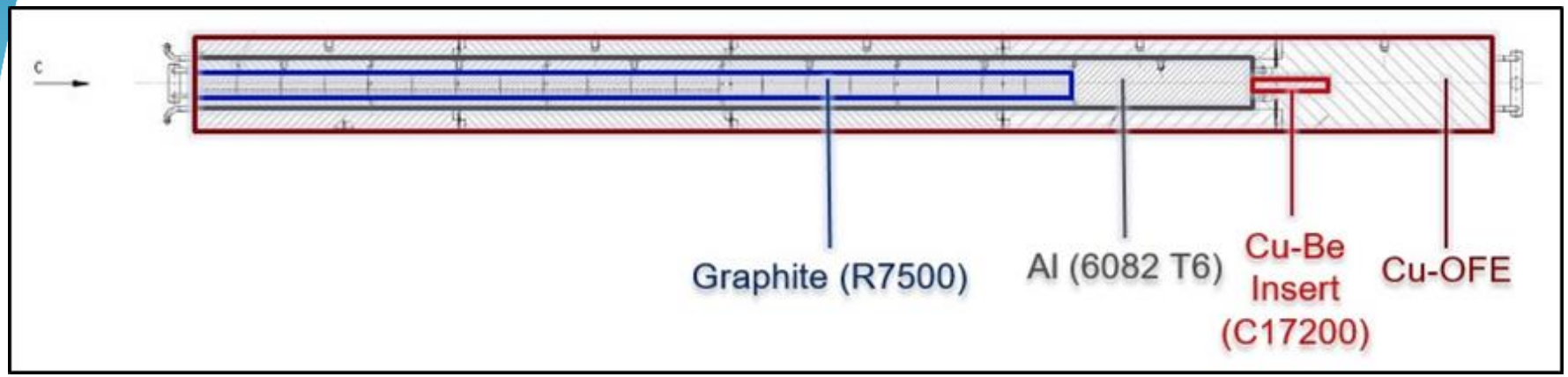
ITEM: 1 (LHC external dumps) - QUESTIONS

- *Is the system(s) affected by any NCR or limitation that could undermine the HL-LHC performance?*
  - **YES**
- *Is the system(s) affected by any obsolescence that could impair its efficient exploitation and that is not addressed in the present LHC-CONS program or HL-LHC project?*
  - **YES**
- *Is the system(s) missing spares and that could create issues to its efficient exploitation*
  - **NO**

ITEM: 2 (TED/TBSE)

Rational of the request			
Current TED & TBSE (in the SPS transfer lines to the LHC) are not capable of resisting to a beam impact from the HL-LHC beam. Movement mechanics and control system generating downtime for the machine. Very limited amount of spares.			
Total Budget request	**2.2 MCHF** (full consolidation quoted, only LHC-related)	Budget to be allocated in years (from-to)	2022-2025
Material budget request	1.5 MCHF	Personnel available [y/n] in addition to personnel budget request	YES
Personnel budget request	0.7 MCHF – FELL		
Consequences of suppression of request on HL performance			
In case of beam impact, machine will be stopped to exchange core (~1-2 weeks), if available as spare (currently only 1 spare fully qualified)			
Consequences of delay of request to LS4 or later			
Beam availability (downtime of machine)			

ITEM: 2 (TED/TBSE)



- According to LHC Design Report, TEDs are required to intercept the full high energy beam from SPS (CERN-2004-003-V3) (cooling)
  - "The TED must be able to sustain many beam aborts at the full intensity of $4.9*10^{13}$ protons, without alteration of the properties of the core" [lhc-project-report-465]
- TBSE are single pulse beam stoppers (no cooling)
- LHC related => 4(2) TEDs (5), 2 TBSEs (4)

ITEM: 2 (TED/TBSE)

- The existing TEDs cannot sustain even a single shot of the LIU beams (288 bunches, full intensity) without a major failure (SPS-TED-EN-0001). EN/STI cannot precisely predict the severity of this failure.
- The functionality of the TEDs as absorbing device after the mentioned failure would be compromised and would require a replacement
- EN/STI cannot be considered responsible nor evaluate the performance of the TEDs with LIU beams as personnel safety device, in particular after an impact causing the failure of the device
- Mechanics and control obsolete and not up to standards
- HiRadMat TED (same design) cannot be used w/ LIU beams

ITEM: 2 (TED/TBSE) - QUESTIONS

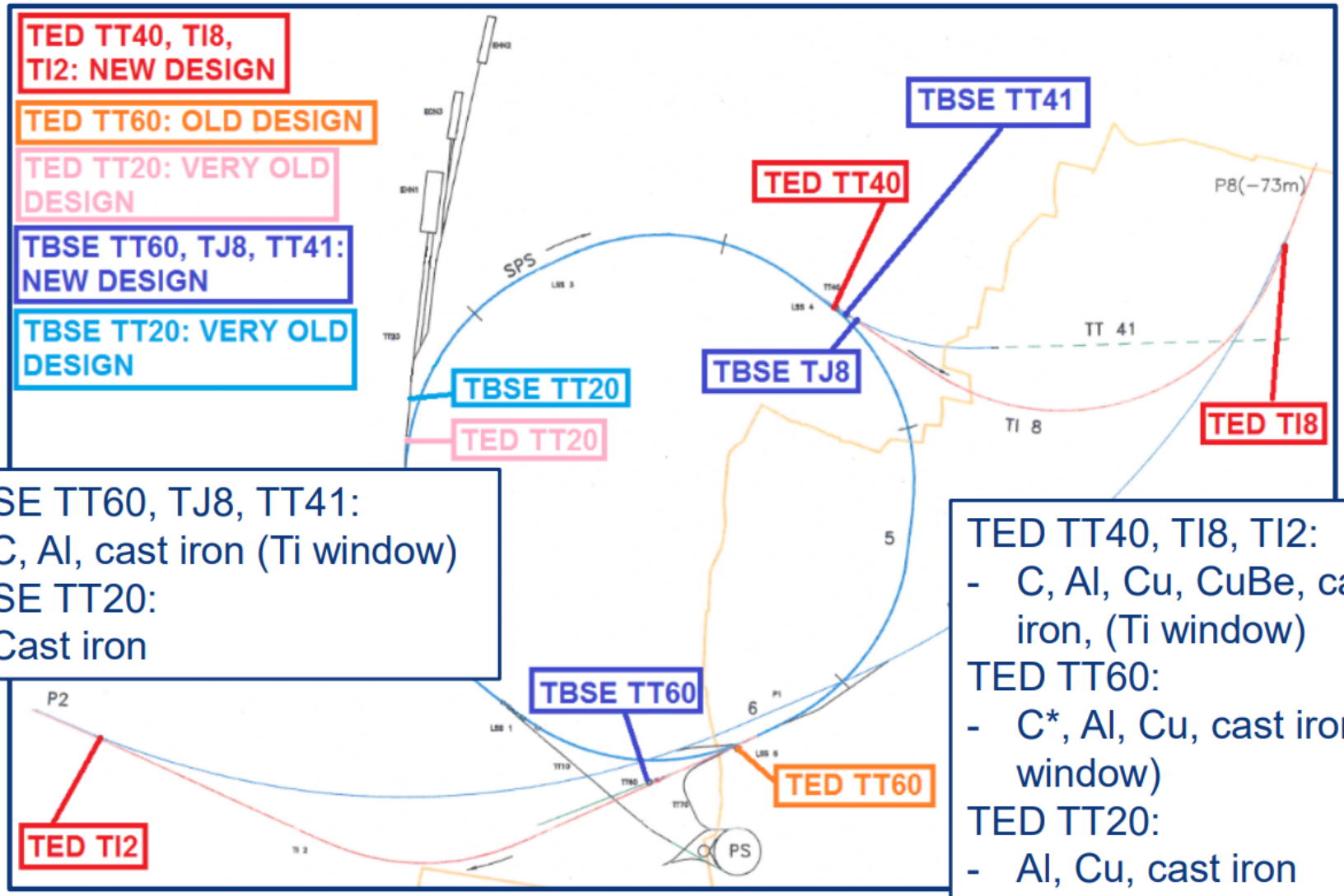
- *Is the system(s) affected by any NCR or limitation that could undermine the HL-LHC performance?*
  - **YES**
- *Is the system(s) affected by any obsolescence that could impair its efficient exploitation and that is not addressed in the present LHC-CONS program or HL-LHC project?*
  - **NO**
- *Is the system(s) missing spares and that could create issues to its efficient exploitation*
  - **YES**

Summary

Priority (1-3)	Item n.	Description	Approval Status:
1	1	Construction of new LHC external dumps	New
2	2	Construction of upgraded TED/TBSE cores and mechanical/control system upgrade*	New

* Standardization and spare would suggest consolidating also those devices for slow extraction (but out of the scope of LHC)

BACKUP



TBSE TT60, TJ8, TT41:
- C, Al, cast iron (Ti window)

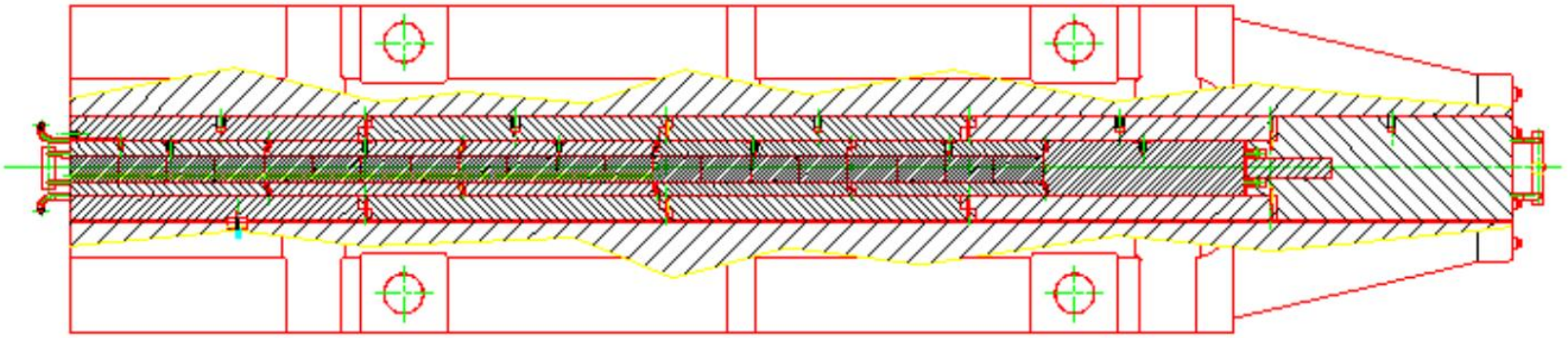
TBSE TT20:
- Cast iron

TED TT40, TI8, TI2:
- C, Al, Cu, CuBe, cast iron, (Ti window)

TED TT60:
- C*, Al, Cu, cast iron, (Ti window)

TED TT20:
- Al, Cu, cast iron

TED for LHC



TBSE