CONS and HL-LHC day
Analysis of needs from BE-BI

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BE-BI
Approved Requests

LHC-CONS & R2E Approved Requests
(Currently no approved HL-CONS requests for BE-BI)

Item	Description	Approved Budget (MCHF)	Spending ⇒ 2020 (MCHF)	Spending 2021-2025 (MCHF)
1	**R2E** Consolidation of Standard LHC BPM system (Radiation Hard Components)	2.85	2.15	0.70
	LHC-CONS Consolidation of Standard LHC BPM system (Standard Components)	4.20	0.5	3.70
	TOTAL	**7.05**	**2.55**	**4.40**

- Complete consolidation of the LHC BPM system
  - Tunnel & surface electronics
  - Aiming to be ready for LS3
    - Could wait for deployment in LS4
    - Need components manufactured & ready as back-up for post LS3 operation
  - Assumes re-use of existing fibre-optic cabling network
    - Replacement due to ageing or radiation damage not foreseen
- HL-WP13
  - Special electronics for new stripline monitors in LSS1 & LSS5

LHC-CONS & R2E Approved Requests

Item	Description	Approved Budget (MCHF)	Spending ⇒ 2020 (MCHF)	Spending 2021-2025 (MCHF)
2	**R2E** Development of Rad Hard Electronics for LHC BLM	0.3	0.3	
	LHC-CONS Development of Rad Hard Electronics for LHC BLM	0.2	0.2	
	HL-13 Production & Installation of Rad Hard Electronics for LHC BLM (LSS)	0.7		0.7
	TOTAL	**1.2**	**0.5**	**0.7**

- Development of radiation hard ASIC
  - Eliminates need for long cables
  - More margin between quench threshold & noise level

LHC-CONS Approved Requests

Item	Description	Approved Budget (kCHF)	Spending $\Rightarrow$ 2020 (kCHF)
3	**Consolidation of Fast BCTs (complete)** Complete detector & acquisition electronics renovation	135	135
4	**Consolidation of Interlock BPM System (LS2)** Acquisition electronics renovation	300	300
5	**VME fan replacement (LS2)** Replacement of Power Supply and Fan-Tray Units	400	400
6	**Consolidation of Standard LHC BLM System (LS2-LS3)** Surface electronics renovation	1000	1000
7	**Consolidation of LHC Wirescanners (LS2)** Control electronics renovation	150	150

BE-BI
Unapproved Requests by CONS or HL Baseline

Unapproved LHC-CONS / HL Baseline Requests

Item	Description	Budget Request (kCHF)	Allocated from	Priority
8	**Unapproved LHC-CONS** Consolidation of Head-Tail Instability Monitors	250	2019 to 2020	2

- Essential tool to understand origin of instabilities
  - Most recently showing that fast rise-time in 16L2 instability from tail break-up
- Consolidation Proposal
  - Replacement of Outdated Oscilloscope Based Acquisition System
    - Runs old, unsecure windows version
    - Limited in memory depth
- Proposal
  - Replace existing system with new state-of-the-art electronics during LS2
  - Off the shelf equipment – can be bought as soon as money available
  - Some SW (BI & possibly CO) manpower required to adapt to existing framework
- Need for HL
  - Monitor of reference for instability analysis
  - WP13 building more sensitive higher frequency versions but will need benchmark

Unapproved LHC-CONS / HL Baseline Requests

Item	Description	Budget Request (kCHF)	Allocated from	Priority
9	**Removed in HL Rebaselining** Renovation of Wirescanner Mechanics	680	2021 to 2025	1

- Reference beam profile measurement system
  - Provides cross calibration for all other profile measurement systems
- Consolidation Proposal
  - Replacement of old mechanics
  - Design & some components date from LEP era
- Some consolidation already necessary to address reliability issues
  - New bellows, new ferrite holder.
  - New control electronics already funded by LHC-CONS
- Proposal
  - Complete replacement of wirescanner mechanics
  - Use experience from LIU upgrade of all injector scanners
- Need for HL
  - Only way to ensure reliability of this essential system after LS3

BE-BI
New requests in view of HL-LHC installation
(to meet HL-LHC goals)

New LHC-CONS / HL-CONS Requests

Item	Description	Budget Request (MCHF)	Allocated from	Priority
10	**LHC / HL-CONS** Consolidation of Beam Gas Ionisation Profile Monitors	1.5 to 2.5	2019 to 2025	2
11	**HL-CONS** Consolidation of Standard BLM Tunnel Electronics	~ 4	2023 to 2028	1

ITEM: 10, Beam Gas Ionisation Profile Monitors

Summary of the Request			
Total Budget request	1.5 MCHF (no magnet) to 2.5 MCHF (SC magnet)	Budget to be allocated in years	2019 - 2025
Material budget request	1.25 – 2.25 MCHF	Personnel available in addition to personnel budget request	YES
Personnel budget request (M2P budget)	250 kCHF – Fellow/PJAS + Student		

Consequences of suppression of request on HL performance

- No bunch by bunch measurement of ion beam sizes at injection
- No measurement of beam size during acceleration

Consequences of delay of request to LS4 or later

- Non-optimised ion operation for initial HL Run

ITEM: 10, Beam Gas Ionisation Profile Monitors

- LHC Beam Gas Ionisation Profile Measurement System
  - For measurement of transverse beam sizes of primarily ion beams
    - Wirescanners limited in use to low intensity beams
    - Synchrotron light monitor inefficient for ions at injection energy & on ramp
- Current System
  - Never became fully operational due to many issues
    - Suffers from significant space charge effects for proton beams above 2TeV
    - Detector & camera performance issues worked on and solved in 2016
    - Had to be removed in EYETS due to RF heating (impedance)
      - Tank needs complete re-design to make it impedance compliant
- Progress in the injectors
  - Duplicate LHC system now being made operational in the SPS
    - Showing some nice results
  - New technology of in-vacuum Pixel Detectors pioneered by LIU for PS
    - Results promising & removes need for regular exchange of in-vacuum MCP
    - Should be able to work with much lower gas pressure
- Need for HL
  - Could be alternative to BGV (SC magnet > 2T for use with p+)
  - Propose review of all beam profile measurement devices for HL
    - To be scheduled early 2019 after analysis of Run 2, SPS and PS results

ITEM: 11, Standard BLM Tunnel Electronics

Rational of the request			
Total Budget request	~ 4.5 MCHF	Budget to be allocated in years (from-to)	2024 – 2028
Material budget request	~ 4 MCHF	Personnel available [y/n] in addition to personnel budget request	YES
Personnel budget request (M2P budget for MPAs and fellows)	0.5 MCHF – Fellow/PJAS + Students		

Consequences of suppression of request on HL performance

- No HL operation due to unavailability of BLM system

Consequences of delay of request to LS4 or later

- Installation anticipated for LS4
- Later deployment risks less reliability (radiation) & unavailability of spares

ITEM: 11, Standard BLM Tunnel Electronics

- LHC BLM System - composed of 3 parts
  - Radiation tolerant tunnel electronics
  - Fibre-optic transmission
  - Surface electronics for data treatment & threshold evaluation
- Surface Electronics
  - To be renovated in or shortly after LS2
  - Fully funded by LHC-CONS
- Tunnel Electronics
  - Designed for 20 year LHC lifespan
    - Expected end-of-life after LS4
  - R&D on replacement needs to start before LS3
    - All components to be qualified for use in radiation environment
- Fibre-Optic Communication
  - As for LHC BPM system – currently no provisions to replace existing BE-BI fibre-optic distribution in LHC
- Need for HL
  - Vital for HL Operation
    - Cannot function without a fully reliable BLM system

Summary

Priority	Item	Description	Approval Status:
1	11	Standard BLM Tunnel Electronics	NEW
1	10	Consolidation of Beam Gas Ionisation Profile Monitors	NEW
2	8	Consolidation of Head-Tail Instability Monitors	Unapproved LHC-CONS
2	9	Renovation of Wirescanner Mechanics	Unapproved HL-Baseline

- Consolidation of Profile Monitoring Systems
  - Review of all possible techniques foreseen after Run 2
    - Limitations of existing systems (wirescanners & synchrotron light)
    - Best Alternative(s) for HL-LHC (protons & ions)
      - Beam Gas Vertex, Beam Gas Ionisation Monitor, Beam Gas Curtain,….
  - Decision to be made on which to support
    - Some funding already foreseen from HL-WP13
    - Will need to be complemented by CONSOLIDATION