CONCEPTUAL SPECIFICATION

TUNGSTEN SHIELDED CRYOGENIC STRIPLINE BPMS FOR HL-LHC

[BPMSQT]

Equipment/system description

This specification concerns the HL-LHC beam position monitors (BPMs) in front of the Q2b and Q3 magnets and the triplet corrector magnet package. These will be cryogenic stripline BPMs, rotated by 45° to allow the insertion of tungsten shielding in the median planes of both horizontal and vertical axes.

Layout Versions	**LHC sectors concerned**	**CDD Drawings root names (drawing storage):**
V 1.0	LSS1, LSS5	LHC BPMSQT to be created by S. Chemli

TRACEABILITY

Project Engineer in charge of the equipment	**WP Leader in charge of the equipment**	
T. Lefevre	R. Jones	
Committee/Verification Role	**Decision**	**Date**
PLC-HLTC/ Performance and technical parameters	Rejected/Accepted	2014-07-08
Configuration-Integration / Configuraration, installation and interface parameters	Rejected/Accepted	20YY-MM-DD
TC / Cost and schedule	Rejected/Accepted	20YY-MM-DD
Final decision by PL	Rejected/Accepted/Accepted pending (integration studies, …)	20YY-MM-DD

Distribution: HL-TC

Rev. No.	***Date***	***Description of Changes*** *(major changes only, minor changes in EDMS)*
1.0	2014-06-06	Creation Date

1 CONCEPTUAL DESCRIPTION

1.1 Scope

This specification concerns the HL-LHC beam position monitors (BPMs) in front of the Q2b and Q3 magnets and the triplet corrector magnet package. These will be stripline BPMs, rotated by 45° to allow the insertion of tungsten shielding in the median planes of both horizontal and vertical axes.

1.2 Benefit or objective for the HL-LHC machine performance

These BPMs are essential for maintaining a stable orbit at the IP, and could be used for continuous luminosity optimisation.

1.3 Equipment performance objectives

The system should be able to measure the beam position for each beam with a resolution of 1um and a medium term (fill to fill) reproducibility of 10um.

TECHNICAL ANNEXES

2 PRELIMINARY TECHNICAL PARAMETERS

2.1 Assumptions

It is currently assumed that these detectors will be based on stripline BPMs and that only those installed on the Q2b, Q3 magnets and the triplet corrector magnet package require tungsten shielding. It is also assumed that one design can fit all these locations.

2.2 Equipment Technical parameters

The BPM is of a stripline type with the provisional parameters listed in table 1.

Table 1: Equipment parameters

Characteristics	Units	Value
Aperture	mm	Adapted to beam screen aperture.
Total Length	mm	220 (minimum)
Stripline orientation	degrees	45

The length of the BPM is not linked to aperture. The resolution of the system typically scales with decreasing aperture, a larger aperture therefore implies lower resolution.

2.3 Operational parameters and conditions

The signal will be extracted using 8 semi-rigid, radiation resistant coaxial cables per BPM. Two feedthough with 4 coaxial cable connections will need to be integrated into the Q2b and Q3 cryostats and into the cryostat of the triplet corrector magnet package.

2.4 Technical and Installation services required

The system is assumed to present a negligible heat load for the cryogenic system of the inner triplet magnets.

Table 2: Technical services

Domain	Requirement
Electricity & Power	• Eight ½" coaxial cables per BPM connecting the feedthroughs on the cryostat to beam instrumentation racks in the UA/UJ • One additional rack in the UA/UJ for each side of the LSS • Additional fibre-optic links (12 fibres for each side of the LSS) from the UA/UJ to the surface (SR) to complement the existing BPM links.
Vacuum	These BPMs will be an integral part of the beam vacuum system

Table 3: Installation services

Domain	Requirement

Cryostat Assembly	These monitors need to be mouted during assembly of the magnet cryostat components.
Alignment	These BPMs will need to be accurately aligned with respect to the cryostat fiducials.

2.5 Reliability, availability, maintainability

As part of the beam position system of the LHC these components need to be highly reliable and maintenance free. The effect on luminosity optimization and the IR orbit of losing one of these BPMs is currently under evaluation.

2.6 Radiation resistance

The materials used need to able to withstand irradiation up to several MGy.

2.7 List of units to be installed and spares policy

To be installed left and right of IP1 and IP5.

- 1 located in interconnect bewteen Q2A and Q2B
- 1 located in interconnect bewteen Q2B and Q3A
- 1 located in interconnect bewteen Q3A and CP

A total of 12 such BPMs will be installed with 3 spares foreseen for this type of BPM assembly.

3 PRELIMINARY CONFIGURATION AND INSTALLATION CONSTRAINTS

3.1 Longitudinal range

The ideal longitudinal location should correspond as closely as possible to (1.87 + N x 3.743)m from the IP where N is an integer. Any deviation from this will diminish the possibility of the system to distinguish one beam from the other.

3.2 Volume

Volume is ?.

3.3 Installation/Dismantling

Needs integration into the Q2A-Q2B, Q2B-Q3A and Q3B-CP interconnects

4 PRELIMINARY INTERFACE PARAMETERS

4.1 Interfaces with equipment

Interface with the beam screen and cold bore of Q2a, Q2b, Q3a , Q3b and CP. Feedthoughs interface to the cryostats of Q2b, Q3a and CP.

5 COST & SCHEDULE

5.1 Cost evaluation

Baseline APT (budget code : 64063 – HL-LHC Interaction Region BPMs).

5.2 Approximated Schedule

Simplified schedule by years

Table 4: Simplified Schedule

Phase	2014		2015		2016		2017		2018	2019	2020	2021	2022	2023	2024	2025
Engineering specification																
Design & Integration																
Procurement																
Assembly & Verification																
Installation – Commissioning																

5.3 Schedule and cost dependencies

List of conditions and constrains.

- The installation can be done only as part of the cryostat assembly

6 TECHNICAL REFERENCE DOCUMENTS

- To be provided

7 APPROVAL PROCESS COMMENTS FOR VERSION X.0 OF THE CONCEPTUAL SPECIFICATION

7.1 PLC-HLTC / Performance and technical parameters Verification

Comments or references to approval notes. In case of rejection detailed reasoning

7.2 Configuration-Integration / Configuraration, installation and interface parameters Verification

Comments or references to approval notes. In case of rejection detailed reasoning

7.3 TC / Cost and schedule Verification

Comments or references to approval notes. In case of rejection detailed reasoning

7.4 Final decision by PL

Comments or references to approval notes. In case of rejection detailed reasoning