CERN
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the
**Large
Hadron
Collider**
project

Date: 2006-05-04

Engineering Change Order – Class I

Addition of a Beam Loss Monitor Interlock with Direct Input to the LHC Beam Dump

Brief description of the proposed change(s) :

In response to the 2005 Review of the LHC Machine Protection System, an additional set of beam loss monitors has been proposed in IR6, near the TCDQ element. The loss monitors will be hardware configured with relatively high thresholds, with direct inputs to the triggers of the LHC beam dump, i.e. the signals will not pass via the Beam Interlock System.

Equipment concerned :	*Drawings concerned :*	*Documents concerned :*
LBDS	**LHCLSX__0011** **LHCLSX__0012**	**LHC-B-ES-0008 v.2.0** **LHC-TCDQ-ES-0001 v.0.1** **LHC-TCDQ-EC-0001 v.1.0**

PE in charge of the item : **Bernd DEHNING**	*PE in charge of parent item in PBS :* **Brennan GODDARD**
Decision of the Project Engineer :	*Decision of the PLO for Class I changes :*
☐ Rejected.	☐ Not requested.
☐ Accepted by Project Engineer, no impact on other items. *Actions identified by Project Engineer*	☐ Rejected.
☑ Accepted by Project Engineer, but impact on other items. *Comments from other Project Engineers required* *Final decision & actions by Project Management*	☑ Accepted by the Project Leader Office. *Actions identified by Project Leader Office*
Date of Approval : 2006-05-04	*Date of Approval :* 2006-05-04

Actions to be undertaken :

Modify all drawing and engineering specifications concerned to reflect this changes.

Date of Completion : 2006-05-04	*Visa of QA Officer :*

*Note : when approved, an **Engineering Change Request** becomes an **Engineering Change Order/Notification**.*

1. DETAILED DESCRIPTION   by B.Goddard

For the reasons explained in section 2, it is proposed to add four new beam loss monitors (BLM) in IR6, two near each TCDQ element. The loss monitors will be hardware configured with relatively high thresholds, with direct inputs to the triggers of the LHC beam dump system (LBDS), i.e. the trigger signals will not pass via the Beam Interlock System (BIS).

The monitors, data acquisition and triggering will reuse established and readily available SPS BLM technology. This will require 2 VME cards to be housed in each of the two Triggering and Synchronisation Units (TSU) of the LBDS. No remote configuration of the system will be possible, which means a fixed interlock level, independent of the LHC energy. The interlocks cannot be remotely masked. However, the status, loss rates and thresholds will be readable via the LHC control system. Clearly the interlock thresholds must be chosen with care, to provide adequate protection while avoiding spurious beam dumps.

2. REASONS FOR CHANGE   by B.Goddard

In the 2005 review of the LHC Machine Protection system [1], the subject of worst case failures was raised, with concerns over potential failures of the LBDS and BIS. To provide an extra degree of safety, in the event of a failure of the BIS to forward a trigger signal to the LBDS (either through a total failure of e.g. the BLM system or the BIS itself), one simple and robust extra measure is to locate dedicated BLMs at the TCDQ/Q4 in IR6, where the horizontal beam size is relatively large due to the high β value. These BLMs can be hardwired directly to the dump trigger TSU without passing through the BIS. Obviously these direct interlock BLMs need much higher thresholds than the other BLMs in the ring, and should also be based on a different technology. This system is intended to alleviate the effects of such a catastrophic failure, probably restricting damage to the LHC collimation system.

3. IMPACT ON COST, SCHEDULE & PERFORMANCE by B.Dehning/B.Goddard

- There will be a small **cost impact with respect to the LHC baseline**. The cost for the extra BLMs, acquisition cards, triggering cards, cabling minor design changes and drawings is estimated at a total of **20 kCHF**.
- This change will have **no impact** on the schedule
- There will be a **positive impact** on the LHC performance, in the form of increased safety and protection against a subset of the worst-case failures.

4. IMPACT ON OTHER ITEMS   by B.Goddard

The VME crate for the LBDS TSU must house the two BLM cards, requiring minor modifications to the control software to be able to read the status etc. The TSU must also have a trigger input for this interlock.

5. CHANGE CLASS   by B.Goddard

The proposed changes are of CHANGE CLASS I.

6. **COMMENTS** (COMPULSORY)   **by B.Goddard**

The proposed changes have been endorsed by the MPWG [2] and LTC [3].

7. **COMMENTS** (IF REQUIRED)   **by other Project Engineers**

8. **COMMENTS** (IF ANY)   **by PLO appropriate Committees**

9. **REFERENCES**

[1] http://lhc-mp-review.web.cern.ch/

[2] http://lhc-mpwg.web.cern.ch/ Meeting 53, 16 December 2005.

[3] http://edms.cern.ch/lhc_proj/plsql/lhcp.page?p_number=7700 Meeting 52, 15 March 2006.