**CERN**
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the **Large Hadron Collider** project

*LHC Project Document No.*
**LHC-X5ZDC-EC-0001**

*EDMS Document No.*
**753836**

*Engineering Change requested by ( Name & Div./Grp. ) :*
**D. Macina TS/LEA, M. Murray PH/UCM**

Date: 2006-08-30

## Engineering Change Order – Class I

# The CMS ZDC

***Brief description of the proposed change(s) :***

The CMS experiment proposes to install Zero Degree Calorimeters (ZDC) in the TAN absorber on either side of IP5. A few details on the detectors and the associated services are given. No changes are expected in the LHC layout.

| ***Equipment concerned :*** | ***Drawings concerned :*** | ***Documents concerned :*** |
|---|---|---|
| **TAN.4R5**<br>**TAN.4L6**<br>**X5ZDC** | **LHCLSXG_0003**<br>**LHCLSX__0009**<br>**LHCLSX__0010** | |

| ***PE in charge of the item :*** | ***PE in charge of parent item in PBS :*** |
|---|---|
| **S.Chemli** | **P.Proudlock** |

***Decision of the Project Engineer :***

- ☐ Rejected.
- ☐ Accepted by Project Engineer, no impact on other items.
  *Actions identified by Project Engineer*
- ☑ Accepted by Project Engineer, but impact on other items.
  *Comments from other Project Engineers required*
  *Final decision & actions by Project Management*

***Date of Approval :*** 2006-08-30

***Decision of the PLO for Class I changes :***

- ☐ Not requested.
- ☐ Rejected.
- ☑ Accepted by the Project Leader Office.
  *Actions identified by Project Leader Office*

***Date of Approval :*** 2006-08-30

***Actions to be undertaken :***

Modify the drawing concerned to reflect the changes described in this ECO.

| ***Date of Completion :*** 2006-08-30 | ***Visa of QA Officer :*** |
|---|---|

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

## 1. DETAILED DESCRIPTION

**by D. Macina, M. Murray.**

The CMS experiment proposes to install Zero Degree Calorimeters (ZDC) in the TAN absorber on either side of IP5 [1]. The ZDC is a tungsten+quartz-fibre sampling Cerenkov calorimeter split into hadronic (HAD) and electromagnetic (EM) sections. The calorimeter will complement the acceptance of the CMS central detector since it will detect neutral particles emitted in the very forward region. The EM section will occupy the first 10 cm slot in the TAN absorber. The second slot is reserved for the machine beam rate monitor (BRAN) while the remaining eight slots 80 cm long will be occupied by the HAD section of the calorimeter (See Fig. 1). The calorimeter is radiation hard up to ~ 20 Grad, i.e. it is very useful for physics measurements in nucleus-nucleus (AA) collisions and low luminosity proton-proton (pp) collisions. The RHIC experience has shown that the ZDC can be used as a beam instrumentation tool during the AA, proton-nucleus (pA) and pp runs and it can complement the existing LHC accelerator instrumentation.

The CMS ZDC will be installed before the LHC start-up and it will take data both during the pp runs and the AA runs until the nominal pp luminosity is attained. Then, in order to limit the absorbed dose, it will be removed during the pp runs and re-installed during the AA runs.

The EM section is made of 33 layers of 2 mm thick tungsten plates and 33 layers of 0.7 mm diameter quartz fibers. The HAD section consists of 24 layers of 15.5 mm thick tungsten plates and 24 layers of 0.7 mm diameter quartz fibers. The fibers are grouped together to form readout bundles and are coupled to photomultiplier tubes (PMT).

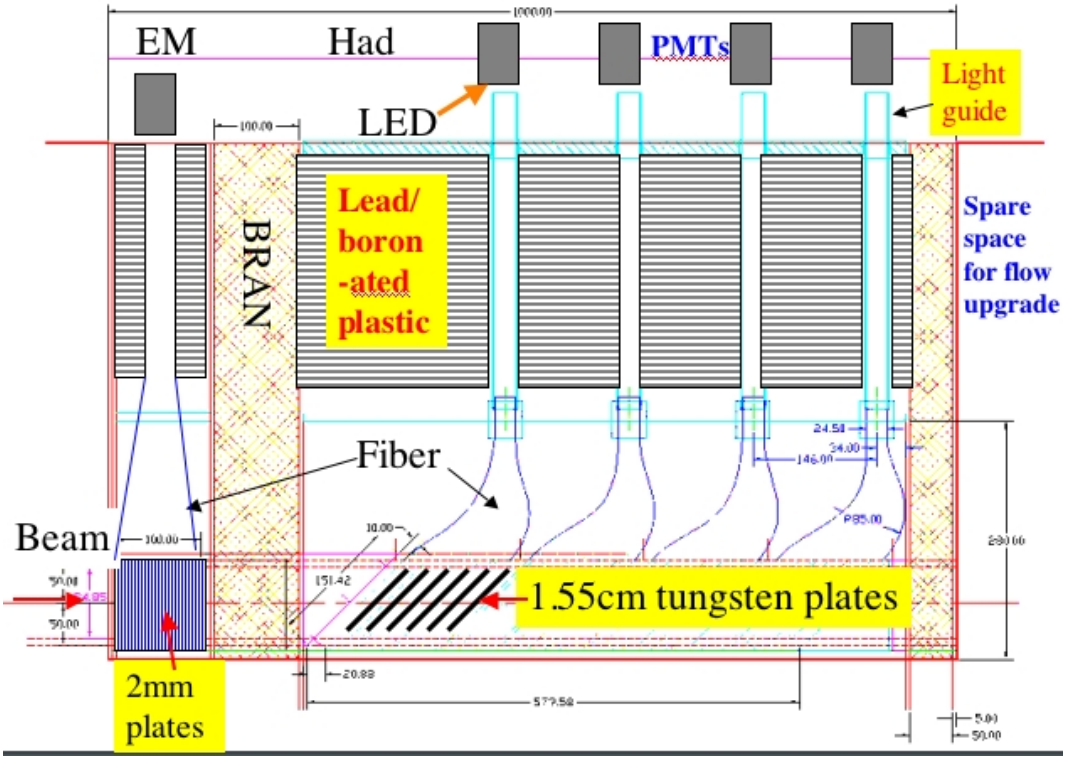


Fig. 1 Side View of the CMS ZDC

The detectors will need the services listed below:

- Cabling – All the signal/HV/power cables are pulled to the electronics room near IP5 (USC55). The ZDC will make use of the cable trays already installed in the tunnel. The cables will be pulled by the TS/LEA group and the installation dates have been planned in collaboration with the TS/IC Planning Section.
- Optical fibers – A few optical fibers are needed between USC55 and the ZDC for the laser monitoring system. The fibers will be provided by CMS and will be pulled by TS/EL. The installation dates will be planned in collaboration with the TS/IC Planning Section.
- Patch panel: This should be mounted near the TAN close to the cable tray.

Finally, radiation protection considerations are being addressed in collaboration with the SC/RP group. The design will be optimized for handling in a high radiation environment. Remote handling for reinstallation and removal during later phases might be necessary.

## 2. REASONS FOR CHANGE

**by D. Macina, M. Murray**

No changes are expected in the LHC layout since the detectors will be inserted in the available space inside the TAN absorber. However, some work has to be foreseen to provide services to the detectors.

## 3. IMPACT ON COST, SCHEDULE & PERFORMANCE

**by D. Macina, M. Murray**

The change has no impact on the LHC cost. The installation of all services is being organized to be compatible with the actual machine installation schedule.

## 4. IMPACT ON OTHER ITEMS

**by D. Macina, M. Murray**

All detectors inserted in the TAN and their services have to avoid any interference with the TAN alignment system. Therefore, the following has been agreed with the Survey Group (TS/SU):

- Longitudinally, only the space between the two alignment targets can be occupied
- Detectors and their services can occupy the volume on top of the TAN surface up to a maximum height of 30 cm.

The conditions above are fulfilled by the CMS ZDC.

## 5. CHANGE CLASS

**by Project Engineer**

Class I

## 6. COMMENTS (COMPULSORY)

**by Project Engineer**

## 7. COMMENTS

## 8. COMMENTS (IF ANY)

**by PLO appropriate Committees**

## 9. REFERENCES

[1] THE ZDC TECHNICAL DESIGN REPORT HTTP://ZDC.WEB.CERN.CH/ZDC/