

# Summary of Expenditure for CMS Maintenance & Operations for the Year 2010

## INTRODUCTION

This document summarizes the expenditure that the CMS Collaboration has made in 2010 in order to maintain and operate the already constructed detectors and Collaboration-wide facilities (M&O Cat. A) as well as expenses made directly by the Sub-detector communities to maintain their respective Sub-detectors (M&O Cat. B).

We present the income received in a manner similar to Common Funds and we report the payments classified following the Scrutiny Group's classification.

This is the ninth report that the CMS Collaboration presents on M&O Expenditures and the eighth year we report the M&O Cat. B. The budget request for M&O in 2010 was made in October 2009 (cf. CERN-RRB-2009-111).

Commitments are not detailed in this report owing to the very nature of M&O: long-term commitments should be rare and they will be commented upon in the text in the event they occur.

Most of the Funding Agencies have by now signed the M&O MoU.

## 1. INCOME

The M&O 2010 approved budget totalled 11'911 kCHF plus 1'800 kCHF for Energy consumption.

The actual invoiced amount was 12'742 kCHF.

We note that for 2010 only 30 kCHF, are still outstanding to date.

## 2. PAYMENTS

### 2.1 M&O-A

An overview of expenditure versus budget is shown in the Annex 1.

The expenses classification presented here follows the categories established by the Scrutiny Group.

- **Expenses**

It was reported in both the April and October 2010 RRB meetings that urgent emergency repairs of the detector cooling system were required and carried out at the beginning of

2010 in order to avoid a serious risk of leaks. This operation carried an overall cost of 1'121 kCHF. It was agreed at the October 2010 RRB that, although the costs are incurred in 2010, they would be included in the 2011 M&O-A budget in order to balance the corresponding overspend in 2010 (since no provision was available for this purpose).

These unforeseen costs have generated an over-spending in the relevant categories in Detector Related Costs, Laboratory Operations and General Services, which corresponds approximately to the above-mentioned amount. This concerns the following budget lines: A.1.6, A.1.10, A.1.11, A.1.12, A.1.13, A.1.16, A.6.02, A.7.04, A.7.05 and A.7.08.

Due to savings made in other areas it has been possible to reduce the overall over-spend on the M&O-A Budget (without Power) to only 380 kCHF.

In addition to the above-mentioned overspending related to the bushing replacement, expenditures differed in some other areas as specifically mentioned below.

In the area A.1.05, Gas Consumption, there continues to be an overspend as in the previous year which is due to the gas recycling system not yet attaining its full capacity. The expenditure on this item was 596 kCHF as compared to a budget of 496 kCHF. According to the Operational Model agreed with the Scrutiny Group in 2010, which differentiates M&O costs between a running and a shutdown year, the expenditure forecast was estimated to be 550 kCHF.

Progress is being made with implementing CF4 recuperation (CSC circuit) and once this plant is fully operational, savings of the order of 100 kCHF per year are expected.

Expenditures incurred in the area A.1.07, Cooling Fluids (above -50°C) amounted to 198 kCHF vis-à-vis a budget allocation of 220 kCHF. A more precise estimate of annual consumption can be made only at the end of 2011, as the amount spent during the year does not correspond to the actual consumption due to the need of maintaining a reserve. This is necessary especially due to the risk of fluid loss, such as the one due to the persistent leak problem with the Tracker SS2 plant.

A significant overspend was incurred in the area A.1.09, Cryogenic fluids with an expenditure of 109 kCHF vis-à-vis a budget allocation of 40 kCHF. This was due mainly to Cold Box pollution problems which led to a larger than expected requirement for helium flushing as well as modifications to the dewar system for liquid Nitrogen provision. Technical modifications made during 2010 are expected to resolve the situation and therefore expenditures in 2011 should remain within allocation.

An overspend was incurred in the area A.7.01, Cooling and Ventilation with an expenditure of 650 kCHF vis-à-vis a budget allocation of 595 kCHF. This was due to CERN charging the cost of the Service Level Agreement for Detector Cooling for the both 2009 and for 2010 during the course of last year.

In order to reduce the overall overspend in the M&O-A budget, expenditures in some areas were delayed. This concerns mainly the purchase of videoconference equipment in A.3.02, Online hardware in A.4 and expenditures related to Outreach in A.7.12.

## • Outstanding commitments

The total amount of open commitments at the end of the year totalled some 931 kCHF, of which some 30% are related to industrial support contracts for 2010. The remainder are for consumables and goods to be delivered this year, of which 239 kCHF is for DAQ equipment and 162 kCHF for cooling fluid.

## 2.2 M&O-B by sub-detector

- **Tracker**

Contributions from Funding Agencies fully covered the Tracker budget request, and actually slightly exceeded it with one in-kind contribution. Cash contributions paid directly to Tracker Team Accounts amounted to a record 84% of the request; the rest was paid cash directly by collaborating Institutes for documented purchase of materials and/or services.

Overall, there was no funding problem in 2010. The arrangements with individual Funding Agencies and Institutes worked as expected in all cases. Furthermore, all Funding Agencies provided their expected shares of Human Resources as Technical Manpower at CERN.

During 2010, the major categories of M&O expenses were: Hired Manpower, the maintenance and repair of the Cooling system (which remains a delicate part of the system that requires careful monitoring, more studies and further investments); the maintenance and the procurement of spares for the Power Supply system; the procurement of improved readout modules for the Pixel system. On a few individual items, namely Mechanics and Areas, the expenditure was lower than requested, but some of the investments in these items have simply been delayed to a later date.

- **ECAL**

The total 2010 M&O-B requests for the Material Resources for the Electromagnetic Calorimeter of CMS was 1'433 kCHF. Contributions to these expenses were made either by placing orders directly to, or by cash contributions to the ECAL M&O-B account.

The main expenses were in the category of Hired Manpower at CERN (B.1.14) and to cover the third and last payment for the crystals used to equip the 37th Super Module (B.1.10).

- **HCAL**

HCAL expenditures in 2010 were consistent with the proposed budget, with the largest expenditure being for Hired Manpower at CERN. Spares supplies (clock fanouts, TTCummd boards, magatile optical cables) were also increased in 2010. HCAL achieved stable physics operations, with significant progress in monitoring and identifying problems in the detector and with improved shift organization. The CCM (control, clock, and monitor) server was upgraded and design changes to the DCS/DSS HV supply system were implemented. Calibration procedures were improved and a better understanding of noise sources was achieved. All participating Funding Agencies contributed to these activities.

- **Muon Systems**

### CSC System

For 2010 the spending for the CSC Subsystem was according to plan. All Funding Agencies provided the resources as requested. There were no significant expenditures, which had not been anticipated.

The current estimate is that this budget will be maintained each year through 2015 (this doesn't take into account the possible impact of the ME11 electronics replacement).

As 2011 is the first full year of normal operations (i.e. no significant installation or commissioning work) it is presumed that much will be learnt from current operations, which will allow refining this budget as the year proceeds.

### **DT System**

For the Muon Barrel Drift Tubes and Barrel Alignment and Link Alignment the requested budget was used in line with the original request. During 2010 the largest fraction of the budget was spent, as foreseen, on Hired Manpower, in order to keep few positions of experts and coordinators available at CERN during maintenance of the apparatus and running of the alignment system. The amount of repairs of the HV-LV system was completely in line with expectations. The spent fraction of the budget however has been less than 2009 (65%) due to the fact that few items (which would have brought the budget residual to the same levels of 2009) could not be ordered in 2010. These are the completion of the electronic test setup at Bld. 904, and the completion of the SX5 test area.

The M&O-B sharing between the Funding Agencies took into account the overall responsibilities (in the DT system it was agreed to share by investment until 2012) and all contributions from 2010 budget were received as agreed with the exception of the Spanish contribution which is now handled directly by the Spain Science Ministry and not anymore by CIEMAT and Santander groups. However, there is reassurance that the due contribution has been granted by the Spanish government.

### **RPC System**

The total 2010 M&O-B request for the RPC project was 459 kCHF.

The amount was covered by the Funding Agencies, contributing both in cash and/or in manpower with a percentage related to their financial budget.

Half of the budget was spent to complete the set of spares needed for the power system and electronic. About 130 kCHF was used for Hired Manpower, in order to have technicians, engineers and experts to run the full project.

- **Trigger**

The total trigger M&O B budget for 2010 was 690 kCHF, of which 490 kCHF has been expended directly within institutes towards the maintenance and operational costs of the electronic subsystems for which they are responsible.

177 kCHF income was received as cash contribution to the M&O central account, against which expenditure of 130 kCHF was made towards subsistence for technical manpower at CERN, working largely on common software items. A further 7.2 kCHF was spent on transport, communications and other operational expenses. A larger commitment to manpower is required in 2011, and the 2010 surplus will act to offset this.

## **ANNEXES**

### **Annex 1: M&O Cat. A Expenditures vs. Budget in 2010**

# ANNEX 1

## M & O Cat. A Expenditure vs. Budget in 2010

Year	2010
System	A. M&O-A

Type		Subsystem	Item	kCHF Budget	Payments
Expense	M&O-A w/o Power	A.1. Detector related costs	A.1.01 Magnet	30	28
			A.1.02 Magnet controls	142	155
			A.1.03 Magnet power supply	40	39
			A.1.04 Gas systems	260	259
			A.1.05 Gas consumption	496	596
			A.1.06 Cooling systems	220	324
			A.1.07 Cooling fluids(above -50°C)	220	198
			A.1.08 External cryogenics	375	377
			A.1.09 Cryogenic fluids (below -50°C)	40	109
			A.1.10 Moving /hydraulic systems	80	197
			A.1.11 Detector safety systems	180	327
			A.1.12 Shutdown activities	410	717
			A.1.13 General Technical support	600	698
			A.1.14 UPS maintenance	80	82
			A.1.15 Electronics pool rentals		
			A.1.16 Beam pipe & vacuum	240	270
			A.1.17 Counting & control rooms	220	220
		<i>A.1. Detector related costs Total</i>		3,633	4,596
		A.2. Secretariat	A.2.01 Secretarial assistance	225	236
			A.2.02 Economat	15	15
			A.2.04 Printing and publication	50	46
		<i>A.2. Secretariat Total</i>		290	297
		A.3. Communications	A.3.01 GSM phones; on-call service	20	20
			A.3.02 Collaborative tools	350	314
		<i>A.3. Communications Total</i>		370	334
		A.4. On-line computing	A.4.01 System management	846	820
			A.4.02 Data storage, (temporary on disk)	282	284
			A.4.03 Detector controls	130	92
			A.4.04 Computers /processors /LANs	1,985	1,538
			A.4.05 Software licenses		
		<i>A.4. On-line computing Total</i>		3,243	2,734
		A.5. Test beams, calibration facilities	A.5.01 General operation	40	40
			A.5.02 Common electronics	15	15
			A.5.03 Electronics pool rentals	20	19
			A.5.04 Gas systems	10	10
			A.5.05 Gas consumption	10	11
			A.5.06 External cryogenics		
		<i>A.5. Test beams, calibration facilities Total</i>		95	95
		A.6. Laboratory operations	A.6.01 Assembly areas, clean rooms	600	600
			A.6.02 Workshops	250	279
			A.6.03 Laboratory instruments		
		<i>A.6. Laboratory operations Total</i>		850	879
		A.7. General services	A.7.01 Cooling & ventilation	595	650
			A.7.03 Power distribution system	60	60
			A.7.04 Heavy transport	340	366
			A.7.05 Cranes	35	37
			A.7.06 Cars	30	30
			A.7.08 Survey	65	91
			A.7.09 Storage space	50	52
			A.7.10 Common desktop infrastructure	40	37
			A.7.11 Reviewing & Engineering	350	349
			A.7.12 Outreach	220	160
		<i>A.7. General services Total</i>		1,785	1,832
		A.9. Core Computing Infrastructure & Services	A.9.01 Central computing environment	458	451
			A.9.02 Software process service	220	178
			A.9.03 User support	202	176
			A.9.04 Central production operations	695	653
			A.9.05 Hardware	70	66
		<i>A.9. Core Computing Infrastructure &amp; Services Total</i>		1,645	1,524
		<i>M&amp;O-A w/o Power Total</i>		11,911	12,291
		Power		1,800	518
		<i>Expense Total</i>		13,711	12,809
		<i>Income</i>		12,742	12,711