

# Summary of Expenditure for CMS Maintenance & Operations for the Year 2011

## INTRODUCTION

This document summarizes the expenditure that the CMS Collaboration has made in 2011 in order to maintain and operate the 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).

It presents the income received and reports on the payments classified following the Scrutiny Group's guidelines.

This is the tenth report that the CMS Collaboration presents on M&O Expenditures and the ninth year we report the M&O Cat. B. The budget request for M&O in 2011 was made in October 2010 (cf. CERN-RRB-2010-108).

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 2011 approved budget totalled 12'553 kCHF plus 1'800 kCHF for Energy consumption.

The actual total invoiced amount was 13'366 kCHF.

We note that for 2011 the amount of 772 kCHF, is 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 the April 2011 RRB meeting that urgent emergency repairs of the detector cooling system had to be carried out at the beginning of 2010 in order to avoid a serious risk

of leaks. This operation was conducted at an overall cost of 1'121 kCHF for which there was no provision in the 2010 budget. On recommendation of the Scrutiny Group, it was agreed at the October 2010 RRB that, although the costs were incurred in 2010, they would be included in the 2011 M&O-A budget. It was expected that, as a consequence, the overall spending in the years 2010 and 2011 would remain in line with the total allocation in this period.

These unforeseen costs have generated an over-spending in the relevant categories in Detector Related Costs, Laboratory Operations and General Services. However, due to savings it has been possible to reduce the overall over-spending on the 2010 M&O-A Budget (without Power) to only 380 kCHF. In 2011 the further savings were made in the following budget lines concerned by the bushing repair: A.1.6, A.1.10, A.1.11, A.1.12, A.1.16, A.6.02, A.7.04, A.7.05 and A.7.08. These resulted in an under-spending of some 500 kCHF in 2011 in these budget categories.

In addition to the above-mentioned under-spending related to compensating the cost of the bushing replacement, expenditures differed in some other areas as specifically mentioned below.

In the area A.1.05, Gas Consumption, there was a small under-spending of some 30 kCHF, which is due to mostly to the successful preliminary tests of the CF<sub>4</sub> recuperation plant and generally favourable fluctuation in prices.

There was some under-spending in the area A.1.08, External Cryogenics, where expenditures proved to be slightly less than foreseen due to lower than expected materials costs and the pattern of filter and heat exchanger re-generation cycles mapped onto the calendar year.

An overspend was incurred in the area A.3.02, Collaborative Tools, due to a reduction of the allocation in accordance with the recommendation of the Scrutiny Group. However, due to the continuous reliance of the Collaboration on EVO for its video-conferencing needs, with no viable and less costly alternative identified, the allocation remained at a similar level as last year. In order to cover the related costs CMS deferred the replacement of video-conferencing equipment and used this allocation to cover the invoice from EVO.

The most significant saving has been made in the area of A.4, Online Computing, which amounted to 1.3 MCHF and, in agreement with the Scrutiny Group, these funds will be transferred to the special DAQ account approved at the October 2011 RRB.

A global view of the period 2010–2011 shows that the overall savings made, when comparing the two years' integrated budget with expenditures, amount to some 1.4 MCHF. This corresponds principally to the aforementioned savings in the DAQ area. Consequently the overall spending during this two-year period was almost fully in line with CMS commitments made to the Scrutiny Group and to the RRB closing with a 78 kCHF surplus. This corresponds to a variation of only 0.3% when comparing the budgetary allocation and expenditures over this two-year period.

## • Outstanding commitments

The total amount of open commitments at the end of the year totalled some 500 kCHF, of which some 40% are related to industrial support contracts for 2011. The remainder are for consumables and goods to be delivered this year, of which 118 kCHF is for DAQ equipment and 100 kCHF for safety-related items.

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

- **Tracker**

Contributions from Funding Agencies covered 98.9% of the TK budget request. Some Agencies had problems paying their contribution in full due to EUR/CHF exchange rate fluctuations. Cash contributions from Funding Agencies have increased but collaborating Institutes still continue to contribute with manpower for the maintenance and operation of the detector either at CERN or at the home Institute.

Overall, there was no funding problem in 2011. The arrangements with individual Agencies and Institutes worked as expected in all cases.

During 2011, the major categories of M&O expenses were: Hired Manpower, Controls, and the maintenance and repair of the Cooling system (which remains a delicate part of the system that requires careful monitoring and further investments).

In many categories (chiefly: Gas, Cooling and Power systems, but also Read-out electronics and Areas) the expenses have been much lower than budgeted. This is because jobs that are needed but can only be performed during a long shutdown, and which were planned for 2011 when the budget was requested, have been forcibly deferred to 2013 due to the extension of the current LHC running period.

As a result of the deferral of most major interventions, in total the expenditures amounted to 1'254 kCHF, corresponding to only 72% of the request. Even though not all contributions have been fully paid, some savings constitute an available cash reserve, which has been taken into account when formulating the budget request for 2013. In fact, during 2013 the deferred jobs will have to be performed, and for them some of the procurements will have to take place during 2012 in order for the items to be ready for installation at the beginning of LS1. After estimating the cost of all jobs planned for 2013, both deferred and new, and after having set aside the money needed for the related procurements to be paid in 2012, the combined saved cash amount of 2010 and 2011 will be subtracted from the 2013 request.

- **ECAL**

The total 2011 M&O-B requests for the Material Resources for the Electromagnetic Calorimeter of CMS was 1'140 (2011 was the first year where no large spare was bought and the annual budget was reduced by about 300 kCHF). Contributions to these expenses were made either by placing orders directly or by cash contributions to the ECAL M&O-B account. All participating Funding Agencies contributed to the expenses. The main expenses were in the category of Hired Manpower at CERN (B.1.14).

As concerns the ECAL projection up to 2016, the preliminary report is the same total amount as for 2012 (but transferring 50 kCHF from Cooling to Controls where Lasers are included).

ECAL is in the process of defining a more detailed expenditure profile during LS1, however it is assumed that the largest cost share (Hired Manpower at CERN) can hardly be reduced. The ECAL budget also has to foresee some 300 kCHF for a new spare laser, which however, can be covered without requiring an increase of the total budget.

For the time being it is proposed to maintain the current budget estimate as draft baseline, waiting for the Internal Scrutiny Group study to update it for the October RRB where the budget is final.

- **HCAL**

HCAL operates largely on a "you built it, you maintain it" model, with groups joining HCAL after construction completion assuming their proportionate share of maintenance and operations costs. As such there is no explicit HCAL M&O-B fund, but rather the in-kind contributions of the collaborating institutions/Funding Agencies that constitute the HCAL M&O-B.

HCAL expenditures in 2011 were consistent with the proposed budget, with the largest expenditure being for Hired Manpower at CERN. The largest materials expenditures were for silicon photomultiplier (SiPM) replacements for the HO HPDs and their associated control and mounting boards, and for a test stand at CERN for SiPM burn-in. Spares supplies were also increased in 2011.

HCAL experienced stable operations throughout 2011 with over 99% good channels, with calibration and noise suppression well optimized. Excellent understanding of MET in data and simulation was achieved. All participating Funding Agencies contributed to these activities.

- **Muon Systems**

#### **CSC System**

For 2011 the spending for the CSC Subsystem was according to plan. The entire system performed well with an efficiency of better than 98%. There were no problems related to the increase of luminosity. All Funding Agencies provided the resources as requested. There were no significant unforeseen expenditures.

The current estimate is that this budget will be maintained through 2016. Experience with the 2011 operation, which was the first year of normal running, allows some confidence in this extrapolation. While there were no significant problems the CSCs did experience steady maintenance on the system, primarily for reloading and/or changing the firmware that controls the readout.

This M&O B funding, of course, does not include the installation of the ME4/2 chambers and the replacement of the ME1/1 electronics, which is expected to occur in 2013 and 2014.

#### **DT System**

During 2011 the largest fraction of the budget was spent, as foreseen, on Hired Manpower, in order to keep key positions of experts and coordinators available at CERN for the maintenance and running of the apparatus and of the alignment system. The amount of repairs of the HV-LV system was completely in line with expectations.

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). All contributions from 2011 budget were received or their payment is imminent. The contribution of the previous year (2010) has been delivered at 100%.

On top of this in 2011 the DT Subsystem received a new extra contribution of Hungary and of Estonia, of 5kCHF each.

As concerns the DT prevision plan for 2013-2016, as was done in the past, the known and planned expenses are distributed in order to cope with next years' activities while keeping the overall budgetary envelope constant. With the completion of two main items in 2014 (TRB and LV connectors), it is foreseen, in the following two years of stable data taking conditions, to reduce of the overall DT M&OB budget.

### **RPC System**

The original request for 2011 was 269 KCHF, which includes material and Hired Manpower needs, and was divided in cash contributions and in-kind contributions. The percentage of in-kind contribution is gradually being reduced.

Physicists, engineers and technicians also ensure maintenance and operation with presence at CERN financed by the home institutions and not accounted in the M&O-B budget.

In 2011 the RPC Subsystem spent 223 kCHF corresponding to 83% of total requested budget. A consistent fraction of the budget was spent on Hired Manpower, in order to keep few positions of experts available at CERN for the operation and maintenance of the RPC systems. The expenditure on Hired Manpower was above the initial estimate and consequently a higher allocation will be requested in the future.

All Funding Agencies/Institutes contributed as expected both in cash and with in-kind contributions.

- **Trigger**

The total Trigger M&O B budget for 2011 was 690 kCHF, of which 423 kCHF has been expended directly within institutes towards the maintenance and operational costs of the electronic subsystems for which they are responsible. A total of 197 kCHF income was received as cash contribution to the M&O central account, against which expenditure of 252 kCHF was made towards subsistence for technical manpower at CERN, working largely on common software items. The deficit was covered by the balance from prior years. A further 15 kCHF was spent on transport, communications and other operational expenses. The manpower costs are again expected to be above the cash receipts in 2012.

## **ANNEXES**

**Annex 1 :** M&O Cat. A Expenditures vs. Budget in 2011

# ANNEX 1

## M & O Cat. A Expenditure vs. Budget in 2011

Year	2011
System	A. M&O-A

Type	M&O-A w/o Power	Subsystem	Item	kCHF	
				Budget	Payments
Expense		A.1. Detector related costs	A.1.01 Magnet	30	30
			A.1.02 Magnet controls	142	140
			A.1.03 Magnet power supply	41	41
			A.1.04 Gas systems	260	259
			A.1.05 Gas consumption	550	520
			A.1.06 Cooling systems	331	256
			A.1.07 Cooling fluids(above -50°C)	220	174
			A.1.08 External cryogenics	375	321
			A.1.09 Cryogenic fluids (below -50°C)	40	30
			A.1.10 Moving/hydraulic systems	199	167
			A.1.11 Detector safety systems	291	239
			A.1.12 Shutdown activities	679	627
			A.1.13 General Technical support	640	646
			A.1.14 UPS maintenance	80	80
			A.1.16 Beam pipe & vacuum	181	174
			A.1.17 Counting & control rooms	152	152
			A.1.18 Safety	100	101
		<i>A.1. Detector related costs Total</i>		4,310	3,955
		A.2. Secretariat	A.2.01 Secretarial assistance	232	234
			A.2.02 Economat	15	14
			A.2.04 Printing and publication	50	34
		<i>A.2. Secretariat Total</i>		297	283
		A.3. Communications	A.3.01 GSM phones; on-call service	20	20
			A.3.02 Collaborative tools	262	282
		<i>A.3. Communications Total</i>		282	302
		A.4. On-line computing	A.4.01 System management	938	924
			A.4.02 Data storage, (temporary on disk)	461	234
			A.4.03 Detector controls	130	56
			A.4.04 Computers/processors/LANs	1,314	319
		<i>A.4. On-line computing Total</i>		2,843	1,534
		A.5. Test beams, calibration facilities	A.5.01 General operation	41	42
			A.5.02 Common electronics	15	14
			A.5.03 Electronics pool rentals	20	22
			A.5.04 Gas systems	10	10
			A.5.05 Gas consumption	10	10
		<i>A.5. Test beams, calibration facilities Total</i>		96	99
		A.6. Laboratory operations	A.6.01 Assembly areas, clean rooms	600	604
			A.6.02 Workshops	293	291
		<i>A.6. Laboratory operations Total</i>		893	895
		A.7. General services	A.7.01 Cooling & ventilation	595	588
			A.7.03 Power distribution system	60	56
			A.7.04 Heavy transport	356	275
			A.7.05 Cranes	57	42
			A.7.06 Cars	41	41
			A.7.08 Survey	99	65
			A.7.09 Storage space	50	72
			A.7.10 Common desktop infrastructure	40	40
			A.7.11 Reviewing & Engineering	350	347
			A.7.12 Outreach	222	231
		<i>A.7. General services Total</i>		1,870	1,759
		A.9. Core Computing Infrastructure & Services	A.9.01 Central computing environment	562	566
			A.9.02 Software process service	317	317
			A.9.03 User support	208	208
			A.9.04 Central production operations	806	791
			A.9.05 Hardware	70	74
		<i>A.9. Core Computing Infrastructure &amp; Services Total</i>		1,964	1,956
		<i>M&amp;O-A w/o Power Total</i>		12,553	10,781
		<i>Power</i>		1,800	373
		<i>Expense Total</i>		14,353	11,154
		<i>Income</i>		13,366	12,540