

## Report of the LHC M&O Scrutiny Group for the October 2012 RRB

### 1. Membership of the RRB M&O Scrutiny Group for 2012

At the end of 2011 four members left the Scrutiny Group after three or more years of service: Paul Dauncey(Imperial College, London), Martyn Davenport(CERN), Cristinel Diaconu(Marseille), Michal Turala(Cracov). They were replaced by new members. The USA provided an additional member for the Scrutiny Group. The members in 2012 are: Gabriele Cosmo (CERN), Marcos Dracos(Strasbourg), George Ginther (FNAL,Rochester), Stefan Haider(CERN), Enrico Iacopini (INFN Firenze), Robert Kephart(FNAL), Bernd Löhner (DESY,Chair), Gerhard Mallot (CERN), Sascha Schmeling (CERN; Secretary), Christos Touramanis(Liverpool), Emmanuel Tsesmelis (CERN), Didier Vilanova(CEA).

### 2. General remarks

Since 2010 the LHC continuously improved its performance and impressively exceeded original expectations for integrated luminosity. At the same time the LHC experiments demonstrated convincingly reliable operation and recorded data at trigger rates and background conditions which already exceeded partly the expected values for design performance of the LHC. The running mode of the LHC with 50 ns bunch spacing (as opposed to the design mode with 25ns bunch spacing) in particular results in up to 40 overlay events per bunch crossing at the beginning of a fill for ATLAS and CMS. This leads to unanticipated demands on the trigger and data acquisition systems as well as the core computing facilities and personnel. The experiments express the urgent need to operate the LHC at a bunch spacing of 25 ns in the future. If this operating mode cannot be achieved major adjustments and modifications to the online as well as offline systems and the manpower required will have to be made to continue to operate the experiments with high efficiency.

The enormous efforts by the LHC and the experiments lead to the discovery of a new particle, possibly the long awaited Higgs boson. It is gratifying to see the continuous support and the financial efforts made by the various Funding Agencies rewarded by this significant scientific success.

Major parts of the LHC experiments have been in operation now for about 10 years. As a result increased maintenance, consolidations, and replacement will take place during the long shutdown LS1 in 2013-2014. In addition some detector components are exhibiting initial signs of radiation damage.

The experiments have been using EVO as the primary video-conferencing tool. Part of the costs was paid through M&O by the experiments, with CERN supporting the remainder this year. As of the end of 2012 CERN will stop funding EVO and switch to a commercial system called VIDYO. The costs for the usage of this collaborative tool will be fully assumed by CERN.

In preparation for the design performance of the LHC at higher energy and luminosity, which is intended to be reached between the restart after LS1 and a second long shutdown (LS2) starting 2018, the experiments have to update parts of their detectors. Presently Technical Design Reports (TDR) for upgrades are in preparation or have already been submitted. To date, the Scrutiny Group has attempted to ensure a separation of upgrades projects costs and

M&O budgets. Since R&D projects and preparations for the upgrades are running or have to start very soon the experiments are eager to have the upgrade costs scrutinized possibly by a separate group.

The Scrutiny Group acknowledges that CERN has taken a positive attitude in showing leadership in safety and infrastructure related items which enabled M&O A budget reductions in respective areas.

### **3. Scrutiny process**

The first meeting of the RRB M&O Scrutiny Group in 2012 took place on 2-4 May. At this meeting, the Resource Coordinators of the five experiments ALICE, ATLAS, CMS, LHCb and TOTEM met with the Scrutiny Group to review the amounts spent in 2011 and to present proposals for the budgets in 2013 and projections for following years. Between the meeting in May and the final meeting at the end of August the Scrutiny Group members conducted 10 meetings with Resource Coordinators and other representatives of the experiments plus additional telephone conferences and e-mail exchanges to scrutinize in detail the budget requests of the experiments for the year 2013 and thereafter. The scrutinizers of each experiment summarized the scrutiny process in internal reports. The Scrutiny Group held their autumn meeting with the five experiments on 27-28 August 2012. The Resource Coordinators and other representatives of the experiments provided additional clarifications of their budget requests for 2013 and beyond, and the final numbers were agreed upon between the experiments and the Scrutiny Group.

Since 2010 the Scrutiny Group asked the experiments to review their regular online-hardware replacement procedure. This procedure was based on an agreement between the Scrutiny Group and the experiments from 2004. The replacement cycle was four years for major parts of the online system in particular the high-level trigger farm PCs. In 2011 the experiments formulated an updated procedure which essentially endorsed the original agreement with the addition that the replacement cycle was more clearly defined as after “4 full years of usage”. The 2012 budget requests were made on that basis. The Scrutiny Group considered this an interim procedure, requesting an exploration of the possibility of moving to a five year replacement cycle. The experiments agreed to investigate that option but asserted that a necessary condition would be the availability of warranty up to five years for the PCs. A resolution could not be obtained in time for the 2011 RRB meeting in October where the 2012 budgets were to be addressed. After the spring 2012 meeting of the Scrutiny Group, the experiments expressed a willingness to adopt a five year replacement cycle and began preparing their budget requests for 2013 accordingly. During the summer, following a suggestion of the Scrutiny Group a task force of the experiments’ online coordinators formulated a new agreement which is endorsed by the Scrutiny Group. The new agreement has been submitted as a document to this RRB meeting (CERN-RRB-2012-118).

The result of this new agreement is a considerable reduction of the online budget requests. For the bigger experiments savings amount up to 1 MCHF per year. Other reasons that the final budget requests differ from the estimates made in October 2012 include the shift of the start of LS1 to March 2013, the complete assumption of the cost of a collaborative tool (VIDYO) by CERN, additional contributions to safety costs by CERN, and the assumption of the costs for an online database administrator by CERN.

#### 4. Budget requests for 2013

Table 1 provides a summary of the M&O requests for the year 2013.

<b>Experiment</b>	<b>Total w/o Power costs</b>	<b>Total with NMS Power costs</b>	<b>Total with full power costs</b>
ALICE M&O A	4650	4872	5371
ALICE M&O B	1658	-	-
<b>ALICE M&amp;O A+B</b>	<b>6308</b>	<b>6534</b>	<b>7029</b>
ATLAS M&O A	14623	15348	16823
ATLAS M&O B	5127	-	-
<b>ATLAS M&amp;O A+B</b>	<b>19750</b>	<b>20475</b>	<b>21950</b>
CMS M&O A	13789	14534	15439
CMS M&O B	5915	-	-
<b>CMS M&amp;O A+B</b>	<b>19704</b>	<b>20449</b>	<b>21345</b>
LHCb M&O A	2580	2706	3550
LHCb M&O B	1180		
<b>LHCb M&amp;O A+B</b>	<b>3760</b>	<b>3886</b>	<b>4730</b>
TOTEM M&O A	413	413	413
TOTEM M&O B	247	-	-
<b>TOTEM M&amp;O A+B</b>	<b>660</b>	<b>660</b>	<b>660</b>

Table 1: Request for 2013 M&O (in kCHF).

#### 5. ALICE

##### *M&O A closing report for 2011*

The closing report for the ALICE 2011 M&O-A budget was submitted to the RRB meeting on 25 April 2012. The Scrutiny Group received a detailed level-2 breakdown of the closing report for their meeting on 2 May 2012. The expenditures without power costs for M&O-A amounted to 6,277 kCHF. This includes 1000 kCHF which have been transferred into the online-hardware replacement account at the end of 2011. The 2011 M&O A budget amounts to 4491 kCHF. The overspend of 1786 kCHF results from the transfer into the online replacement account and from higher detector related cost for gases because of leaks and modified running conditions, from a consolidation of the uninterruptable power supply system, and from shutdown activities during the technical stop at the end of 2011. The additional costs were communicated to the Scrutiny Group already in 2011. The Scrutiny Group endorsed the plan that these additional expenditures be paid from the cash surplus of

3115 kCHF existing as of the end of 2010. In this way no additional M&O A costs are incurred and the cash surplus is reduced. The budgeted non-member states (NMS) power costs are 879 kCHF, the actual costs amount to 724 kCHF. ALICE will rebate the difference of 155 kCHF in 2013.

The Scrutiny Group recommends approval of the ALICE M&O A closing report for 2011.

### ***M&O B closing report for 2011***

The actual M&O B expenditures in 2011 amounted to 1820 kCHF. This is a mix of expenses at CERN and at various institutes in cash as well as in-kind contributions. The budget for 2011 is 1832 kCHF. The detector component coordinators presented detailed information on the expenditures. It turned out that the SDD shows an overspend due to deferred payments from the past for manpower and that there is an underspend in the SSD because planned costs for low voltage power supplies have been deferred to 2013.

The Scrutiny Group recommends approval of the ALICE M&O B closing report for 2011.

### ***Situation of M&O in 2012***

No indications exist so far that the M&O A and M&O B expenses in 2012 will significantly deviate from the approved budgets.

### ***Budget request for M&O Category A in 2013***

Table 2 shows the 2012 M&O A budget for ALICE, the proposed budget for 2013 and the projections through 2017.

<b>ALICE M&amp;O A Budget Requests</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>
<i>Detector related costs</i>	1,253	1,733	1,356	1,200	1,237	1237
<i>Secretariat</i>	208	208	208	208	208	208
<i>Communications Total</i>	40	0	0	0	0	0
<i>Core computing</i>	537	537	537	537	537	537
<i>On-line computing</i>	2,012	1,033	1,587	1,847	1,810	1,810
<i>Test beams, calibration facilities</i>	85	30	85	85	85	85
<i>Laboratory operations</i>	250	280	245	235	235	235
<i>General services</i>	550	829	632	538	538	538
<b>TOTALS without power</b>	<b>4,935</b>	<b>4,650</b>	<b>4,650</b>	<b>4,650</b>	<b>4,650</b>	<b>4,650</b>
<i>Power</i>	2,386	721	1,374	2,386	2,386	2,386
<b>GRAND TOTALS</b>	<b>7,321</b>	<b>5,371</b>	<b>6,024</b>	<b>7,036</b>	<b>7,036</b>	<b>7,036</b>

**Table 2: ALICE M&O A budget request for 2013 and projections through 2017 (in kCHF).**

During the LS1 period ALICE plans to open the detector for maintenance, consolidation and to install additional detector components. This is the main reason that detector related costs and general services costs are increased w.r.t. 2012. The plan is to install at least three TRD super-modules, one PHOS module as well as the Di-jet Calorimeter (DCal), consisting of eight super-modules. A major campaign of infrastructure consolidation addresses the refurbishment of outdated electrical infrastructure in the counting rooms, the refurbishment of

the general cooling and ventilation systems, and the consolidation of detector services in the cavern.

At the RRB meeting in October 2011 the prediction of the ALICE M&O A budget without power costs for 2013 was 4935 kCHF, the same as for 2012. The actual request for 2013 and predictions for future years are now about 6% lower, partly due to the reduced online-hardware replacement costs. The variation of the power costs reflect the shutdown period in 2013 and 2014.

The Scrutiny Group recommends approval of the ALICE 2013 M&O A budget request.

### ***Budget request for M&O Category B in 2013***

The ALICE M&O B budget request for 2013 and projections to 2016 are shown in table 3.

<b><i>ALICE M&amp;O B Budget Requests</i></b>	<b><i>2012</i></b>	<b><i>2013</i></b>	<b><i>2014</i></b>	<b><i>2015</i></b>	<b><i>2016</i></b>
<b><i>Mechanics</i></b>	<b>28.5</b>	<b>50</b>	<b>40.5</b>	<b>26.5</b>	<b>26.5</b>
<b><i>Gas Systems</i></b>	<b>82</b>	<b>38</b>	<b>38</b>	<b>38</b>	<b>38</b>
<b><i>Cooling Systems</i></b>	<b>110</b>	<b>151</b>	<b>101</b>	<b>94</b>	<b>94</b>
<b><i>FEE Spares</i></b>	<b>100.5</b>	<b>135</b>	<b>119</b>	<b>105</b>	<b>105</b>
<b><i>Standard Electronics LV/HV PS</i></b>	<b>421</b>	<b>322.5</b>	<b>241.5</b>	<b>212.5</b>	<b>212.5</b>
<b><i>Standard Electronics Crates</i></b>	<b>63.5</b>	<b>26.5</b>	<b>27.5</b>	<b>17.5</b>	<b>17.5</b>
<b><i>Standard Electronics R/O Modules</i></b>	<b>172.5</b>	<b>94.5</b>	<b>106</b>	<b>166</b>	<b>106</b>
<b><i>Controls (DCS &amp; DSS)</i></b>	<b>33</b>	<b>33.5</b>	<b>29.5</b>	<b>29.5</b>	<b>29.5</b>
<b><i>Sub-Detectors Spares</i></b>	<b>81.5</b>	<b>143</b>	<b>140</b>	<b>41</b>	<b>41</b>
<b><i>Areas</i></b>	<b>57</b>	<b>42</b>	<b>42</b>	<b>42</b>	<b>42</b>
<b><i>Communications</i></b>	<b>92.5</b>	<b>91</b>	<b>91</b>	<b>88</b>	<b>88</b>
<b><i>Store Items</i></b>	<b>83.5</b>	<b>97.5</b>	<b>79.5</b>	<b>78.5</b>	<b>78.5</b>
<b><i>Technical Manpower @ CERN Industrial Support</i></b>	<b>23</b>	<b>6</b>	<b>6</b>	<b>6</b>	<b>6</b>
<b><i>Technical Manpower @ CERN Subsistence</i></b>	<b>433.4</b>	<b>427</b>	<b>410</b>	<b>353</b>	<b>353</b>
<b><i>Grand Total in kCHF</i></b>	<b>1782</b>	<b>1658</b>	<b>1472</b>	<b>1298</b>	<b>1238</b>
<b><i>Technical Manpower @ CERN In-Kind from Institutes in Man-Months</i></b>	<b>324</b>	<b>270</b>	<b>192</b>	<b>192</b>	<b>192</b>

**Table 3: ALICE M&O B budget request for 2013 and projections until 2016 (in kCHF).**

The collaboration has now sufficient experience in running and maintaining the individual detector components. This led to a reconsideration of last year's predictions with the result of slightly reduced M&O B costs in 2013 and the following years. The reduction results mainly

from lower cost estimates for Standard Electronics and reduced manpower needs. The total estimates for 2013 and 2014 are slightly higher than for the following years due to the shutdown work which entails higher subsistence costs for manpower at CERN.

## 6. ATLAS

### *M&O A closing report for 2011*

ATLAS submitted their closing report for the 2011 M&O A budget to the RRB on 24 April 2012. The 2011 M&O A budget including NMS power cost was 16563 kCHF. The total payments amount to 16621 kCHF including NMS power costs of 936 kCHF. In addition, there are open commitments of 1900 kCHF at the end of 2011 driven by procurements for the magnet and cryogenic consolidation project. Without these commitments the 2011 budget and payments are nearly balanced. Due to the commitments there is a considerably negative budget balance and cash balance at the end of 2011, but those commitments do not represent unanticipated expenses.

The Scrutiny Group recommends approval of the ATLAS M&O A closing report for 2011.

### *M&O B closing report for 2011*

The ATLAS M&O B closing report for 2011 was submitted to the RRB on 24 April 2012. The costs for all detector components are 6372 kCHF including 1469 kCHF for hired manpower at CERN. In detail, the costs are: 3174 kCHF for the Inner Detector, 1629 kCHF for the Liquid Argon Calorimeter, 807 kCHF for the Tile Calorimeter, and 762 kCHF for the Muon System. For each detector subsystem the costs are higher than the budgets but due to accumulated savings from previous years the budget balance for M&O B at the end of 2011 is 546 kCHF, corresponding to about 8% of the budget. Once the open commitments of 331 kCHF are taken into account, the unobligated balance is 215 kCHF.

The Scrutiny Group recommends approval of the ATLAS 2011 M&O B closing report.

### *Situation in 2012*

There are no indications that the M&O A and M&O B costs will significantly deviate from the 2012 budgets.

### *Budget request for M&O Category A in 2013 and forecasts to 2018*

Table 4 shows the proposed budget for ATLAS in 2013 and the projections until 2018.

<i>ATLAS M&amp;O A Budget Requests</i>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>
<i>Detector related costs</i>	6,493	7,532	6,807	4,887	5,127	5,477	5,787
<i>Secretariat</i>	305	305	305	305	305	305	305
<i>Communications Total</i>	410	250	220	180	180	180	220
<i>Core computing</i>	2,128	2,128	2,128	2,128	2,128	2,128	2,128
<i>On-line computing</i>	1,897	2,300	2,384	5,542	5,002	4,622	3,115
<i>Test beams, calibration facilities</i>	2,435	360	730	250	250	250	690
<i>Laboratory operations</i>	105	105	135	105	105	105	135

<i>General services</i>	1,274	1,643	1,581	1,204	1,204	1,234	1,783
<b>TOTALS w/o power</b>	<b>15,046</b>	<b>14,623</b>	<b>14,290</b>	<b>14,600</b>	<b>14,300</b>	<b>14,300</b>	<b>14,163</b>
<i>Power</i>	2,820	2,200	2,200	2,200	2,200	2,200	2,200
<b>GRAND TOTALS</b>	<b>17,866</b>	<b>16,823</b>	<b>16,490</b>	<b>16,800</b>	<b>16,500</b>	<b>16,500</b>	<b>16,363</b>

**Table 4: ATLAS M&O A budget for 2012, proposal for 2013 and projections through 2018 (in kCHF).**

ATLAS has worked out consolidation plans to prepare the detector for optimal data taking during future running periods. These consolidation projects have started already in the past and were planned to continue over several years. The installation of the Insertable B-Layer (IBL), as the fourth layer of the pixel detector, was originally planned for 2016 but is now advanced towards the end of LS1 in 2014. The installation of the IBL and the new aluminium and beryllium beam-pipes makes it necessary to remove a small wheel of the Muon Detector. The costs for the removal will be covered by CERN except for specialist manpower for uncabbling, re-cabbling, and re-commissioning of the chambers. ATLAS is developing with outside companies procedures and shielding measures to reduce as much as possible the radiation exposure for people working close to the beam position during LS1. The M&O costs for this safety project are reduced by CERN contributions of 300 kCHF/year from 2014 onwards. Once the Pixel Detector has been removed from the experiment it has to be brought to a nuclear laboratory which has been built at Point 1. A failure of the cryogenics system of the ATLAS magnets may stop the experiment's operation for several months. A consolidation of the cryo-system is in preparation since 2009. Major work will have to be done during LS1. The delay of the latter changes the project's schedule. Other major consolidation projects are a new evaporative cooling system for the Inner Detector and the Pixel Detector, new chambers for the Muon Detector in the area of the feet, improvement of the geometrical coverage. The M&O A budget estimates for 2013 and the following years are considerably lower than anticipated as of the RRB meeting in October 2011. The main reason for this reduction is the change of the online-hardware replacement strategy which is now based upon a replacement cycle of five years for the HLT farm PCs. Compared to the previous replacement cycle of four years this leads to costs which are lower by about 0.9 MCHF per year. However, these anticipated savings are partially offset by other projected online tasks, such as an increase of 245 kCHF for network replacements between 2013 and 2018, replacements in the area of the Readout System for which a total of 2 MCHF are incorporated in the 2013 and 2014 budgets, and an amount of 780 kCHF in the budgets between 2013 and 2018 for replacement of Single Board Computers in the VME crates which house the Read Out Drivers. ATLAS made efforts and succeeded to reduce requests and projections in other parts of the budgets. The sum from 2013 to 2018 of budgets without power costs is now about 6.5 MCHF lower than it was in October 2011 and including full power costs it is lower by about 9 MCHF. The positive attitude of CERN in showing leadership in safety and infrastructure related items contributes to these reductions. The Scrutiny Group recommends approval of the ATLAS 2013 M&O A budget request.

#### ***Budget request for M&O Category B in 2013 and forecasts to 2018***

The ATLAS Collaboration conducts their own internal scrutiny procedures of the M&O B budgets for each of the subsystems and provides reports to the Scrutiny Group. The M&O B budget request for 2013 is 5127 kCHF which is 90 kCHF less than last year's forecast. Tables 5a and 5b show the proposed amounts for the M&O B budgets of the detector subsystems including forecasts through 2018.



<b>ATLAS M&amp;O B Requests</b>							
Subsystems	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>
<i>Inner Detector (ID)</i>	2435	2465	2295	2245	2245	2245	2345
<i>Liquid Argon Calorimeter (LAr)</i>	1196	1081	1111	981	981	981	1071
<i>Tile Calorimeter (TileCal)</i>	617	647	647	604	604	604	604
<i>Muon Detectors (Muons)</i>	640	650	570	570	800	830	830
<i>Forward Detectors (FD)</i>	262	284	243	167	167	170	167
<b>Totals</b>	<b>5150</b>	<b>5127</b>	<b>4866</b>	<b>4567</b>	<b>4797</b>	<b>4830</b>	<b>5017</b>

**Table 5a: ATLAS M&O B budgets for 2013 and projections through 2018 (in kCHF).**

<b>ATLAS M&amp;O B Budget Requests ID&amp;TileCal&amp;LAr&amp;Muons</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>
<i>Mechanics</i>	58	63	78	73	140	140	140
<i>Gas-Systems</i>	69	29	29	29	29	29	29
<i>Cryo-System</i>	5	5	5	55	55	55	55
<i>Cooling System</i>	33	53	93	33	33	33	33
<i>FE Electronics</i>	500	487	481	131	131	131	131
<i>Standard Electronics LV/HV PS</i>	868	720	692	868	730	730	715
<i>Standard Electronics Crates</i>	411	396	369	384	522	522	502
<i>Standard Electronics RO Modules</i>	348	447	327	310	315	315	315
<i>Controls (DCS,DSS)</i>	200	147	133	125	162	162	165
<i>Sub-Detector Spares</i>	63	84	46	30	81	81	78
<i>Areas</i>	308	308	308	308	338	341	311
<i>Communications</i>	32	31	31	32	32	32	32
<i>Store Items</i>	201	215	215	202	212	212	212
<i>Hired Manpower @ CERN</i>	1764	1852	1739	1597	1627	1657	1919
<i>Hired Inst. MP @ 90 kCHF/FTE</i>	290	290	320	390	390	390	380
<b>Totals</b>	<b>5150</b>	<b>5127</b>	<b>4866</b>	<b>4567</b>	<b>4797</b>	<b>4830</b>	<b>5017</b>
<i>Technical Manpower OTP (FTE)</i>	315	291	296	286	186	296	296
<i>Core Computing (infra &amp; services in FTE)</i>	157	157	157	0	0	0	157

**Table 5b: ATLAS M&O B budget for 2013 and projections through 2018 (in kCHF and FTE)**

The total amount requested for the 2013 M&O B budget is about equal to the 2012 M&O B budget and 90 kCHF less than the forecast provided last year. The present forecast for the years 2013-2018 totals 29204 kCHF which is 484 kCHF lower than last year's prediction. The contribution to the total M&O B budget for 2013 as well as for the integral for 2013-2018 from hired manpower at CERN is nearly constant at a level of 35% of the M&O B budget request.

The Insertable B-Layer (IBL) is a consolidation project of the Pixel detector. A final version of Addendum No. 1 to the "Memorandum of Understanding for the Collaboration in the



Construction of the ATLAS Detector” is now available (CERN-RRB-2012-028). The cost sharing among the Funding Agencies is defined in this addendum but not all Funding Agencies have finally decided whether their contribution should be counted as M&O B or as project contribution. The only cost change for the IBL is the addition of the diamond beam-monitor which adds 336 kCHF to the project costs but nothing to M&O B.

The 2013 Liquid Argon Calorimeter (LAr) M&O B budget is about 10% lower than the costs in 2012 as well as the 2013 prediction made last year. The major cost drivers are the payback of the loan for Wiener low voltage power supplies and manpower during the shutdown. The warranty for these new Wiener power supplies expires at the end of 2015. Therefore additional 100 kCHF are foreseen in the budgets thereafter.

The Tile Calorimeters M&O B budget request for 2013 is slightly higher than in 2012 but the same as predicted last year. The major cost item is the replacement of low voltage power supplies (LVPS) which are being fabricated. During LS1 the full production of 260 LVPS will be installed. Therefore the technical manpower from institutes had to be increased from 28 to 32 FTE during 2013 and 2014. The cost of the LVPS program is stable at 1100 kCHF and the payments will be completed in 2015.

During LS1 the Muon Detectors will be completed by the installation of chambers in the feet region of ATLAS. This requires an increase in manpower requests during 2013 when most of the work will be done. Therefore the M&O B request for 2013 is 10 kCHF higher than for 2012. For 2014 and 2015 the requests are reduced but they rise again in 2016 to 2018 due to increased manpower needs for the commissioning of the new detectors.

The Forward Detectors have their own M&O B budget since 2012. During LS1 the detectors (ALFA, LUCID, ZDC) will be brought to the surface for maintenance. During the present running period it became obvious that ALFA detector experienced excessive heating due to beam RF losses. An active cooling system is needed and 20 kCHF in 2013 and 60 kCHF in 2014 are foreseen for that purpose. An additional detector is still under discussion and shall be decided soon. This is the AFP, a detector about 400m downstream of the ATLAS detector in the LHC tunnel to detect protons scattered under a small angle. No provision is made so far in the M&O B budgets for the AFP.

The Scrutiny Group recommends the approval of the ATLAS M&O B budget for 2013.

## **7. CMS**

### ***M&O A closing reports for 2011***

The CMS Collaboration presented their closing report for 2011 at the RRB meeting on 23 April 2012. The 2011 M&O A budget without power costs was 12553 kCHF. The total power costs were budgeted at 1800 kCHF with a NMS part of 813 kCHF. The actual costs in 2011 amounted to 12579 kCHF without power but including 1296 kCHF transferred into the online replacement account. The actual NMS power costs were 373 kCHF. Without the power costs the 2011 M&O A budget is nearly balanced. It should be noted that at the end of 2010 CMS ran into serious problems with water leaks and in the technical stop at the end of 2010 a large number of bushings had to be replaced. This created unforeseen cost of about 1100 kCHF which could not be accommodated in the 2010 budget but had to be moved to the 2011 budget. As a consequence CMS had to reduce considerably the expenses in 2011, mainly in the areas Detector related costs, Laboratory Operation, and General Services. In this way CMS achieved a positive budget balance of 96 kCHF for 2010 and 2011 combined. At the time of the RRB meeting in October 2011 an opening of the CMS detector during the technical stop around the end of the year was under consideration. The costs of such an operation were estimated to about 1 MCHF. The collaboration finally decided against that opening.

## ***M&O B closing report for 2011***

The CMS M&O B closing report was submitted to the RRB on 23 April 2012. The costs for all detector subsystems amount to 5517 kCHF including costs for hired manpower at CERN as well as in-kind contributions. The corresponding budget was 6418 kCHF. The subsystem coordinators presented in some detail the various expenses. For some subsystems a considerable surplus from previous years has been accumulated. This surplus is projected to be obligated mostly in 2013 to keep the requests low although during the shutdown year increased efforts have to be made for material resources and also for manpower.

## ***Status in 2012***

There are no indications yet that the M&O A and M&O B costs will deviate significantly from the approved budget.

## ***Budget request for M&O Category A in 2013 and projections until 2016***

Table 6 shows the proposed M&O A budget for CMS in 2013 and the projections until 2016.

<b>CMS M&amp;O A Budget Requests</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
<i>Detector related costs</i>	3956	4905	4592	3786	3786
<i>Secretariat</i>	297	357	297	297	297
<i>Communications</i>	370	120	120	120	120
<i>Core computing</i>	1964	1964	1964	1964	1964
<i>On-line computing</i>	3798	2880	3898	3898	3880
<i>Test beams, calibration facilities</i>	96	96	96	96	96
<i>Laboratory operations</i>	919	1108	578	484	484
<i>General services</i>	1835	2359	2111	1835	1835
<b>TOTALS w/o power</b>	<b>13235</b>	<b>13789</b>	<b>13656</b>	<b>12480</b>	<b>12462</b>
<i>Power</i>	1800	1650	1750	1800	1800
<b>GRAND TOTALS</b>	<b>15035</b>	<b>15439</b>	<b>15406</b>	<b>14280</b>	<b>14262</b>

**Table 6: CMS M&O A budget for 2013 and projections through 2016 (in kCHF).**

The estimated total costs for 2013 are slightly higher than the 2012 values. This results from 2013 being a shutdown year. The long shutdown extends also over most of 2014, therefore the predictions for 2014 are also higher than for 2012 and for 2015-2016. Compared to the prediction available by the RRB meeting in October 2011 of 15606 kCHF (including power costs) for the 2013 budget projection the request for 2013 is now slightly smaller. However, the costs for the various sub-items in table 6 changed considerably. The change of the start of the shutdown to February 2013 deferred part of the increased shutdown costs. On the other hand, unforeseen expenses turned up which had to be included. The collaboration decided, encouraged by the LHCC, to use the HLT farm during part of the long shutdown for off-line data processing. Since the water-cooling system of the HLT will be switched off for maintenance an independent cooling system has to be installed. The costs for this extra cooling could be kept reasonably low by using an existing spare unit available at CERN. A type of quick connectors for water cooling inside the detector showed corrosion and therefore the whole set of connectors has to be replaced. The dry air and nitrogen distribution system to the inside of the detector developed micro-leaks which have to be fixed during the long shutdown. Electronics cards on the cathode strip chambers of ME1/1 have to be replaced by modified ones. This necessitates modifications of the cover plates of the housings. Because

the old cover plates may have been activated machining these plates is very difficult. It is more efficient to produce new ones. Some of the machines in the workshop at point 5 have to be replaced for safety reasons. The above mentioned cost reductions and additional expenses almost balance. The estimated budgets for 2015 and 2016, after the long shutdown, are considerably lower than the budgets for previous years.

The Scrutiny Group recommends the approval of the CMS M&O A budget request for 2013.

### ***Budget request for M&O Category B in 2013 and forecasts to 2016***

The CMS M&O B budget request for 2013 is shown in table 7a. The projections through 2016 are presented in table 7b.

<b><i>CMS M&amp;O B Budget Request 2013</i></b>	<b>Tracker</b>	<b>ECAL</b>	<b>HCAL</b>	<b>MUON</b>	<b>Trigger</b>	<b>Core Computing</b>	<b>Total</b>
<i>Mechanics</i>	40	20	0	20	0	0	80
<i>Gas-Systems</i>	190	10	0	20	0	0	220
<i>Cryo-System</i>	0	15	0	0	0	0	15
<i>Cooling System</i>	200	50	0	0	0	0	250
<i>FE Electronics</i>	0	0	70	46	0	0	116
<i>Standard Electronics LV/HV PS</i>	45	80	2	101	0	0	228
<i>Standard Electronics Crates</i>	0	20	43	70	0	0	133
<i>Standard Electronics RO Modules</i>	40	50	67	92	234	0	483
<i>Controls (DCS,DSS)</i>	95	85	3	69	0	0	252
<i>Sub-Detector Spares</i>	0	0	69	22	0	0	91
<i>Areas</i>	120	80	36	64	0	0	300
<i>Communications</i>	70	10	1	29	15	0	125
<i>Store Items</i>	70	50	15	41	0	0	176
<i>Hired Manpower @ CERN</i>	710	550	767	1250	170	0	3447
<i>Hired Inst. MP @ 90 kCHF/FTE</i>							
<b><i>Totals</i></b>	<b>1580</b>	<b>1020</b>	<b>1072</b>	<b>1824</b>	<b>419</b>	<b>0</b>	<b>5915</b>
<i>Technical Manpower OTP (FTE)</i>	0	0	0	0	0	0	0
<i>Core Computing (infra &amp; services in FTE)</i>	0	0	0	0	0	8	8

**Table 7a: CMS M&O B subsystems budget request for 2013 (in kCHF and in FTE).**

<b>CMS M&amp;O-B Requests</b>							
Amount (kCHF/FTE)				Year			
<b>Description</b>	<b>Detector</b>	<b>Subsystem</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
Material Resources	Tracker	Pixel	285	295	175	185	185
		SST	1305	1285	1425	1195	1195
	Tracker Total		1590	1580	1600	1380	1380
	ECAL		1123	1020	1120	1120	1120
	HCAL		1531	1072	1018	1018	1018
	Muon	Barrel Alignment	53	53	53	53	53
		Drift Tubes	488	481	483	388	438
		EMU	1063	911	911	911	911
		LinkAlignment	16	16	16	16	16
		RPC	275	363	363	254	254
	Muon Total		1895	1824	1826	1622	1672
	Trigger		500	419	419	419	419
	<b>Material Resources Total</b>			<b>6639</b>	<b>5915</b>	<b>5983</b>	<b>5559</b>
Core Computing Human Resources Total			8	8	8	8	8

**Table 7b: CMS M&O B subsystems budget projections (in kCHF and FTE).**

As in previous years, the costs for hired manpower at CERN are roughly half the total M&O B costs being a little higher in 2013 than in 2011 and in 2012 because of the shutdown activities.

Almost all subsystems plan major maintenance and replacements during the shutdown. The fact that the 2013 M&O B budget request nevertheless comes out lower than the one for 2012 is because the accumulated surpluses for some subsystems are planned to be used for those shutdown activities. For the following years the estimated needs are again lower since more reliable estimates are possible after the experience of several years of operation.

The Scrutiny Group recommends the approval of the CMS M&O B budget request for 2013.

## 8. LHCb

### *Closing reports for 2011*

LHCb submitted their closing report for 2011 at the RRB meeting on 25 April 2012. The expenses in 2011 without power costs amounted to 2649 kCHF, to be compared to the approved budget of 2545 kCHF. The budgeted NMS power costs were 114 kCHF, identical to the actual NMS power costs. The M&O A expenses in 2011 include transfers of 700 kCHF into the online-hardware replacement account. The integrated budget balance at the end of 2011 amounts to 247 kCHF.

The Scrutiny Group recommends approval of the LHCb 2011 closing report.

### *Situation in 2012*

There are no indications that the M&O A and M&O B costs will significantly deviate from the 2012 budgets.

***Budget request for M&O Category A in 2013 and projection until 2016***

Table 8 shows the proposed M&O A budget for LHCb in 2013 and the projections until 2016.

<b>LHCb M&amp;O A Budget Requests</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
<i>Detector related costs</i>	880	920	920	880	880
<i>Secretariat</i>	185	185	185	185	185
<i>Communications</i>	50	10	10	10	10
<i>Core computing</i>	150	170	170	170	170
<i>On-line computing</i>	900	890	890	890	890
<i>Test beams, calibration facilities</i>	30	35	35	25	25
<i>Laboratory operations</i>	50	50	50	50	50
<i>General services</i>	330	320	320	320	320
<b>TOTALS w/o power</b>	<b>2575</b>	<b>2580</b>	<b>2580</b>	<b>2530</b>	<b>2530</b>
<i>Power</i>	970	970	600	300	970
<b>GRAND TOTALS</b>	<b>3545</b>	<b>3550</b>	<b>3180</b>	<b>2830</b>	<b>3500</b>

**Table 8: LHCb M&O A budget for 2013 and projections through 2016 (in kCHF).**

The proposed M&O A budget for 2013 is very similar to the 2012 budget. The shutdown in 2013 leads to slightly higher detector related costs for maintenance and consolidation projects. A major activity during the shutdown is the exchange of a section of the beryllium beam-pipe because the present one turned out to have micro-leaks. The new beam-pipe has to be baked out. It is not decided yet whether the VELO has to be dismantled for the bake-out procedure. The cost for the new beam-pipe is paid for by the CERN vacuum group. The cost increase in core computing is mainly due to more manpower for programming multi-core computers which can only be done during shutdown times. The increased efforts for core computing are expected to continue in the following years for preparation of higher luminosity and data rates. In 2014 a larger replacement of online computers is foreseen. The costs will be covered via the online-hardware replacement account. The LHCb Collaboration delivered a detailed list of planned activities during the shutdown in 2013 and 2014. These activities were found adequate by the Scrutiny Group.

The Scrutiny Group recommends approval of the proposed 2013 M&O A budget for LHCb.

***Budget request for M&O Category B in 2013 and projections through 2016***

The LHCb Resource Coordinators presented the M&O B costs for 2012 as the typical costs for operating and maintaining subsystems as shown in table 9a. They amount to 1066 kCHF per year. Table 9a also shows the distribution of the costs for the various participating countries. The requests for 2013 M&O B and the projections for the following years until 2016 are shown in table 9b.

CALO (CERN, ES, FR, RO, RU)	315
Level_0 (FR, IT)	60
Muons (CERN, IT, RU)	151
On Line (CERN)	80
Outer Tracker (GE, NL, PL, PRC)	120
RICH (CERN, IT, UK)	125
Silicon Trackers (CH, ES, GE, UKR)	80
VELO (CERN, CH, EI, NL, RU, UK, USA)	135

CERN (CA, MU, ON, RI, VE)	220
CH (STs, VE)	81
ES (CA, STs)	35
FR (CA, L0)	140
GE (OT, STs)	93
IT (L0, MU, RI)	130
NL (OT, VE)	90
RU (CA, MU, VE)	115
UK (RI, VE)	135

**Table 9a: A typical LHCb M&O B budget (in kCHF).**

<b>M&amp;O B budgets 2010 -2016</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
Mechanics	111	65	65	110	110	65	65
Gas-system	10	10	10	10	10	10	10
Cryo-system	0	0	0	0	0	0	0
Cooling system	15	15	15	15	15	15	15
FE electronics	124	125	125	125	125	125	125
Standard electronics	229	224	224	250	250	224	224
Controls, (DCS, DSS)	68	70	71	70	70	60	60
Sub-Detector Spares	200	200	170	200	200	170	170
Maintenance of clean rooms	45	45	45	45	45	45	45
Communications	31	37	36	30	30	30	30
Store Items	25	25	25	25	25	25	25
Hired Manpower @ CERN (in CHF )	0	0	0	0	0	0	0
Technical Manpower @CERN (in FTE)	290	295	280	300	300	280	280
<b>Totals (CHF)</b>	<b>1148</b>	<b>1111</b>	<b>1066</b>	<b>1180</b>	<b>1180</b>	<b>1049</b>	<b>1049</b>

**Table 9b: LHCb M&O B budgets from 2010 through 2016 (in kCHF).**

The Resource Coordinator of LHCb provided the Scrutiny Group with a detailed list of planned activities during the shutdowns 2013-2014 for the various subsystems. The Scrutiny Group considered these tasks justified.

The Scrutiny Group recommends approval of the LHCb 2013 M&O B budget proposal.

## 9. TOTEM

### *Closing reports for 2011*

Totem presented their closing report at the RRB meeting on 24 April 2012. The total M&O A cost in 2011 amount to 469 kCHF including open commitments/deferrals of 52 kCHF. Note that the closing report from 24 April lists 417 kCHF as payments which do not include these commitments/deferrals. The integrated budget balance is -14 kCHF and the integrated cash balance is -9 kCHF with total outstanding contributions of 5 kCHF.

The M&O B budget for 2011 is 247 kCHF and the actual costs are given with also 247 kCHF. The Scrutiny Group recommends approval of the TOTEM closing reports for 2011 M&O A and M&O B.

### *Situation in 2012*

There are no indications yet that the M&O A and M&O B costs will significantly deviate from the 2012 budget.

### *Budget request for M&O Category A in 2013*

Table 10 shows the proposed M&O A budget for TOTEM in 2013 and the projections through 2016.

<b>TOTEM M&amp;O A Budget Requests</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
<i>Detector related costs</i>	142	129	131	142	142
<i>Secretariat</i>	44	44	44	44	44
<i>Communications</i>	3	3	3	3	3
<i>Core computing</i>	92	92	92	102	102
<i>On-line computing</i>	96	78	78	106	106
<i>Test beams, calibration facilities</i>	20	33	33	30	30
<i>Laboratory operations</i>	13	13	13	13	13
<i>General services</i>	30	21	28	30	30
<b>TOTALS w/o power</b>	<b>440</b>	<b>413</b>	<b>422</b>	<b>470</b>	<b>470</b>
<i>Power</i>	0	0	0	0	0
<b>GRAND TOTALS</b>	<b>440</b>	<b>413</b>	<b>422</b>	<b>470</b>	<b>470</b>

**Table 10: TOTEM M&O A budget for 2013 and projections through 2016 (in kCHF).**

The estimated M&O A costs for 2013 are slightly lower than for the previous year. This is mainly due to smaller gas consumption and reduced cooling needs during the shutdown, reduced online costs, and reduced support for survey. However, other items increase slightly such as moving hydraulics and electronics pool rentals. The T1- and T2-detectors will have to be removed during the shutdown. Most of the tooling needed has already been built for the last installation period during the technical stop 2011-2012. An agreement exists with CMS on technical help and splitting of costs. TOTEM is now integrated in the CMS trigger. The readout data streams are still separate. During the shutdown time TOTEM together with CMS will integrate the data streams into one stream. This is the reason why the core computing effort will not decrease in 2013 and 2014.

The Scrutiny Group recommends approval of the proposed TOTEM 2013 M&O A budget.

### *Budget request for M&O Category B in 2013*

Table 11 shows the TOTEM M&O B request for 2013 and projections through 2016. The M&O B budgets are estimated to be constant at the same level for the coming years.

<b>TOTEM M&amp;O B budgets</b>	2012	2013	2014	2015	2016
Detector related costs	195	195	195	195	195



On-line computing	50	50	50	50	50
General services	2	2	2	2	2
<b>TOTAL</b>	<b>247</b>	<b>247</b>	<b>247</b>	<b>247</b>	<b>247</b>

**Table 11: TOTEM M&O B budget for 2013 and projections through 2016 (in kCHF).**

The M&O B costs are estimated to be constant over the years. This is supported by the experience from previous years.

The Scrutiny Group recommends approval of the TOTEM M&O B budget for 2013.

### **10. Composition of the Scrutiny Group in 2013**

The Scrutiny Group in 2012 received five new members as replacement for the members who left the group after three or more years of service. At the end of 2012, four of the members will have served for four or more years. Some of them might have to be replaced for 2013. The present chairman of the Scrutiny Group will have served for four years at the end of 2012. He will leave the group and a new chairman will have to be identified.

### **11. Summary**

Table 1 gives a summary of the requested M&O Category A budgets for ALICE, ATLAS, CMS, LHCb and TOTEM. The Scrutiny Group has carefully scrutinized the budget requests of these five experiments, examining in detail many of the line items.

**The RRB Scrutiny Group recommends approval by the RRBs of the 2013 requests for M&O budgets for ALICE, ATLAS, CMS, LHCb and TOTEM.**