Report of the LHC M&O Scrutiny Group for the October 2010 RRB

1. Membership of the RRB M&O Scrutiny Group for 2010:

The membership of the Scrutiny Group remained unchanged in 2010. The members were:

Giovanni Batignani (INFN Pisa), Gabriele Cosmo (CERN), Martyn Davenport (CERN),
Paul Dauncey (Imperial College London), Cristinel Diaconu (Marseille),
George Ginther (FNAL,Rochester), Bernd Löhr (DESY,Chair), Gerhard Mallot (CERN),
Sascha Schmeling (CERN; Secretary), Emmanuel Tsesmelis (CERN),
Mihał Turała (INP Cracow).

2. Scrutiny process

The first meeting of the RRB M&O Scrutiny Group in 2010 took place on 10 and 11 May. At this meeting, the Resource Coordinators of the five experiments, ALICE, ATLAS, CMS, LHCb and TOTEM, met with the Scrutiny Group and reviewed the figures for the amounts spent in the in 2009 and proposed to be budgeted in 2011 and the following years. During the summer months, the Scrutiny Group members conducted several face-to-face meetings with Resource Coordinators and other persons of the experiments as well as telephone conferences to scrutinize in detail the budget requests of the experiments for the year 2011 and thereafter. It was agreed that the deadline for the delivery of the final numbers for the 2011 budget requests was 15 August 2010. After that date the scrutinizers of each experiment summarized the scrutiny process and the final numbers in reports. These reports were discussed by all Scrutiny Group members at their second meeting on 30 and 31 August 2010. The Resource Coordinators and other persons of the experiments gave additional explanations of their budget requests for 2011 and beyond, and the final numbers were agreed upon between the experiments and the Scrutiny Group. The efficiency of the scrutiny process was made possible by the well appreciated co-operation of the Resource Coordinators and other persons of the experiments and by the quality of the delivered information.

3. General remarks

The extended shutdown period in 2009 and the decision to operate the LHC almost continuously during 2010 and 2011 with only a short technical stop around Christmas time lead to expenses substantially different from the 2009 budgets and in some cases impacted the planning for future years. As a consequence of the abbreviated running period in 2009, power costs for some experiments turned out to be lower than budgeted. Shutdown related costs, in particular for manpower, generally were higher than foreseen in the budget. The fact that there will be only a short technical stop at the end of 2010 instead of a regular shutdown necessitated for some experiments shutdown work in 2009 in anticipation of the long running period ahead and of the long shutdown period in 2012.
After the restart of LHC operations in 2010, the experiments quickly achieved impressive performances. The Scrutiny Group congratulates the experiments on their commissioning and the

convincing demonstrations of their readiness. The data-acquisition and the reconstruction of the data function well and the efficiency of data taking is already extremely high shortly after the start of the data taking period. The operation of the detectors and the routinely reconstruction of the collected data resulted in further insight in on-line and off-line manpower needs. This has been used as input to the budget estimates for 2011 and future years.

This year's scrutiny process included, in addition to the usual activities, some common topics of discussion which are related to the start-up of the experiment's data taking and to the new periodical running schedule of the LHC.

- In view of the new LHC running schedule, the Scrutiny Group asked each of the experiments to estimate the difference between a running year and a shutdown year for their M&O A budget needs. It turned out that in general a shutdown year will be more expensive than a running year because of the need for technical personnel and specialised manpower during the shutdown. This is partly balanced by reduced costs for gas consumption and power. However, the detector components still have to be kept under gas at a certain level and most of the experiment's electronics will stay on during the shutdown, the latter being the major part of the power consumption. There are slight differences between the experiments but overall the costs during a shutdown year are not significantly higher than for a running year if only regular maintenance is considered. Any major repair work during a shutdown may, however, increase the costs for a shutdown year considerably.

- In order to enable efficient data collection, the experiments have to replace on-line hardware components for the trigger and data acquisition systems regularly. In 2004, an agreement between the LHC experiments, the CERN management and the RRBs has been set up which outlined this process for all the experiments. Under this plan replacement of hardware, such as disks and file servers, were expected to occur typically after three years. Processors were anticipated to be replaced typically after four years, while central network switches were expected to be replaced after five years. The costs of these replacements represent a substantial component of future M&O A budgets. For at least two years, the Scrutiny Group and the Director of Research and Scientific Computing (DRC) have been anticipating a revisiting of this agreement after the experiments have gained experience with colliding beam operation. The experiments declare their willingness to review this topic, but at least some insist that any new agreement must be reached via a common process which involves all experiments. The Scrutiny Group strongly recommends that budget requests for on-line hardware replacement to be made at the RRB meeting in April 2011 be based on a revised model. Agreement has been reached between the Scrutiny Group and the DRC that the DRC initiate a process which will result in a new agreement for on-line hardware replacement by end of February 2011. Thus the budgets for the 2012 on-line hardware replacements and for the following years should be based on the new agreement.

- A new level-2 category has been added to the M&O A budget spreadsheets this year. This entry is labelled Safety, and has been included to accommodate various non-detector safety related expenses considered necessary by the experiments, but that have not been covered to date by M&O C funds. Table 1 shows the amounts for the category Safety for the experiments.

Safety cost [kCHF]	2011	2012	2013	2014
ALICE	77	85	35	35
ATLAS	830	850	880	950
CMS	100	100	100	100
LHCB	10	10	10	10
TOTEM	0	0	0	0

Table 1: Safety costs which are not Detector Safety (in kCHF).

- In the past, efforts have been made to maintain the M&O A budgets at the same level over the years as much as possible, not only for the total budget but also for individual level-2 items. The built-up of the experiment's on-line data acquisition systems is going to be completed soon. This increases rapidly the numbers of hardware modules to be replaced periodically. As a consequence, the M&O A requests for on-line replacement will soon become a sizable part of the total M&O A budget. The new scenario for the LHC operation with almost continuous running periods of three years followed by one year of shutdown will concentrate necessary repair work in these shutdown years. Because of the periodic on-line hardware replacement and major repairs during the shutdowns the spending profiles of the experiments for M&O A may vary considerably from year to year. The collaborations seem inclined to stay nevertheless with an M&O A budget profile which is almost constant over the years apparently concluding that this represents the Funding Agencies preferences. Given the anticipated variations in needs from year to year, such flat budgets can only be achieved if some mechanism is introduced to smooth out invoicing in a given year for funds which are not intended to be spent in that year but saved for later use. This bares the risk that according to document CERN-RRB-2006-026 refund of surplus may be necessary if the income for a given year is more than 10% higher than the actual expenses. Even more important is the fact that accumulation of money in several level-2 items will make it increasingly difficult for the Scrutiny Group to perform its task, follow the money flow and at the end give a well justified recommendation to the RRBs. In meetings with the experiments the Scrutiny Group expressed its preference for actual budgets which will naturally exhibit larger year to year variations. The Scrutiny Group seeks advice from the RRBs regarding how to proceed in the future.

- The CERN IT-Department and the LHC experiments are presently testing a replacement of the EVO system for the video communication within the collaborations. This replacement is a commercial product called VIDYO. If VIDYO is found to satisfy the requirements of the experiments, then it is expected to replace the EVO system by the end of 2011. The DRC originally expected that only a one-time license fee will have to be paid for VIDYO which will be borne by CERN. The DRC advised the collaborations to request in the M&OA budget for 2011 half the amount which they had to pay in 2010 for EVO and to allocate nothing for such expenses in the coming years. Recently the Scrutiny learned that VIDYO will very likely also generate ongoing costs. These costs may, however, be much lower than for EVO. It now seems likely that the experiments will be asked to support these costs, whose size is not yet clearly defined. The projections for future year budgets do not currently reflect any estimate of these costs.

- The Scrutiny Group notes that the current budget planning adopted by the experiments frequently employs a model for replacement of electronics based upon an assumption that a 5% replacement rate is applicable. It might be appropriate to revisit this working assumption and compare against observed experience since routine operations have been established.

4. Budget requests for 2011

Table 2 gives a summary of the requests for Category A M&O for the year 2011.

Experiment	Total w/o power costs	Total with NMS power costs	Total including full power costs	Percentage of M&O A w/o power compared to construction costs
ALICE	4,491	5,134*	7,292	2.2%
ATLAS	15,623	16,623*	18,443	2.6%
CMS	12,553	13,384	14,353	2.4%
LHCb	2,545	2,672	3,515	3.3%
TOTEM	440	440	440	6.0%

Table 2. Request for 2011 M&O Category A (in kCHF).

* The NMS power sharing for 2011 is still preliminary.

5. ALICE

Closing report for 2009

The closing report for the ALICE 2009 M&O-A Budget was submitted to the RRB for the meeting on 21 April 2010. The Scrutiny Group received a detailed level-2 breakdown of the closing report for their meeting on 10 May 2010. The expenditures without power costs for M&O-A including commitments from the previous year amount to 4,887 kCHF which has to be compared to 4,687 kCHF budgeted. The 2009 total energy expenditure amounts to 513 kCHF, the NMS part of it is153 kCHF. However, the power consumption in the 2009 M&O A request had been overestimated. ALICE has refunded 78.8 kCHF in 2009 after the book closing. This results in the NMS part of the power costs for 2009 of 74.2 kCHF.
The cash balance of ALICE M&OA is positive, 1,972 kCHF out of a total of 20,852 kCHF of contributions. Outstanding contributions are 689 kCHF compared to a total of 21,417 kCHF of received, including in-kind contributions.
The scrutinizers looked through all items in the level-2 breakdown, all expenditures were found to be well justified. Differences between budgeted costs and actual expenditure are small. The slight overspending in 2009 results from work done in the long 2009 shutdown.

The Scrutiny Group recommends the approval of the ALICE 2009 M&O A closing report.

Budget request for M&O Category A in 2011

Table 3 shows the proposed budget for ALICE in 2011 and the projections until 2014.

ALICE	2011	2012	2013	2014
w/o power [kCHF]	4,491	7,023	4,963	4,895
with power [kCHF]	7,292	7,311	7,794	7,726

Table 3: ALICE M&O A budget proposal for 2011 and projections until 2014.

The ALICE M&O A request for 2011 amounts to 7,292 kCHF. It is slightly higher than the 2010 budget of 7,209 kCHF. The longer running time planned in 2011 leads to higher power costs which are almost balanced by a reduction in the overall M&O A costs. Costs for shutdown activities are less in 2011 due to only a short technical stop. In addition, part of the replacement for on-line hardware has been postponed to 2012. The general services costs increased because the cooling and ventilation system of the magnet and the experimental area has to be improved. Discussions are still going on in the collaboration whether the detector should be opened during the technical stop at the end of 2010. Initially, an opening was planned in a stop of at least 10 weeks. Presently, the scheduled length of the stop is 9.2 weeks. No costs are foreseen in the 2010 and 2011 budgets for an opening of the detector over the Christmas period of 2010.
ALICE provided the Scrutiny Group with an estimate for the M&O A costs during a full running year and a shutdown year. During a shutdown year, the cost for hired manpower and technical support is about twice that of a running year whereas the power costs are greatly reduced. The estimated total M&O A costs for 2012 are almost the same as for 2011. This is the effect of a balance between planned on-line hardware replacements in 2012, which increase considerably the M&O A costs without power, and the much lower power costs due to 2012 being a shutdown year. For 2013 and 2014 the predicted costs are slightly higher (7,794 kCHF and 7,726 kCHF). The ALICE collaboration has accumulated by now a considerable positive cash balance. If this will persist in 2011 the Scrutiny Group will suggest using part of the cash balance to reduce the cost peak foreseen in 2012.

The Scrutiny Group discussed in detail all level-2 items of the M&O A request with the ALICE collaboration. The planned budget items for 2011 are considered necessary and reasonable expenditures. The Scrutiny Group recommends the approval of the ALICE request for the 2011 M&O A budget.

6. ATLAS

Closing report for 2009

ATLAS submitted their closing report for 2009 M&O A budget to the RRB on 20 April 2010. The total cost is 14,408 kCHF for M&O A including NMS power costs of 936 kCHF. The actual costs have to be compared to the budgeted costs including the NMS-part for power of 14,546 kCHF. In addition, ATLAS reported that the outstanding commitments at the end of 2009 amounted to 448 kCHF. The ATLAS M&O B closing report for 2009 was submitted to the RRB meeting on 20 April 2010. The sum of M&O B expenditures in 2009 for all subsystems was 6,246 kCHF to be compared to the 2009 M&O B budget of
6,976 kCHF. The latter amount contained an anticipated contribution to the IBL of 800 kCHF. The expenditures for M&O A are well balanced against the budget, the actual M&O B spending is about 10% below budget, but outstanding commitments account for much of this difference.

The Scrutiny Group recommends the approval of the ATLAS 2009 M&O A closing report.

Budget request for M&O Category A in 2011

Table 4 shows the proposed budget for ATLAS in 2011 and the projections until 2015.

ATLAS	2011	2012	2013	2014	2015
w/o power [kCHF]	15,623	17,920	15,610	16,311	15,243
with power [kCHF]	18,443	20,120	18,430	19,131	18,063

Table 4: ATLAS M&O A budget proposal for 2011 and projections through 2015.

The proposed budget for the year 2011 has been carefully investigated in five meetings between members of the Scrutiny Group and the ATLAS Resource Coordinator and Technical Coordinator. The requested budget for 2011 is about 13% higher (excluding power cost) compared to the 2010 budget request. (Note that the corresponding M&O A budget projections for the year 2011 made in 2009 was 17,156 kCHF, which is 10% higher than the current proposal). This considerable increase over 2010 operating costs is due to several reasons outlined below.
Costs are generated by planned modifications of the beam-pipe and new tools for work on the beam-pipe, once it has been activated by irradiation, and the need for changes required for the installation of the IBL. This activity is part of the IBL project. It started already in 2010 and is expected to continue in the following years. The integrated amount requested from M&O A budgets is 4,065 kCHF. This money is to be spent for beam-pipe modifications, cabling, and power supplies which are considered M&O A expenses by the collaboration. An interim MoU for

the IBL project exists and it is presently being signed by the respective Funding Agencies. The IBL project is still not approved by the LHCC. Therefore the same remarks made last year (CERN-RRB-2009-078) still apply. The budget requests for 2011 presented here include significant M&O A funds (940 kCHF) and M&O B funds (1,100 kCHF) intended for the IBL, and their endorsement by the Scrutiny Group should be considered contingent upon LHCC approval of the IBL project. It is worth mentioning that the assumed price for the planned Beryllium part of the beam-pipe is the current best estimate derived from a quotation made in 2003.
A new level-2 item was introduced this year. It is intended to accommodate safety related costs which do not naturally fit into the 'Detector Safety' category. For ATLAS the total costs in this category amount to 3,820 kCHF for the time period until the end of 2015. The budgeted costs are mainly for radiation safety and protection of personnel.
The planned replacement of on-line computer hardware contributes significantly to the increase of the 2011 budget request, accounting for more than 10% of the M&O A budget. The model for the exchange of hardware is based on the ATLAS interpretation of an agreement between the experiments, the Scrutiny Group at that time and the CERN management (see the respective part of the introduction of this document for a related discussion).
In 2010 a program was started to consolidate the evaporative cooling system of the Inner Detector. Two alternative solutions are presently under study. Last year the Scrutiny Group requested an approval of the chosen solution by the LHCC (see CERN-RRB-2009-078). The LHCC encouraged the collaboration to continue these studies and find a solution for the replacement of the existing compressors (Minutes 101st Meeting of the LHCC, May 2010, CERN/LHCC 2010-008). The endorsement of the requested budget by the Scrutiny group is contingent on the final approval of the chosen solution by the LHCC. Due to the changed running cycle of the LHC and the planned long shutdown in 2012 the anticipated spending profile for the consolidation of the evaporative cooling system has been modified as shown in table 5.The total costs of this consolidation increased from 1,460 kCHF to 1,600 kCHF.

M&O A ID cooling consolidation	2010	2011	2012	2013	SUM
Planned in 2009	400	360	350	350	1460
Planned in 2010	420	380	780	20	1600

Table 5: Planned ATLAS M&O A spending profile for the Consolidation of the Inner Detector Cooling (in kCHF).

In 2009 the ATLAS Collaboration discussed an upgrade of the system of distribution racks for the Inner Detector coolant fluid. This plan has now been abandoned. No contributions for it had been incorporated in the M&O A budget requests in 2010.
Consolidation and upgrade of the ATLAS Magnet infrastructure is a project which also started already in 2009. Originally it consisted mainly of the upgrade of the cooling compressors and the purchase of a spare compressor. This project has now been extended to additional consolidation and upgrade of the magnet vacuum system and the helium system. The total cost of the consolidation/upgrade package is 3,930 kCHF. Table 6 shows the budgets for 2009 and 2010 and the planned budgets for 2011 through 2015 for the magnet consolidation, and for comparison the budgets for all Magnet related costs of the total ATLAS budgets.

Year	2009	2010	2011	2012	2013	2014	2015	SUM
Budget for Magnet	2463	2338	1420	2277	1540	1178	1200	10547
Costs of cons./upgr.	980	1108	297	1155	390	0	0	3930

Table 6: M&O A budget planning for the Magnet costs and for the subset of those costs to be devoted to the consolidation and upgrade of the Magnet system (in kCHF).

The completion of the ATLAS DAQ system with 3010 processors nodes to handle design luminosity was planned for 2010 (as of the 2009 projections). This build-up will be paid for by construction money. In light of the revised operating schedule, the build-up of the farm has been stretched until 2013. This also defers replacement costs. It should be noticed that if CERN decides to change the supplier for network switches ATLAS intends to follow this lead. This might generate costs of 2 to 3 MCHF which are not included in the budget forecast.
The ATLAS Collaboration requests the same number of FTEs for core computing as in the previous year (when it had been increased by two FTEs). This number is expected to stay constant over the coming years.
The Scrutiny Group recommends the approval of the ATLAS M&O A proposal for 2011 under the conditions made for the IBL project and the evaporative cooling for the Inner Tracking Detector.

Budget request for M&O Category B in 2011

ATLAS Collaboration conducts its own internal scrutiny for the M&O B budgets for each of the subsystems and provides reports to the Scrutiny Group. The M&O B budget request for 2011 is 6,135 kCHF. This is about 12% higher than the amount budgeted in 2010 (and 6% higher than the amount forecast for 2011 during the 2009 budget planning). Table 7 shows the proposed amounts for the M&O B budgets of the detector components.

ATLAS M&O B	2010	2011	2012	2013	2014	2015
Inner Detector	2,875	3,585	3,835	3,265	2,395	2,245
Liquid Argon	1,321	1,186	1,176	996	996	796
Tile Calorimeter	605	724	673	669	668	505
Muons	700	640	720	570	570	570
Total	5,501	6,135	6,404	5,500	4,629	4,116

Table 7: ATLAS M&O B budget for 2010, request for 2011 and projections for 2012 through 2015 (in kCHF).

Compared to the estimates for 2011 to 2014 made in October 2009 (CERN-RRB-2009-078) this is an average increase of 6% with a maximum of 12% in 2012. The main cost increases originate from the Inner Detector (780 kCHF) and from the Tile Calorimeter (474 kCHF) and Liquid Argon Calorimeter (410 kCHF) whereas there are reductions for the Muon System (300 kCHF). The Inner Detector M&O B budget includes significant support for the IBL project, as shown in table 8. Note that the Scrutiny Group endorsement of this budget request is contingent upon the LHCC approval of the IBL project.

M&O B IBL	2009	2010	2011	2012	2013	2014	Total
[kCHF]	600	200	1100	1300	900	100	4200

Table 8: Planned M&O B contributions to the IBL project.

The Low Voltage Power Supply system (LVPS) of the Tile Calorimeter shows an unexpectedly high rate of failures. Therefore it is planned to replace the existing modules with improved ones which are under development at ANL. The total cost will be 1,089 kCHF of which 119 kCHF per year are included in the budget request for 2011 through 2014. The rest of this power supply replacement project is proposed to be financed via savings in maintenance costs because the detector will be closed in 2011, 2013 and 2014.
The optical transmitter systems (OTX) for the Inner Detector as well as for the Liquid Argon Calorimeter are a potential cause for concern. The Inner Detector budget request includes 140 kCHF for a replacement of accessible transmitters, with the expectations that more drastic measures not yet reflected in the current budget projections may eventually be required. In the case of Liquid Argon Calorimeter transmitters, the problems are correlated with VCSELs having a narrow optical spectrum. Costs for a potential final remedy are not yet included in the budgets. These costs might turn out to be ~220 kCHF if the double fibre optics is selected.

The Scrutiny Group devoted one of the meetings with the ATLAS representatives to a detailed review of the proposed M&O B costs. These requests are considered reasonable. The Scrutiny Group recommends approval of the ATLAS M&O B proposal for 2011 (with the specified contingent endorsement of the IBL request).

7. CMS

Closing reports for 2009

CMS submitted their closing report for 2009 M&O A budget to the RRB on 19 April 2010. The actual costs amounted to 13,792 kCHF for Category A including NMS power costs of 196 kCHF. Included in this sum are commitments of 801 kCHF for future years. The actual expenditures have to be compared to the 2009 M&O A budget of 11,216 kCHF. There are mainly three

reasons for the overspending of about 2.5 MCHF. The shutdown in 2009 was twice as long as foreseen. This required maintaining specialized teams for technical support over a longer period. The planned continuous running in 2010 and 2011 necessitated already in 2009 some preparations for the long shutdown in 2012. The safety system of the detector has been improved and as a consequence of the September 2008 accident at the LHC, additional safety installations had to be provided. The cost for the use of EVO, a collaborative tool for communication, has been unexpectedly charged to the collaboration. The deficit in 2009 is partly covered by integrated savings for M&O A during the years 2002 to 2008 of 2,078 kCHF leaving a deficit of 488 kCHF. The latter amount is planned to be balanced by savings in the years 2010 and 2011. In discussion with the Scrutiny Group the areas in which savings are expected to occur have been indicated.

The Scrutiny Group recommends the installation of a mechanism which may address the possibility of large overspending in case of an accident or unforeseen events in the future. Part of this must be early transmission of information to the CERN management, the Funding Agencies and the Scrutiny Group as well as fast feedback from the Funding Agencies and from the Scrutiny Group. Such a mechanism should then be applicable to all LHC experiments.

The Scrutiny Group recommends the approval of the CMS 2009 M&O A closing report.

Budget request for M&O Category A in 2011

Table 9 shows the proposed M&O A budget for CMS in 2011 and the projections until 2014.

CMS	2011	2012	2013	2014
w/o power [kCHF]	12,553	14,760	12,576	10,752
with power [kCHF]	14,353	16,560	14,376	12,552

Table 9: CMS M&O A budget proposal for 2011 and projections until 2014.

The proposed CMS M&O A budget for 2011 is 5.4% higher without power cost compared to the 2010 budget. It differs substantially from the requests made at the RRB meetings in October 2009 (13,419 kCHF w/o power cost) and in April 2010 (15,320 kCHF w/o power cost). Already at the end of 2009 leaks in the main cooling system inside the CMS detector made it necessary to open the detector shortly before Christmas and repair the cooling system until end of February 2010. This generated unforeseen cost of 1,121 kCHF at the beginning of 2010. In detailed discussion with the Scrutiny Group the following solution has been agreed upon. The financial situation in 2010 is already very tight because the 488 kCHF overrun in 2009 has to be saved in this year. Therefore the funding of the repair of the cooling system is moved to 2011. The situation in 2011 could be relieved by postponing planned on-line hardware replacements which should have been purchased according to the existing plan. This moves 1,933 kCHF from 2011 to the years 2012-2013 where it will then, however, lead to increased expenses in this area. The changed running

plans for the LHC, i.e. continuous running in 2010 and 2011 and a long shutdown in 2012, have led also to some changes in the M&O A requests for 2011 and for the estimates in the following years. Additional costs arose in 2010 and will remain as ongoing costs for safety courses and safety training of personnel and for the fire protection system. Due to a LHC-wide recommendation of the Safety Committee the sniffers in the CMS detector will be operated as L3 alarm system (personnel protection). This requires a service level agreement which costs 76 kCHF per year. These safety costs amount to 100 kCHF in the request. For the budget request of 2011 all 'Operation' budget lines excluding those covered by Service Level Agreements have been indexed by 3% for inflation.
The CMS M&O A budget proposals have been carefully scrutinized and the above proposed plan has been found acceptable by the Scrutiny Group. It has to be pointed out that this solution leaves CMS with no financial reserves for the coming years from which unforeseen events could be covered. The CMS collaboration emphasizes that a procedure should be established for the case that necessary, unforeseen additional costs will arise.
The TOTEM experiment is operated by a separate collaboration but resides partly inside the CMS detector. The TOTEM collaboration plans to install the still missing T1 detector components during the LHC technical stop over Christmas 2010. The T1 detector components have to be placed inside the endcaps of the CMS detector. This requires significant effort from the CMS collaboration. No provision is made in the CMS budget request for costs that may be incurred due to these installations.

The Scrutiny Group recommends the approval of the CMS M&O A request for 2011.

8. LHCb

Closing reports for 2009

LHCb submitted their closing report for 2009 M&O A budget to the RRB on 21 April 2010. The actual costs amounted to 2,471 kCHF for Category A including NMS power costs of 84 kCHF. This lies below the budgeted costs of 2,592 kCHF. The main contributions to the actual costs were detector related (921 kCHF), on-line computing (740 kCHF), and general services (337 kCHF) costs. The savings of 121 kCHF compared to the 2009 budget originated essentially from postponing on-line hardware replacement due to the modified LHC running schedule. The actual consumption of gas was lower than budgeted. However, the last-quarter bill of 60 kCHF arrived only in 2010. Cooling-fluid costs exceeded the budgeted numbers because of leaks in the systems. The leaks have been cured by now and less consumption is expected in the future. Online computing manpower was overspent by 66 kCHF due to the request of the IT-Department to pay 1 FTE for data base management. The integrated total balance (budgeted-actual) for the years 2002-2009 amounts to 589 kCHF which is 23% of the typical yearly M&O A budget. The integrated cash balance is 199 kCHF due to outstanding contributions of 389 kCHF.

The Scrutiny Group recommends the approval of the LHCb 2009 M&O A closing report.

Budget request for M&O Category A in 2011

Table 10 shows the proposed M&O A budget for LHCb in 2011 and the projections until 2014.

LHCb	2011	2012	2013	2014
w/o power [kCHF]	2,545	2,617	2,627	2,607
with power [kCHF]	3,515	2,917	3,227	3,577

Table 10: LHCb M&O A budget proposal for 2011 and projections until 2014.

The proposed M&O A budget for 2011 without power cost of 2,545 kCHF is very similar to the 2010 budget of 2,512 kCHF. The total estimated power cost of 970 kCHF for 2011 is approximately 60% higher than in the 2010 budget due to the planned continuous running in 2011 and the discount applied in 2010, due to reduced running period in 2009. The NMS part of the power cost is 127 kCHF. The projection until 2014 is almost flat for the costs without power. Total costs for power fluctuate according to the planned running schedule of the LHC.
The LHCb collaboration foresees to complete the on-line farm by the end of 2010. Accordingly, the replacement profile was then estimated under an operational model particular to LHCb:

- A significant part of the system (1.0 MCHF from 4.5 MCHF of core funds) for mostly LAN infrastructure is already covered by long-term warranty or maintenance contracts.
- The replacement profile of the remaining 3.5 MCHF 'renewable' components (0.5 MCHF spent in 2008, 1 MCHF in 2009 and 2 MCHF in 2010 all from core funds) results from the operational model: buy components as late as possible, replace components only when broken, assume the replacements follow a typical lifetime of 6 years (Gaussian distributed with a sigma of 2 years), assume that the same computing capacity will cost progressively about 12% less each year (considered conservative).

With the accumulated savings from under-spending on these items during 2008-2010 (about 460 kCHF), LHCb estimated that a constant annual budget of about 270 kCHF for these 'renewables' plus 80 kCHF for other items will cover expenditure at least until late in the decade. As a result, the budget request is for 300 kCHF in 2011 then 350 kCHF/year for the following years (see table 11). Due to the smeared distributions and the falling cost assumptions, the simulation appears relatively insensitive to using 5 instead of 6 years average lifetime (+50 kCHF/year). Assuming no progressive decrease in processor costs over the years results in a 300 kCHF/year increase. The anticipated spending profile is shown in table 11.

LHCb	2008	2009	2010	2011	2012	2013	2014
[kCHF]	155	300	200	300	350	350	350

Table 11: LHCb spending profile for on-line computing replacements.

Implicit to the LHCb operational model for replacements is a steady accumulation of a surplus dedicated to future replacement purchases in order to prepare for the peak in replacement spending around 2016. This surplus must be protected for use only for its proper purpose and also be clearly visible to the Scrutiny Group in order to monitor the money flow. A suitable mechanism for LHCb (and perhaps for other experiments) must be devised in the coming year.

The power cost estimate for future years has been modulated with the LHC running schedule. The magnet power consumption is the major part of power consumption at LHCb. The total power budgets for 2008 to 2010 and the estimates for 2011 and later are shown in table 12.

Total Power	2008	2009	2010	2011	2012	2013	2014
[kCHF]	300	600	600	970	300	600	970

Table 12: LHCb total power costs from 2008 to 2014.

In 2009, LHCb paid one FTE requested from the IT division for database management. From February 2010 on, only 0.5 FTE is being charged to LHCb. There is a new Service Level Agreement for the support of the vacuum system which costs 90 kCHF per year. It is foreseen to exchange the beam-pipe during the 2012 shutdown. The cost of 1,500 kCHF will not be requested as M&O A but will be paid for by CERN.
The request for Core Computing personnel is 150 kCHF. For 2010 a rise from 100 kCHF to 150 kCHF was approved by the Scrutiny Group. This level is retained for 2011 onwards. It covers the subsistence of four physicists from outside institutes quasi-permanently at CERN.
The request for Online Computing personnel has decreased from 400 kCHF to 360 kCHF.

The proposed M&O A budget for 2011 was discussed in detail at a meeting of the Resource Coordinator and the Technical Coordinator of LHCb with members of the Scrutiny Group. Satisfactory answers were received to all raised questions. The Scrutiny Group considers the request in the 2011 budget to be justified.

The Scrutiny Group recommends the approval of the requested LHCb M&O A budget for 2011.

9. **TOTEM**

Closing reports for 2009

TOTEM submitted their closing report for 2009 M&O A budget to the RRB on 20 April 2010. The actual costs amounted to 410 kCHF. No power costs are currently attributed to the TOTEM experiment. The actual costs are 8.6% below the budget of 449 kCHF. There are no individual level-2 items which deviate substantially from the budgeted values. Taking into account the carry-over from previous years and commitments from 2009, the integrated cash balance is presently 6 kCHF.

The Scrutiny Group recommends the approval of the TOTEM 2009 M&O A closing report.

Budget request for M&O Category A in 2011

Table 13 shows the proposed M&O A budget for TOTEM in 2011 and the projections until 2014.

TOTEM	2011	2012	2013	2014
[kCHF]	440	409	437	430

Table 13: TOTEM M&O A budget proposal for 2011 and projections until 2014.

The TOTEM M&O A budget requests are almost constant and slightly lower than for 2010. The decrease in 2012 is mainly due to reduced costs for on-line computing and cooling. During the technical stop of LHC at the end of 2010 to beginning of 2011 TOTEM plan to install their last missing detector components, the T1 telescopes. Although the costs for this operation fall under construction costs it is not excluded that some charges from service groups will appear as M&O A costs. The installation is a combined operation with the CMS experiment. CMS and TOTEM are currently estimating the resulting costs and are negotiating with CERN management the related funding. Storage space and buffer zones for the T1 telescopes will be provided by CMS from their requested funds. The Scrutiny Group recommend that TOTEM and CMS formalise their financial inter-dependence.

The Scrutiny Group recommends the approval of the TOTEM M&O A budget for 2011.

10. Service Level Agreements

A meeting on Service Level Agreements (SLA) took place in August between all the LHC experiments, the EN Department and the Scrutiny Group to review the situation of the SLAs.

- Power Distribution & Cooling/Ventilation
  The current agreement covers the period 2005-2010. EN Department is preparing input data for the agreement which will cover future years. The experiments Technical Coordinators and Resource Coordinators will then be asked to sign the document.

- Detector Cooling
  Separate SLAs exists for detector cooling. The costs for dry air and the inertion systems are not yet included. ALICE and CMS request the preparation of a corresponding document.

- IT Oracle Database
  The Agreement detailing costs for provision of IT Oracle Database needs has to be completed and should include the relevant cost estimates.

All other Service Level Agreements are still valid. Nothing else has to be done now.

11. Composition of the Scrutiny Group in 2011

At the end of 2010, four members of the Scrutiny Group have each served for at least three years: G.Batignani, M.Davenport, C.Diaconu,G.Ginther, and E.Tsesmelis. The Scrutiny Groups thanks these colleagues for their invaluable contributions to the work of the group. They will have to be replaced or their membership has to be extended by the RRBs.

12. Summary

Table 2 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 Scrutiny Group took note of Category B estimates where available, but looked in more detail at the Category B budget request for ATLAS. It should be noted that the Scrutiny Group's endorsement of the contributions in the 2011 budget requests for the ATLAS projects IBL and Inner Detector cooling consolidation is contingent on the approval of these projects by the LHCC.

The RRB Scrutiny Group recommends approval by the RRBs of the 2011 estimates for the M&O budgets for ALICE, ATLAS, CMS, LHCb and TOTEM.