



## LHCb

### Minutes of the 8th RESOURCES REVIEW BOARD Meeting

(Held at CERN on 24<sup>th</sup> April 2002)

Present:

*Europe:*

G. Wormser (IN2P3, Paris), B. Jean-Marie;  
J. Engelen (NIKHEF, Amsterdam), A. J. Van Rijn;  
F. Cervelli (INFN, Roma), C. Martellotti;  
J. Królikowski (State Committee for Scientific Research, Warsaw);  
E. Popa (Institute of Atomic Physics, Bucharest);  
V.I. Savrin (Ministry of Science and Technologies, Moscow);  
A. Ferrer (CICYT, Madrid), B. Adeva;  
R. Wade (PPARC, Swindon), N. Harnew;  
B. Grynyov (Ministry for Science and Technology, Kiev), G. Zinoviev.

*Asia:*

Yongtao Zhang (National Natural Science Foundation of China, Beijing), M. Pu.

CERN:

R.J. Cashmore (chairman), E.M. Rimmer (secretary),  
P. Geeraert, K.H. Kissler, A.J. Naudi, D. Schinzel, E. Tsesmelis.

LHCb:

T. Nakada, H.-J. Hilke, C. Matteuzzi, A. Smith, W. Witzeling.

Apologies:

Université de Lausanne, Lausanne.

**8th Meeting of the LHCb Resource Review Board RRB, 24th April 2002**

Documents CERN-RRB-2002-*nnn* can be found at <http://web.cern.ch/Committees/LHCRRB/LHCb/>

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**1. & 2. Introduction & Approval of the minutes of the last meeting**

*R.J. Cashmore*

*Director for Collider Programmes*

The Chairman, R.J. Cashmore, welcomed delegates, pointing out that the M&O budget and the MoU for M&O are very important agenda items for the meeting.

The Minutes of the last meeting were **approved** without changes. There were no matters arising.

**3. Status of the experiment**

*Spokesperson T. Nakada*

*Paper CERN-RRB-2002-031*

*Presentation CERN-RRB-2002-070*

Nakada started by noting that membership of the LHCb collaboration has not changed since September 2001: 45 institutes plus 3 associate institutes with, at present, just 4 MoU signatures missing – BMBF (Germany), Poland, Brazil and China.

The LHCb detector is being optimised to reduce the material budget. This effects the VELO, RICH-1 and the outer and inner trackers, and the tracking strategy is being adapted to the new configuration. Submission of the ‘LHCb-light’ TDR, with expected performance figures, is expected towards the end of 2002.

The status of the various sub-systems is reflected in the approval dates of the TDRs:

Magnet	Apr 2000
Calorimeters	Feb 2001
RICH	Feb 2001
Muon System	Nov 2001
VELO	Nov 2001
Outer Tracker	Feb 2002
Online System	Apr 2002
<i>Inner Tracker, Trigger, Computing</i>	<i>To come</i>

– *Magnet*: most of money committed and the magnet is well into production.

– *Calorimeters*: most of the money for raw material for the ECAL and HCAL is committed, on schedule and within budget. About 15% of the ECAL is manufactured and module assembly is proceeding at ~10 modules/day, production of modules for the HCAL tile calorimeter is underway, and the EDR for the SPD-Preshower is completed, as is the PRR for the front-end ASIC chips of all three systems.

– *VELO*: detector optimisation involves fewer stations (21 vs 25 in the TDR) each with increased performance; VELO data will be used intensively in track finding. The VELO sits as close to the beam as is feasible, so the design of the enclosing vacuum tank is very important. Various tests of the vacuum system, for tightness, quality, etc., are being carried out. The next design review by the machine groups will be in autumn 2002. For the VELO electronics, two rad-hard FE chip prototypes have been developed; BEETLE 1.1 in 0.25 $\mu$ m CMOS (also used for the Inner Tracker and Pile-Up Trigger) and the SCTA-VELO in DMILL adapted from an ATLAS chip; a choice will be made in autumn 2002.

– *RICH*: the removal of the shielding plate between the magnet and RICH-1 for LHCb-light optimisation results in a small magnetic field in RICH-1 necessitating some design changes. The engineering design of RICH-2 is not affected by LHCb-light optimisation and the EDR is currently in progress. One of the major RICH issues is the photon detectors, for which the baseline design are HPDs. Prototype read-out chips have been used in bump-bonded assemblies, but running at only at half the design target rate of 40 MHz; recently received revised chips now reach 40 MHz. The situation will be reviewed in June 2002.

– *Trackers*: LHCb-light will have fewer, more performant tracker stations (4 vs 9 in the TDR), 1 in front of the magnet, 3 behind, none inside; the robustness of TT1 in front of the magnet is being carefully studied.

- *Outer tracker*: the 3 LHCb-light stations (previously 4) are identical with those described in the TDR; a 3m long prototype module, built in Heidelberg, is installed in HERA-B for real-life testing in a harsh radiation environment. The electronics, unaffected by the optimisation, is still under development and is on time.
- *Inner Tracker*: TDR to be submitted autumn 2002; having switched to a full-Si design, Si tests, detector design and electronics development work is in progress and on schedule; a beam test has been set up with one ladder using the BEETLE chip developed for the VELO.

– *Muon system*: is not affected by LHCb-light; it consists of RPCs built in industry and wire chambers built in the institutes for which production tools are presently being prepared. For the muon shield, iron blocks have been recuperated from the CERN neutrino beam. The FE chips (CARIOCAS) in 0.25 $\mu$ m CMOS technology are being developed at CERN. These boards may also be used for the RPCs.

– *Trigger*: TDR to be submitted beginning 2003; consists of Level-0, Level-1, and a higher level trigger based on an on-line filter farm; for the hardware Level-0 trigger, a circuit has been simulated and a prototype is being built to test the results, for the Level-1 processor trigger, a SCI network prototype with 1 MHz data transfer has been tested, and a prototype with ~ 30 processors has demonstrated that the transfer rate can exceed LHCb requirements.

– *Computing*: the Online DAQ and Experimental Control System TDR has been approved. However there is a problem of missing manpower that must be solved by the collaboration. For the Offline Software and Computing infrastructure, the TDR is now not foreseen before mid-2004, a date to be aligned with the other LHC experiments and the LHC Grid project. In the meantime, performance studies for the remaining sub-system TDRs are being done in several collaborating institutes using OO-based software. To overcome the manpower shortage LHCb is setting up computing agreements in which CERN takes overall responsibility for core Online and Offline tasks and manpower is contributed by collaborating institutes. The first such agreement, for event visualization, is ready to be signed with LAL; others are in preparation for GRID related activities (UK), analysis framework (Brazil), GEANT4 (Russia), SPECS (LAL), etc.

Nakada summarised the overall status as follows. The majority of the TDRs have been submitted and approved, and re-optimization of the detector is proceeding as planned. Construction of the magnet and of E/H-CAL modules is on time and within budget. At the pit, DELPHI is fully dismantled and modification of the area has started. To date LHCb has no cost over-run; planning is being adapted to fit the new LHC schedule and the full detector should be ready for physics in 2007.

*Discussion*

- J. Engelen (NL): LHCb-light has to go through the appropriate scientific committees; it looks like a good idea but why is it being done? Does LHCb-classic not work? If it turns out that you have been too aggressive in removing tracking stations, is it easy to add them.
- TN: the original tracker design was too optimistic; as it became more realistic each station became thicker and thicker until it was decided that a drastic change was needed; stations can be put back if necessary because the space is left empty.
- G. Wormser (FR): can the effect of 'ghost tracks' be sufficiently well evaluated?
- TN: yes, they are < few% of the found tracks per event.
- F. Cervelli (IT): have all possible sources of background been included?
- TN: yes; using GEANT and the updated configuration, material, etc.; these studies are part of the optimisation procedure.

**4. Report from the LHCC** *LHCC Scientific Secretary E. Tsismelis*  
*Paper CERN-RRB-2002-014*

Since the last RRB the LHCC held LHCb sessions in November 2001, and January and March 2002. The Committee considers that LHCb is progressing well, meeting its milestones and respecting the overall schedule, in line with being ready for LHC start-up in April 2007. The LHCC Magnet Advisory Group has no major concerns regarding the LHCb dipole magnet and good progress was reported for the Hybrid Pixel Detector (HPD) prototype for the RICH read-out. Although this device is now operational, the LHCC considers that remaining bump-bonding problems could potentially cause the most serious delay to the LHCb schedule if they are not solved soon.

Concerning TDRs, the LHCC recommended approval of the Outer Tracker and Online System TDRs and these were approved by the Research Board in February 2002 and April 2002 respectively. LHCb is re-optimising its detector to reduce the material budget. The LHCC will receive a progress report in May, followed by a Detector Re-optimisation TDR in the autumn showing the overall performance and integration of tracking detectors. The Inner Detector TDR will now be submitted at the end of 2002, one year later than originally scheduled, but the LHCC does not consider this delay to be critical. The Committee noted that a new date of mid-2004 has been proposed for the Computing TDR and it remains to be seen whether this is consistent with the overall program.

**LHC COMPUTING GRID PROJECT**

The LHCC has recommended that it should treat the LHC Computing Grid Project in the same way as the experiments. This means that the Grid Project will submit documents and reports for review by the LHCC, including the project's TDRs. The Committee is now analysing the relation between detector parameters and computing requirements, particularly the trigger rates and associated physics performance.

**TEST BEAMS**

The LHCC has reviewed requests for test beams in 2003 - 2006. It considers that all 4 experiments need beams in 2003 - 2004 to calibrate calorimeters, validate front-end read-out electronics and DAQ chains, monitor detector construction quality and test alignment procedures. In 2005, ALICE, ATLAS and LHCb have no compelling test requirements, while CMS's needs in 2004 - 2006 are driven primarily by ECAL calibration. Therefore, the experiments have been asked to proceed without SPS test beams in 2005. However, the LHCC recommends that PS test beams operate throughout 2003 - 2006.

*Discussion*

- G. Wormser: concerning the HPD delay risk, is there a financial risk; is there an alternative technology?
- H-J. Hilke (LHCb): the change of one year in the machine schedule gives more time before we have to adopt the fall-back solution of the multi-anode PM that is more expensive by ~ 1 MCHF and would mean finding savings elsewhere. There will be a review in May/June 2002; the bonding milestone is not passed and progress during the next months will drive the decision.

- RJC: ALICE also had bonding problems that are now solved; does that help LHCb?  
 H-J. H: if, like ALICE, the circuits operate at room temperature there are no problems, but building them into the tube requires heating them and this causes problems; we took the ALICE design and the pad size is smaller than LHCb needs, so one possible solution would be to use larger pads.  
 TN: concerning the late date of the Computing TDR, mid-2004 is not yet decided, it just seems to be a reasonable guess that all 4 experiments will be ready and so can be synchronised.  
 RJC: the LHCC is generally content with LHCb's progress; it is following the HPD problem closely; the Committee favours the examination of a move to LHCb-light; the RRB can be pleased that there are no cost overruns.

## 5. Status of collaboration accounts *CERN Finance Division Leader A.J. Naudi*

*Paper CERN-RRB-2002-007*

Updating the distributed document, Naudi reported additional income of 72 kCHF, additional expenditure of 28.1 kCHF and no change in the 3.1 MCHF of outstanding commitments. He noted that a few FAs have still not paid their 2001 contributions; they will receive letters after the meeting reminding them to pay these dues as soon as possible.

R. Wade (GB): how sure is LHCb that the missing contributions will be paid?

A. Smith (LHCb): we have no real worries, apart from Brazil (they have not signed the MoU).

## 6. Budget matters

### • *Report on CORE expenses for 2001-2003*

*Resource Co-ordinator A. Smith*

*Paper CERN-RRB-2002-029*

The RRB took note of the following information:

For the period  $\leq$  2001 CORE expenses in MCHF were:

<i>Commitments</i>		
<i>Common Fund</i>	Magnet	4.63
	Calorimeters	1.10
<i>Direct sub-systems funds</i>	Calorimeters	0.579
<i>Payments</i>		
<i>Common Fund</i>	Magnet	0.988
	Calorimeters	0.017
<i>Direct sub-systems funds</i>	Calorimeters	0.183

For 2002:

Institutes/Countries that have not already made major contributions have been asked for a minimum of 8 kCHF each. Larger contributions have been received from IN2P3 (320 kCHF), NIKHEF (500 kCHF) and Zürich (32 kCHF). Expected payments in MCHF are:

<i>Common Fund</i>	Magnet	2.9
	Infrastructure	0.2
	Calorimeters	1.5
<i>Direct sub-systems funds</i>	Calorimeters	4.28
	Muon	0.44
	Outer Tracker	0.98
	RICH	0.70
	VELO	0.57

For 2003, very preliminary estimates in MCHF are:

<i>Common Fund</i>	Calorimeters	1.6
<i>Direct sub-systems funds</i>	Calorimeters	4.58
	Muon	2.38
	Outer Tracker	2.21
	RICH	4.64
	VELO	1.46
	Trigger	0.20
	DAQ/DCS	2.39

## 7. M&O

- **Scrutiny Group Report**                      *Scrutiny Group Chair, D. Schinzel*  
*Paper CERN-RRB-2002-036*                      *Presentation CERN-RRB-2002-081*

Cashmore asked the Scrutiny Group Chair to thank, on behalf of the RRBs, all of those who have worked hard to produce accurate estimates of the expected M&O costs of the experiments.

Current members of the M&O Scrutiny Group are:

Atul Gurtu	Tata Institute
Bernard Aubert	IN2P3, Annecy
Brigitte Bloch-Devaux	CEA, DAPNIA
Franco Cervelli, Paolo Giubellino	INFN
Guy Lujckx	NIKHEF
Jim Yeck	DoE
Kai Koenigsmann	University of Freiburg
Peter Chochula	Comenius University, Bratislava
Steinar Stapnes	University of Oslo
Sven-Olof Holmgren	University of Stockholm
T. Camporesi, D. Plane, D.Schinzel (Chair) and E.M. Rimmer (Secretary)    CERN	

Given M&O estimates for 2002 – 2007, the Group was asked to:

- flag items linked to Construction, Commissioning and Integration
- flag items for which costs are intrinsically unreliable or likely to vary with time
- flag items for which a change in strategy might produce economies
- identify items related to shut-down activities
- identify cost drivers

In addition, the Group decided to:

- standardize the data presentation formats to facilitate comparison between Collaborations
- review and analyze the spending profile

M&O 'A' costs, to be paid in common across the experiment, were identified and the estimates carefully checked. Between August 2001 and April 2002 the scrutiny resulted in small cost reductions before 2005, and small increases thereafter.

LHCb has the size of a LEP experiment and the collaboration wishes to deal internally with M&O B costs. The Scrutiny Group accepted this approach and so B costs, not yet fully estimated, have not been scrutinised in detail. (The plot shown in *CERN-RRB-2002-081* falls to zero in 2004 not because B costs will be zero but because they have not been estimated beyond 2003.)

The Group concluded that the LHCb M&O Category A cost estimates for 2002 are sound and ready for endorsement; 2003 estimates will be further scrutinised ready for approval at the October RRB. The Group recommends that LHCb should handle its B costs internally, until further notice.

For on-line computing, a common strategy is needed for charging for raw data storage and common guidelines are needed for equipment replacement cycles.

*Discussion*

- G. Wormser: are the estimates based on the 'old' machine schedule?  
DS: yes; that explains the profile around 2005/6; the numbers will be updated for October.  
F. Cervelli: LHCb-light may have different M&O costs.  
A. Smith: probably more for Category B than for Category A, and probably not very different.  
RJC: the RRB can expect to see changes due to changes in both the machine schedule and the detector.

- **Category A M&O Status for 2002 & Estimates for 2003** *A. Smith*  
*Paper CERN-RRB-2002-030*

For 2002 a Category A M&O budget of 371 kCHF was tabled at the RRB last October and, as agreed, 30% invoices were issued to the FAs based on numbers of PhDs or equivalent. Smith presented figures for the remaining 70% contributions, without the power discount for Member States and non-Member States that have contributed to the LHC machine. Cashmore said that in future, power discounts will be made before invoice figures are presented.

*Discussion*

- G. Wormser: concerning the 'PhD or equivalent' counting rule, in the MoU it seems that all engineers have been counted; also one French institute is missing, Annecy.  
RJC: the 'PhD or equivalent' numbers have been agreed inside LHCb and it will hold things up if we have to redo them all.  
G. Wormser: it is a problem because in the other experiments we have applied the rule that a PhD is someone with a PhD and that would change the numbers substantially.  
J. Królikowski (PL): Poland has the same problem; there are names in the LHCb MoU that would not appear in the ATLAS/CMS lists; this makes Poland's share of LHCb M&O larger than for the other 3 experiments and that will be hard to justify; I would say that the LHCb Polish list should be about half its present size or less; the numbers came as a surprise to me; the notion of 'equivalent degree' seems to have been applied in a very 'relaxed' way compared with other collaborations.  
RJC: I'm surprised that this is being reported so late and that there are such big discrepancies; we have had no problems in the other experiments so why has this happened in LHCb?  
G. Wormser: maybe LHCb has some special internal rules, but it is preferable if the rules are consistent.  
RJC: for IN2P3 the difference would be around 10 kCHF in 2002; we are seeing one of the teething troubles of introducing the scheme; a new list will be prepared for October and the easiest, though perhaps not the right, way would be to leave the 2002 numbers as they are and list them correctly for 2003 onwards when costs will be higher.  
T. Nakada: each collaborating institute gave us numbers and we didn't check each number.  
N. Harnew (GB): I know that the list has been made consistently within LHCb, so if France removes its engineers so will everyone else and the ratios may not change much; I had understood that ATLAS and LHCb counted physicists and engineers while CMS only counted physicists.  
RJC: ratios will change if some institutes have proportionally more engineers involved than others; each experiment has been allowed to reach an agreed internal consistency.  
A. Ferrer (SP): implementing the 'PhD equivalent' rule is not easy; I am happy if there is internal consistency but in LHCb all Spanish engineers have been counted, which is not correct; ATLAS also includes engineers but with a more restricted definition; the problem is the inconsistency between experiments; we can either try to give the experiments a better definition of 'PhD equivalent' or ask them to use a uniform definition; if this is not solved there will be problems in later years when the sums of money involved will be bigger.  
J. Engelen: the Netherlands list has similar problems, even non-University people appear on it; a unified approach would be helpful.  
RJC: we can ask the Resource Co-ordinators, especially for ATLAS and LHCb, to inspect their categorisations and to then try to bring LHCb more into line with ATLAS and CMS, without insisting on exact definitions; practices vary from country to country.

- R. Wade: could the Scrutiny Group examine the lists? There could be long discussions in future if lists change dramatically as the consequences on M&O bills are calculated.
- RJC: having the lists scrutinised doesn't seem like a good idea; as already noted, if everyone cuts back their lists, it will make no overall difference.
- R. Wade: if number-changing is to create a second-order effect, it is imperative that all Institutes carefully examine their numbers.
- RJC: if the Collaboration is dealing with all Institutes in the same way, changing the way will not change the relative numbers, with possibly one or two exceptions.
- J. Królikowski (PL): we need consistency between experiments; the FAs will make comparisons; I cannot defend the LHCb number of 21 for Poland.
- RJC: be careful; the experiments are different, involvement levels are also different and may be visible in these lists; we have shown that M&O as a fraction of capital investment is about the same as at LEP; M&O per physicist will change if the number of physicists is changed.
- G. Wormser:  
D, Schinzel: is the total of 371 kCHF the final scrutinised number?  
yes; the number for September 2001 given in my presentation had already been reduced by the October RRB..
- A. Smith: power discounts must also be applied before invoices are sent out.

The RRB **asked the LHCb Resource Co-ordinator** to contact his counterparts, especially in ATLAS, and come to the **October RRB** with the **'PhD or equivalent' problem solved**. It was agreed that as the lists are homogeneous within LHCb and **2002 numbers** are not very large, they **will not be changed**. The RRB **accepted the M&O Category A costs for 2002** as presented and agreed that the **remaining 70% invoices can be issued**.

For 2003, the preliminary estimate of the total Category A budget is 620 kCHF, 40 kCHF less than the last numbers reported by the Scrutiny Group, with power costs estimated at 170 kCHF. Smith presented the sharing of the contributions among FAs using the same numbers for PhD equivalents as for 2002. The costs will be further scrutinised, sharing lists will be revised and power discounts will be included before the numbers are presented for approval in October. The RRB **took note** of this information.

Cashmore reminded the RRB that, according to the MoU, Scrutiny Group members serve for 2 years; half of them are replaced each year, and its composition is agreed each April. He asked RRB delegates to provide him with **names of candidates for the 2003 Scrutiny Group before the October meetings**. After further discussions, 50% of the present group can then be renewed next April. This was accepted.

- **Memorandum of Understanding**                      *A. Smith*  
*Paper CERN-RRB-2002-032*

All 4 MoUs have a common body text, 7 common Annexes and 9 collaboration-specific Annexes. LHCb-specific Annexes containing updated versions of data given in the Construction MoU are:

- 1 : Institutes in LHCb and Names of their Representatives to the Funding Agencies
- 2 : List of Funding Agencies and their Representatives
- 4 : Sub-system Structure of the LHCb Detector
- 5.1 : Organisational Structure of LHCb
- 5.2 : Management and other senior positions within LHCb and the people currently holding them
- 6 : Overview of the Technical Participation of Institutes in Detector Construction

New Annexes are:

- 7 : Common Items for M&O Costs
- 8 : Sub-detector systems : CORE values of deliverables (slightly adapted Construction MoU values)
- 10 : Category B headings
- 13 : Participants in the LHCb Collaboration by Country and Institute.

E. Popa (RO) had not received a copy of the MoU; Smith will give him one. Note that the text is available at <http://web.cern.ch/Committees/LHCRRB/LHCb/>

The RRB **accepted the M&O MoU for circulation for signature** after final **updates and error corrections** in the LHCb-specific Annexes; these should be sent to A. Smith by **May 10th 2002**. Cashmore thanked the RRB for taking this important step for LHCb.

**8. & 9. Summary, future activities, date of next meeting & A.O.B.**

*R. Cashmore*

LHCb is making good progress and will be helped by the agreed circulation of the M&O MoU.

Cashmore announced that this will be the last RRB meeting for Hans-Jürgen Hilke, who has been Technical Co-ordinator, Resource Co-ordinator, Team Leader, GLIMOS ... for LHCb. He hands resource co-ordination to Alasdair Smith, technical co-ordination to Werner Witzeling and team leadership to John Harvey. Cashmore thanked Hans-Jürgen for his valuable contribution to getting LHCb into its present healthy and lively state. Delegates expressed their appreciation by a round of applause.

Next meetings: October 21st - 23rd, with LHCb on the morning of Wednesday 23rd.