



C M S

Minutes of the 14th RESOURCES REVIEW BOARD Meeting

(Held at CERN on 22nd April 2002)

Present:

Europe:

J. Lemonne (FWO, Brussels), J. Sacton (FNRS, Brussels);
D. O. Riska (Helsinki Institute of Physics, Helsinki), J. Tuominiemi;
M. Spiro, (CEA-Saclay, Gif-sur-Yvette), M. Debu, J. Rander;
G. Wormser (IN2P3, Paris), B. Ille;
J. Richter, A. Lindner (BMBF, Bonn), K. Ehret, T. Müller (Universität Karlsruhe);
G. Vesztergombi (KFKI-RMKI, Budapest);
F. Cervelli (INFN, Roma), U. Dosselli, G. Tonelli;
J. Królikowski (State Committee for Scientific Research, Warsaw);
G. Barreira (ICCTI, Lisboa);
F.E. Grishaev, V.I. Savrin (Ministry of Science and Technology, Moscow);
P. Adzic (Ministry of Science, Technologies and Development, Belgrade);
A. N. Sissakian (Dubna), I. A. Goloutvin;
A. Ferrer (CICYT, Madrid), M Cerrada;
Q. Ingram (PSI, Villigen) ; A. Fritschi, C. Adusumalli (ETHZ), F. Pauss;
R. Wade (PPARC, Swindon), R.M. Brown.

N.America:

J. Lightbody, J. Whitmore (NSF);
J. Yeck (DOE), D. Green.

Asia:

Yongtao Zhang (National Natural Science Foundation of China, Beijing),
Ynglan Zhang, P. Ji, M. Pu;
S. Bhave (Department of Atomic Energy, Mumbai), S. N. Ganguli;
R. Mansouri (Ministry of Science, Research and Technology, Tehran).

CERN:

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

CMS:

M. Della Negra, A. Ball, L. Foà, A. Hervé, A. Petrilli, T. Virdee.

Apologies:

Bundesministerium für Bildung, Wissenschaft und Kultur, Wien;
Ministry of Science and Technology, Zagreb

14th Meeting of the CMS Resource Review Board RRB, 22nd April 2002

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

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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, particularly the new members from Iran and Serbia. He introduced another new participant, Karl-Heinz Kissler, the CERN Programme Controller, who will attend the RRBs of all 4 experiments from now on. Cashmore ended his introduction by mentioning Maintenance & Operation and Costs to Completion as especially important agenda items for the present meeting.

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

5. Financial matters

CERN Finance Division Leader A.J. Naudi

This item was taken out of sequence.

• Common Fund Account

Paper CERN-RRB-2002-005

Updating the distributed document, Naudi reported that additional expenditure had amounted to 204 kCHF. Additional contributions, mostly for 2002, had been received (kCHF):

Belgium, UCL	70
Greece, Athens (for 2001)	42
Finland	134
United Kingdom	359
India	75
Turkey	30
Austria	100
Σ	<i>810</i>

Naudi noted that Poland is the only MS with an outstanding contribution up to 2001, of 280 KCHF. Given that there are some 10 MCHF of outstanding commitments to be paid during 2002 –2004, he urged Poland to pay as soon as possible

• **Market Surveys & Invitations to Tender** *CERN-RRB-2002-006*

Updating the distributed document, Naudi reported:

IT 2434/EP Order placed 8 April 2002
IT 2686/EP 2 offers from France and 2 from Italy; under evaluation, adjudication value 692,400 CHF
IT 2690/EP contract under internal circulation for ~ 4.2 MCHF
IT 2691A/EP Sumitomo contract signed for 1.13 MCHF (well below initial price of 1.77 M)
IT 2810A/EP NGK Insulators Ltd (JP) chosen; contract being prepared for 2.5 MCHF

3. Status of the experiment *Spokesperson M. Della Negra*
Paper CERN-RRB-2002-016 *Presentation CERN-RRB-2002-048*

• *Collaboration*

CMS currently numbers 1855 scientists from 145 laboratories in 33 countries. plus 59 scientists from 8 Associated Institutes. Since the last RRB, Serbia has joined with 10 physicists from the VINCA Institute of Nuclear Sciences and the University of Belgrade Physics Faculty; their physics interest is the ECAL pre-shower counter. As part of the Co-operation Agreement signed with CERN last July, Serbia will supply CMS magnet corner pieces as an in-kind contribution of 400 kCHF. There are two new Italian INFN groups, from Milan Bicocca University (interested in ECAL cooling with Rome) and Naples University (RPCs with Bari and Pavia). New Zealand will apply to join in June 2002 (groups from Auckland and Canterbury interested in pixels and the on-line farm) and discussions are underway with Brazil, Ireland, Mexico, Thailand and the US Heavy Ion community. New Associate Institutes are RIE, St Petersburg (ECAL endcap vacuum phototriodes) and the Pakistani National University of Science and Technology (core software). In March, Myasishev Design, Moscow (ECAL endcap alveolar structures) applied for Associate Institute status.

Changes in the Management Board and Steering Committee are A. Petrilli as Resources Manager, P. Sharp as Electronics System Co-ordinator, Ph. Bloch as ECAL Project Manager, deputy J. Rander, D. Stickland as the Computing Core Software Project Manager, T. Muller as Conference Committee Chairman and Q. Ingram as secretary to the MB and the CB. A new Manufacturing Progress review has been introduced in conjunction with a Cost to Completion Review to be held for each sub-detector just after the start (~10%) and near to the end (~70%) of mass assembly.

• *Civil engineering*

Problems with the caverns now seem to be over. The concrete pillar separating the two caverns is 100% complete; the experimental cavern is > 50% complete, excavation having reached 8 metres below the LEP tunnel level; the service cavern is also > 50% finished and will be ready in March 2004.

• *Magnet*

The 5-disk barrel yoke is finished and both 3-disk endcap yokes are ready. Assembly of the swivelling platform is complete and it will be tested using a counterweight to simulate cantilevering 250 T of cold mass. Assembly of the conductor is now going very well; 8 (out of 21) 2.65-kilometre lengths have been successfully produced with 19 expected to be finished by end 2002. Work has started on the 1/4-size coil-winding prototype. The full-size coil is made of 5 submodules and a supply problem for special high strength alloy elements for the mandrels, plates and flanges has delayed construction by 6 months. However one mandrel is now built, and the first coil will be completed end 2002, the last by end 2003.

- *Inner Tracker*

50% of the Si Strip Tracker budget is committed. Milestone 200 modules have been produced in all regional centres. Hybrid optimization for a safer design and better cost containment has shifted the start of final module production from June 2002 to November 2002. Rods, parts of the tracker mechanics, are being equipped and tested while every attempt is being made to reduce the material budget of these support structures. Procurement of opto-electronics for the optical links is well advanced and all pre-final components in a full link have been tested.

The pixel detector is not on the critical path. The final DMILL chip was submitted in December 2001 and is now being translated into $1/4\mu\text{m}$ CMOS technology. To minimise risks, the detector will be inserted into CMS at the last moment when the beam is stable; this procedure is being studied in a full-scale mock-up. A full-scale exercise of cabling is also underway.

- *ECAL*

The goal is to have the ECAL complete and commissioned by April 2007 and planning is essentially driven by the electronics. Crystals are no longer on the critical path as all 138 ovens at BTCP, Russia, have been modified to grow large *boules* each yielding 2 crystals. The barrel crystal contract has been placed while offers for endcap crystals await clarification of CMS's financial situation.

The expected rate of 5000 Avalanche PhotoDiodes/month has been reached and 25,000 out of 130,000 have been delivered. The first 1,100 production Vacuum Phototriodes have also been delivered.

Mechanical assembly of the first super-module has started in CERN and Rome. Endcap 5x5 'super-crystal' matrices connected to VPT photodetectors are being produced in Russia.

ECAL electronics are on the critical path. In 2001, CMS and LHCC Reviews revealed major cost overruns. Doubling the speed of optical links thereby halving the cost was an insufficient remedy. In March 2002 it was decided to alter the architecture to generate the L1 trigger primitive on-detector reducing links and off-detector electronics by factor of ~ 10 but introducing a schedule delay. In addition, the FPPA had a noise problem and it is now hoped to go for final submission in May 2002. Because of these re-designs, the electronics team has been completely reorganised to create synergy between ECAL, Tracker and Preshower groups. To meet the target completion date of April 2007, construction of bare super-modules will start in 2002 with integration of electronics following a tight schedule later, in a separate chain.

- *HCAL*

The HCAL is well on schedule. Despite earlier worries, 9 out of 36 HF wedges are now delivered to CERN. Construction of the calorimeter is almost finished, integration of the electronics is underway, and testing and commissioning are starting.

- *Muon system*

Mass production of 250 barrel Drift Tube chambers at 4 different sites (RWTH-Aachen, CIEMAT-Spain and INFN Legnaro and Torino) has posed problems and must be watched closely. The technology for producing plate electrodes has been transferred from Torino to Dubna and for producing I-beam electrodes from Bologna to Protvino. Both Russian laboratories are now producing electrodes at nominal speed allowing assembly to proceed as planned at the 4 sites. Electronics inside the gas volume are on schedule. The next milestone is to finish 70 chambers by end 2002 and all 250 chambers by mid-2005.

Work on the 540 endcap Cathode Strip Chambers, also at 4 sites, is more advanced. Using identical tooling FNAL has assembled 76 out of 148 chambers, St. Petersburg 15 out of 114, Beijing 7 out of 148, while Dubna has assembled 18 out of 72 of the special ME1/1 chambers using different tooling. Final Assembly and System Testing FAST sites at the University of Florida and UCLA are in production. A prototype CSC has been installed on the endcap disk at CERN; full area coverage with final chambers will start early in 2003.

- *Data Acquisition*

A new modular design of the Event Builder will be described in the DAQ TDR to be submitted end - 2002. The EVB is now broken into functionally identical, parallel sub-systems each based on a 64x64 switch. The DAQ is sliced into 8 sub-systems that can be progressively added during commissioning. A demonstrator slice, using a 32x32 switch, has shown the feasibility of the 64x64 architecture. Planning foresees the full DAQ system installed in 2007/2008 to optimise cost/performance.

- *High Level Trigger*

The CMS level 1 trigger (now in construction) is followed by a High Level Trigger that must reduce the rate by a factor of 1,000 to reach the maximum recording rate of 100 events/second. The HLT will run in a processor farm and studies are underway using immense amounts of simulated data to measure the speed of the physics algorithms. Detailed analysis shows 400ms/event are needed on a Pentium III/700MHz processor. Extrapolating expected performance improvements ~ 2,500 CPUs will be needed at start-up in 2007 to reduce an expected Level 1 output rate of 50kHz to 80Hz for recording. This means that discovery physics is safe whereas Standard Module physics will be driven by the availability of resources for off-line reconstruction.

- *Schedule*

A new V33 draft schedule takes into account the revised LHC machine schedule. V33 will be presented to the LHCC in October and milestones will be rebaselined to it. It contains an extended surface phase that will allow more risks to be covered before equipment is placed underground. It also includes testing a full vertical slice of CMS with prototypes of the final DAQ in test beams above ground. There will be additional C&I costs, outlined later, but the extra work on the surface will cut the risk of having to solve problems after the detectors are installed underground.

Assuming that the costs-to-completion are covered, V33 aims at a complete CMS detector for low-luminosity start-up in 1 April 2007 (except for the forward pixels and ME4):

2004	July	UX and US area ready (+12 months, date now firm)
	Nov - 2005 April	Install floor plates and shielding in UX area
2005	Jan - April	Magnet test on surface (+9 months)
	May	Start lowering CMS
	July	ECAL Barrel (EB) ready for installation (+ 4 months)
	Nov	Start EB installation + cabling (3 months float)
	Oct	Tracker ready for installation
2006	Feb	Start Tracker installation + cabling (3 months float)
	April - Sept	EE+ (ECAL endcap +ve z-side) calibration in SPS beam
	Nov	Start EE+ installation
2007	Jan	Start EE- installation
	April	CMS closed and ready

Discussion

D.O. Riska (FI):	what does low luminosity mean?
MDN:	2×10^{33} cm ⁻² s ⁻¹ , as advertised by the machine group
M. Cervelli (IT):	does the redesign of the ECAL electronics create temperature sensitivity problems?
MDN & R. Brown (CMS):	the performance is not modified; it is just a question of keeping the data on-detector until the trigger decision has been taken, as is done for the Tracker. In fact, power consumption is reduced by the re-design, alleviating this problem.
RJC:	it is the job of LHCC to ensure that such a re-design is technically sound.

4. Report from the LHCC *LHCC Scientific Secretary E Tsesmelis*
Paper CERN-RRB-2002-013

Since the last RRB the LHCC held CMS sessions in November 2001, January 2002 and March 2002.

The Committee notes that CMS is developing a financial plan for completion and, in line with the new LHC machine schedule, a schedule V33 and a financial plan for an initial detector to be ready by 1 April 2007. The LHCC judges CMS to be on schedule to meet this date, despite delays noted in some sub-systems. A Comprehensive Review will take place in October 2002.

- *Magnet*: the LHCC Magnet Advisory Group MAG notes good progress with the conductor, yoke assembly and auxiliary systems. However, there has been a 6-month delay in producing the mandrel for the winding prototype and the MAG considers that the new schedule to have all coil modules at CERN by end 2003 is challenging.
- *Tracker*: CMS has shown that the effects of highly ionising particles and pinholes in the connection between the AC-capacitors and sensors do not pose a problem. There is good progress towards the so-called Milestone-200 tests planned for 2002.
- *Electromagnetic CALorimeter*: the ECAL electronics and the consequent delays are of major concern. CMS is currently evaluating how to proceed and will report to the LHCC in May 2002.
- *Muon Spectrometer*: progress has been made on developing a production plan and schedule and on implementing a management structure for the RPCs. Nonetheless, there are still technical uncertainties as to whether to coat the end-cap RPCs with linseed oil. Concerns also exist over the production rate of the Drift Tube chambers.
- *Trigger*: the LHCC is reviewing CMS trigger rates and associated physics performance and comparing the outcome with corresponding studies in ATLAS.

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 (FR): how essential for CMS is a test beam in 2006? The External Review Committee may propose reducing test beam availability.
- RJC: comments of the ERC are of course welcomed by CERN Management, but at the moment it is judged that the only cut possible is the SPS in 2005 to provide the experiments with the facilities they need; clearly this will be continually evaluated.
- T. Virdee (CMS): we have a strong preference to fully map and calibrate one ECAL endcap 'dee' in 2006; we would have to study the impact of any change in test beam availability.
- E. Tsesmelis: SPS-to-LHC injection tests are foreseen during 2006 and so the SPS should be running then.

RJC: CMS has made excellent progress but the ECAL is clearly a critical item and several groups have already teamed-up rapidly and effectively to develop contingency plans. Crisis has been turned into virtue by rationalising the ECAL electronics and generating a sensible sequence for the latest possible date for endcap installation. The extra work on the surface will allow much more of the detector to be tested before installation and the 3-month contingency should be kept at this stage. Introducing 10% and 70% production level Reviews provides a further control of schedules and costs. However, testing and commissioning plans are very tight and any help the FAs can offer will be most welcome.

6. Budget matters

Resources Manager, A. Petrilli

• Expenditure for construction 1995-2001

Paper CERN-RRB-2002-009 Presentation CERN-RRB-2002-049

Petrilli presented the CMS construction costs up to end 2001. Expenditure is reported in current prices while original MoU cost estimates are in 1995 prices (2000 prices for the Tracker).

in MCHF	1995 – 2000		2001		1995 – 2001		1995 – 2001	
	Committed	Paid	Committed	Paid	Committed	Paid	Committed	Paid
Magnet CP	104.6	64.1	6.9	8.7	111.6	72.8	92%	60%
Offline CP	0.8	0.8	0.3	0.3	1.1	1.1	31%	31%
Subdetectors	74.5	62.5	55.6	36.2	130.1	98.7	39%	30%
Σ	179.9	127.4	62.8	45.3	242.8	172.7	53%	38%

In principle, a 'commitment' is the total amount for which a legally binding document has been signed. However, expenditures are reported by a large number of institutes with their own policy on commitments. For institutes that only report 'payments', these are shown as 'commitments', so the total level of commitments is likely to be higher.

Full details of Planned, Actual and Cost-to-Completion C-to-C profiles for 1995 – 2007 can be found in the documents presented. NB: the cumulated commitment for Bulgaria 1995 – 2001 is erroneously shown as 100% in the documents; it should be 38% i.e. 230 kCHF.

Cashmore commented that the plots clearly show CMS entering the end game. C-to-C is now a substantial part of the remaining funding needed and must have the urgent attention of the RRB to ensure that CMS stays on schedule.

7. Maintenance & Operation

• Scrutiny Group Report

Scrutiny Group Chair, D. Schinzel

Paper CERN-RRB-2002-036

Presentation CERN-RRB-2002-076

Cashmore introduced this item by thanking all of those who have worked hard since the last RRB to produce a clear vision 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 checked. They included administrative and secretarial assistance, support linked use of test (beam)s, workshops, storage areas, installations (cryogenics, vacuum), moving equipment, lifting gear, etc.

The Group made a preliminary report to the RRB in October 2001 (RRB-D-2001-8) having carefully scrutinised 8 major A cost items; it has now scrutinised all items. During this work, several items related to Commissioning & Integration rather than Maintenance & Operation were identified and their costs removed to give a much more realistic spending profile for M&O (see graphs in the presented documents).

In the past, M&O B cost estimates were left to the Collaborations and Institutes involved in particular sub-systems. However, LHC sub-systems have the size of former LEP experiments and therefore the Group was asked to have a close look at the B costs which, from past experience, should not exceed 5% of the CORE value per annum. To do this, sub-system oriented templates and estimate guidelines were developed to cover, for each sub-system, items such as mechanics, gas and cooling systems, electronics, spares, (some to be bought 'now' while the technologies are still available) and manpower. The Group discussed B cost estimates with experts from each sub-system and from CERN before accepting them as accurate and reasonable.

The C costs, paid by CERN, were judged to be incomplete. The Group unanimously considered that CERN's support for LHC experiments is substantially more than given by the existing template. If needed, CERN should provide a complete list with Cost Estimates.

The Group concluded that CMS M&O cost estimates for 2002 and 2003 are sound and ready for endorsement. Costs for 2004 - 2007 depend on LHC machine schedule and will therefore have to be revised to be in line with the new start-up date. M&O cost drivers are manpower and service contracts. For on-line computing, a common strategy is needed for charging for raw data storage and common guidelines are needed for equipment replacement cycles. There is a wide discrepancy between the experiments at present in projected on-line costs, however this has little impact in 2002 and 2003.

Discussion

- U. Dosselli (IT): are the profiles shown based on start-up in '06 or '07?
RJC: numbers were prepared for an '06 start-up however the '07 possibility was known before it was official in March and so some updating has been done but not all; this will not effect '02/'03 very much but profiles thereafter can be expected to change as they are refined.
- M. Spiro (FR): is it agreed that A-cost sharing is by PhDs and B-cost sharing by investment?
DS: that is nothing to do with the Scrutiny Group
RJC: in the past the RRBs have decided that A cost sharing shall be by author and, on the recommendation of the experiments, B by investment.
- MDN (CMS): CMS leaves B cost sharing to the institution board of each sub-detector group, but there is a hint of a 'common' part inside some sub-detectors for which sharing might be by PhDs. The final sharing will be reported to the RRB.
- RJC: that clarification is useful and in the spirit of B costs, namely to leave them to the experiments to find something that will work and learn as they go.

- DS: the B costs were examined at the request of the experiments since some sub-detectors are as large as a LEP experiment; ATLAS wanted a scrutiny, CMS and ALICE a review and LHCb wanted to treat their B costs internally.
- M. Spiro: is there double counting between some A costs and the common parts of the B costs?
- DS: sub-systems are so large that they may have a 'Common Fund' component, however, double counting was specifically excluded in the Scrutiny Group's B cost guidelines and it was checked; in addition, only true M&O costs were accepted; no C&I or upgrades.
- RJC: the job of the Scrutiny Group is to comment on the numbers; the Collaboration should discuss B cost sharing with the FAs involved in each sub-system and report to the RRB.
- G. Wormser: were spares not foreseen in the CORE costs, and why is 5% the magic level of replacement for all sub-systems when some will not be accessible regularly?
- DS: the guidelines are general and we trust the experts have made allowance for accessibility
- H. Foeth, we have made such allowance; only useable spares will be bought, tied to reality; some spares
- T. Virdee & will be bought for use during construction, e.g. in the Si tracker
- L. Foà (CMS):

- **Status of M&O Category A budget for 2002** *A. Petrilli*
Paper CERN-RRB-2002-037 Presentation CERN-RRB-2002-050

Petrilli updated the M&O A costs presented to the October 2001 RRB. Since then the Scrutiny Group has introduced a cost-neutral change of classification and there has been a decrease in expected 2002 expenditures. The total now stands at **1,001 kCHF** and cost sharing is based on a count of PhD collaborators as of December 14, 2001. A first installment of **415 kCHF** has been billed (30% of the unrevised expenditure, as agreed by the RRB last October) of which 209 kCHF had been paid at the time of the meeting. Petrilli thanked Italy for paying the full 100% amount for 2002.

Discussion

- D. O. Riska: earlier CMS M&O 2002 costs were shown as 730 kCHF; now they are 1,001 kCHF.
- AP: 730 kCHF was the 70% remaining to be invoiced.
- M. Spiro: what about rebates?
- RJC: instead of rebates, CERN will pay power costs, fully for MS countries and in part for non-MS countries that contributed to building the LHC machine, in the way defined in the M&O MoU. It should however be noted that CMS 2002 power bill is small, ~ 50 kCHF.
- S. Bhava (IN): is the rebate now on power only?
- RJC: the rebate concept is no longer retained in the current MoU; instead CERN will pick up energy costs, fully or partly, similar to the practice in the LEP era.
- J. Yeck (US_DOE): we recognise these M&O Category A costs as legitimate and will pay our invoices
- G. Vesztergombi (HU): owing to the upcoming change of government, no statement can be made for Hungary

The RRB then **agreed to the 2002 M&O Category A costs** as presented and to second instalment invoices being issued for a total of 586 kCHF.

- **Preliminary draft budget for M&O 2003** *A. Petrilli*
Paper CERN-RRB-2002-015 Presentation CERN-RRB-2002-051

Petrilli explained that the 2003 budget request is only for Category A M&O and that the 2002 - 2007 profiles for Category A and Category B included in the documents are for information only. 2003 Category A cost sharing is based on the PhDs list in the CMS M&O MoU, CERN-RRB-2002-033. The estimates, for a total of 2,106 kCHF, are very preliminary and unscrutinised. As detailed in the MoU, input from the Scrutiny Group will be included in the version presented for approval in October.

As mentioned earlier, the subdetector groups are responsible for organising M&O Category B expenses and collecting common funds if needed. The level and sharing of Category B costs will be presented to the RRB for information in October.

Discussion

- 1 the total presented here 2106 kCHF elsewhere it appears as 2006 kCHF.
AP: a request has been added for 1 FTE of secretarial help; this still has to be scrutinised.
G. Wormser: it would be useful to have power on a separate budget line.
RJC: is it already in CERN-RRB-2002-015 as point A 7.02 of Annex I.1
S.N. Ganguli (IN): normally M&O is paid in advance; so shouldn't the budget come next year?
RJC: yes; it should be approved in October 2002 with a first status report in April 2003.
R. Wade (GB): when does the cost sharing table get updated?
RJC: according to the MoU, author lists are updated in September and used to prepare cost divisions presented to the October RRBs for the following year.

The RRB **took note of the 2003 M&O Category A cost estimates** as presented and requested that they be scrutinised before presentation for approval in October.

Cashmore then reminded the RRB that, according to the MoU, Scrutiny Group members serve for 2 years, half of them being replaced each year, and its composition agreed each April. He proposed that the present launch group be retained for the remainder of the 2002 exercise and that RRB delegates 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 for M&O (CMS Annexes)** A. Petrilli
Paper CERN-RRB-2002-033 Presentation CERN-RRB-2002-074

CMS-specific Annexes give a snapshot of the collaboration at the end of 2001. They are based on Construction MoU Annexes with updates to the funding, financial and scientific participation. New Institutes that joined CMS before the end of 2001 have been added and those that had withdrawn have been removed. Annex 4 reflects the Tracker change of structure described in Amendment #1 to the Construction MoU.

As specified in the MoU, Annex 13, which lists CMS scientists holding a PhD or equivalent qualification, will be updated yearly and presented to the October RRB along with the Draft Budget for M&O for the following year. The present list is as of December 14, 2001.

Discussion

- RJC: work on the MoU has been going on for nearly 2 years and it is today's business to decide to circulate it for signature and for use as the basis for future operation of the experiment.
J. Sacton: concerning point 3.2, it is written "*pre-exploitation refers to the time ... to the time after they have been commissioned*". Does this mean there is no M&O before commissioning.
RJC & D. Jacobs (CERN): a distinction is intended between 'pre-exploitation' and 'exploitation'; in an earlier draft the onset of M&O appeared linked to the end of C&I; that has been removed and it is accepted that M&O begins now, steadily increasing until data-taking begins.
R. Wade: will these essentially bi-lateral agreements be identical for all partners?
RJC: yes, and we hope they will remain so; if there are any differences for newcomers they will be brought to the attention of the RRB.

The RRB **accepted the M&O MoU for circulation for signature** after any final updates and error corrections in the CMS-specific Annexes; these should be sent to A. Petrilli by **May 10th 2002**. Cashmore thanked everybody who had helped CMS reach this important point.

Discussion

- G. Wormser: if in-kind manpower is available for M&O it should be reported to the RRB.
RJC: it has always been recognised that some countries may have difficulty to pay the full M&O bill in cash, although the more cash the better to give maximum flexibility. In some circumstances in-kind manpower might be desirable but it should fit into a plan; that could be part of the 2003 budget presentation in October.
- MDN: CMS has received no in-kind manpower offers so far for 2002 or 2003.
L. Foà: this will be addressed during the next CMS week.
- V.I. Savrin (RU): this has been discussed in the Joint Working Group and we plan to pay cash for Category A M&O but in future may substitute some part by manpower; we will try to produce a plan.
- A.N. Sissakian (RU): it is better for Dubna to pay in manpower, but this must be discussed.
- G. Wormser: is all of this reporting etc. spelled out in the MoU?
RJC: yes.

8. Construction budget and C&I

- **Scrutiny Group Report** *D. Schinzel*
Paper CERN-RRB-2002-047 Presentation CERN-RRB-2002-077

The M&O scrutiny revealed the existence of uncovered C&I (Commissioning and Integration) costs. C&I is agreed to be (non-recurrent) work in assembly and test areas, away from the underground cavern, whereas M&O is (recurrent) work in assembly and active storage areas, or in or close to the cavern. C&I costs stood out clearly in the initial 'M&O' spending profiles of CMS and ATLAS.

Cashmore remarked that by October 2001, C&I had already been separated out from M&O and there was a potential overlap with CORE costs. After the October RRB, albeit belatedly, he had asked the CORE Group chair, W. Bartel, to join forces with Schinzel to form a small, joint C&I Scrutiny Group. Its members were:

From CORE: W. Bartel, P. Lazeyras, K. Potter
From the M&O SG: P. Giubellino, D. Plane, J. Yeck
with E.M. Rimmer (Secretary) and D. Schinzel (Chair)

They set out to scrutinize C&I cost levels and spending profile and to spot any accidental double counting. They recognised several valid reasons for additional C&I: initial underestimation of the complexity of LHC detectors, unforeseeable circumstances such as civil engineering delays, an increase in the service contracts needed and paid for by the Collaborations and justified changes in strategy for risk reduction or better maintainability.

The scrutinised CMS C&I spending profile is bell-shaped, peaking at 5 MCHF in 2003 and falling to zero in 2007. Costs are essentially linked to increased commissioning on the surface, improved detector installation and access facilities, and extra manpower for general services. The Group judged that both the cost levels and profile are justified and noted that the 2003 peak indicates urgency.

Discussion

- RJC: it was agreed last October that urgent C&I items could be covered using baseline construction budget funds provided that this was well documented and until C-to-C and C&I were examined together.
- M. Spiro: one reason given for additional C&I costs is the decrease in CERN's budget and manpower; this is also happening elsewhere, so maybe it cannot be taken for granted that crane drivers, etc., are paid for by the outside institutes.
- RJC: it is not taken for granted but we must find a way to assemble as many resources as possible; CMS has identified C-to-C and C&I items for which resources do not currently exist; e.g. CERN no longer has crane drivers; they have to be bought and CERN does not have the money to do

- G. Wormser: that except by moving it from somewhere else; this problem has to be faced by all of us together. what fraction C&I costs is manpower and what fraction can be provided by external institutes as they reach the end of their construction phase?
- DS & A. Hervé (CMS): 50% is manpower; using external manpower depends on finding the right people; e.g. institutes probably have surveyors, designers, expert cablers, etc., but crane drivers and heavy riggers are less obvious.
- RJC: CMS should interact with the institutes on this issue.
- G. Wormser: CMS should be encouraged to do this because it is a good way for some institutes to contribute.
- F. Cervelli (IT): the Scrutiny Group did an important job but INFN would like to look at the numbers carefully, including manpower estimates, before reaching any decision.
- RJC: that is fine but CMS must validate any manpower contributions and agree to their costing.

- **CMS Financial Plan**

Paper CERN-RRB-2002-010

M. Della Negra

Presentation CERN-RRB-2002-052

Della Negra pointed out that ~70% of available funds will have been committed by the end of 2002 and that additional funds must be committed soon to have an initial low luminosity CMS detector ready in 2007. This will be the complete detector minus the 4th endcap muon station (ME4) and the 3rd forward pixel disk, staging already foreseen in the Construction MoU. At the October 2001 RRB, a global shortfall of 67.9 MCHF for C-to-C + C&I was reported for the initial detector. Since then further savings/staging of ~5 MCHF has reduced this to 62.7 MCHF. If this amount is forthcoming, CMS will cap the shortfall at this level and build-to-budget.

The total cost estimate of the initial CMS detector – ~ 513 MCHF – has not changed since October 2001. The 2 MCHF shortfall in the HCAL has been removed by reducing the number of longitudinal samplings. HCAL costs and funding have been evaluated, in particular for in-kind contributions. Tracker funding by the Swiss Universities has increased by 0.5 MCHF. The shortfall in the muon system has been reduced by 3 MCHF by reducing the number of ME1/1 electronics channels and re-staging the ME4/1 electronics (in October ME4/1 electronics had been 'un-staged' compared with the Construction MoU).

The total cost for C&I is now 14.65 MCHF where, after scrutiny, 2.2 MCHF of extra work in SX5 has been shifted from sub-detector C-to-C to C&I. Of the 14.65 MCHF, 3.16 M are for additional commissioning on the surface, 3.84M for improved detector installation and access facilities and 7.65 M for general services, mainly manpower. Offers of manpower as in-kind contributions will have to be carefully assessed and might be over-subscribed.

CMS proposes to divide the shortfall into a common part of 21.3 MCHF (14.6 C&I, 3.5 magnet, 3.2 infrastructure), a 6% increase in investment, and a sub-systems part of 41.4 MCHF, an 11.3% increase. Switzerland is not being asked to contribute to these extra costs as it is providing an exceptional investment of 86.5 MCHF. All other funding agencies are asked to contribute at least 17.3% of their capital investment (as shown in Table 4 of CERN-RRB-2002-010). Preliminary indications are that many FAs are positive towards finding the extra funds.

CMS proposes that the common shortfall is shared by everyone and sub-system shortfalls, in the tracker (6.9 M), the ECAL (24 M) and the muon system (10.5 M), are to be targeted at those collaborators involved. The ECAL shortfall dominates and is made up of 19 M for the crystals (11 M because of \$-rate fluctuation and 8 M for extra infrastructure in Russia to grow big *boules*), plus a 5 M cost overrun in electronics. Large contributions are being asked from CERN –13.5 M, Italy – 12.9 M and the US – 15 M. In the past the good cost performance of the US groups has allowed the release of contingency funds for items that were not part of their MoU obligations (9.4 MCHF in the period 1998/2001). The extra US contribution currently proposed supposes a continued good performance in future and the consequent availability of contingency funds. Priorities for using these funds will be decided by the CMS Steering Committee with all the sub-detector Project Managers (indeed 2.8 MCHF

have already been committed in 2002 to procure ME1/ 1 electronics). In all cases, shortfalls have been reallocated, whenever possible, to contracts that can be placed as late as possible.

After the last RRB, the Director of Research requested CMS to prepare a plan in which 20 MCHF of the then shortfall (67.9 MCHF) is not covered on time but may become available later. 5 MCHF of savings/staging has already been achieved as reported above. A further 8 M could be 'saved' by starting with 50% of DAQ capacity plus 0.5 M from the associated reduction of the required SCX cooling and ventilation plant. A possible saving of ~5 M by standardising LV supplies across CMS is under technical evaluation and will be decided by June 2002. This would also decrease the M&O effort needed later and so is strongly favoured by CMS management. So a saving of ~ 18.5 MCHF could be achieved without affecting the performance of the initial detector. Additional funds from new collaborators and potential new collaborators amounting to 0.9 M have already been included in the Financial Plan.

To keep the initial detector on schedule, critical payments in 2002 amount to 3.9 MCHF for sub-detector items and 2.2 MCHF for C&I. These are essentially covered except for 0.4 M for neutron shielding for the ME chambers and 1.8 M of the C&I costs. CERN-CMS substitution funding can only provide up to 0.6 M leaving 1.6 M to be found within the collaboration. CERN helping with the cash flow but volunteers are needed to help with additional money.

Beyond the initial detector, ~ 19 M CHF are needed to upgrade CMS for high luminosity operation, essentially to install the 4th muon station, some extra neutron shielding and the 3rd forward pixel layer. The decision to build some of these items will only be taken after inspection of the first physics data and a plan to fund this upgrade will have to be worked out in due time.

Assuming a physics run in June 2007, ideally the spending profile for the years 2002 to 2010 is:

(MCHF)	2002	2003	2004	2005	2006	2007	2008	2009	2010	SUM	$\Sigma(02-07)$
Construction	90.00	81.10	65.00	12.00	6.00					254.10	254.10
Cost to Complete	3.90	6.72	17.15	11.90	5.93	0.50	2.00			48.10	46.10
C&I	2.24	4.98	3.75	2.34	1.35					14.65	14.65
M&O Cat A	1.00	2.01	3.30	5.35	7.30	9.20	14.20	14.20	14.20	70.76	28.16
M&O Cat B		1.63	3.72	4.88	6.95	8.00	8.00	8.00	8.00	49.17	25.17
Hi L Upgrades						10.00	8.00			18.00	10.00
TOTAL	97.14	96.43	92.92	36.47	27.53	27.70	32.20	22.20	22.20	454.78	378.18

On behalf of CMS, Della Negra expressed gratitude for the positive responses from many Funding Agencies concerning covering the CMS shortfall. He asked the FAs to commit to the additional funds and again stressed the need to find an extra 1.6 MCHF for 2002. Once CMS has clear indications of how much extra money will become available and when, the collaboration will prepare a final Financial Plan for the October 2002 RRB and work towards an amendment to the Construction MoU to take into account additional contributions.

Discussion

- G. Wormser: CMS has done a good job and they hope to find the missing money but perhaps we should determine what is the minimum amount guaranteed now and improve the situation later rather than hoping for the best and cutting back if necessary; this would ensure that money is spent only where it is needed and would be a more convincing plan to present outside the RRB.
- J. Sacton: there appear to be two types of staging: one is a confusing mixture of staging and savings, the other is clearly for the high luminosity upgrade.

- MDN: the first is what could be done if extra funds are 20 MCHF less than 67.9M; the second does not need to be discussed until later, around 2005.
- RJC: as already mentioned, many decisions concerning high luminosity running will only be taken after inspection of the first physics data; the staging/savings plan corresponds somewhat to what Wormser is proposing.
- MDN: if more staging is done by moving items into a high luminosity upgrade, then more will have to be done later; staging is not saving.
- G. Barreira (PT): we should congratulate CMS on having reduced the shortfall, however, when we try to help, e.g. to cover the 1.6 MCHF missing in 2002, we need to know how this cost is divided among the FAs? Elsewhere the FAs have been asked for 17.3% of their capital investment. After an earlier meeting, Portugal has had an estimate approved for its share of extra costs for 2002-2010 but now it is not clear what we must provide this year.
- RJC: there are two separate problems; one is how to finish CMS, the other is what to do this year. Let us take general comments and then come back to the sharing among FAs and what to do next.
- S. Bhawe (IN): it is accepted that everyone must contribute to the shortfall, but why 17.3% across the board – this would be difficult for India – why not proportional to capital investment, and why should countries contribute in areas in which they do not participate? (MDN later clarified that India, along with all collaborating countries, is indeed being asked for 17.3% of its capital investment).
- RJC: in the last RRB some ideas on how to proceed were taken as guidelines to promote discussions; the extra costs of CMS have been identified as ~ 63 MCHF and, as a guideline, they have been apportioned according to the original contributions to CMS of ~ 450 MCHF.
- MDN & L. Foà: the guidelines for cost sharing will of course be discussed which each FA; 17.3% is a fraction which, if contributed by every FA, would entirely cover the shortfall; it is 17.3% of the capital investment of each country not 17.3% of the shortfall and 1/3 of it is allocated to shortfalls in common items.
- S. Bhawe: can contributions be in-kind?
- RJC: yes, if appropriate, e.g. Iran is looking to provide shielding, but cash will always be needed.

Cashmore then presented a table showing the CMS guideline requests for extra funds from each country and some very preliminary indications received to date of the amounts that might be forthcoming. CERN will contribute 13.5 MCHF and several FAs feel that they may be able to find a substantial fraction or indeed all of the amounts requested.

[There then followed a very positive and helpful discussion during which several FAs presented the current status in their country and some 'commitments' were confirmed or modified. It is inappropriate to minute these comments in detail as discussions will continue between CMS and the FAs on a one-to-one basis, but the overall outcome was that at least ~ 50 MCHF of additional funds seemed likely to be found..]

At this stage, each FA had been able to get a feeling for what 'the others' were likely to do and Cashmore proposed that they should try to converge on guaranteed figures that could be turned into a realistic CMS plan by October. To do this CMS needs estimates of amounts and time profiles from the FAs so that any cash flow problems are clear, particularly if CERN help is sought to solve them.

Further discussion

- G. Wormser: can CMS not go faster than October towards a plan based on ~ 50 MCHF acquired?
- RJC: although we can be confident that at least 50 MCHF will be found, it is still worth taking time to see whether more can be made available.
- M. Spiro: supposing that in the end there is a '50 MCHF plan', it should be endorsed by the LHCC.
- RJC: of course, to be sure that it makes technical and scientific sense; in fact, it should be submitted to the Comprehensive LHCC Review of CMS in October.
- MDN: for clarification, we should set a deadline for written indications/commitments from each FA so that CMS can make a plan for October. Can we go line-by-line through the guideline requests asking each FA whether they can make a firm commitment here and now to get an idea of the minimum that will be available?

(Responses were positive and supportive but the line-by-line examination of the requests is not minuted in detail as several FAs reported that they were still negotiating at a national level and not all FAs were present.)

It was decided that discussions between CMS and the FAs should continue and that FAs will send **written indications of amounts and profiles for additional funds to CMS by end June.**

Cashmore then addressed the immediate problem of finding 1.6 MCHF urgently in 2002. Portugal and France/IN2P3 could transfer money rather soon and Cashmore will discuss this with them. Other FAs who can do the same or make firm commitments for later payments to keep CMS on schedule should contact Cashmore or Della Negra as soon as possible.

- **Preliminary draft budget for construction in 2003** *A. Petrilli*
Paper *CERN-RRB-008* *Presentation* *CERN-RRB-2002-053*

Petrilli presented the preliminary funding requirements for payments planned in 2003, pointing out that by then the magnet, all subdetectors and the DAQ system will be in construction. He emphasised that the figures are to provide input for further discussions with the Funding Agencies to prepare a draft 2003 budget for approval at the October RRB.

As presented, the 2003 budget differs from those of previous years in that it includes C&I and C-to-C as separate items. These will be absorbed in the overall construction once the Financial Plan is finalized. Planned payments amount to 95.3 MCHF with an expected income of 79 MCHF. Annex 11 of CERN-RRB-2002-008 summarizes the 2003 budget by Funding Agency and by subsystem. The CMS Common Fund is expected to have a positive balance at that time, whereas the tracker (-2.9 M), ECAL (-2.7 M), infrastructure (-1 M) are all at present underfunded while C&I (-5 M) and C-to-C (-6.7 M) are unfunded. Obviously, finalization of the Financial Plan will affect the eventual 2003 budget.

9. & 10. Summary, future activities, date of next meeting & A.O.B. *R. Cashmore*

Cashmore thanked the RRB for having taken the important step of agreeing on the M&O MoU and for examining the CMS financial plan in detail. Given the late hour and the pressing need to catch the busses to visit CMS (or ATLAS), he promised that a summary of decisions taken and other important points would be distributed to delegates quickly, prior to the detailed minutes.

A very important future activity is that discussions concerning additional funds should continue and FAs should send **written indications of amounts and profiles to CMS by end June.** CMS can then prepare a final revised Financial Plan based on realistic numbers for presentation at the October RRB.

Next meetings: October 21st - 23rd, with CMS on the afternoon of Tuesday 22nd.