

Preliminary Draft Budget for CMS Construction in the Year 2007

INTRODUCTION

This document summarizes the preliminary funding requirements for the payments that the CMS Collaboration plans to make in the year 2007 in order to follow the detector construction schedule.

The year 2007 will be the tenth year of construction, most of the sub-detectors will be finished.

This preliminary draft budget for the year 2007 is based on the overall planning as presented at this RRB.

The figures shown as "Estimate of Income and Payments expected in 2007" in the Summary Table (Annex 10) are still very tentative at the present stage, and many of them are not yet agreed by the appropriate CMS Funding Agencies. According to the established procedure, this document is meant to give timely information to the CMS Resources Review Board (RRB) and to provide input for further discussions with the CMS Funding Agencies to prepare the Draft 2007 Budget, which will be submitted for approval to the RRB in October 2006.

The financial commitments arising from contracts that are expected to be placed in the years 2006 and 2007 will depend, case by case, on contractual policy and the associated negotiations with the potential contractors. It is, therefore, too early to present reliable and precise estimates for all the commitments to be made by the end of the year 2007.

The financial commitments on the Common Funds will be normally limited to the cash balance of these Funds (unless Funding Agencies underwrite formal guarantees for future payments).

1. MAGNET

An overview of the preliminary 2007 budget requirements is shown in **Annex 1**.

Many construction funds have been authorized up to and including the year 2006. Due to some delay in the construction, part of the authorized funds need to be carried forward to the year 2007 for payment. No new funds are requested for 2007.

The Common Fund is expected to go into deficit during 2007 until the last expected contributions have been received.

Following the agreed policy of the CMS Collaboration concerning the ways of making contributions to the CMS Common Projects, the Preliminary Draft Budget for 2007 for the CMS Magnet is broken down by the three following categories:

- (a) procurements from the CMS Magnet Common Fund,
- (b) payments to contracts and
- (c) in-kind contributions.

1.1 Procurements from the CMS Magnet Common Fund

Items that are neither procured directly through CMS institutes, nor provided as in-kind contributions are procured through CERN and paid from the CMS Magnet Common Fund.

No new commitments are foreseen for the year 2007.

To close the existing procurements, the largest payments from the CMS Magnet Common Fund will be for the:

- final payment related to the rental of the 2000 ton crane, including the insurance;
- reinstallation of cryogenics in USC;
- studies and supervision for final commissioning in UXC.

1.2 Payments to Contracts

Many large procurements for the CMS magnet were organized through institutes of the CMS Collaboration. The largest payments to contracts will be the final payment related to the DWE contract for the welding of the vacuum tank and moving system for the heavy pieces in UXC5. There are no new commitments for 2007.

1.3 In-kind Contributions

All approved in-kind contributions have been delivered to CERN and have been reported to the RRB in previous years.

2. TRACKER

An overview of the preliminary 2007 budget requirements is shown in **Annex 2**.

The Tracker 2007 CORE budget is dominated by, on the one hand, the costs for installation at Point 5 and, on the other hand, by Cost to Completion contributions, covering procurements largely completed in 2006.

3. ELECTROMAGNETIC CALORIMETER

An overview of the preliminary 2007 budget requirements is shown in **Annex 3**.

In BTCP, the Barrel crystals production should end in February 2007, which will then switch its whole capacity to the Endcaps crystals production. In parallel, other Endcaps crystals will be produced in SIC during 2007. Present plans foresee 1550 barrel and 12325 Endcaps crystals being produced in 2007. Expenditures for crystals, their characterization and activities in Regional Centers correspond to about 80% of the total expenditure, which will occur in the year 2007.

About 9% of the total ECAL payments expected to be due in 2007 will be for electronic modules, mostly for Off-detector Readout modules and for low voltage power supplies.

Assembly and installation, mainly for the Endcaps, should represent 6% of the payments.

For about 18% of the 2007 payments, the Funding Agencies, which will cover the corresponding expenses are yet (mid March 2006) to be determined.

In 2008 there will be still significant payments, mainly for the remaining Endcaps crystals, and for the assembly and the installation of the Endcaps.

4. HADRON CALORIMETER

There is no preliminary 2007 budget request.

The tasks for HCAL in 2007 involve the remaining installation and cabling activities. Some payments might still take place in 2007.

5. MUON DETECTOR

An overview of the preliminary 2007 budget requirements is shown in **Annex 5**.

5.1 Barrel Drift Tubes (DTs)

The installation and the commissioning of the chambers will be completed at the beginning of 2007. The budget request in 2007 covers the completion of the power supply system, balconies and gas analysis system.

5.2 Forward ME1/1

No budget request in 2007. The budget request in 2006 will complete the construction work.

5.3 Endcap Cathode Strip Chambers (CSCs)

No budget request in 2007. The budget request in 2006 will complete the construction work.

5.4 Barrel Resistive Plate Chambers (RPCs)

No budget request in 2007. The budget request in 2006 will complete the construction work.

5.5 Forward Resistive Plate Chambers (RPCs)

Purchases of final parts of detector components and monitoring will be made by Pakistan. Assembly and installation will be a significant part of the total expenditure. More precise numbers will be available for the October 2006 RRB.

5.6 Alignment

Concerning the barrel alignment (5.6.1), the 30 kCHF estimated for 2007 will be reserved for last minute expenses (tools, materials, informatic items).

As for the link alignment (5.6.3) the estimated total amount is 50 kCHF. As before, this amount is reserved for last remaining expenses.

6. TRIGGER AND DATA ACQUISITION

An overview of the preliminary 2007 budget requirements is shown in **Annex 6**.

6.1 Trigger

There is no trigger expenditure foreseen in 2007. The project should be concluded.

6.2 Data Acquisition

Purchase of components for the Event Filter will be pursued in 2007.

7. OFFLINE COMPUTING

An overview of the preliminary 2007 budget requirements is shown in **Annex 7**.

CERN acts as central point for the storage of information concerning the Collaboration and its computing. There is an on-going improvement programme on file- and information-servers to provide the necessary computing facilities, project management, consultancy and support. In order to sustain the prototyping work, which is in accordance with the CMS Computing Model and its associated milestones, it is necessary

to upgrade the existing equipment and purchase new systems. The software development team makes use of commercial software products, which allow the team to take advantage of modern techniques. Software licenses are purchased for the CMS-wide use and evaluation of software products.

8. INFRASTRUCTURE

An overview of the preliminary 2007 budget requirements is shown in **Annex 8**.

Many construction funds have been authorized up to and including the year 2006. Due to some delay in the construction, part of the authorized funds need to be carried forward to the year 2007 for payment.

Funds amounting to 1.5 MCHF have been requested in April 2005 RRB to cover the overcost of Rotating Shielding (0.75 MCHF) and Low Voltage system (0.75 MCHF). These funds are now needed in 2007 to cover infrastructure completion.

The largest payments foreseen are for completion of low voltage distribution system, commissioning of rack system and installation of control room at Point 5.

9. COMMISSIONING & INTEGRATION

An overview of the preliminary 2007 budget requirements is shown in **Annex 9**.

Additional funds are necessary to complete the installation of CMS in time. These funds, estimated to 1.3 MCHF, will be used to provide additional manpower and organize shift work particularly for cabling, duplicate installation tooling to speed installation, pay overtime and provide dummy patch panels to replace missing sub-detector elements, like ECAL supermodules and Tracker, to allow cabling to proceed in a timely fashion. In view of the schedule pressure, it is necessary to engage some of these expenses already in 2006 (around 180 kCHF).

The main expenses foreseen are for:

- overtime;
- duplication of installation tooling;
- tooling to ease beam pipe installation;
- dummy EB and Tracker patch panels;
- additional installation manpower and shift work.

10. SUMMARY

The numbers given in this document are summarized in **Annex 10**.

Annex 10 shows all funds needed by CMS during the year 2007 to follow the detector construction schedule.

It should be noted that the budget shows an overall deficit of some 5.8 MCHF. This is the effect almost exclusively of the difficulties detailed in the CMS Status Report (cf. CERN-RRB-2006-031).

The Magnet Common Fund foreseen deficit at the end of 2007 is not covered by the existing pledges and no more funds are expected.

It should also be noted that:

- (1) Many numbers shown as "Estimate of Income and Payments expected" have not yet been agreed with the respective Funding Agencies. At this stage they are just indicative and for discussions in view of the preparation of the "CMS Draft Budget for 2007" which will be presented at the October 2006 RRB.
- (2) The use of uncommitted funds, which may have been allocated by the Funding Agencies to their respective institutes in previous years for payments expected in 2006, is a matter of policy for the respective Funding Agencies and their associated institutes. Therefore they are not included in this document (except for the CMS Common Funds).

11. ANNEXES

Preliminary Budget Requirements for 2007

- | | |
|------------------|--|
| Annex 1: | Superconducting Magnet |
| Annex 2: | Tracker |
| Annex 3: | Electromagnetic Calorimeter |
| Annex 4: | Hadron Calorimeter |
| Annex 5: | Muon Detector |
| Annex 6: | Trigger and Data Acquisition |
| Annex 7: | Offline Computing |
| Annex 8: | Infrastructure |
| Annex 9: | Commissioning & Integration |
| Annex 10: | Summary of Income and Payments expected in the year 2007 |

ANNEX 1

SUPERCONDUCTING MAGNET

Payments expected in the Year 2007 (kCHF)

	<u>CE-Ref</u>	Payments expected in 2007
<u>Procurements from Common Fund</u>		
CF-01 He Refrigeration External Plant (Transfer)	1.3.15.B	500
CF-02 Studies and Supervision	1.3.19	270
CF-03 2'200 t Crane Rental	1.4.01	500
<u>Subtotal Procurements from Common Fund</u>		1,270
<u>Payments to Contracts</u>		
<u>Package A (Barrel Yoke and Vacuum Tank)</u>		
	<u>Subtotal</u>	<input type="text"/>
<u>Package B (Endcap Disks)</u>		
	<u>Subtotal</u>	<input type="text"/>
<u>Package C (Superconducting Cable)</u>		
	<u>Subtotal</u>	<input type="text"/>
<u>Package D (Coil Winding)</u>		
	<u>Subtotal</u>	<input type="text"/>
<u>Package F (Assembly of Barrel & Vacuum Tank on the Surface)</u>		
	<u>Subtotal</u>	<input type="text"/>
<u>Package H (Swiveling Platform)</u>		
	<u>Subtotal</u>	<input type="text"/>
<u>Subtotal Payments to Contracts</u>		<input type="text"/>
<u>In-kind Contributions</u>		
<u>Subtotal In-kind Contributions</u>		<input type="text"/>
<u>OVERALL TOTAL</u>		1,270

ANNEX 2

Payments expected in the Year 2007 (kCHF)

TRACKER

	<u>CE-Ref</u>	<u>Payments expected in 2007</u>
<u>Pixel Detectors</u>		
Detectors (incl. Pre-series)	<u>2.1</u> 2.1.01	10
Electronics (include. Engineering)	2.1.02	45
Module Mechanics	2.1.03	175
Support Structures & Assembly	2.1.04	50
Monitoring	2.1.05	30
Service Systems	2.1.06	261
	<u>Subtotal</u>	571
<u>Silicon Detectors</u>		
Procurement of Sensors	<u>2.2</u> 2.2.01	921
	<u>Subtotal</u>	921
<u>Electronics for Si Detectors</u>		
Module Electronics	<u>2.3</u> 2.3.01	25
FED	2.3.06	929
	<u>Subtotal</u>	954
<u>Power Supplies for Si Detectors</u>		
Cables (installed)	<u>2.4</u> 2.4.02	581
	<u>Subtotal</u>	581
<u>Mech. Struct. & Cooling for Si Detectors</u>		
General Cooling	<u>2.5</u> 2.5.07	488
Integration (st, ts,...)	2.5.08	230
	<u>Subtotal</u>	718
<u>Monitoring for Si Detectors</u>		
Temperature Control	<u>2.6</u> 2.6.03	100
	<u>Subtotal</u>	100
<u>Data Acquisition for Si Detectors</u>		
Test Stands	<u>2.7</u> 2.7.01	75
	<u>Subtotal</u>	75
<u>Installation of Si Detectors</u>		
Installation Manpower	<u>2.8</u> 2.8.01	252
	<u>Subtotal</u>	252
<u>OVERALL TOTAL</u>		4,172

ANNEX 3		
ELECTROMAGNETIC CALORIMETER		
Payments expected in the Year 2007 (kCHF)		
	<u>CE-Ref</u>	Payments expected in 2007
<u>Barrel</u>	<u>3.1</u>	
Crystals	3.1.1	3,046
Electronics	3.1.2	427
Assembly and Installation	3.1.4	400
	<u>Subtotal</u>	3,873
<u>Endcaps</u>	<u>3.2</u>	
Crystals	3.2.1	13,625
Electronics	3.2.2	1,401
Mechanics	3.2.3	225
Assembly and Installation	3.2.4	800
Monitoring	3.2.5	140
Preshower	3.2.6	580
	<u>Subtotal</u>	16,771
<u>OVERALL TOTAL</u>		20,644

<u>ANNEX 4</u>		
HADRON CALORIMETER		
Payments expected in the Year 2007 (kCHF)		
	<u>CE-Ref</u>	Payments expected in 2007
<u>Barrel</u>	<u>4.1</u>	<input type="text"/>
	Subtotal	<input type="text"/>
<u>Outer Barrel</u>	<u>4.2</u>	<input type="text"/>
	Subtotal	<input type="text"/>
<u>Endcap</u>	<u>4.3</u>	<input type="text"/>
	Subtotal	<input type="text"/>
<u>Outer Endcap</u>	<u>4.4</u>	<input type="text"/>
	Subtotal	<input type="text"/>
<u>Forward</u>	<u>4.5</u>	<input type="text"/>
	Subtotal	<input type="text"/>
<u>OVERALL TOTAL</u>		<input type="text"/>

ANNEX 5

MUON DETECTOR

Payments expected in the Year 2007 (kCHF)

	<u>CE-Ref</u>	Payments expected in 2007
<u>Barrel Drifttubes</u>	<u>5.1</u>	
Electronics	5.1.2	162
Service Systems	5.1.6	108
	<u>Subtotal</u>	270
<u>Forward ME 1/1</u>	<u>5.2</u>	
	<u>Subtotal</u>	
<u>Endcap CSC</u>	<u>5.3</u>	
	<u>Subtotal</u>	
<u>Barrel RPC</u>	<u>5.4</u>	
	<u>Subtotal</u>	
<u>Forward RPC</u>	<u>5.5</u>	
	<u>Subtotal</u>	
<u>Alignment</u>	<u>5.6</u>	
Barrel	5.6.1	30
Link	5.6.3	50
	<u>Subtotal</u>	80
<u>OVERALL TOTAL</u>		350

<u>ANNEX 6</u>		
TRIGGER/DATA ACQUISITION		
Payments expected in the Year 2007 (kCHF)		
<u>Trigger</u>	<u>CE-Ref</u>	Payments expected in 2007
	6.1	<input type="text"/>
	Subtotal	<input type="text"/>
<u>Data Acquisition</u>	<u>CE-Ref</u>	Payments expected in 2007
Event Filter	6.2	<input type="text"/>
DAQ Integration	6.2.1	3,340
	6.2.6	500
	Subtotal	3,840
<u>OVERALL TOTAL</u>		3,840

ANNEX 7	
OFFLINE COMPUTING	
Payments expected in the Year 2007 (kCHF)	
<u>Offline Computing</u>	<u>CE-Ref</u>
File Servers	7.1
Information Servers	7.1.1
System Assembly	7.1.2
Software Licenses	7.1.5
System Management	7.1.6
	7.1.7
OVERALL TOTAL	

Payments expected in 2007
40
30
40
10
110
230

ANNEX 8		
INFRASTRUCTURE		
Payments expected in the Year 2007 (kCHF)		
	<u>CE-Ref</u>	Payments expected in 2007
<u>Access and Survey</u>	<u>8.1</u>	<input type="text"/>
	Subtotal	<input type="text"/>
<u>General Installation</u>	<u>8.2</u>	
Counting Room Structures	8.2.1	250
Racks with Cooling	8.2.2	500
Electrical Distribution from Outlets	8.2.3	750
Cable Trays to Counting Rooms	8.2.7	300
	Subtotal	1,800
<u>Cooling & Ventilation</u>	<u>8.3</u>	
	Subtotal	<input type="text"/>
<u>Safety</u>	<u>8.4</u>	
	Subtotal	<input type="text"/>
<u>Fixed Cranes</u>	<u>8.5</u>	
	Subtotal	<input type="text"/>
<u>Shielding Systems</u>	<u>8.6</u>	
Rotating Shielding	8.6.1	750
Mechanics and Shielding for HF	8.6.3.A	80
	Subtotal	830
OVERALL TOTAL		2,630

ANNEX 9		
Commissioning and Integration		
Payments expected in the Year 2007 (kCHF)		
	<u>CE-Ref</u>	Payments expected in 2007
Additional facilities for commissioning on	<u>9.1</u>	[]
	Subtotal	[]
Detector installation, opening and access	<u>9.2</u>	
Installation and access tooling	9.2.1	250
Detector installation, opening and access facilities	9.2.02	180
Beam-pipe & vacuum tooling & pipe support structure	9.2.5	80
	Subtotal	510
General Services	<u>9.3</u>	
Extra engineering design for integr. of magnet&det.	9.3.5	330
CMS Technical support team	9.3.6	300
	Subtotal	630
 <u>OVERALL TOTAL</u>		 1,140

ANNEX 10

Income and Payments expected in the Year 2007

(This table concerns all payments needed to complete the CMS detector, including items funded by the Cost Increase as described in the CMS Status Report, cf. CERN-RRB-2006-031)

Funding Agencies	COMMON PROJECTS					SUB-DETECTORS					Infrastructure	Commissioning & Integration	TOTALS		
	Common Fund	Payments to Contracts	In-kind Contributions	Subtotals for Magnet	Offline Computing	Totals Common Projects	Tracker	Electromagnetic Calorimeter	Hadron Calorimeter	Muon Detector				Trigger and Data Acquisition	Totals Sub-detectors
	MAGNET				OFFL	Σ						Σ		Σ	
Austria							51					51			51
Belgium	37			37		37	73					73			110
Bulgaria															
CERN							1,456			1,000		2,456	2,630		5,086
China															
Croatia															
Cyprus								96				96			96
Estonia															
Finland	80			80		80	140 (1)					140			220
France - CEA								190		840		1,030			1,030
France - IN2P3							140	2,121				2,261			2,261
Germany							341		21			362			362
Greece								154				154			154
Hungary									30			30			30
India								206				206			206
Iran															
Ireland															
Italy							822	96		182		1,100			1,100
Korea															
Mexico															
New Zealand															
Pakistan [A]															
Poland															
Portugal								20				20			20
RDMS - Russia [A]								6,628				6,628			6,628
RDMS - DMS															
Serbia															
Spain										117		117			117
Switzerland - ETHZ					125	125		7,000		1,000		8,000			8,125
Switzerland - PSI							439			500		939			939
Switzerland - Universities															
Taipei								150				150			150
Turkey															
United Kingdom								344				344			344
USA - DOE							132			500		632			632
USA - NSF															
Funds expected to be carried forward from 2006	445			445	912	1,356								-564	792
Income expected in 2007 plus funds from 2006	560			560	1,037	1,598	3,594	17,005		350	3,840	24,789	2,630	-564	28,453
Planned payments	1,270			1,270	230	1,500	4,172	20,644		350	3,840	29,006	2,630	1,140	34,276
Funds expected to be carried forward to 2008	-710			-710	807	98	-578	-3,639				-4,217		-1,704	-5,823

[A] = Estimated 'Net Western Value.'

(1) An additional 300 kCHF will be available for the Cost Increase reported at the April 2005 RRB by 2010

Shaded fields indicate that no contribution is expected in 2007 for this sub-detector from that Funding Agency