

Draft Budget for CMS Construction in the Year 2007

INTRODUCTION

This document summarizes the 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 completed.

This draft budget for the year 2007 is based on the overall planning as presented at this RRB. The budget shows a deficit due to missing pledges for covering the cost increase presented to the RRB meeting of April 2005.

The figures shown as "Income and Payments expected in 2007" in the Summary Table (Annex 10) are to be considered as best estimates at the present stage.

The financial commitments arising from contracts that are expected to be placed in the year 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 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.

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. All such procurements will have been paid by the end of 2006.

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 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, as well as additional costs, related in particular to Cables and Power Supplies.

At present, there are 250 kCHF not covered for Cables in the 2007 Tracker Budget.

3. ELECTROMAGNETIC CALORIMETER

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

The Barrel crystals production should end in February 2007 in BTCP (Russia), which will then switch its whole capacity to the Endcaps crystals production. In SIC (China), the Endcaps crystals production, which begins in the autumn 2006 should continue during the whole year 2007. Expenditures for crystals, their characterization and activities in Regional Centers are about 80% of the total expenditures, which will occur in the year 2007.

A new order for the procurement of the last 5'500 endcap crystals is being negotiated. Payments would largely take place in 2008. Payments in 2007 are not included.

About 7% of the total ECAL payments expected to be paid in 2007 will be for electronic modules, mostly for Off-detector Readout modules.

The main other expenditures correspond to the Preshower (4%), Assembly and Installation, mostly for Electronics (4%) and Endcaps Mechanics (3%).

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 2007 budget request.

The tasks for HCAL in 2007 involve the remaining installation and cabling activities.

5. MUON DETECTOR

An overview of the 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)

The budget request in 2007 will complete the construction work in the Electronics and Services areas.

5.5 Forward Resistive Plate Chambers (RPCs)

All components will have been contracted by the end of 2006. Electronics and Assembly and installation makes up the total expenditure for 2007.

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, assembly).

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 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 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 2007 budget requirements is shown in **Annex 8**.

All construction funds have been committed 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 and Low Voltage distribution system. These funds have now been committed and will be needed in 2007 to cover infrastructure completion payments.

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 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 and pay overtime. In view of the schedule pressure, it was necessary to engage some of these funds already in 2006 (around 180 kCHF). This has been covered by USA-DoE as part of their Cost to Completion contribution.

The main expenses foreseen are for:

- overtime;
- duplication of installation tooling;
- tooling to ease beam pipe installation;
- 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 10.2 MCHF. This is the effect almost exclusively of the difficulties detailed in the CMS Financial Plan (cf. CERN-RRB-2006-105) in collecting all necessary pledges.

The deficit of the Magnet Common Fund at the end of 2007 is covered in the CMS Financial Plan (cf. CERN-RRB-2006-105).

It should also be noted that:

- (1) Many numbers shown as "Income and Payments expected" are current best estimates.
- (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 2007, 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

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	1,125
CF-02 Studies and Supervision	1.3.19	830
CF-03 2'200 t Crane Rental	1.4.01	1,120
<u>Subtotal Procurements from Common Fund</u>		3,075
<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>		3,075

ANNEX 2

TRACKER

Payments expected in the Year 2007 (kCHF)

	<u>CE-Ref</u>	<u>Payments expected in 2007</u>
<u>Pixel Detectors</u>	<u>2.1</u>	
Detectors (incl. Pre-series)	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>	<u>2.2</u>	
Procurement of Sensors	2.2.01	1,187
	<u>Subtotal</u>	1,187
<u>Electronics for Si Detectors</u>	<u>2.3</u>	
FED	2.3.06	498
	<u>Subtotal</u>	498
<u>Power Supplies for Si Detectors</u>	<u>2.4</u>	
Power Supplies	2.4.01	428
Cables (installed)	2.4.02	828
	<u>Subtotal</u>	1,256
<u>Mech. Struct. & Cooling for Si Detectors</u>	<u>2.5</u>	
General Cooling	2.5.07	340
Integration (st, ts,...)	2.5.08	170
	<u>Subtotal</u>	510
<u>Monitoring for Si Detectors</u>	<u>2.6</u>	
Temperature Control	2.6.03	100
	<u>Subtotal</u>	100
<u>Data Acquisition for Si Detectors</u>	<u>2.7</u>	
	<u>Subtotal</u>	
<u>Installation of Si Detectors</u>	<u>2.8</u>	
	<u>Subtotal</u>	
<u>OVERALL TOTAL</u>		4,122

ANNEX 3

ELECTROMAGNETIC CALORIMETER

Payments expected in the Year 2007 (kCHF)

	<u>CE-Ref</u>	<u>Payments expected in 2007</u>
<u>Barrel</u>	<u>3.1</u>	
Crystals	3.1.1	4,569
Assembly and Installation	3.1.4	400
	<u>Subtotal</u>	4,969
<u>Endcaps</u>	<u>3.2</u>	
Crystals	3.2.1	10,761
Electronics	3.2.2	1,347
Mechanics	3.2.3	626
Assembly and Installation	3.2.4	330
Monitoring	3.2.5	175
Preshower	3.2.6	760
	<u>Subtotal</u>	13,999
<u>OVERALL TOTAL</u>		18,968

ANNEX 4

HADRON CALORIMETER Payments expected in the Year 2007 (kCHF)

	<u>CE-Ref</u>	Payments expected in 2007
<u>Barrel</u>	<u>4.1</u>	
	Subtotal	<input type="text"/>
<u>Outer Barrel</u>	<u>4.2</u>	
	Subtotal	<input type="text"/>
<u>Endcap</u>	<u>4.3</u>	
	Subtotal	<input type="text"/>
<u>Outer Endcap</u>	<u>4.4</u>	
	Subtotal	<input type="text"/>
<u>Forward</u>	<u>4.5</u>	
	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	78
Service Systems	5.1.6	246
	<u>Subtotal</u>	324
<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>	
Electronics	5.4.2	125
Service Systems	5.4.6	92
	<u>Subtotal</u>	217
<u>Forward RPC</u>	<u>5.5</u>	
Electronics	5.5.2	300
Assembly and Installation	5.5.4	100
	<u>Subtotal</u>	400
<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>		1,021

ANNEX 6

TRIGGER/DATA ACQUISITION Payments expected in the Year 2007 (kCHF)

	<u>CE-Ref</u>	Payments expected in 2007
<u>Trigger</u>	<u>6.1</u>	<input type="text"/>
	Subtotal	<input type="text"/>
<u>Data Acquisition</u>	<u>6.2</u>	
Event Filter	6.2.1	<input type="text" value="7,090"/>
DAQ Integration	6.2.6	<input type="text" value="500"/>
	Subtotal	<input type="text" value="7,590"/>
OVERALL TOTAL		<input type="text" value="7,590"/>

ANNEX 7

OFFLINE COMPUTING

Payments expected in the Year 2007 (kCHF)

	<u>CE-Ref</u>	Payments expected in 2007
<u>Offline Computing</u>	<u>7.1</u>	
File Servers	7.1.1	40
Information Servers	7.1.2	30
System Assembly	7.1.5	40
Software Licenses	7.1.6	10
System Management	7.1.7	110
<u>OVERALL TOTAL</u>		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"/>
	<u>Subtotal</u>	<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
	<u>Subtotal</u>	1,800
<u>Cooling & Ventilation</u>	<u>8.3</u>	
	<u>Subtotal</u>	<input type="text"/>
<u>Safety</u>	<u>8.4</u>	
	<u>Subtotal</u>	<input type="text"/>
<u>Fixed Cranes</u>	<u>8.5</u>	
	<u>Subtotal</u>	<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
	<u>Subtotal</u>	830
<u>OVERALL TOTAL</u>		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>		 2,440

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 Financial Plan, cf. CERN-RRB-2006-105)

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
	MAGNET			OFFL	Σ						Σ		Σ	
Austria	0 (1)		0		0	204 (1)					204			204
Belgium	37		37		37	17					17			54
Bulgaria														
CERN						635				1,000	1,635	2,630		4,265
China														
Croatia														
Cyprus							96				96			96
Estonia														
Finland	290 (1)		290		290	340 (1)					340			630
France - CEA							190			840	1,030			1,030
France - IN2P3						341	2,121				2,462			2,462
Germany														
Greece							238			2,060	2,298			2,298
Hungary									30	90	120			120
India							206				206			206
Iran														
Ireland														
Italy						1,614	50		457		2,121			2,121
Korea										500	500			500
Mexico														
New Zealand														
Pakistan [A]									400		400			400
Poland														
Portugal							111			100	211			211
RDMS - Russia [A]							1,671				1,671			1,671
RDMS - DMS														
Serbia														
Spain									134		134			134
Switzerland - ETHZ				125	125		7,000			2,000	9,000			9,125
Switzerland - PSI						439				500	939			939
Switzerland - Universities						150					150			150
Taipei							150				150			150
Turkey														
United Kingdom							1,016				1,016			1,016
USA - DOE						132				500	632	1,300		1,932
USA - NSF														
Funds expected to be carried forward from 2006	405 (2)		405	332 (2)	736								-564	172
Income expected in 2007 plus funds from 2006	730		730	457	1,188	3,872	12,849		1,021	7,590	25,332	2,630	736	29,886
Planned payments	3,075		3,075	230	3,305	4,122	18,968		1,021	7,590	31,701	2,630	2,440	40,076
Funds expected to be carried forward to 2008	-2,345		-2,345	227	-2,117	-250	-6,119				-6,369		-1,704	-10,190

[A] = Estimated 'Net Western Value.'

- (1) Including cashflow help from CERN for funds available 2008-2010
- (2) Including provision for the Forward RPC loan (cf. CMS RRB-MI 2001-12)

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