CMS Project Status and Issues

- **Magnet**
- **Schedule/Milestones**
- **Funding Risks**
- **Contingency Plans**
- **Tracker Issues**
- **Software/Computing Issues**

DOE/NSF Review
FNAL
19 August 1999

M. Della Negra
CMS Spokesperson

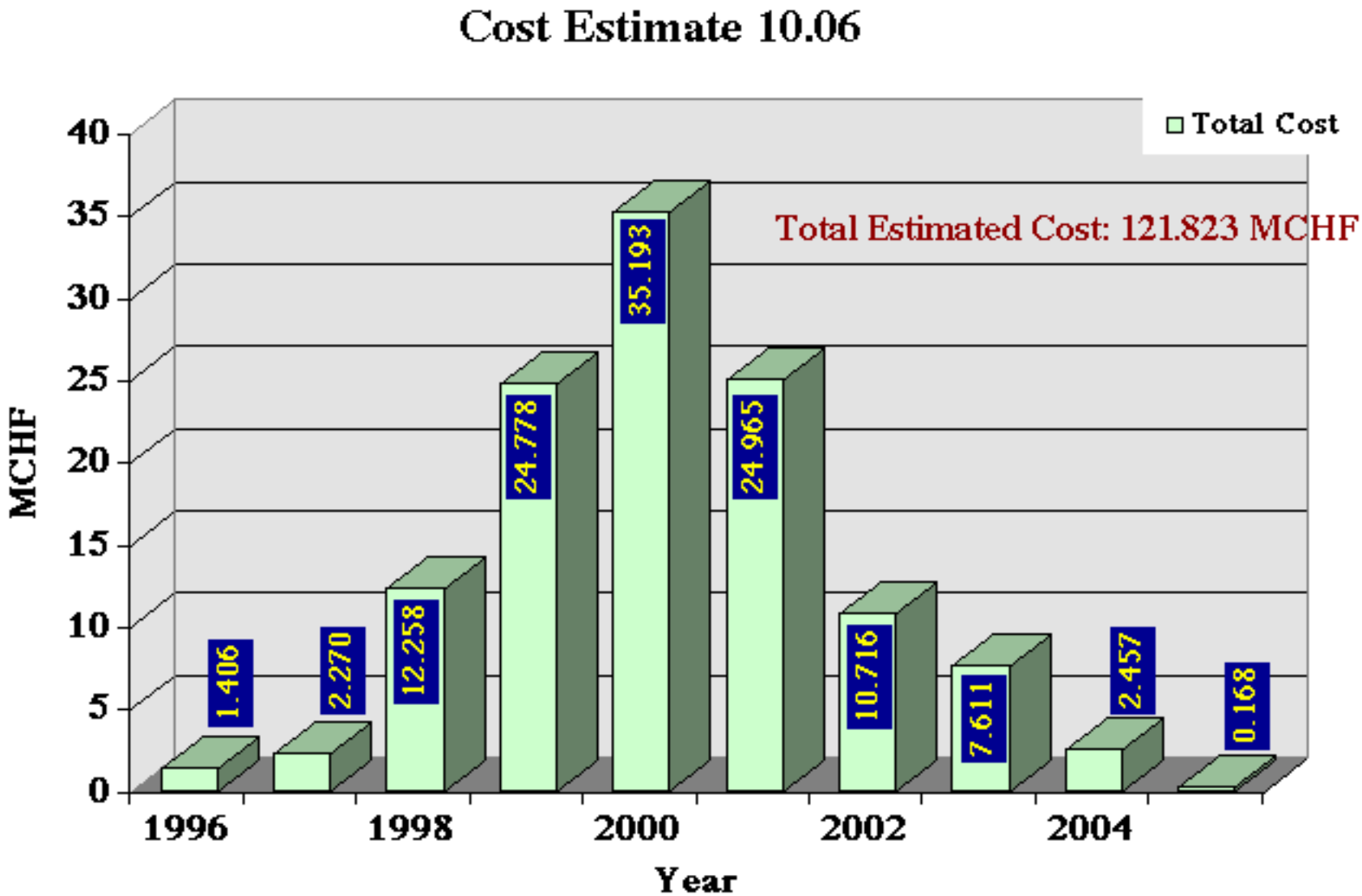
Magnet Cost

	Cost V9 (MCHF)	Cost V10 (MCHF)	Committed (MCHF)	Not Comm. (MCHF)
Barrel/Vac. Tank	31.2	31.4	27.0	4.4
End-Caps	21.2	15.9	10.4	5.5
Coil	64.7	68.2	31.5	36.7
Installation	4.8	6.3	0.0	6.3
TOTAL	**121.9**	**121.8**	**68.9**	**52.9**

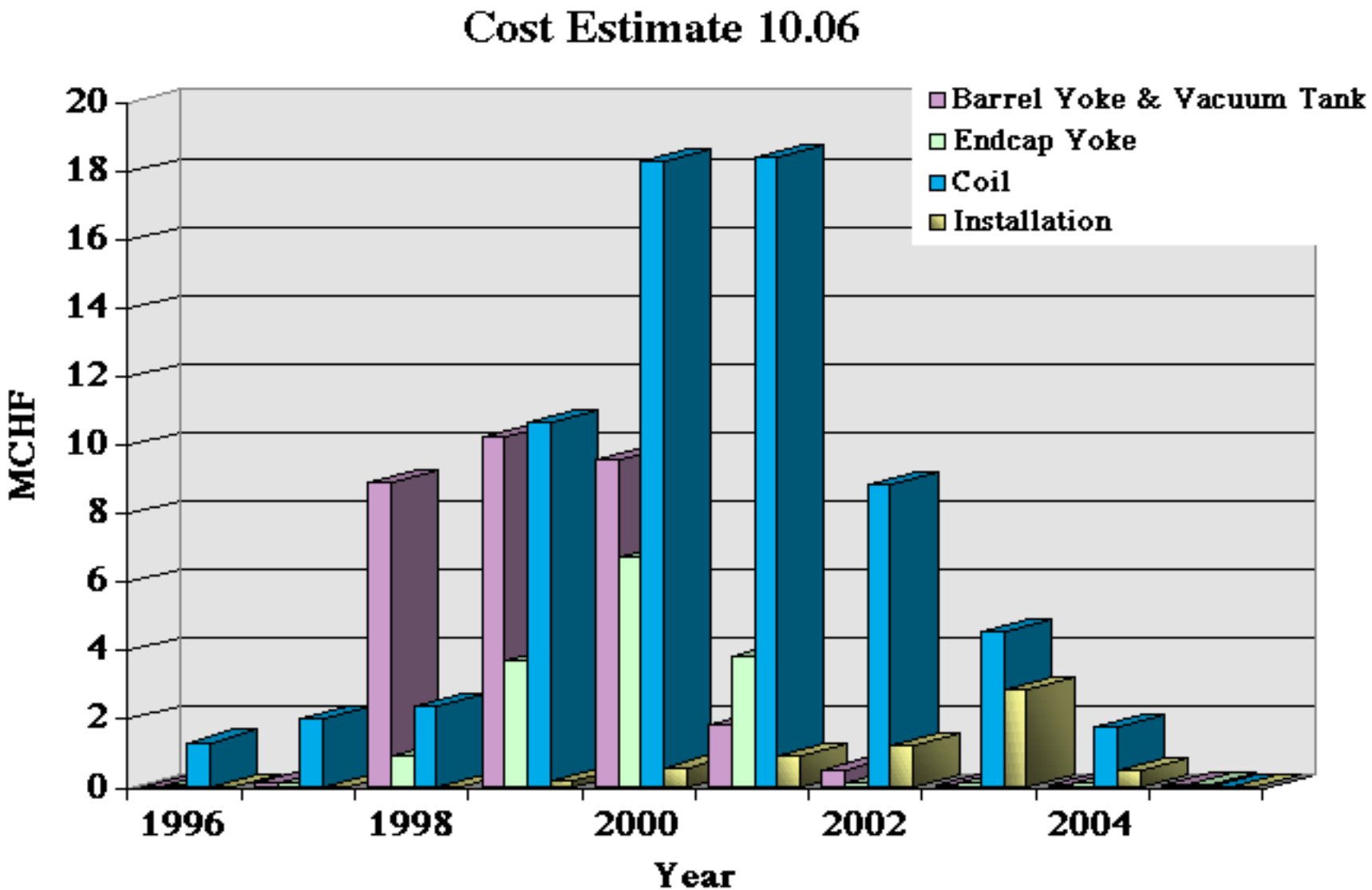
The tender for the winding of the coil (15 MCHF) has been launched in May by INFN. Answers are expected by 10th September. This is a strategic contract as the winding operation is on the critical path.

The magnet project is on budget and on schedule. However the situation will be really understood only after the contract for the winding has been awarded (70% of total magnet cost committed).

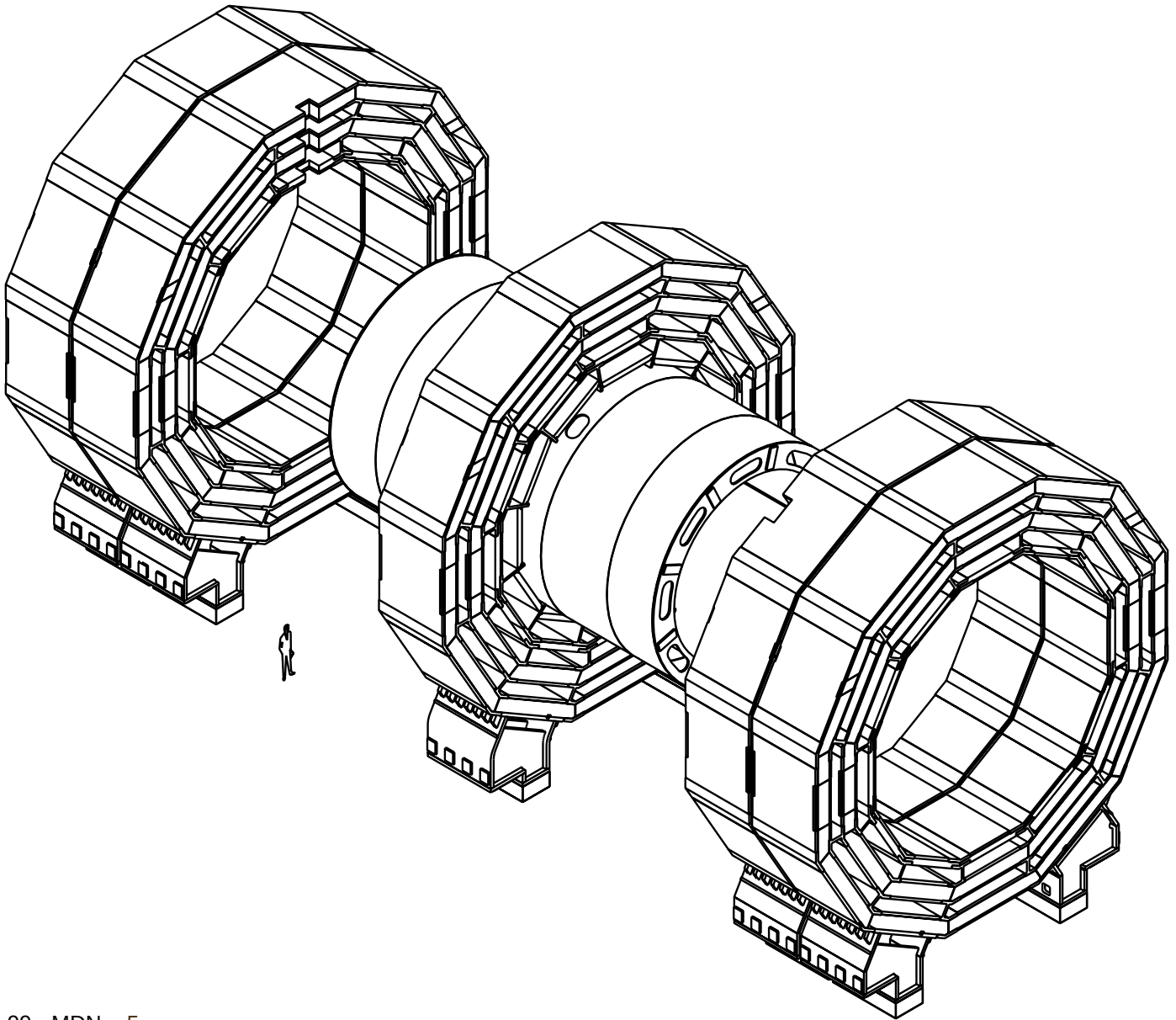
Magnet Payment Profile (1)



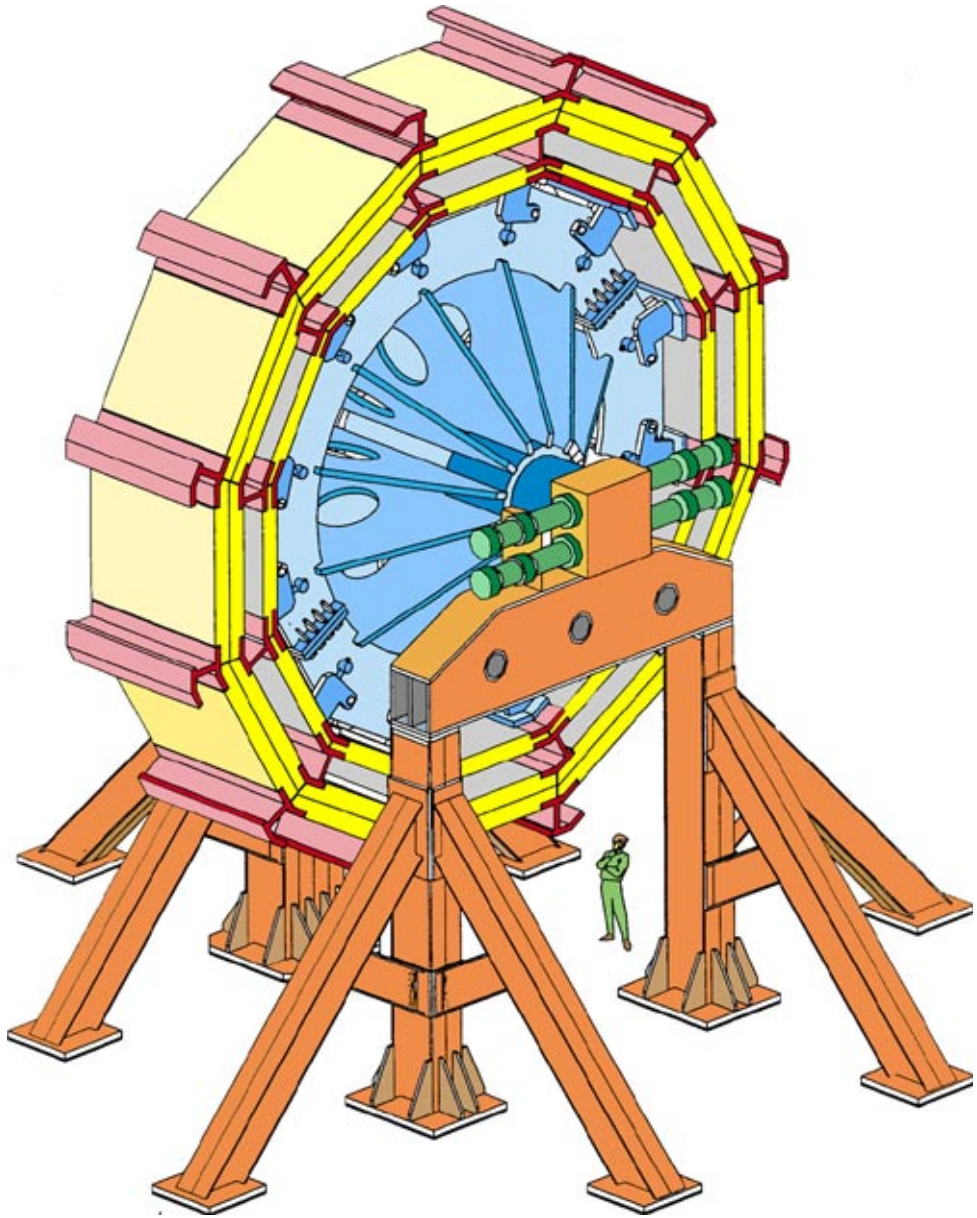
Magnet Payment Profile (2)



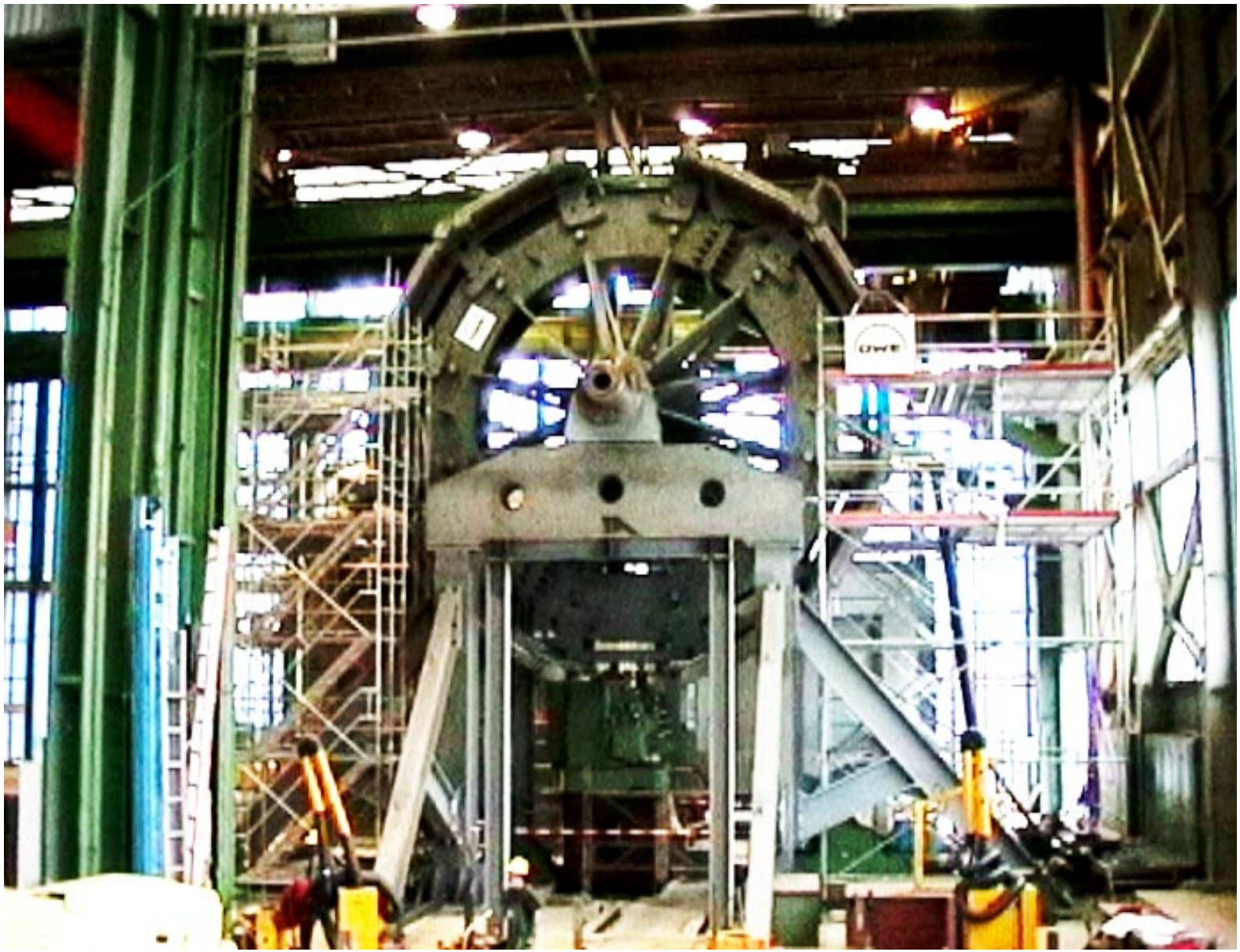
Magnet Barrel Yoke



Ferris Wheel Design

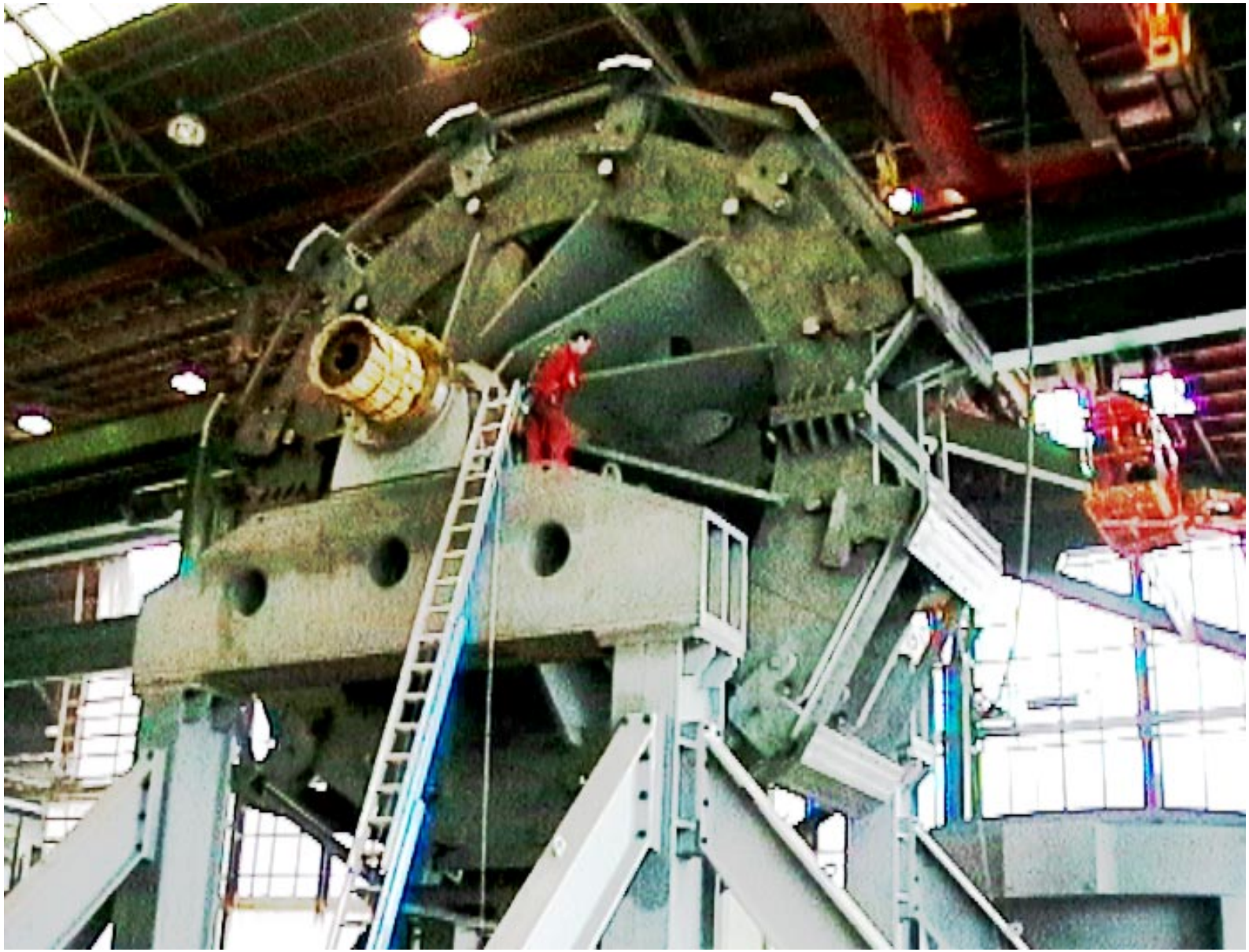


Ferris Wheel at DWE (1)



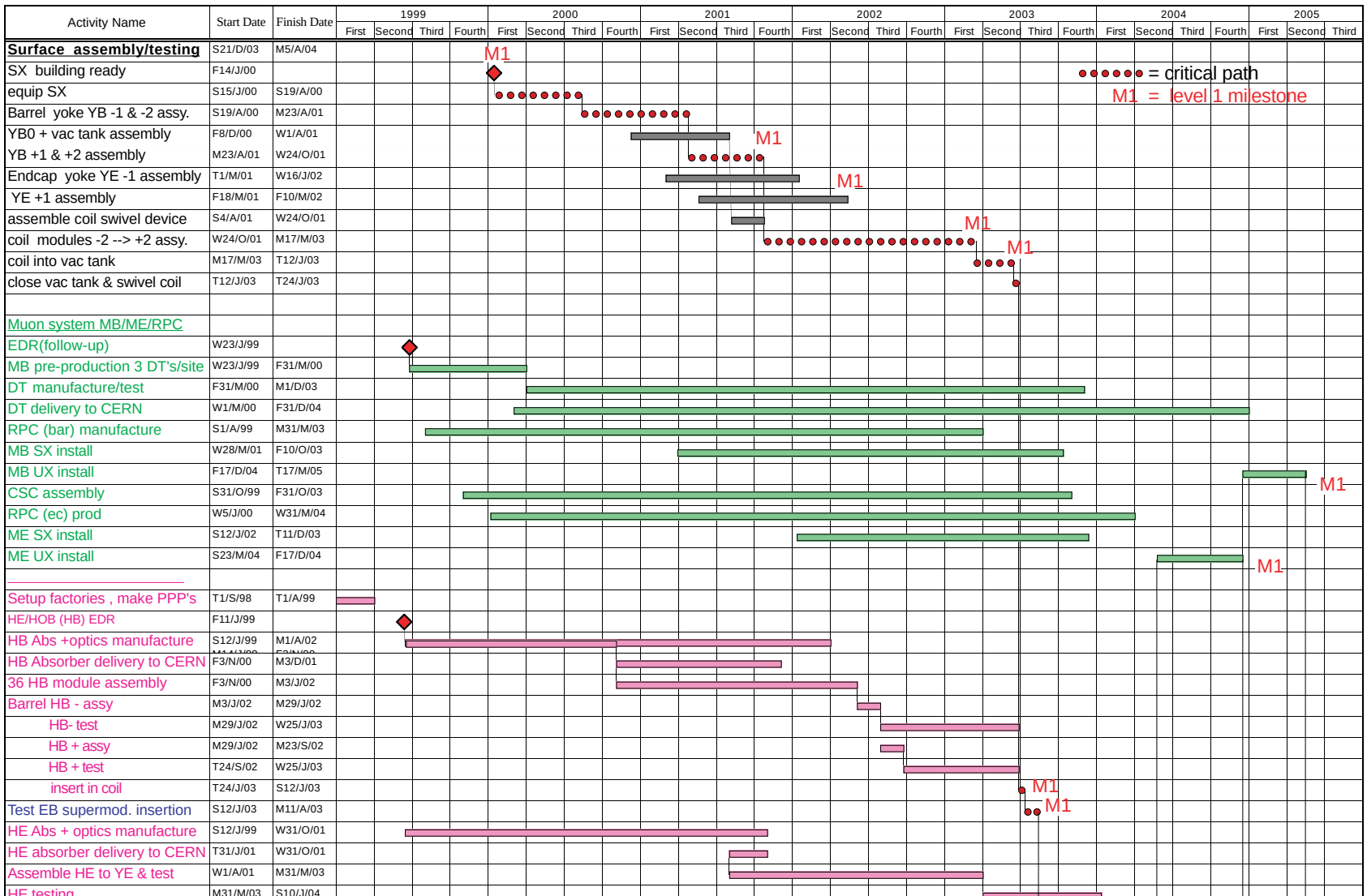
Ferris Wheel at DWE (2)

Ferris Wheel at DWE (3)



Summary Schedule (1)

CMS Summary Schedule v 1.0 9'th June 1999 (preliminary)

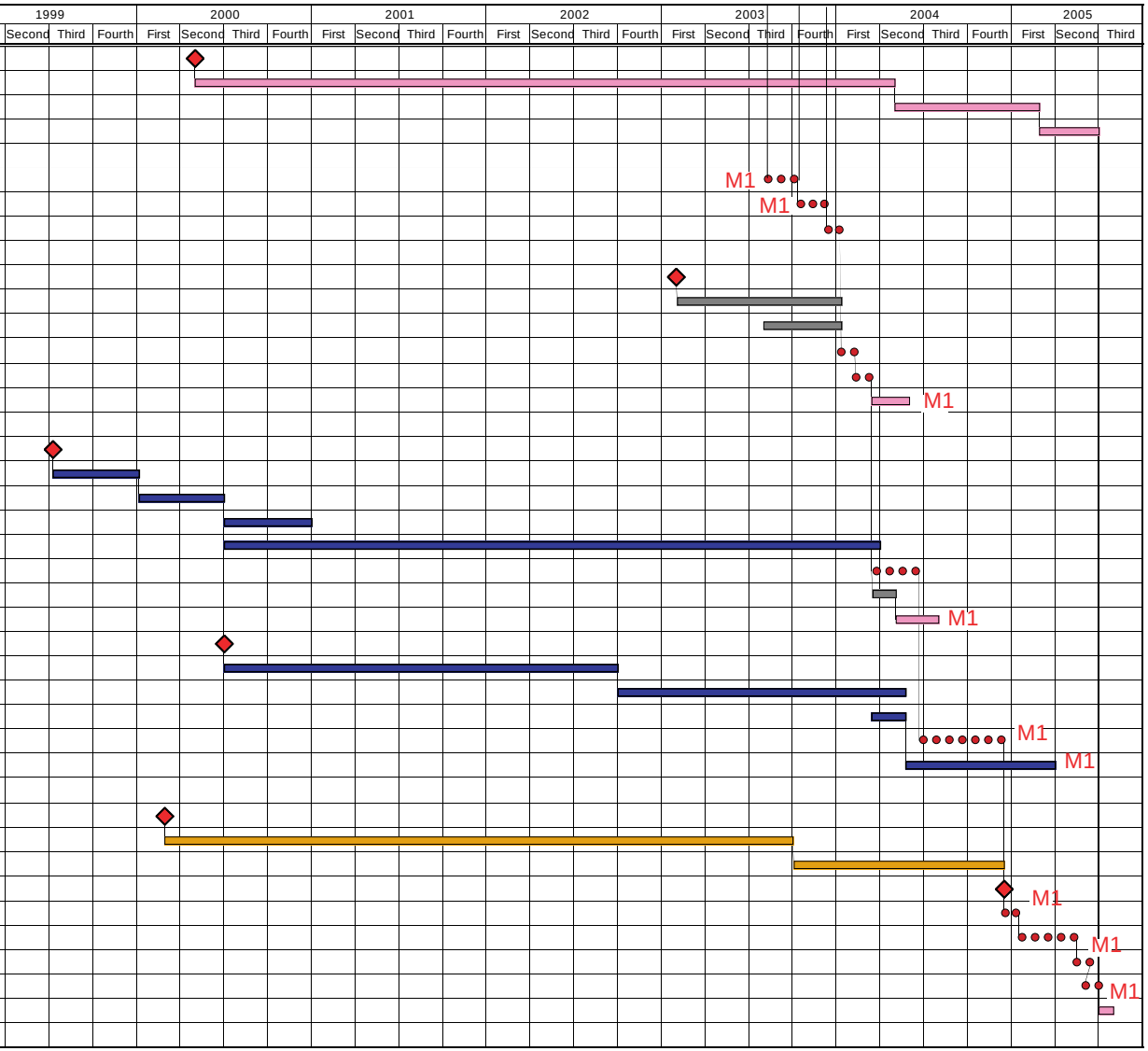


Activity Name	Start Date	Finish Date
Surface assembly/testing	S21/D/03	M5/A/04
SX building ready	F14/J/00	
equip SX	S15/J/00	S19/A/00
Barrel yoke YB -1 & -2 assy.	S19/A/00	M23/A/01
YB0 + vac tank assembly	F8/D/00	W1/A/01
YB +1 & +2 assembly	M23/A/01	W24/O/01
Endcap yoke YE -1 assembly	T1/M/01	W16/J/02
YE +1 assembly	F18/M/01	F10/M/02
assemble coil swivel device	S4/A/01	W24/O/01
coil modules -2 --> +2 assy.	W24/O/01	M17/M/03
coil into vac tank	M17/M/03	T12/J/03
close vac tank & swivel coil	T12/J/03	T24/J/03
Muon system MB/ME/RPC		
EDR(follow-up)	W23/J/99	
MB pre-production 3 DT's/site	W23/J/99	F31/M/00
DT manufacture/test	F31/M/00	M1/D/03
DT delivery to CERN	W1/M/00	F31/D/04
RPC (bar) manufacture	S1/A/99	M31/M/03
MB SX install	W28/M/01	F10/O/03
MB UX install	F17/D/04	T17/M/05
CSC assembly	S31/O/99	F31/O/03
RPC (ec) prod	W5/J/00	W31/M/04
ME SX install	S12/J/02	T11/D/03
ME UX install	S23/M/04	F17/D/04
Setup factories , make PPP's	T1/S/98	T1/A/99
HE/HOB (HB) EDR	F11/J/99	
HB Abs +optics manufacture	S12/J/99	M1/A/02
HB Absorber delivery to CERN	F3/N/00	M3/D/01
36 HB module assembly	F3/N/00	M3/J/02
Barrel HB - assy	M3/J/02	M29/J/02
HB- test	M29/J/02	W25/J/03
HB + assy	M29/J/02	M23/S/02
HB + test	T24/S/02	W25/J/03
insert in coil	T24/J/03	S12/J/03
Test EB supermod. insertion	S12/J/03	M11/A/03
HE Abs + optics manufacture	S12/J/99	W31/O/01
HE absorber delivery to CERN	T31/J/01	W31/O/01
Assemble HE to YE & test	W1/A/01	M31/M/03
HE testing	M31/M/03	S10/J/04

Summary Schedule (2)

CMS Summary Schedule v 1.0 9'th June 1999 (preliminary)

Activity Name	Start Date	Finish Date
HF EDR	S30/A/00	
HF manufacture & assembly	S30/A/00	F30/A/04
HF assembly	F30/A/04	M28/F/05
HF testing	M28/F/05	F1/J/05
Magnet tests		
cool coil	M11/A/03	F10/O/03
close yoke, test	F10/O/03	T11/D/03
final mag test	T11/D/03	W7/J/04
Underground installation		
UX ready	F31/J/03	
UX infrastructure & rot shield	S1/F/03	S10/J/04
install gantry crane	T31/J/03	S10/J/04
lower YE + & coil/YB	S10/J/04	M9/F/04
lower HB + & HB -	T10/F/04	S14/M/04
HB testing	S14/M/04	M31/M/04
ECAL,EB/EE		
EDR barrel (EB)	T8/J/99	
crystal optimisation, protmod	T8/J/99	W5/J/00
Supermod 1 assembly	W5/J/00	F30/J/00
Supermod 1 calib	F30/J/00	S31/D/00
36 Supermods assy/cal	F30/J/00	T1/A/04
EB install	S14/M/04	S20/J/04
YE - lower	M15/M/04	M3/M/04
HE testing	M3/M/04	S31/J/04
EDR endcap (EE)	F30/J/00	
EE : Dee 1 assembly/cal	F30/J/00	M30/S/02
EE: 4 Dees assembly/cal	M30/S/02	S23/M/04
EE+ and EE- install	S13/M/04	S23/M/04
EB test	S20/J/04	F17/D/04
EE test	S23/M/04	T31/M/05
TRACKER, TK		
EDR	M28/F/00	
TK manufacture	M28/F/00	W1/O/03
TK assembly & burn-in	T2/O/03	F17/D/04
Tracker to SX	F17/D/04	
TK install	F17/D/04	M17/J/05
TK test	M17/J/05	T17/M/05
	T17/M/05	T16/J/05
close detector, OK for beam	W1/J/05	M4/J/05
Install HF, close shielding	F1/J/05	M1/A/05



Milestones (1)

CERN/LHCC 99-26

Milestones CMS Milestones - version 2.0 31'st July 1999

Level 1 Milestones

Surface Hall (SX5) ready	01/00
Underground Hall (UX5) Ready	01/03
Submit Trigger TDR	11/00
Submit DAQ TDR	12/01
End Assembly of Barrel Yoke	06/01
End Assembly of Endcap Yoke	01/02
End Assembly of Coil	02/03
Slide Coil into Vac-tank	04/03
End Assembly of HB in SX5	07/02
End Assembly of HE (on YE) in SX5	05/02
End Trial Insertion of HB in Vac Tank	07/03
End Trial Mounting of EB Super Module on HB	08/03
Start Cool-down of Coil	08/03
Close Yoke, and Start Magnet Test in SX5	09/03
Start Lowering Magnet Parts	01/04

etc. (24 L1 Milestones, 164 L2 Milestones, 216 L3 Milestones)

Milestones (2)

Milestone reporting:

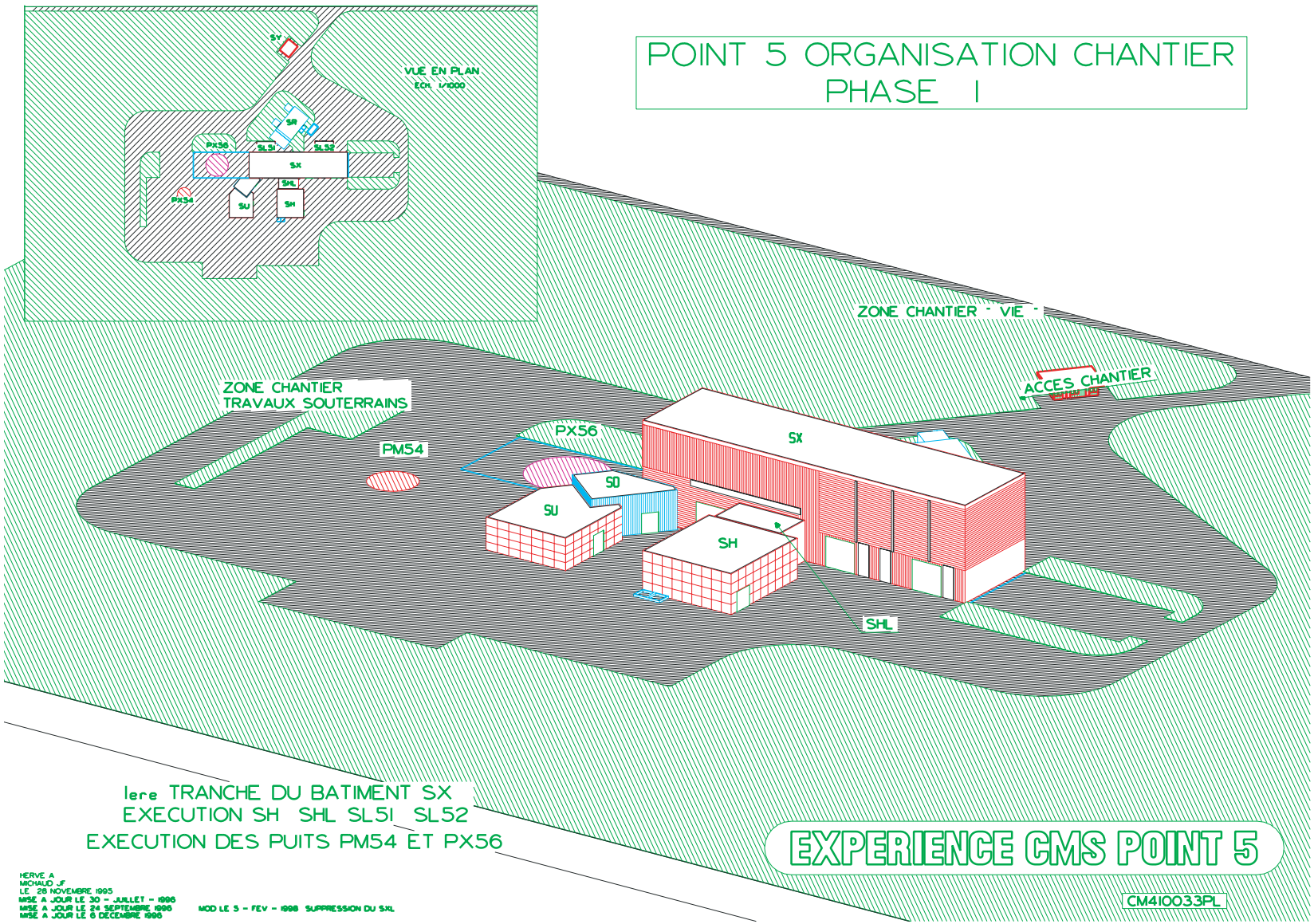
Level 1 : in writing to CMS Steering Committee & LHCC

Level 2 : in writing to CMS Steering Committee & LHCC

Level 3 : verbally to CMS Steering Committee and
to LHCC referees by CMS Technical Coordination

Note: US CMS Milestones L1 and L2 are a subset of the CMS Milestones

Point 5 Design



Point 5 August 1999

Funding Risks

Magnet	**3.1 MCHF**
Barrel Yoke Contract (R)	1.4 MCHF
Dump Resistor (R)	0.3 MCHF
Common Fund (K)	1.4 MCHF
Infrastructure	**2.1 MCHF**
Racks (R)	0.4 MCHF
Riser system for HF (R)	0.3 MCHF
Shielding and table for HF (R)	1.4 MCHF
HCAL	**3.1 MCHF**
HE Brass (550 tons) (R)	1.6 MCHF
Mechanics for HF (R)	1.1 MCHF
HF Optics (H)	0.4 MCHF
Tracker	**1.0 MCHF**
FWD MSGCs (R)	1.0 MCHF
ECAL	**2.7 MCHF**
EE Mechanics (R)	1.0 MCHF
EE VPTs (R)	0.8 MCHF
Preshower (G)	0.9 MCHF
Muons	**3.5 MCHF**
FWD RPCs, 3 stations (K)	2.0 MCHF
ME1/1 electronics (R)	1.5 MCHF
TriDAS	**1.4 MCHF**
DAQ (G)	0.9 MCHF
RPC Trig (K)	0.5 MCHF

Total Funding Risk : 16.9 MCHF

(Russia 10.8 MCHF, Korea 3.9 MCHF,
Hungary 0.4 MCHF, Greece 1.8 MCHF)

Funding Risks: A Common Problem

Extract from a letter from the Spokesperson to D. Green and E. Temple:

The Collaboration has decided to consider the funding risks as a common problem, i.e. manage as common projects.

The total shortfall has been estimated to be about 17 MCHF in deliverable value.

In the US accounting system this translates to about 30 MUSD of risk in total project cost.

The US share of this risk is 20%, i.e. some 6 MUSD.

Time critical components requiring the immediate help from the Collaboration have been identified.

Immediate help from US_CMS:

1) HF engineering design to be regrouped in FNAL.
2) Procurement of 550 tons of brass plates for HE (1.6 MCHF).

Help from US_CMS to be decided by the end of the year:

3) HF mechanics and Optics (1.5 MCHF)
4) HF shielding and Table (1.4 MCHF)
5) ME1/1 electronics (1-1.5 MCHF)

CMS management will work to minimize the impact of common problems but we expect that some permanent redistribution of responsibility will be necessary. In addition there is some uncertainty in the cost of the tracker as the design will only be frozen at the end of the year.

It was therefore decided to define by the end of 1999 a new baseline CMS Detector, which could be guaranteed to be ready in 2005, within the available resources.

Roadmap for Decisions (1)

1999

Jun	YB Iron Blocks (1.4 MCHF) (CERN to CF)
Jun	Decison on transfer of full HF engineering design to FNAL
Jun	Dump Resistor (0.3 MCHF) (CERN to CF)
July	HE Brass (550 tons 1.6 MCHF) (US)

Decide up to here

Dec	Freeze baseline Tracker. Revise Baseline CMS detector.
Dec	Finalize Funding Plan for HF
	Mechanics and Optics (1.5M$ $\rightarrow$ 1.5 MCHF) (US)
	Table and Shielding for HF (1.4 MCHF) (US)
Dec	ME1/1 electronics (Chips and components,1-1.5 MCHF, US)

2000...

Roadmap for Decisions (2)

2000

Feb	Tracker MSGCs (sensor EDR- Feb: 1.0 MCHF – absorb in re-optimization Tracker)
Jun	Forward RPCs (3 stations + ME1/1) (procure 1 MCHF of RPC material? and send to Pakistan for assembly and test)
Jun	ECAL: After ECAL Endcap EDR in June procure alveolar structures (1.0 MCHF) and VPTs (0.8 MCHF) using ECAL funds (international competitive tendering should have been organised in advance, 1999?)

2001

Dec	Racks (0.4 MCHF) (covered by CERN)

2003

DAQ (0.9 MCHF) Greece

????

Preshower (0.9 MCHF) Greece
RPC Trigger (0.5 MCHF) Korea
CF shortfall (Korea 1.4 MCHF)

Tracker Issues

	Phase II Si + MSGC (MCHF)	Funding (MCHF)	Phase I Si + MSGC (MCHF)	Baseline 1 Si + MSGC (MCHF)	Baseline 2 All Silicon (MCHF)
Pixels	8.2	8.0	8.2	8.2	8.2
Inner (Si)	30.5	24.7	25.3	25.0	25.0
Outer (MSGC or Si)	42.6	34.3	34.4	36.0	39.1
Gen. Mechanics	6.1	5.9	6.1	6.1	6.1
TOTALS	**87.4**	**72.9**	**74.0**	**75.3**	**78.4**

Phase II: TDR Design full luminosity, Electronics rad hard CMOS (2.8 CHF/Ch.)
Phase I: TDR Design, stageing scenario.
Avoid Stageing scenario: Reduce #channels by 10%, Submicron Electronics (2 CHF/Ch.)
Baseline 1: Inner 5 Silicon, outer 6 MSGC layers
Baseline 2: Inner 5 Silicon, outer 5 Silicon layers (All Silicon)

Decision between Baseline 1 and 2 in December 1999 based on feasibility, schedule, cost and performance.
MSGC: Robustness test at PSI in November
Silicon: Large (11 cm), long (16.5 cm), thick (400 μm) detectors (6" technology)

Expected Performance B2 vs B1

Tracking Performance:

- Less points (5 vs 6)
- Less double-sided layers (2 vs 3)
- Similar resolution (40 μm)
- Same momentum Resolution
- Same impact parameter/b-tagging performance
- Pattern Recognition expected to be the same
- Smaller dependence on the angle of the tracks

Material Budget:

Expected to be equal or lower

ALL THIS TO BE VALIDATED BY SIMULATION

Software/Computing Issues

High Level Triggers:

- After a hardware Level-1 all further event selection occurs in a farm of processors.
- well engineered, reliable and efficient software is needed, must be ready in 2005.
- Distinction between online and offline software should be minimal.
- CMS Decision: Stop Fortran developments, switch to C++ and OO.
- Second version of offline reconstruction in OO released June 1999 (ORCA-2)..
- Physics Reconstruction and Selection sub-project formed in April.

  Initial goal: tackle Level-2, 3, ... and provide required input for DAQ TDR (end 2001).

  Led by P. Sphicas (MIT/CERN) + 4 Conveners + Sw/Comp rep.

  e/γ: C. Seez, jets/E_t^{miss}: S. Eno (Maryland), μ: U. Gasparini, b/τ: A. Caner

Offline Computing (Model):

- Centre at CERN (storage of raw data, first reconstruction pass)
- 'Regional Centres' to reconstruct, analyse, simulate, store, with network access and a capability of $\approx$ 20% of centre at CERN
- Address these issues in 'MONARC' LCB Common Project at CERN
- CERN Director of Research has launched a Review of LHC Computing to report back by end 2000. Review political, financial and technical implications.