US CMS

The Compact Muon Solenoid

US CMS

Project Management Plan

Draft

September 30, 1996

US CMS Project Management Plan

ABSTRACT

This Management Plan sets forth the specific plans, organization, responsibilities and systems to be used in managing the work necessary for successful completion of the US Compact Muon Solenoid (CMS) construction project. The US CMS construction project is both a DOE Major Systems Acquisition (MSA) project and an NSF Major Research Equipment (MRE) project, with the project office located at the Fermi National Accelerator Laboratory. This project includes the construction of elements of the CMS detector for which the US groups collaborating on CMS take responsibility.

The US groups will participate in the building of the Compact Muon Solenoid (CMS) experiment which is designed to study the collisions of protons on protons at a center of mass energy of 14 TeV at the Large Hadron Collider (LHC) at CERN. To enable studies of rare phenomena at the TeV scale, the LHC is designed to operate at a luminosity of 10^{34} cm^{-2} s^{-1}. The physics program includes the study of electroweak symmetry breaking, investigation of the properties of the top quark, searches for new heavy gauge bosons, probing quark and lepton substructure, looking for supersymmetry and exploring for other new phenomena. The CMS collaboration has proposed to build a compact solenoidal detector designed to function at the highest luminosities available at the LHC. The detector will be built around a high-field (4 T) superconducting solenoid, leading to a compact design for the muon spectrometer. In order to detect new physics signatures efficiently identification of muons, photons, electrons, and neutrinos has been emphasized. The US CMS Group agrees to take leadership responsibility in the CMS experiment for the endcap muon system including the chambers, steel design and integration, and for all hadron calorimetry, as well as associated aspects of the trigger and data acquisition system. The US CMS Collaboration also agrees to work on important areas of electromagnetic calorimetry, tracking, and software.

In accordance with DOE Order 4700.1, Attachment II-4, page II-65 "The plan should be kept current as the project progresses and an annual review of the plan, with appropriate updating of sections should be made by the managing organization to assure that it is current." US CMS is keeping the Project Management Plan (PMP) current by page changes. These changes will be distributed by the US CMS Project Office. The US CMS PMP will be distributed as a controlled document by the US CMS Project Office at Fermilab. Changes will also be distributed by the US CMS Project Office.

Document Control and Distribution:

Submitted, Accepted, and Approved by:

US CMS
Project Management Plan

TABLE OF CONTENTS

List of Tables vi

List of Figures vii

List of Abbreviations and Acronyms viii

I. Introduction 1

II. Project Objectives 9

III. Project Organization and Responsibilities 15

IV. Work Plan 41

V. Work Breakdown Structure 45

VI. Project Schedule and Milestones 53

VII. Cost and Labor Estimates 61

VIII. Work Authorization and Project Control System 63

IX. Reporting and Review 69

Annex I. Advance Acquisition or Assistance Plan 95

LIST OF TABLES

I-1 US CMS Collaboration....6
I-2 US CMS Subsystem Participation....7
II-1 US CMS Project Cost Estimate....14
V-1 Project Summary WBS, and WBS Level 2 Managers....48
VI-1 CMS Project Milestones....56
IX-1 US CMS Institutions and Members....73
IX-2 US CMS Memorandum of Understanding....76
IX-3 US CMS Memorandum of Understanding Amendment....87

LIST OF FIGURES

I-1 View of the CMS Detector....................5

II-1 CMS Construction Schedule....................13

III-1 CMS Management Board....................27

III-2 CMS Technical Board....................28

III-3 CMS Finance Board....................29

III-4 US CMS Management Board....................30

III-5 US CMS Project Office....................31

III-6 US CMS Management Organization Relationships....................32

III-7 US CMS MOU, Authorization, Funding, and Reporting Structures....................33

III-8 Muon Project....................34

III-9 HCAL Project....................35

III-10 Trigger and Data Acquisition Project....................36

III-11 ECAL Project....................37

III-12 Tracking Project....................38

III-13 Software Technical Board....................39

III-14 Magnet Technical Board....................40

LIST OF ABBREVIATIONS AND ACRONYMS

AAAP	Advance Acquisition or Assistance Plan
ACWP	Actual Cost of Work Performed
APP	Advance Procurement Plan
BAO	Batavia Area Office
BC	Budgeted Cost
BCCB	Baseline Change Control Board
BCWP	Budgeted Cost of Work Performed
BCWS	Budgeted Cost of Work Scheduled
CCB	Configuration Control Board
CD	Construction Directive
CDR	Conceptual Design Report
CERN	European Laboratory for Particle Physics
CH	Chicago Operations Office
CMS	Compact Muon Solenoid
CPR	Cost Performance Report
CSCG	Cost/Schedule Controls Group
CS^2	Cost Schedule Control System
DAQ	Data Acquisition
DCC	Document Control Center
DHEP	Division of High Energy Physics
DOE	Department of Energy
EA	Environmental Assessment
EAC	Estimate at Completion
ECAL	Electromagnetic Calorimeter
ECR	Engineering Change Request
EMU	Endcap Muon System
ER	Office of Energy Research
ESAAB	Energy System Acquisition Advisory Board
ES&H	Environment, Safety and Health
FES	Facilities Engineering Services
FIFS	Fermilab Integrated Financial System
FNAL	Fermi National Accelerator Laboratory (Fermilab)
FONSI	Finding of No Significant Impact
FSAR	Final Safety Analysis Report
GeV	Giga-electron-Volt
HCAL	Hadron Calorimeter
HENP	High Energy and Nuclear Physics
L3M	Level 3 Manger
MAP	Mitigation Action Plan
MOU	Memorandum of Understanding
MRE	Major Research Equipment
MSA	Major System Acquisition
NSF	National Science Foundation

PMG	Project Management Group
PMP	Project Management Plan
PSAR	Preliminary Safety Analysis Report
PSWBS	Project Summary Work Breakdown Structure
QA	Quality Assurance
QAC	Quality Assurance Committee
QAP	Quality Assurance Plan
QC	Quality Control
R&D	Research and Development
SOW	Statement of Work
SQIP	Specific Quality Implementation Plan
TEC	Total Estimated Cost
TeV	Tera-electron-Volt
TPC	Total Project Cost
URA	Universities Research Association
WBS	Work Breakdown Structure

Section I
Introduction

I. Introduction

This document describes the Project Management Plan (PMP) that the US CMS Collaboration will follow to meet the technical, cost, and schedule objectives of the US CMS Project, a Department of Energy (DOE) Major System Acquisition (MSA) per DOE Order 4700.1 and NSF Major Research Equipment (MRE) Project. The project will have its management office at Fermilab, in Batavia, Illinois. Fermilab is a DOE Laboratory operated under contract DE-AC02-76-CH-03000 by the Universities Research Association, Inc. (URA). DOE, NSF, Fermilab and the US CMS Collaboration will work together as a team to accomplish the US CMS Project. This PMP for construction of US CMS, a project baseline and execution document, sets forth the plans, organization and systems that will be used to manage this DOE MSA and NSF MRE project. This document is organized per the "Guidance for Preparing a Project Management Plan" contained in DOE Order 4700.1, Chapter II (attachment II-4) dated 6-2-92.

A. The US CMS Project

The US CMS Collaboration is part of CMS. CMS is a collaboration which will conduct an experimental investigation of the interactions of protons on protons at a center of mass energy of 14 TeV at the Compact Muon Solenoid (CMS) experiment planned for the Large Hadron Collider (LHC) at CERN. In order to explore the TeV mass scale, the LHC is designed to operate at a luminosity of 10^{34} cm^{-2} s^{-1}. The physics program includes the study of electroweak symmetry breaking, investigation of the properties of the top quark, searches for new heavy gauge bosons, probing quark and lepton substructure, looking for supersymmetry and searching for other phenomena outside the standard model. Models of electroweak symmetry breaking generally include a scalar field whose interactions give mass to the W and Z bosons, as well as the fermions. The dynamical component of this scalar field, the Higgs boson, is expected to decay into WW and ZZ pairs if its mass exceeds 180 GeV. Other theories predict new particle states that decay to ZZ, WW, WZ or γZ pairs. Thus, the study of boson pairs is an important venue for understanding electroweak symmetry breaking. This study requires efficient detection of the W and Z decay electrons, neutrinos and muons over as large a solid angle as possible.

The CMS detector is designed to exploit the full range of physics at the LHC up to the highest luminosities. The detector tracking and calorimetry components are to be built within a high-field (4 T) superconducting solenoid, leading to a compact design for the muon spectrometer. Identification of muons, photons and electrons, and precise measurement of these particles with an energy resolution of 1% over a large momentum range, are emphasized in the design considerations. A perspective view of the CMS Detector is shown in Fig. I-1.

There are two systems where the US has overall responsibility: the endcap muon system and the HCAL system. US CMS groups will take construction responsibility for these and other items. The US has complete endcap management responsibility, but only partial construction responsibility. Three of the four detector stations will be built by the US. The US will design the endcap steel; it will be constructed as a CMS common project. The hadron calorimetry is similarly partitioned: the US groups will build the barrel, supply the endcap transducers and front-end electronics, and build half of the very forward system while maintaining complete HCAL management responsibility.

For the other subsystems, the US responsibilities are not global. However, in every case they are focused on particular area of US expertise. For example, US groups have overall CMS Trigger management responsibility and will do essentially all endcap muon level 1 triggers and all calorimeter level 1 triggers, and all endcap silicon pixels.

B. The Participants

The major participants in the US CMS Project are: the DOE Office of Energy Research (ER); the ER Office of High Energy and Nuclear Physics (HENP); the HENP Division of the High Energy Physics (DHEP); the DOE Chicago Operations Office (CH); the CH Batavia Area Office (BAO); the National Science Foundation (NSF); Fermilab, operated by URA, as host Laboratory; and the collaborating US CMS institutions. In addition, the CMS detector will be operated at CERN near Geneva, Switzerland. The CMS experiment is an international enterprise of which the US CMS Collaboration is only a part.

A substantial number (~325) of US physicists have been welcomed as full partners in the CMS collaboration. A list of the current institutions and contact persons of US CMS is given in Table I-1.

The areas of construction responsibility of the US CMS institutions are given in Table I-2.

C. The Project Management Plan

The PMP presents the top level technical, cost, and schedule baselines for the US CMS Project, and sets forth the organization, systems, and plan by which the project participants will manage the US CMS Project.

The management approach described here is based on ER and NSF experience with projects to construct complex detectors designed as research tools to advance the frontiers of knowledge. Three fundamental principles underlie the development of an organizational structure, the assignment of roles and responsibilities, and the implementation of management systems to optimize the success of such projects. These principles are as follows:

a. The US CMS Collaboration has the primary responsibility for the successful achievement of the performance goals within the cost and schedule objective.

b. Relevant formal management systems and requirements are implemented consistent with optimizing the project success and accounting properly for the use of public funds.

c. Project Management is a team approach involving ER, HENP, DHEP, CH, BAO, NSF, Fermilab, and US CMS.

Following this introductory section, Section II provides an overview of the US CMS Project, the design goals, scope and objectives. The roles and responsibilities of the major project participants are defined in Section III. Section IV through VII describe the work and its organization and the associated cost, schedule, and technical baselines. A discussion of the system that will be used to manage and control cost and schedule and to measure the technical performance of the project is given in Section VIII. Reporting requirements and review procedures are described in Section IX. The Advanced Acquisition or Assistance Plan is provided in Annex I.

This plan will be reviewed and revised, as required, to reflect new project developments and/or other agreements among the participants. Revisions, as they are issued, will be signed by all participants, and will supersede in their entirety previous editions. To the extent that there are inconsistencies or conflicts between this plan and the terms and conditions of applicable laws, regulations, and contracts, the provisions of those documents shall prevail over this plan.

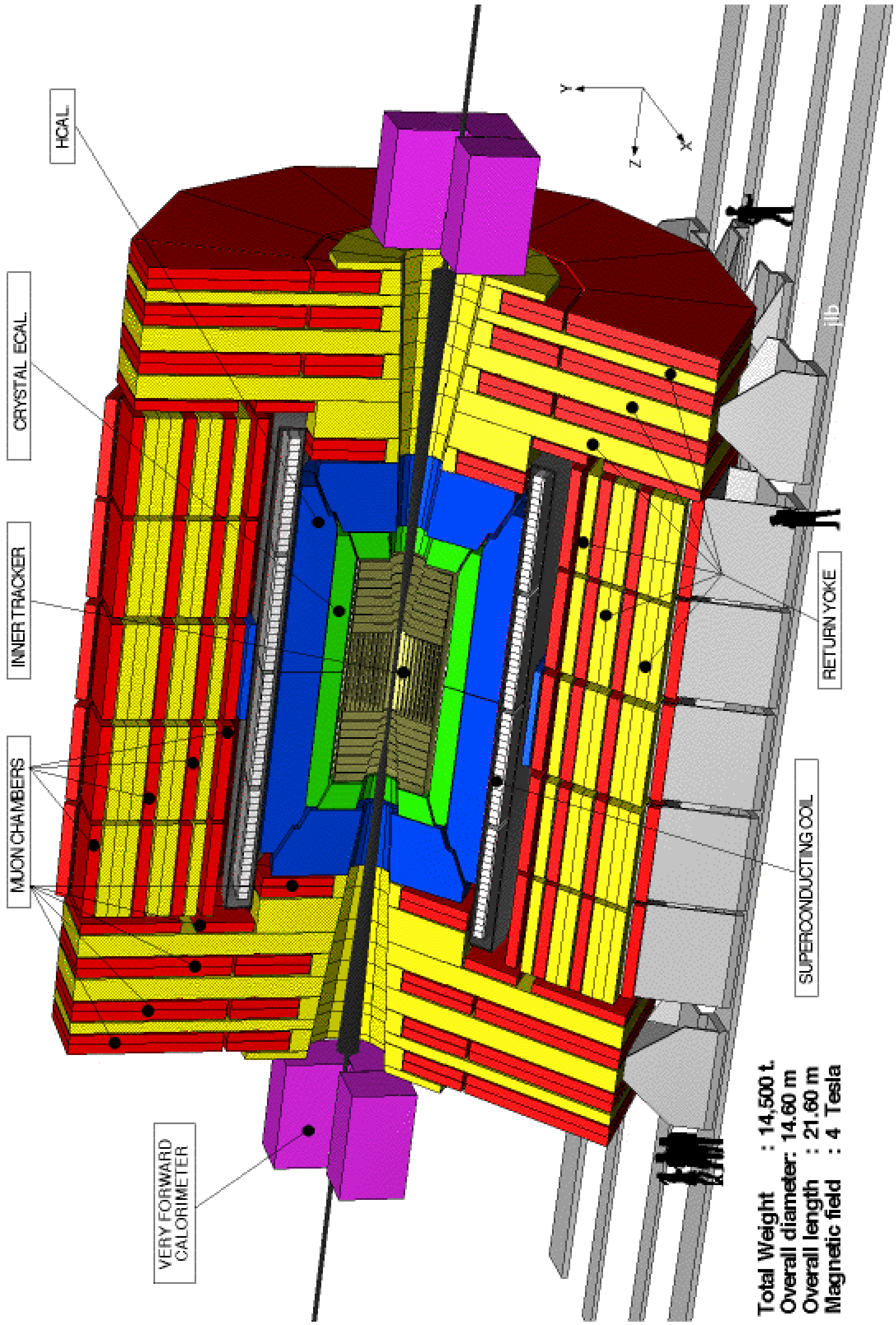
HCAL
CRYSTAL ECAL
INNER TRACKER
MUON CHAMBERS
VERY FORWARD CALORIMETER
RETURN YOKE
SUPERCONDUCTING COIL
Total Weight : 14,500 t.
Overall diameter: 14.60 m
Overall length : 21.60 m
Magnetic field : 4 Tesla

Fig. I-1

Table I-1 US CMS Collaboration

US CMS Collaboration

Collaboration Board Chair: D. Reeder   Spokesperson: D. Green

Institution	Contact Person
University of Alabama	L. Baksay
Boston University	L. Sulak
Brookhaven National Laboratory	C. Woody
University of California, Davis	W. Ko
University of California, Los Angeles	J. Hauser
University of California, Riverside	J. G. Layter
University of California, San Diego	J. G. Branson
California Institute of Technology	H. Newman
Carnegie Mellon University	T. Ferguson
Fairfield University	D. Winn
Fermi National Accelerator Laboratory	D. Green
University of Florida	G. Mitselmakher
Florida State University	V. Hagopian
Florida State University (SCRI)	M. Corden
University of Illinois at Chicago	M. Adams
University of Iowa	Y. Onel
Iowa State University	E. W. Anderson
Johns Hopkins University	C. Y. Chien
Lawrence Livermore National Laboratory	C. Wuest
Los Alamos National Laboratory	H. J. Ziock
University of Maryland	A. Skuja
Massachusetts Institute of Technology	P. Sphicas
University of Minnesota	R. Rusack
University of Mississippi	J. Reidy
University of Nebraska	G. R. Snow
State University of New York at Stony Brook	M. Mohammadi Baarmand
Northeastern University	S. Reucroft
Northwestern University	B. Gobbi
University of Notre Dame	R. Ruchti
Ohio State University	T. Y. Ling
Princeton University	P. Piroue
Purdue University	V. E. Barnes
Rice University	D. L. Adams
University of Rochester	A. Bodek
Rockefeller University	N. D. Giokaris
University of Texas at Dallas	E. J. Fenyves
Texas Tech University	R. Wigmans
Virginia Polytechnic Institute and State University	L. W. Mo
University of Wisconsin	W. H. Smith

Table I-2.: US CMS Subsystem Participation

Endcap Muon	HCAL	Trigger/DAQ
Alabama	Boston	UC Davis
UC Davis	UCLA	UCLA
UCLA	Fairfield	UC San Diego
UC Riverside	Fermilab	Fermilab
Carnegie Mellon	Florida State	Iowa
Fermilab	Illinois Chicago	Iowa State
Florida	Iowa	MIT
Livermore	Iowa State	Mississippi
MIT	Maryland	Nebraska
SUNY Stony Brook	Minnesota	Northeastern
Northeastern	Mississippi	Ohio State
Ohio State	Notre Dame	Wisconsin
Purdue	Purdue	
Rice	Rochester	
UT Dallas	Texas Tech	
Wisconsin	Virginia Tech	
ECAL	**Tracking**	**Software**
Brookhaven	UC Davis	UC Davis
Caltech	Fermilab	UCLA
Fermilab	Florida State (SCRI)	UC Riverside
Livermore	Johns Hopkins	UC San Diego
Minnesota	Livermore	Caltech
Northeastern	Los Alamos	Carnegie Mellon
Princeton	Mississippi	Fermilab
	Northwestern	Florida
	Purdue	Florida State (SCRI)
	Rice	Johns Hopkins
	Texas Tech	Livermore
		Maryland
		SUNY Stony Brook
		Northeastern
		Rice
		Wisconsin

Section II
Project Objectives

II. Project Objectives

A. Project Purpose

The purpose of the US CMS Project is to enable US high energy physicists to participate in research at the high energy frontier available at the Large Hadron Collider (LHC) at CERN.

The US CMS project is described in the US CMS Letter of Intent, and is outlined below. US responsibilities within CMS include both management and construction.

US groups have management responsibility for the Endcap Muon System, the Hadron Calorimeter, and the Trigger. Construction responsibilities within the US extend to portions of all five CMS subsystems: Muon, Hadron Calorimeter, Trigger/DAQ, Electromagnetic Calorimeter, and Tracking. In addition, there is US participation in both the Magnet and Software efforts.

Detection of muons is of central importance in the CMS experiment since muons from p-p collisions will provide clean signatures for a wide variety of new physics processes. The task of the muon detector is to identify these muons and provide a precision measurement of their momenta which ranges from a few GeV to a few TeV. At the LHC, efficient detection of muons from Higgs, W and Z sources requires coverage over a large rapidity interval. The CMS muon system design includes a barrel detector, which has standalone coverage for $0.0 < |\eta| < 0.9$, and an endcap detector, which overlaps the barrel in the region $0.9 < |\eta| < 1.3$ and provides standalone coverage for $1.3 < |\eta| < 2.4$. The endcap detector is crucial for the identification of these processes. For example, simulation studies of the distribution of the most forward muon in Higgs decays show that at least one muon typically appears in the endcap region. US CMS responsibilities are for construction of the endcap muon chambers and level 1 trigger and for design of the steel return yoke.

The basic functions of the CMS calorimeter systems are to identify electrons and photons and to measure their energies (in conjunction with the tracking system), to measure the energies and directions of particle jets, and to provide hermetic coverage for measuring missing transverse energy. The central pseudorapidity range ($|\eta| < 3.0$) is covered by the barrel and endcap calorimeter system (HB, HF, EB, and EF), while the very forward region ($3.0 < |\eta| < 5.0$) is covered by the forward calorimeter system (HV). The barrel and endcap calorimeters sit inside the 4 Tesla field of the CMS solenoid and hence are necessarily fashioned out of non-magnetic material (copper and stainless steel). The barrel hadron calorimeter inside the solenoid is relatively thin. To ensure adequate sampling depth a hadron shower "tail catcher" is installed outside the solenoid coil in both the barrel and endcap regions. The active element of the central hadron calorimeter readout consists of 4 mm thick plastic scintillator tiles with wavelength-shifting (WLS) fiber readout. US CMS responsibilities are for construction of the entire barrel, the forward transducers and readout and roughly half of the very forward system.

US physicists also have responsibilities within the CMS trigger and data acquisition system. For the nominal LHC design luminosity of 10^{34} cm^{-2} s^{-1}, an average of 25 events occur in each crossing with a beam crossing frequency of 25 nsec. This input rate of 10^9 interactions every second must be reduced by a factor of at least 10^7 to 100 Hz, the maximum rate that can be archived by the on-line computer farm. CMS has chosen to reduce this rate in two steps. The first level stores all data for 3 µsec, after which no more than a 100 kHz rate of the stored events is forwarded to the higher level triggers. This must be done for all channels without dead time. The second level trigger is provided by a subset of the on-line processor farm, and passes a fraction of these events for more complete processing by the remainder of the on-line farm. During the 3 µsec of level 1 trigger, decisions must be developed that discard a large fraction of the data while retaining the small portion coming from interactions of interest. The large physical size of the detector and the short decision time present a series of technical and system problems. In as much as the design of an LHC detector trigger system strongly impacts the design of the detector, an LHC detector cannot be designed without addressing the trigger design. US CMS responsibilities are for construction of the level 1 calorimeter and endcap muon trigger and elements of the level 2 event builder switch.

The CMS electromagnetic calorimeter (ECAL) will be a lead tungstate crystal calorimeter. This is a complete absorption calorimeter, with uniform hermetic coverage, capable of achieving the energy resolution required to detect the intermediate mass Higgs decaying into two photons. Lead tungstate crystals have a short radiation length (0.89 cm) and a small Molière radius (2.0). They have a low light yield but this problem is effectively overcome by using large area silicon avalanche photodiodes (APDs). Recently, crystals supplied by the Shanghai Institute of Ceramics have shown no change in light output or attenuation length after 50 kGy (5 Mrads) of ^{60}Co irradiation. US CMS responsibilities in ECAL are to provide a fraction of the transducers, front end electronics, and monitoring systems.

A pixel vertex detector with two barrel layers plus three pixel disks at each end has been adopted as part of the baseline design set out in the CMS Technical Proposal. The US will provide all the forward pixel disks. The goal of the forward pixel disks is to extend precision tracking and secondary vertex measurements out to η of order 2.6 (consistent with the rest of the forward detector) with at least two measurements on a track. The Technical Proposal design has three disks per endcap (actually rings with 7.5 cm inner radius and 15 cm outer radius). The pixels are rectangular (50 x 300 μm^2) with the long dimension approximately radial.

The software and computing hardware required at all stages of CMS are extensive. Without appropriate software development, the hardware design will not be optimized nor will the hardware potential be realized. A software contribution to the design and performance studies of each of the major detector systems is required. The US CMS software community made important contributions to the overall detector performance analysis for the CMS Technical Proposal, including studies of muon momentum resolution, punch-though particles and muon decay, the identification and reconstruction of prompt photons, and the handling of events containing jets.

B. Technical Objectives

[To be completed when negotiations with CERN are complete.]

C. Schedule Decision Points[1]

The Key Decision points and other milestones for the project are shown in Fig. II-1. This overall CMS schedule defines the US CMS Project schedule in as much as the US group are responsible for a subset of the experimental apparatus. Greater schedule details are shown in Section VI.

D. Cost Objectives

The Total Estimated Cost (TEC) for construction of the US CMS Project is $147,539,000 in FY'96 dollars. The cost estimate is summarized in Table II-1. Detailed discussion of the cost estimates, together with obligations and cost profiles based on schedules described in Section VI, are presented in Section VII.

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[1]Both the schedule and cost are, of course, dependent on the rate of funding. The schedule dates represent the results of discussions between CERN, CMS, DOE / NSF and US CMS.

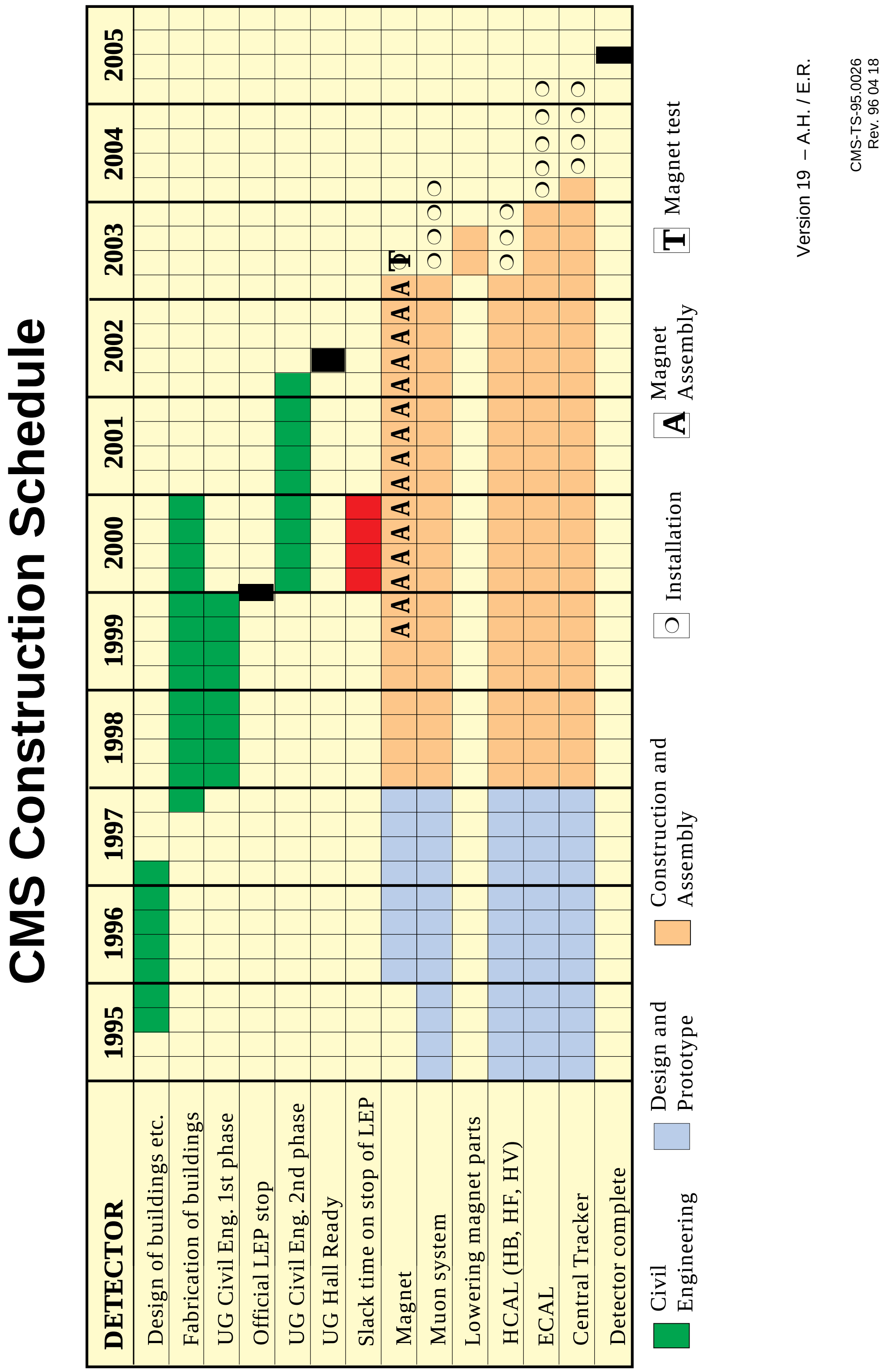

CMS Construction Schedule
DETECTOR
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
Design of buildings etc.
Fabrication of buildings
UG Civil Eng. 1st phase
Official LEP stop
UG Civil Eng. 2nd phase
UG Hall Ready
Slack time on stop of LEP
Magnet
Muon system
Lowering magnet parts
HCAL (HB, HF, HV)
ECAL
Central Tracker
Detector complete
Civil Engineering
Design and Prototype
Construction and Assembly
Installation
Magnet Assembly
Magnet test
Version 19 – A.H. / E.R.
CMS-TS-95.0026
Rev. 96 04 18

Fig. II-1

Table II-1: US CMS Project Cost Estimate.

WBS Number	Description	US Mfg M&S (K$)	US Mfg Labor (K$)	US EDIA (K$)	US Base Cost (K$)	US Cont (K$)	Total US Cost (K$)	DOE Request (K$)	NSF Request (K$)
US CMS Total Project Cost (then-yr $s)							**171,918**	**148,470**	**23,448**
Escalation							24,325	20,919	3,407
FY'96 R&D							2,400	2,300	100
US CMS Total Estimated Cost (FY'96 $s)		**85,037**	**11,265**	**22,633**	**118,935**	**26,257**	**145,193**	**125,252**	**19,941**
1	**Endcap Muon System**	**17,753**	**5,142**	**6,734**	**29,629**	**7,457**	**37,085**	**35,422**	**1,664**
1.1	Muon Measurement System	17,753	5,142	5,309	28,204	7,100	35,304	33,641	1,664
1.2	Endcap Iron Design	0	0	1,425	1,425	356	1,781	1,781	0
2	**Hadron Calorimeter**	**26,941**	**3,178**	**3,337**	**33,456**	**10,037**	**43,493**	**36,407**	**7,086**
2.1	Barrel Hadron Calorimeter	21,518	2,025	2,679	26,221	7,866	34,088	32,036	2,052
2.2	Endcap Hadron Calorimeter	3,196	587	90	3,873	1,162	5,035	0	5,035
2.3	Very Forward Calorimeter	2,227	567	569	3,362	1,009	4,371	4,371	0
3	**Trigger/Data Acquisition**	**9,957**	**464**	**3,892**	**14,313**	**4,112**	**18,425**	**16,567**	**1,858**
3.1	Endcap Muon Level 1 CSC Trigger	1,208	0	893	2,102	609	2,711	2,711	0
3.2	Calorimeter Level 1 Regional Trigger	3,089	0	1,499	4,588	1,330	5,918	5,918	0
3.3	Luminosity Monitor	345	42	48	435	87	522	0	522
3.4	Data Acquisition	5,315	422	1,452	7,189	2,085	9,274	7,937	1,336
4	**Electromagnetic Calorimeter**	**5,742**	**1,382**	**1,675**	**8,800**	**1,696**	**10,495**	**7,724**	**2,772**
4.1	Barrel Photodetectors	2,175	283	314	2,771	693	3,464	693	2,772
4.2	Very Front-End Electronics	2,835	451	922	4,208	717	4,925	4,925	0
4.3	Crystal Processing	176	270	291	737	72	809	809	0
4.4	Monitoring Light Source	556	379	148	1,083	214	1,297	1,297	0
5	**Tracking**	**2,346**	**1,099**	**1,915**	**5,360**	**2,144**	**7,503**	**4,134**	**3,369**
5.1	Forward Pixel Tracker	2,346	1,099	1,915	5,360	2,144	7,503	4,134	3,369
6	**Common Projects**	**22,298**	**0**	**0**	**22,298**	**0**	**22,298**	**19,106**	**3,192**
7	**Project Management**	**0**	**0**	**5,080**	**5,080**	**813**	**5,892**	**5,892**	**0**
7.1	Project Administration	0	0	2,651	2,651	424	3,076	3,076	0
7.2	Technical Coordination	0	0	2,428	2,428	389	2,817	2,817	0

Section III

Project Organization and Responsibilities

III. Project Organization and Responsibilities

A. Introduction

The US CMS Project operates within the context of CMS as an internationally funded experiment located at CERN. The CERN management has ultimate responsibilities for CMS and requires that CMS report to it. The executive function in CMS is provided by the CMS Management Board. The composition of that board is given in Fig. III-1. The CMS Management Board is advised on technical matters by the Technical Board (Fig. III-2) and on financial matters by the Finance Board (Fig. III-3).

Within CMS, the US CMS Collaboration acts congruently with a governance which is described below.

B. US CMS Organization

The organization of the US CMS Collaboration is described below. The organization of the full CMS Collaboration is described in the CMS Technical Proposal, in the CMS Interim Memorandum of Understanding, and in the CMS Constitution.

1. Membership

All US members of the CMS Collaboration are members of the US CMS Collaboration. Institutions which have applied for CMS membership but have not yet been accepted or rejected shall be non-voting members of the US CMS Collaboration. (The US CMS institutions and members are listed in Table IX-1.)

2. Collaboration Board

The US CMS Collaboration Board is the governing body and highest authority of the US CMS Collaboration. The Collaboration Board is composed of one representative from each US institution that is a member of the CMS Collaboration. An Institutional Representative is chosen by each US CMS institution. The chair of the Collaboration Board is elected by the board, and serves as the US representative on the CMS Management Board. Collaboration Board decisions are reached by consensus whenever possible. In the event a consensus cannot be reached, matters are decided by a majority vote of the members. (The US CMS Collaboration Board members are indicated in the listing in Table IX-1.)

Meetings

The US CMS Collaboration Board shall hold at least one meeting per year. Presently, the annual meeting and election of officers is held in the spring (April), and a second meeting is held in the fall before the annual budget submission. Other meetings may be called as necessary by the Collaboration Board Chair, or by 25% of the Collaboration Board members. Collaboration Board meetings will be open to all US CMS members, but only the Institution Representative or designee may vote.

Minutes of all US CMS Collaboration Board meetings shall be provided by the US CMS Collaboration Board Chair. The minutes shall be submitted for approval at the next subsequent Collaboration Board meeting, and shall be publicly available to all US CMS Collaboration members.

Voting

Each US CMS Institution shall have one vote, to be cast by the Institutional Representative or designee. The Institutional Representative may designate another CMS member from the same institution as that institution's voting representative.

Elections

Nominations for US CMS elective offices may be made by any US CMS member, and must be seconded by a member of the Collaboration Board. The US CMS Spokesperson shall supervise the election of the US CMS Collaboration Board Chair and of members of the US CMS Management Board, and the US CMS Collaboration Board Chair shall supervise the election of the US CMS Spokesperson. Elections shall be conducted by secret ballot, with the majority of votes of all US CMS institutions being required for election. In the event no candidate receives a majority vote on the first ballot, a runoff between the two candidates receiving the largest number of votes shall be conducted.

Elective Offices

The US CMS elective offices are the US CMS Collaboration Board Chair and the US CMS Spokesperson. The term of the Collaboration Board Chair shall be one year, with the limitation that the Collaboration Board Chair may serve no more than two consecutive full terms. The term of the Spokesperson shall be three years, with the possibility of reelection to succeeding terms. In the event of a vacancy in an elective office, a special election to fill the unexpired term shall be conducted.

Competence

Should serious problems arise concerning the performance of any elected member of the US CMS Management Board, the recommendation for change shall be brought by the US CMS Collaboration Board Chair. (A recommendation for change of the Collaboration Board Chair would be brought by the US CMS Spokesperson.) A decision for change will require a 2/3 majority of the members of the US CMS Collaboration Board.

3. Management Board

The US CMS Management Board is the body concerned with directing the US CMS Project. All major decisions of the US CMS Management Board will be submitted to the US CMS Collaboration Board for ratification. The Management Board is composed of the US CMS Spokesperson, of the US CMS Collaboration Board Chair, of CMS subsystem managers where relevant, of an elected representative from each US CMS subsystem, of liaisons to the US funding agencies, of technical representatives of the major US subsystems, and of US CMS project management representatives. No individual shall have more than one vote regardless of the number of ways he/she may qualify for Management Board membership. The organization and present members of the US CMS Management Board are shown in Fig. III-4.

Minutes of all US CMS Management Board meetings shall be provided by the US CMS Spokesperson. The minutes shall be submitted for approval at the next subsequent Management Board meeting, and shall be publicly available to all US CMS Collaboration members.

Spokesperson

The US CMS Spokesperson is elected by the Collaboration Board, and is the chair of the Management Board. The Spokesperson, acting with the advice and consent of the Management Board, is responsible for the management of the US CMS Project and functions as the US CMS Project Manager. The US CMS Spokesperson serves with the initial and continuing concurrence of DOE and NSF.

CMS Management Representatives

US members of the CMS Management Board shall be members of the US CMS Management Board. CMS Management Board members include the US CMS Collaboration Board Chair and such other US CMS members as shall be chosen by the CMS Collaboration. CMS project managers who are members of the US CMS Management Board shall also serve as the US Coordinator for their respective subsystem. At present, appointed members of the US CMS Management Board exist for the Endcap Muon, Hadron Calorimeter, and Trigger/DAQ subsystems. The organization and present members of the CMS Management Board are shown in Fig. III-1.

US Subsystem Representatives

Each of the six US subsystems (Endcap Muon, Hadron Calorimeter, Trigger/Data Acquisition, Electromagnetic Calorimeter, Tracking, and Software) shall annually elect a representative to the US CMS Management Board. Each US subsystem shall organize a US subsystem Institution Board, composed of one representative from each US CMS institution that is participating in the corresponding CMS subsystem. Each US CMS subsystem Institution Board shall elect a representative who will serve a one year term on the US CMS Management Board. The elections will be organized by the Spokesperson acting as Chair of the Management Board, and will require the majority of the votes cast by the subsystem Institution Board for election. In the event no candidate receives a majority of the votes cast on the first ballot, a runoff between the two candidates receiving the largest number of votes shall be conducted. In the event of a tie, the deciding vote shall be cast by the US CMS Collaboration Board Chair (unless the Collaboration Board Chair is a member of that subsystem Institution Board, in which case the US CMS Spokesperson shall cast the deciding vote). The elected subsystem representative will also serve as the US Coordinator for those subsystems lacking US representation on the CMS Management Board. At present, these subsystems are Electromagnetic Calorimeter, Tracking, and Software. US CMS subsystem institutional participation is shown in Table I-2.

Technical Representatives

The US technical coordinators of the major US subsystems who are members of the CMS Technical Board shall be non-voting members of the US CMS Management Board. These technical representatives will provide the technical expertise needed to make informed project decisions. The organization and present members of the CMS Technical Board are shown in Fig. III-2.

Funding Agency Liaisons

The US members of the CMS Finance Board who are liaisons to US funding agencies (DOE and NSF) shall be members of the US CMS Management Board. The organization and present members of the CMS Finance Board are shown in Fig. III-3.

Project Management Representatives

To facilitate interactions with US funding agencies and for effective management of US CMS activities and resources, a formal project management structure will be set up, with the project office located at Fermilab. The organization of the US CMS Project Office is shown in Fig. III-5. A Project Administrator and a Technical Coordinator are nominated by the US CMS Spokesperson, with the advice and consent of the US CMS Management Board, and with the approval of the US CMS Collaboration Board. The US CMS Project Administrator and the Technical Coordinator shall be non-voting members of the US CMS Management Board.

C. DOE Organization and Responsibilities

DOE was made responsible by Public Law 95-91, dated August 7, 1977, for assuring coordinated and effective administration of Federal energy policy and programs. This law also established with DOE the Office of Energy Research, one of whose missions is to maintain the nation's competitiveness in scientific areas for which DOE is responsible.

As part of the DOE's Energy Research Mission, the High Energy Physics Program within the HENP supports basic research in High Energy Physics. HENP is responsible for long-range high energy physics research. The goals of HENP are identified in the mission area assignments agreed to by the Director of Energy Research and the Under Secretary.

The DOE organizational relationships for the US CMS Project are shown in Fig. III-6.

1. High Energy & Nuclear Physics

The HENP has the overall responsibility for the development of high energy physics and is the lead organization for the US CMS Project. The HENP through its High Energy Physics Division, will provide assistance, guidance and technical overview, overall program policy, planning, program development (including establishment of broad priorities) and budget preparation/defense (with support from the field organization). The prime point of contact for the day-to-day issues will be the US CMS Program Manager with the DHEP.

The responsibilities of the HENP related to the project include the following:

- Approval of the US CMS Construction Project Data Sheet.
- Approval of the US CMS Project Charter, Project Plan, and changes thereto.
- Review and concur in the PMP and changes thereto.
- Review and approve major cost, schedule, and technical baselines and major changes to authorized baselines to be used in the design. (Key Milestones are to be mutually agreed upon with HENP and the US CMS Program Officer and identified on the project master schedule. HENP will approve changes to the control milestones which could have a negative impact on the project's cost or schedule.)
- Provide overall programmatic guidance and direction.
- Review the US CMS Construction Project on a periodic basis with the assistance of CH, BAO, ER and other reviewers as deemed necessary.
- Provide project and R&D funding on a timely basis for the proper execution and support for the project objectives and design goals.
- Coordinate or assist in the coordination with other HQ Offices (i.e. ES&H, etc.).
- Keep CH, BAO, Project Managers informed of programmatic issues and information affecting the project, including status of budget and congressional actions.
- Interface with the Project Manager on a day-to-day basis.

2. Chicago Operations Office

The Manager, CH, has been delegated the responsibility and the authority for the Field Management Oversight of the US CMS Construction Project which includes the line management authority, responsibility and accountability for overall project implementation and contract administration. The execution of this project will be consistent with the approved Project Plan and DOE policies and orders including appropriate application of DOE Order 4700.1 - Project Management System.

3. Batavia Area Office

The Manager, BAO, administers the URA contract and exercises day-to-day oversight of Fermilab. The BAO Manager has been delegated all the responsibility and authority for execution of the project. Among other, this includes the following responsibilities.

- Supervise the performance of the DOE US CMS Project Manager and appropriate staff, and delegate to the DOE US CMS Project Manager the authority for day-to-day implementation, management and direction of the project.
- Provide support for BAO staff, government agencies, or consultants, when necessary and appropriate.
- Review and concur in the PMP and the methods to be used by the DOE US CMS Project Manager.
- Review and approve all documents as required by the Department Orders or other Federal Regulations.
- Approve Fermilab subcontract actions within the authority delegated to him.
- Authorize the R&D work in accordance with DOE Order 5700.7B, Work Authorization System.
- All financial management functions delegated to CH.

D. US CMS Project Office

The US CMS Collaboration is responsible for the design, construction, installation, and commissioning of the US CMS Project. The PMP for US CMS draws on the model used successfully by the ZEUS Project. The US CMS spokesperson retains authority over and responsibility for the achievement of the technical, cost, and schedule goals for this project. The US CMS project manager will establish a project organization which has designated responsibility for the technical, cost, schedule, procurement, and construction aspects of the project. Primary responsibility rests with the US CMS Project Office with support responsibilities carried by existing Fermilab service groups including: the Business Service Section, Facilities Engineering Service Section, the ES&H Section, and the Technical Support Section.

1. Fermilab as US CMS Host Institution

Fermilab has agreed to act as host laboratory to the US CMS Project, and will also serve as geographic host to project reviews. This role is analogous to that of ANL in the recently completed ZEUS Project sited at DESY. The US CMS Project Office will physically reside at Fermilab, and will provide administration for DOE funds. (Administration of NSF funds is provided by the US CMS NSF Office; see below.) Fermilab will also provide Service Accounts for US CMS groups, and travel and purchasing support will be available.

Use of Fermilab facilities and services shall be agreed upon via MOU exactly as with the use of available infrastructure at any US CMS institution. The Spokesperson/Project Manager must report to the Fermilab Director to provide accountability for all services provided to US CMS which are not paid for by US CMS Project funds. The Director may seek advice from the Fermilab Program Advisory Committee. The provided services may include services provided to the Fermilab CMS group or may be services provided to any other US CMS Institution. These items shall be negotiated annually by Fermilab (as host laboratory), by the US CMS Project Manager, and by the collaborating US CMS institution.

The Project Manager shall hold a management reserve each fiscal year. That reserve, typically 20% of the year's allocation, will be committed by the Project Manager during the course of the year based on performance and need of the various groups in the US CMS Collaboration. The reserve will reside in a Fermilab Service Account provided for that purpose, and will not be subject to Fermilab overhead charges.

2. US CMS Project Office at Fermilab

The organization of the US CMS Project Office is shown schematically in Fig. III-5. This office is headed by the US CMS Spokesperson as Project Manager and as Chair of the US CMS Management Board. The Spokesperson can be elected from any US CMS Institution to a three-year renewable term, as discussed in Section III.B of this document.

To facilitate liaison with the host laboratory, the US CMS Spokesperson shall be a Fermilab employee with a (guest) appointment for the duration of the term. The level of that appointment will allow direct access of the Spokesperson, acting as Project Manager, to DOE and NSF.

The annual budget allocation for the US CMS Project shall be set directly through negotiations between the Spokesperson and the relevant funding agencies. Allocations of project funds are the purview of the Spokesperson/Project Manager with the advice and consent of the US CMS Management Board.

All costs of the Project Office (exclusive of physicist salaries) shall be explicitly borne by the US CMS Project and are called out in the US CMS WBS. The costs of

Project Management will not be covered by overhead charges at Fermilab, but will be explicitly included in the project cost estimate.

3. US CMS NSF Office

The US CMS NSF Coordinator shall maintain an office responsible for the administration of NSF funds. The NSF Coordinator is selected by the NSF-funded CMS institutions, and serves as the NSF Liaison on the CMS Finance Board. The organization of the NSF Office is included in the Project Office organization chart shown in Fig. III-5.

4. US CMS Education Office

The US CMS Project Manager shall establish and maintain an Education Office within the US CMS Project Office.

5. Authorization and Funding

The authorization of funds within the US CMS Project is the responsibility of the US CMS Spokesperson / Project Manager with the advice and consent of the US CMS Management Board. The authorization is communicated to the US CMS Project Office and then to the US funding agencies, DOE and NSF, as shown in Figure III-7.

The allocation of funds to US CMS institutions is ultimately defined by the Project Manager. Subsequently, funding is provided to those institutions (including Fermilab as a US CMS collaborating institution) and to Fermilab as US CMS host (management reserve and whatever amount an institution chooses to receive by Memorandum Purchase Order from Fermilab). Explicit arrangements are defined in the annual US CMS MOU Amendment, which appears in Section IX.

6. Fermilab US CMS Experimental Group

The Fermilab CMS physicist group shall be distinct from Fermilab as US CMS host institution, with a leader chosen by that group. The Fermilab CMS Group Leader shall negotiate a US CMS MOU annually with the Spokesperson. The Fermilab CMS group shall function as any other US CMS institution. In particular, the use of Fermilab resources covered in the MOU for the Fermilab group shall cover only those services required by the Fermilab CMS group. Services requested by other US CMS institutions will be negotiated by the Spokesperson and the individual US CMS institution and shall require the concurrence of the Fermilab Director in the annual US CMS MOU Amendment.

7. US CMS Project Manager

The US CMS Project Manager is responsible for monitoring the technical, cost, and schedule progress of the US CMS Project, and is assisted in the execution of the Project by the US CMS Project Office. The US CMS Project Manager provides overall managerial leadership for the US CMS Project and is responsible for assembling the management team responsible for design, construction and operation of the US CMS Project and has direct responsibility for the execution of the US CMS Project. The US CMS Project Manager is the senior spokesperson for the US CMS Project in external interactions with DOE, NSF, Federal and State agencies, the Congress, industry, and other national and international organizations. In the absence of the US CMS Project Manager or any other senior administrator, an appropriate person will be designed as "Acting" on an ad hoc basis.

Specific responsibilities of the US CMS Project Manager include:

- Administering, planning, organizing and controlling the US CMS Project to meet the Project technical, cost, and schedule objectives.
- Establishment of design criteria for all facility systems and obtainment of necessary DOE approval.
- Reviewing and approving the designs and specifications to satisfy the functional requirements.
- Establishing the US CMS Configuration Control Board (CCB), and approving changes within the authority of the Project Manager.
- Submission of reports of project cost, schedule, and technical status to DOE on a periodic basis.
- Submission of budget planning documents for the construction project consistent with the DOE budget cycle.
- Managing contingency budgets subject to DOE Project Manager Approval.
- Identifying the persons with the authority and responsibility for controlling indirect costs.
- Insuring that each control account is assigned to a person who has the authority and responsibility to control the resources and work activities with the written technical, schedule, and cost baselines.

8. WBS Level 2 Managers

The WBS level 2 managers report directly to the US CMS Project Manager and have the specific responsibilities listed below:

- Perform control account management at the second level of the WBS consistent with management responsibilities, organization structure, and commonly accepted practices.
- Ensure that the control account and the schedule status are recorded on a timely basis to maintain current period, cumulative-to-date and at-completion records.

- The WBS level 2 managers are the members of the US CMS management board who are responsible for the particular subsystems of the US CMS work breakdown structure.

Within CMS the detector subsystems are organized as distinct projects. The organization charts for the Muon, HCAL, Trigger/DAQ, ECAL and Tracking Projects are shown in Figs. III. 8, 9, 10, 11, and 12 respectively. The organization of the Software and Magnet Technical Boards are shown in Figs. III-13 and III-14.

9. Support and Programmatic Organization

The US CMS Project Manager will draw on Fermilab resources as agreed by the Fermilab Director. Procedures consistent with the Laboratory’s current accounting, budgeting, human resources, and procurement department policies will be followed and used throughout the Project.

The Project will obtain support to the extent agreed from the Laboratory’s indirect support group, including:

- Accounting
- Budget
- Environment, Safety and Health
- Human Resources
- Legal
- Material
- Facilities Management
- Quality Assurance and Value Engineering Office
- Information Services

The Project will procure services from the Laboratory’s service organizations when cost-effective, in accordance with the Laboratory’s make-or-buy policy. The Laboratory full cost recovery service centers include the following:

- Technical Support Section
- Facilities Engineering Services

All support functions will be provided through the Laboratory matrix organizational lines of authority and responsibility. The US CMS Project will also procure services, when cost effective, from the Laboratory's direct organizational units. The US CMS Project Manager will direct all questions of priority need for Laboratory support assistance not satisfied through normal lines of authority to the Laboratory Director.

10. Project Communications

The US CMS Project necessarily entails coordination between CERN, DOE and NSF. At the experiment level, CMS must coordinate with the US CMS collaboration. The US CMS Management Board serves as the interface between a given US CMS institution and the US CMS Project Office located at Fermilab. Lines of communication are schematically indicated in Fig. III-7.

The US CMS Project is conducted as a team effort involving HENP, DHEP, CH, BAO, NSF, CERN, Fermilab, CMS and US CMS. For the Project to progress rapidly, all parties need to be fully informed of progress, plans, issues, problems, solutions, and achievements in realtime.

Communication among participants is free and informal to the maximum extent feasible. Notes, “drafts,” phone calls, electronic mail, and informal discussions are exchanged frequently among the participants to accomplish information flow, raise issues for mutual resolution, and explore the viability of plans and solutions. Distribution of copies of informal correspondence to all participants is desirable to keep them fully apprised of these communications. Each organizational participant will designate an individual to coordinate informal communications and assure their proper distribution within that organization.

Formal communication of project business flows through channels. Action on and transmittal of formal communications are performed promptly. On most issues, informal communication will have occurred prior to formal communication to minimize surprise and delay and maximize success.

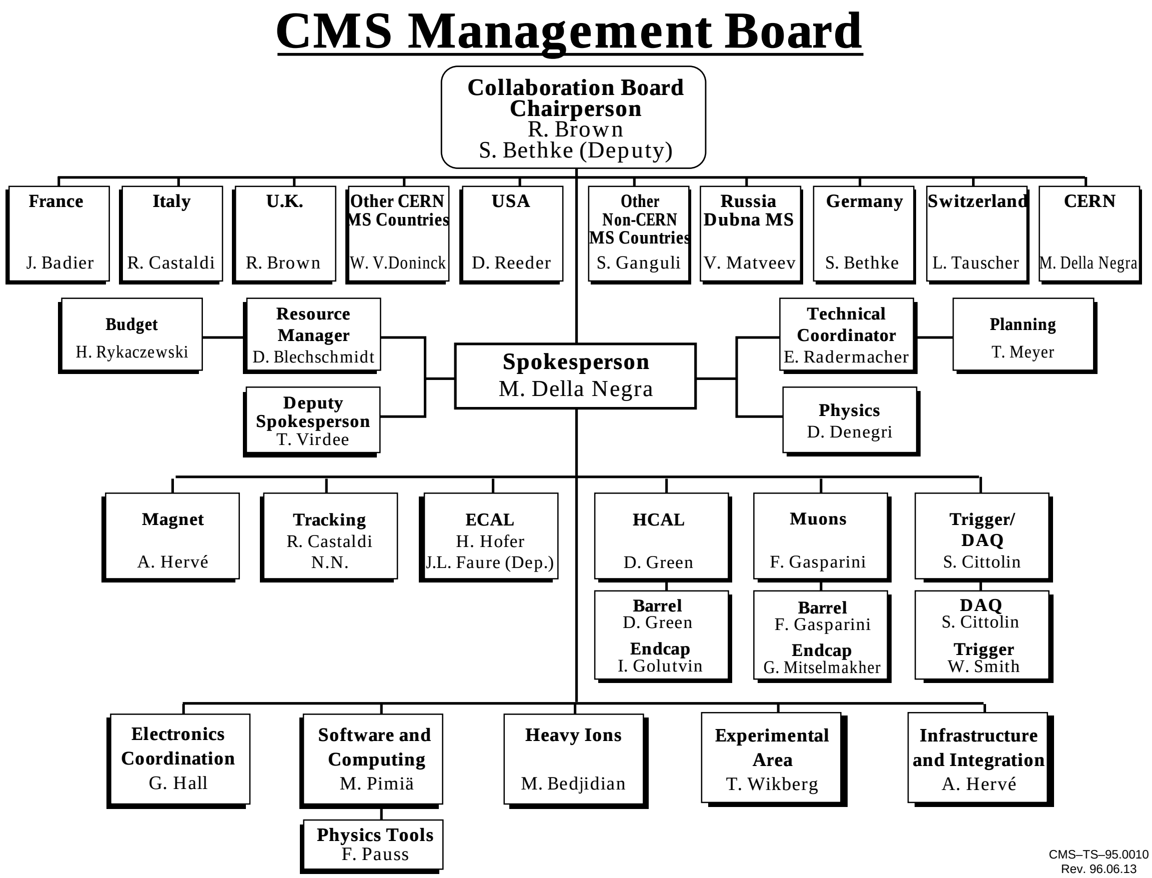

CMS Management Board
Collaboration Board Chairperson
R. Brown
S. Bethke (Deputy)
France
J. Badier
Italy
R. Castaldi
U.K.
R. Brown
Other CERN MS Countries
W. V.Doninck
USA
D. Reeder
Other Non-CERN MS Countries
S. Ganguli
Russia Dubna MS
V. Matveev
Germany
S. Bethke
Switzerland
L. Tauscher
CERN
M. Della Negra
Budget
H. Rykaczewski
Resource Manager
D. Blechschmidt
Deputy Spokesperson
T. Virdee
Spokesperson
M. Della Negra
Technical Coordinator
E. Radermacher
Planning
T. Meyer
Physics
D. Denegri
Magnet
A. Hervé
Tracking
R. Castaldi
N.N.
ECAL
H. Hofer
J.L. Faure (Dep.)
HCAL
D. Green
Muons
F. Gasparini
Trigger/ DAQ
S. Cittolin
Barrel
D. Green
Endcap
I. Golutvin
Barrel
F. Gasparini
Endcap
G. Mitselmakher
DAQ
S. Cittolin
Trigger
W. Smith
Electronics Coordination
G. Hall
Software and Computing
M. Pimiä
Heavy Ions
M. Bedjidian
Experimental Area
T. Wikberg
Infrastructure and Integration
A. Hervé
Physics Tools
F. Pauss
CMS–TS–95.0010
Rev. 96.06.13

Fig. III-1

CMS Technical Board

CMS–TS–95.0011
96-05-31

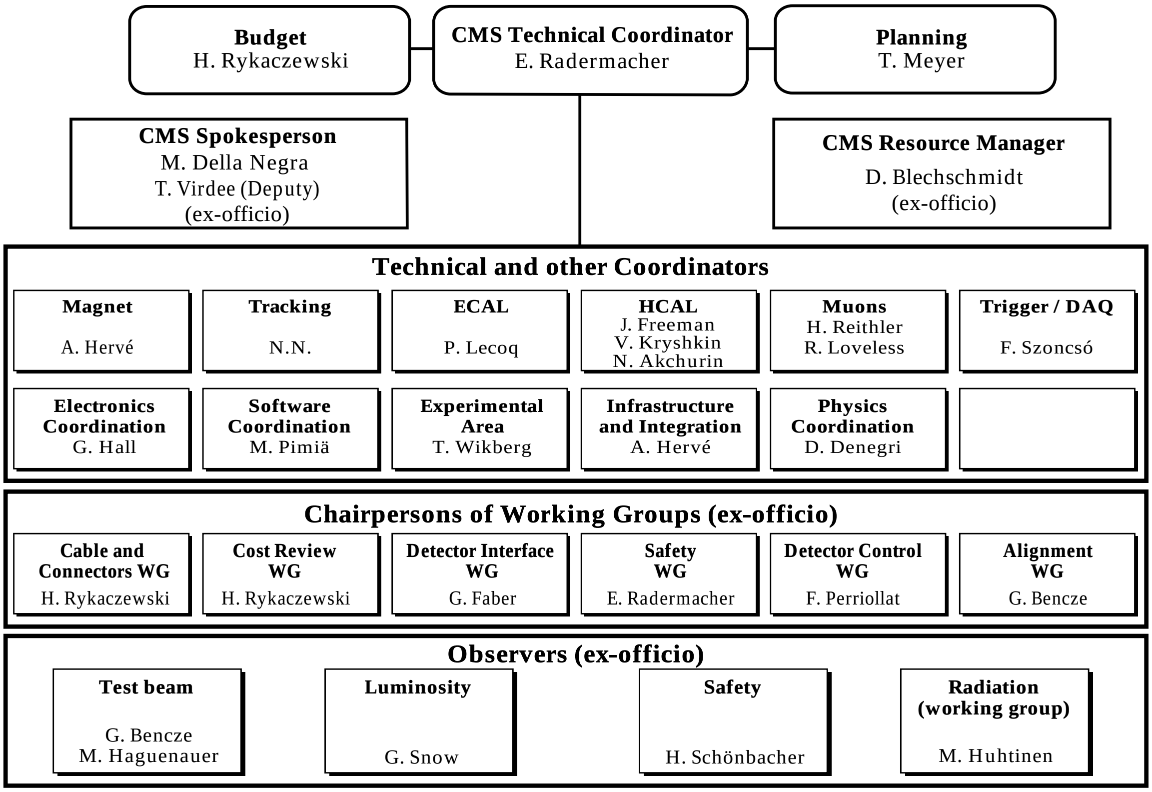
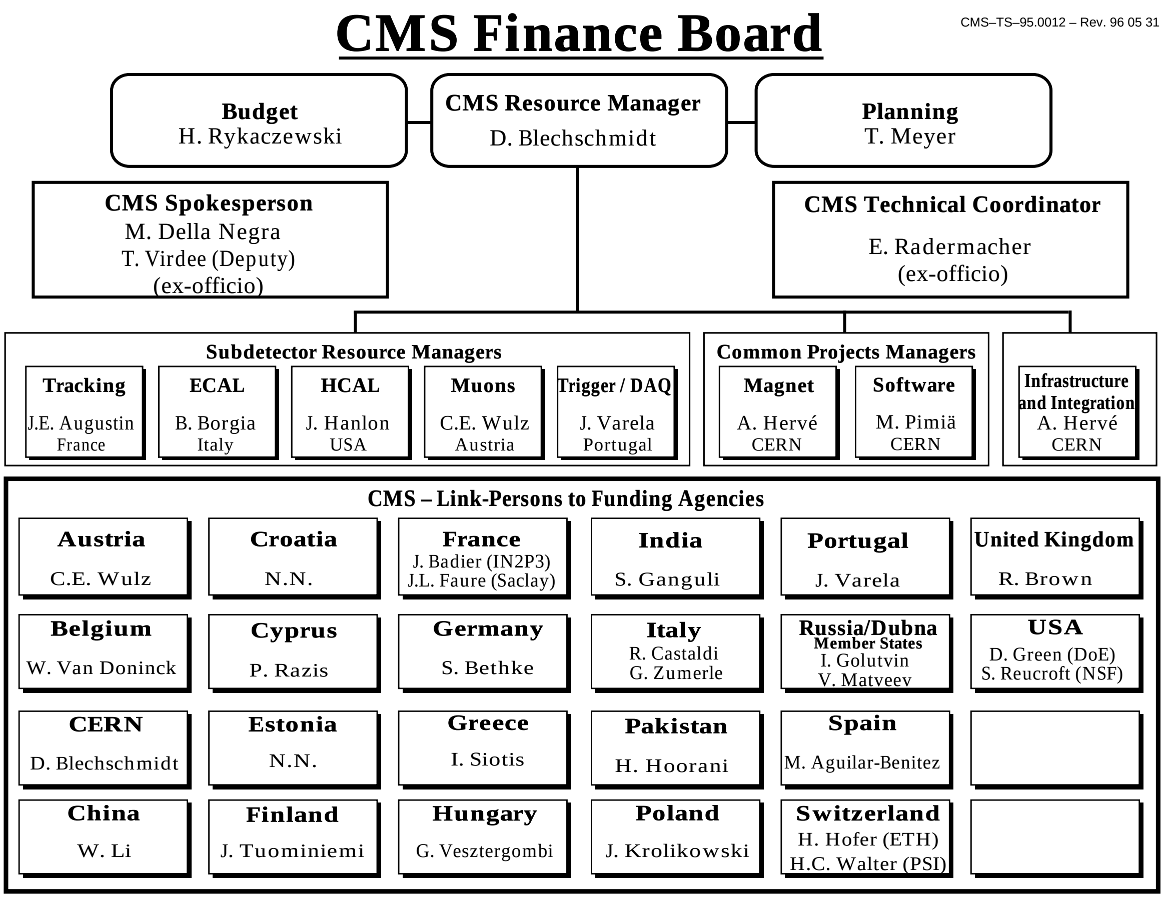


Fig. III-2



CMS Finance Board
CMS–TS–95.0012 – Rev. 96 05 31
Budget
H. Rykaczewski
CMS Resource Manager
D. Blechschmidt
Planning
T. Meyer
CMS Spokesperson
M. Della Negra
T. Virdee (Deputy)
(ex-officio)
CMS Technical Coordinator
E. Radermacher
(ex-officio)
Subdetector Resource Managers
Tracking
J.E. Augustin
France
ECAL
B. Borgia
Italy
HCAL
J. Hanlon
USA
Muons
C.E. Wulz
Austria
Trigger / DAQ
J. Varela
Portugal
Common Projects Managers
Magnet
A. Hervé
CERN
Software
M. Pimiä
CERN
Infrastructure and Integration
A. Hervé
CERN
CMS – Link-Persons to Funding Agencies
Austria
C.E. Wulz
Croatia
N.N.
France
J. Badier (IN2P3)
J.L. Faure (Saclay)
India
S. Ganguli
Portugal
J. Varela
United Kingdom
R. Brown
Belgium
W. Van Doninck
Cyprus
P. Razis
Germany
S. Bethke
Italy
R. Castaldi
G. Zumerle
Russia/Dubna
Member States
I. Golutvin
V. Matveev
USA
D. Green (DoE)
S. Reucroft (NSF)
CERN
D. Blechschmidt
Estonia
N.N.
Greece
I. Siotis
Pakistan
H. Hoorani
Spain
M. Aguilar-Benitez
China
W. Li
Finland
J. Tuominiemi
Hungary
G. Vesztergombi
Poland
J. Krolikowski
Switzerland
H. Hofer (ETH)
H.C. Walter (PSI)

Fig. III-3

US CMS Management Board

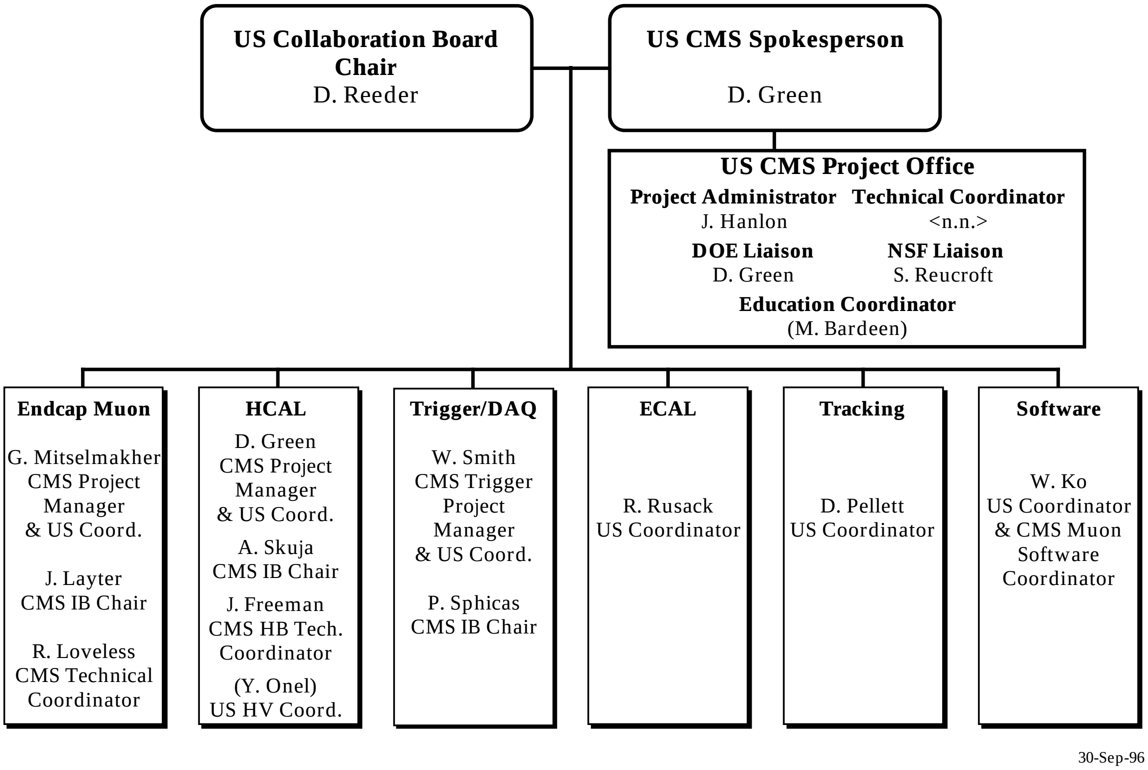


Fig. III-4

US CMS Project Office

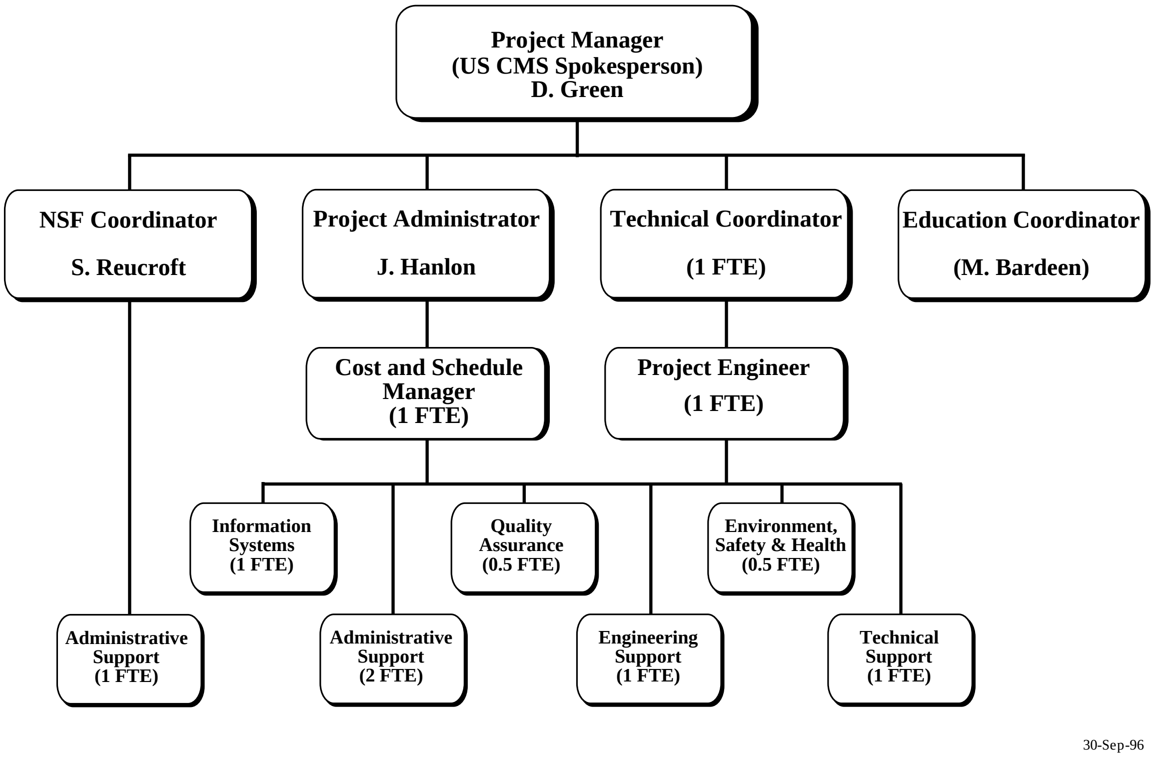


Fig. III-5

US CMS Management Organization Relationships

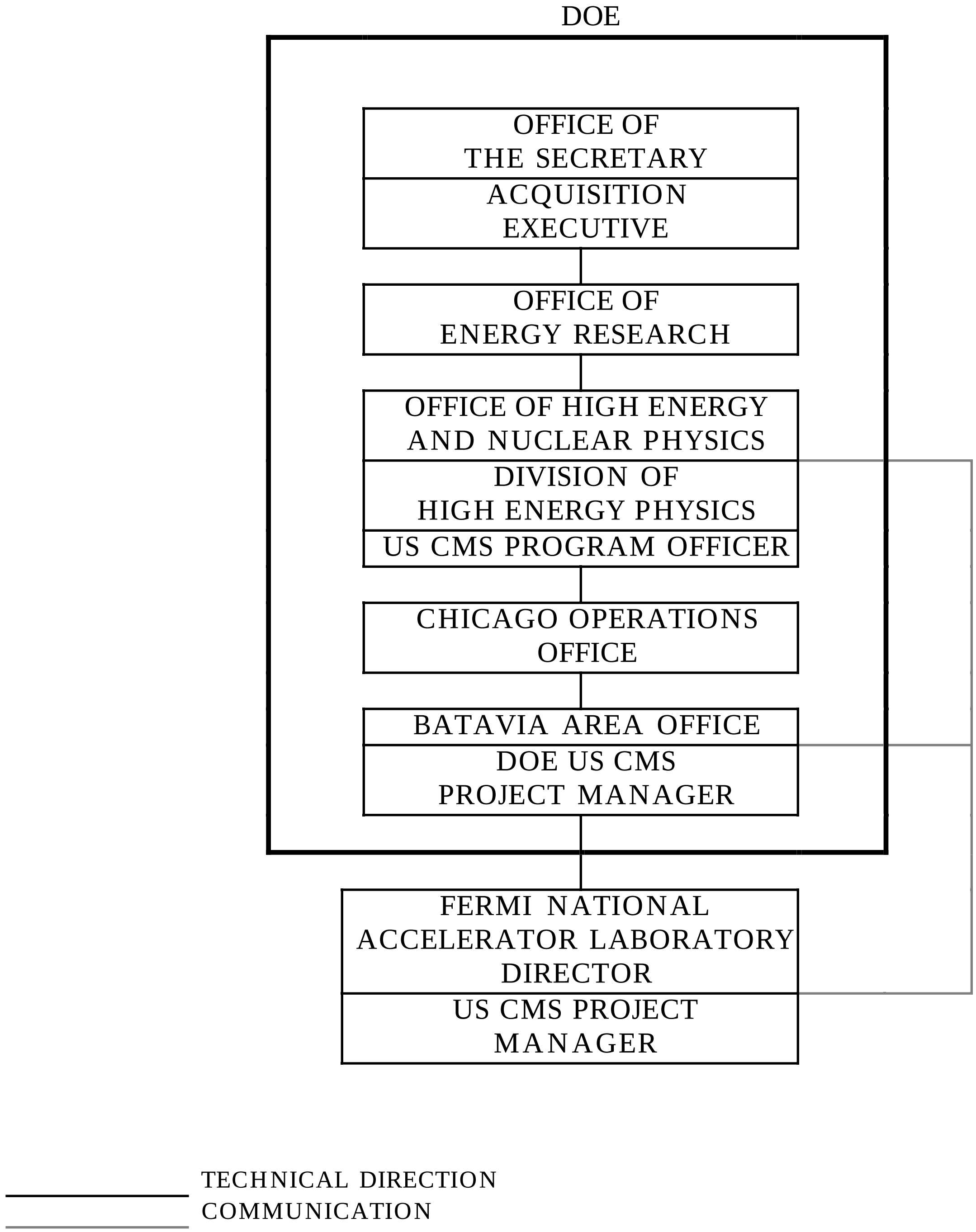
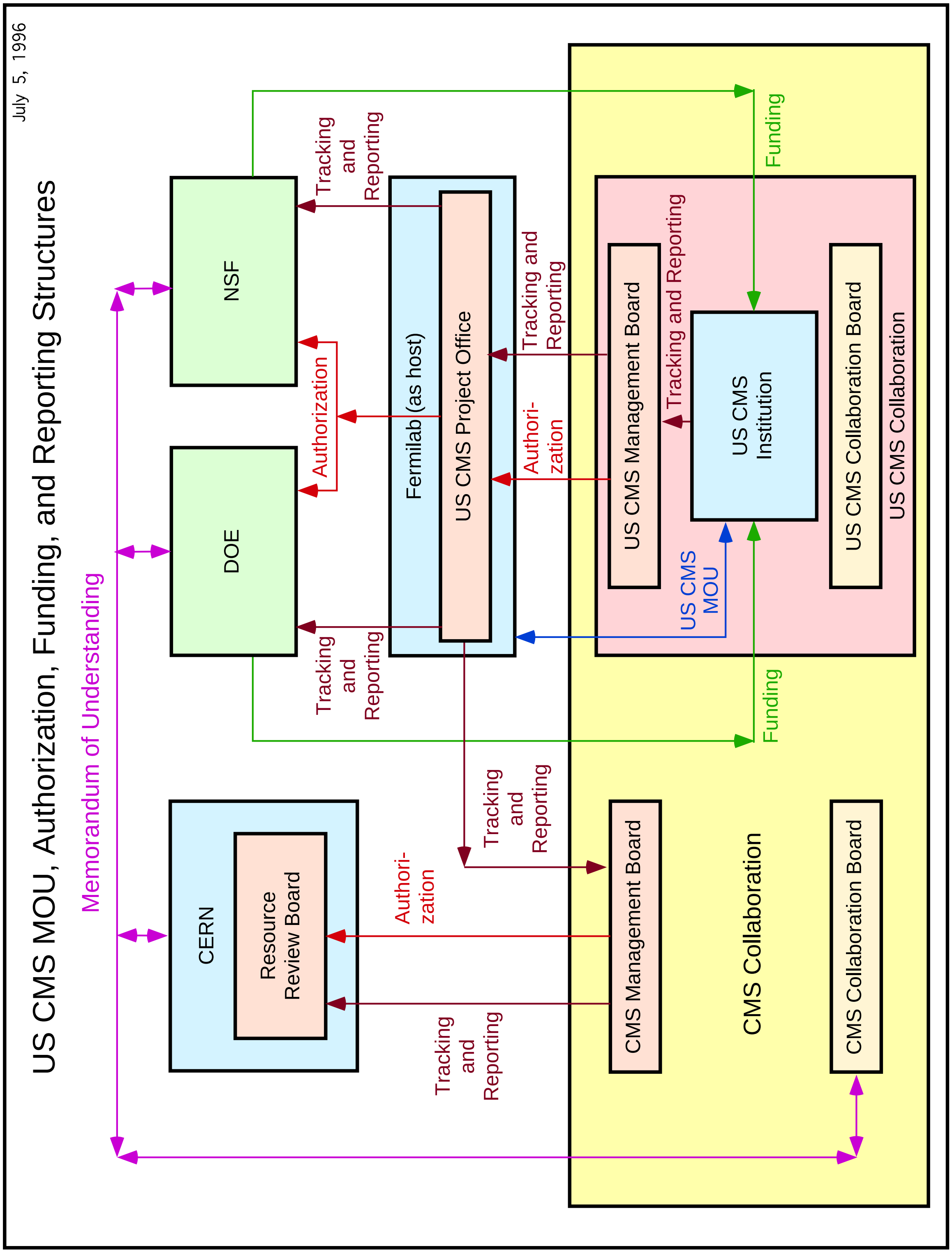


Fig. III-6



US CMS MOU, Authorization, Funding, and Reporting Structures
July 5, 1996
Memorandum of Understanding
NSF
DOE
CERN
Resource Review Board
Fermilab (as host)
US CMS Project Office
Tracking and Reporting
Tracking and Reporting
Authorization
Tracking and Reporting
Authori-zation
Tracking and Reporting
Funding
Funding
US CMS Management Board
Tracking and Reporting
US CMS Institution
US CMS Collaboration Board
US CMS Collaboration
US CMS MOU
Tracking and Reporting
Authori-zation
Tracking and Reporting
CMS Management Board
CMS Collaboration
CMS Collaboration Board

Fig. III-7

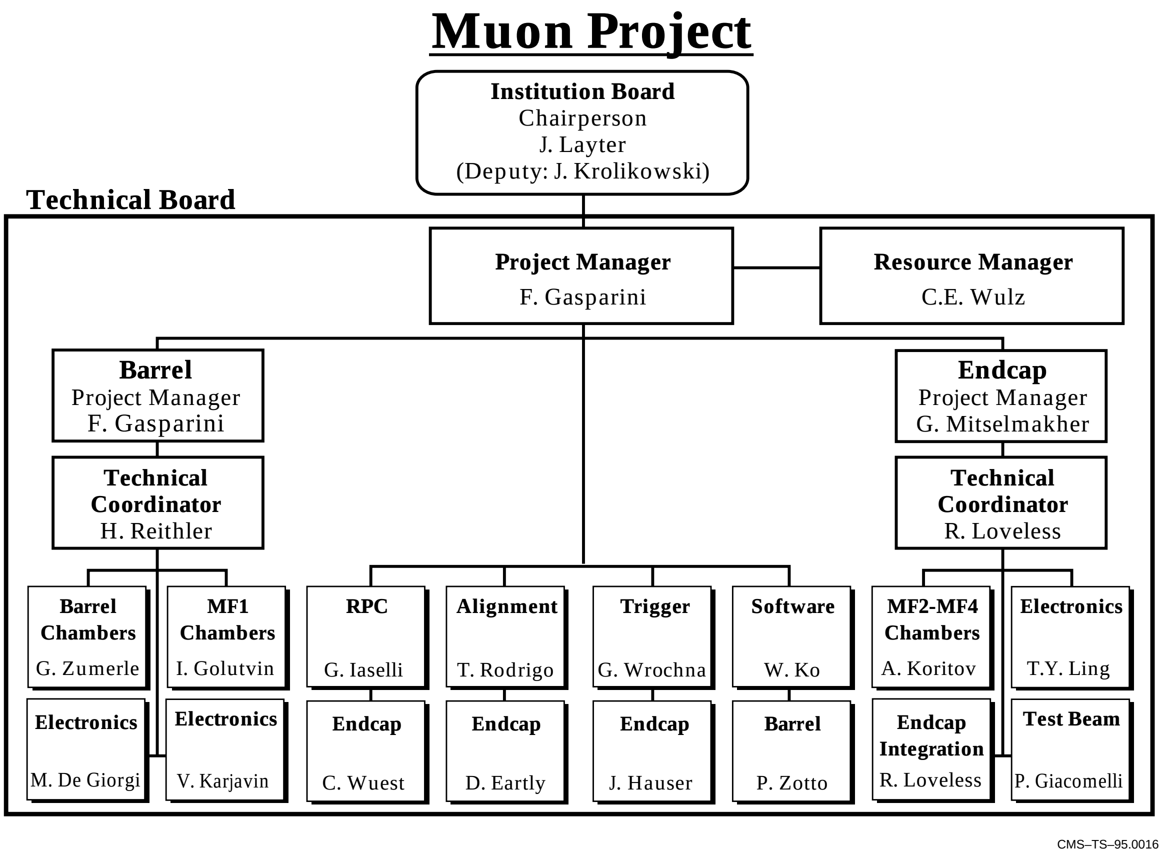

Muon Project
Institution Board
Chairperson
J. Layter
(Deputy: J. Krolikowski)
Technical Board
Project Manager
F. Gasparini
Resource Manager
C.E. Wulz
Barrel
Project Manager
F. Gasparini
Endcap
Project Manager
G. Mitselmakher
Technical Coordinator
H. Reithler
Technical Coordinator
R. Loveless
Barrel Chambers
G. Zumerle
MF1 Chambers
I. Golutvin
RPC
G. Iaselli
Alignment
T. Rodrigo
Trigger
G. Wrochna
Software
W. Ko
MF2-MF4 Chambers
A. Koritov
Electronics
T.Y. Ling
Electronics
M. De Giorgi
Electronics
V. Karjavin
Endcap
C. Wuest
Endcap
D. Eartly
Endcap
J. Hauser
Barrel
P. Zotto
Endcap Integration
R. Loveless
Test Beam
P. Giacomelli
CMS–TS–95.0016

Fig. III-8

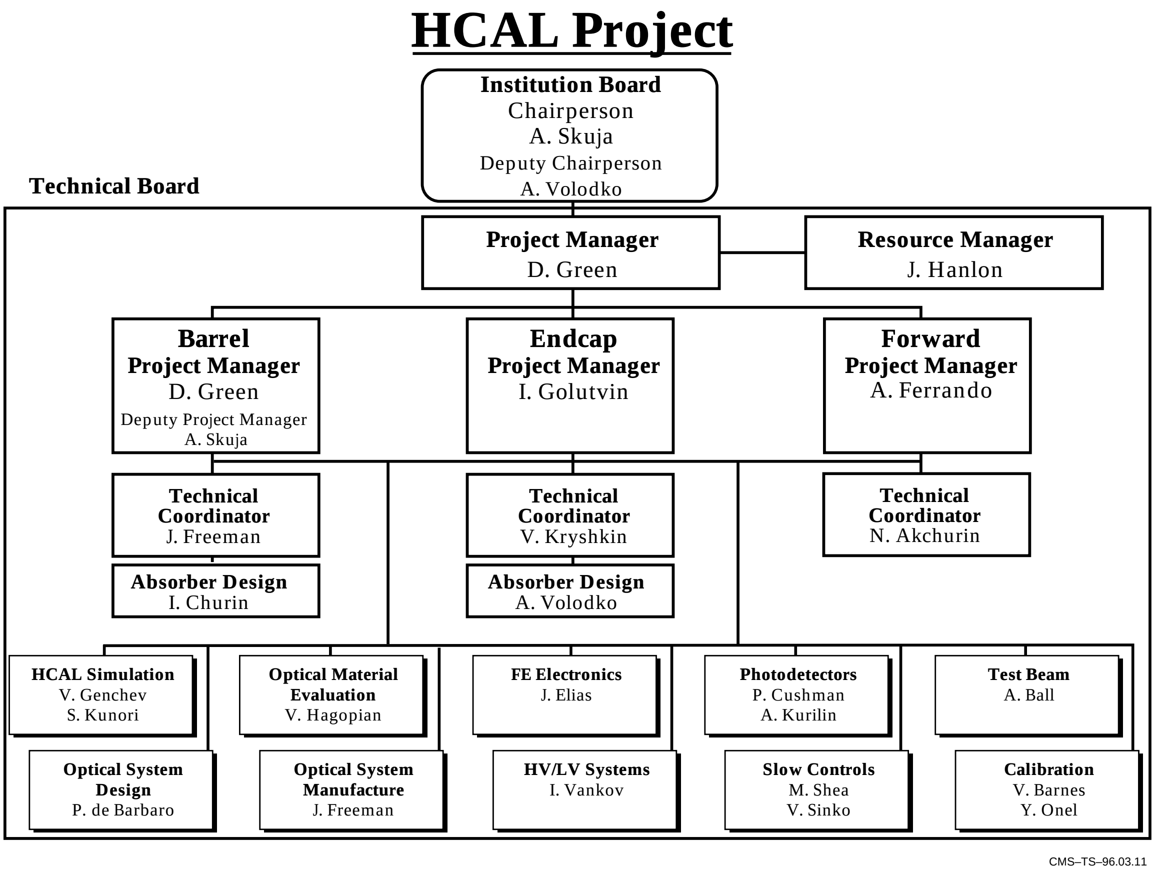

HCAL Project
Institution Board
Chairperson
A. Skuja
Deputy Chairperson
A. Volodko
Technical Board
Project Manager
D. Green
Resource Manager
J. Hanlon
Barrel
Project Manager
D. Green
Deputy Project Manager
A. Skuja
Endcap
Project Manager
I. Golutvin
Forward
Project Manager
A. Ferrando
Technical Coordinator
J. Freeman
Technical Coordinator
V. Kryshkin
Technical Coordinator
N. Akchurin
Absorber Design
I. Churin
Absorber Design
A. Volodko
HCAL Simulation
V. Genchev
S. Kunori
Optical Material Evaluation
V. Hagopian
FE Electronics
J. Elias
Photodetectors
P. Cushman
A. Kurilin
Test Beam
A. Ball
Optical System Design
P. de Barbaro
Optical System Manufacture
J. Freeman
HV/LV Systems
I. Vankov
Slow Controls
M. Shea
V. Sinko
Calibration
V. Barnes
Y. Onel
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Fig. III-9

Trigger and Data Acquisition Project

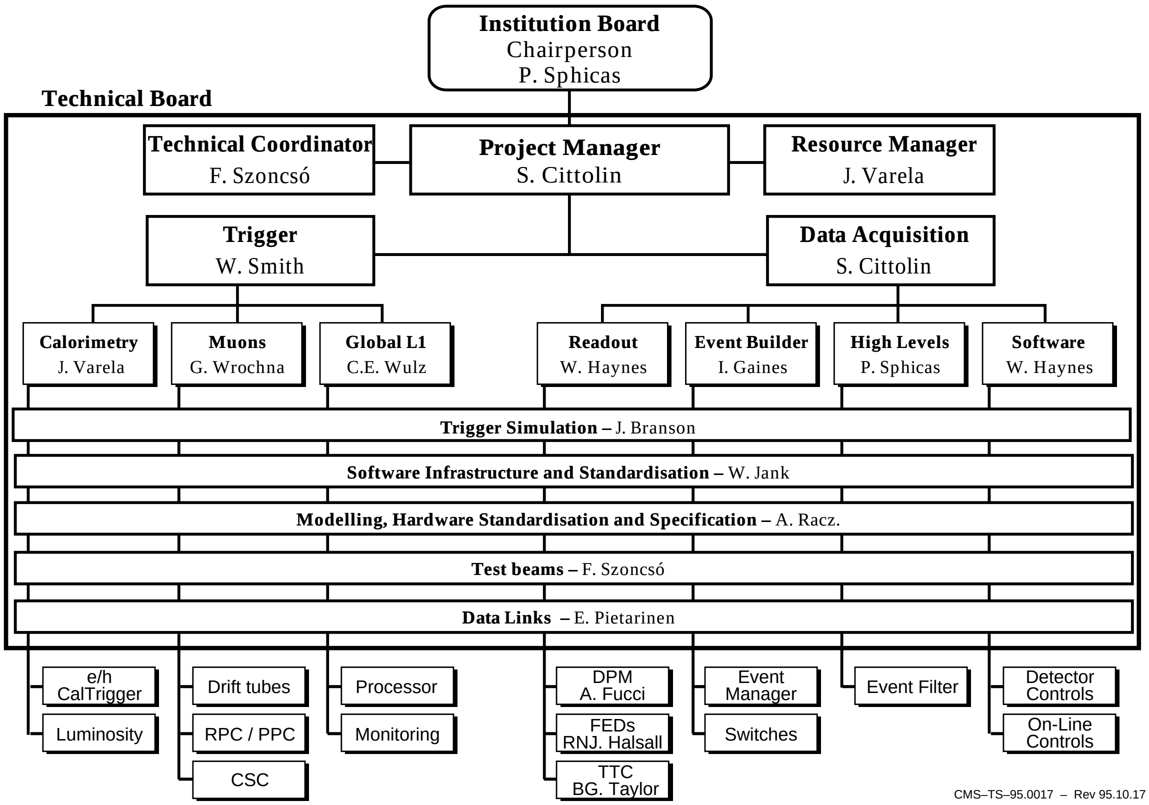


Fig. III-10

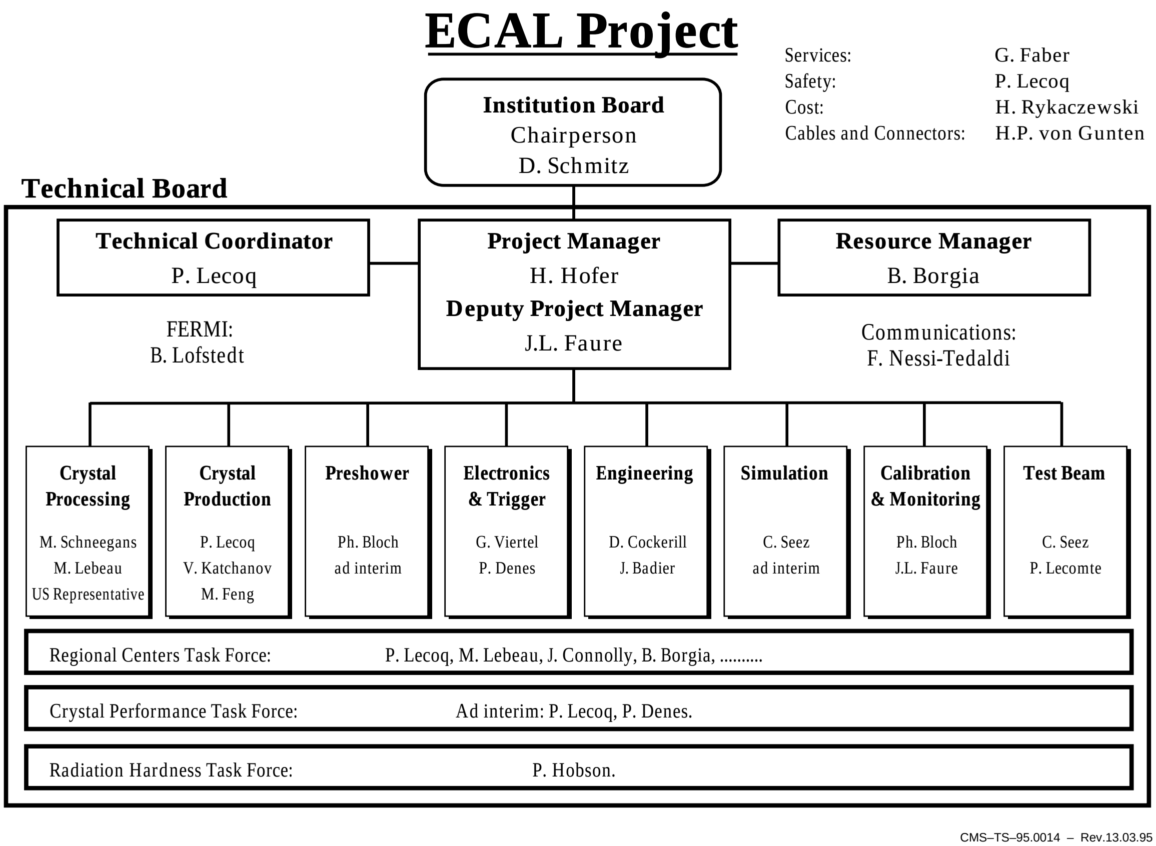

ECAL Project
Services: G. Faber
Safety: P. Lecoq
Cost: H. Rykaczewski
Cables and Connectors: H.P. von Gunten
Institution Board
Chairperson
D. Schmitz
Technical Board
Technical Coordinator
P. Lecoq
Project Manager
H. Hofer
Deputy Project Manager
J.L. Faure
Resource Manager
B. Borgia
FERMI:
B. Lofstedt
Communications:
F. Nessi-Tedaldi
Crystal Processing
M. Schneegans
M. Lebeau
US Representative
Crystal Production
P. Lecoq
V. Katchanov
M. Feng
Preshower
Ph. Bloch
ad interim
Electronics & Trigger
G. Viertel
P. Denes
Engineering
D. Cockerill
J. Badier
Simulation
C. Seez
ad interim
Calibration & Monitoring
Ph. Bloch
J.L. Faure
Test Beam
C. Seez
P. Lecomte
Regional Centers Task Force: P. Lecoq, M. Lebeau, J. Connolly, B. Borgia, ...
Crystal Performance Task Force: Ad interim: P. Lecoq, P. Denes.
Radiation Hardness Task Force: P. Hobson.
CMS–TS–95.0014 – Rev.13.03.95

Fig. III-11

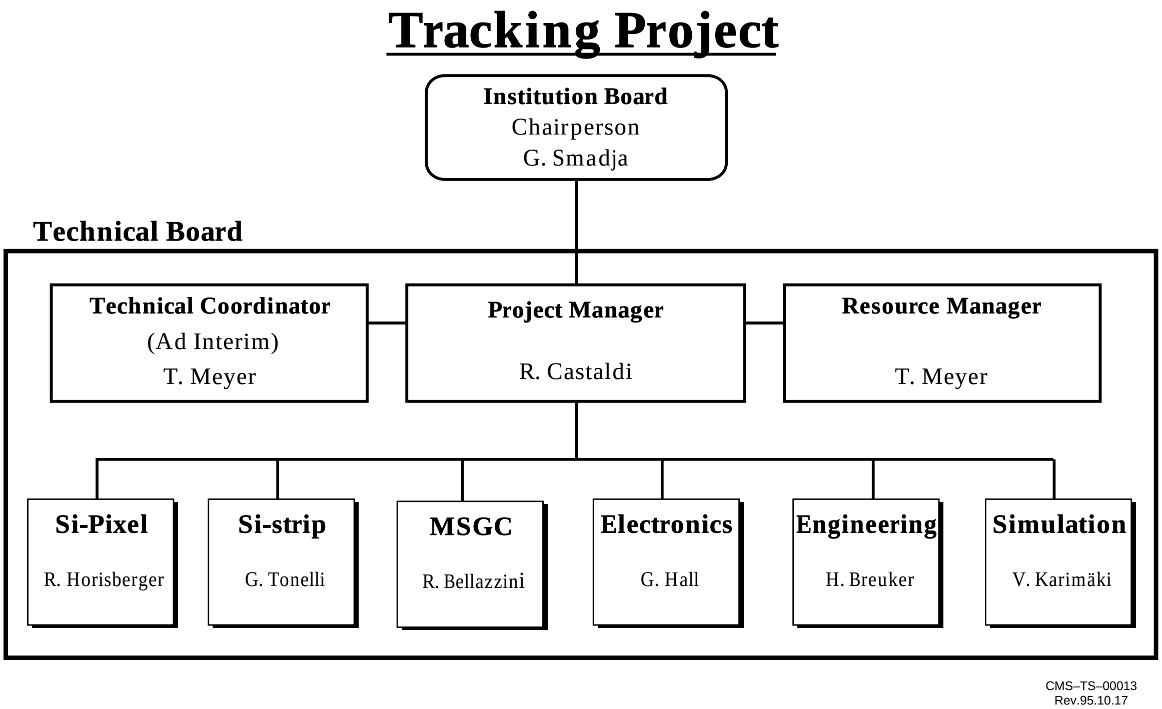

Tracking Project
Institution Board
Chairperson
G. Smadja
Technical Board
Technical Coordinator
(Ad Interim)
T. Meyer
Project Manager
R. Castaldi
Resource Manager
T. Meyer
Si-Pixel
R. Horisberger
Si-strip
G. Tonelli
MSGC
R. Bellazzini
Electronics
G. Hall
Engineering
H. Breuker
Simulation
V. Karimäki
CMS–TS–00013
Rev.95.10.17

Fig. III-12

Software Technical Board

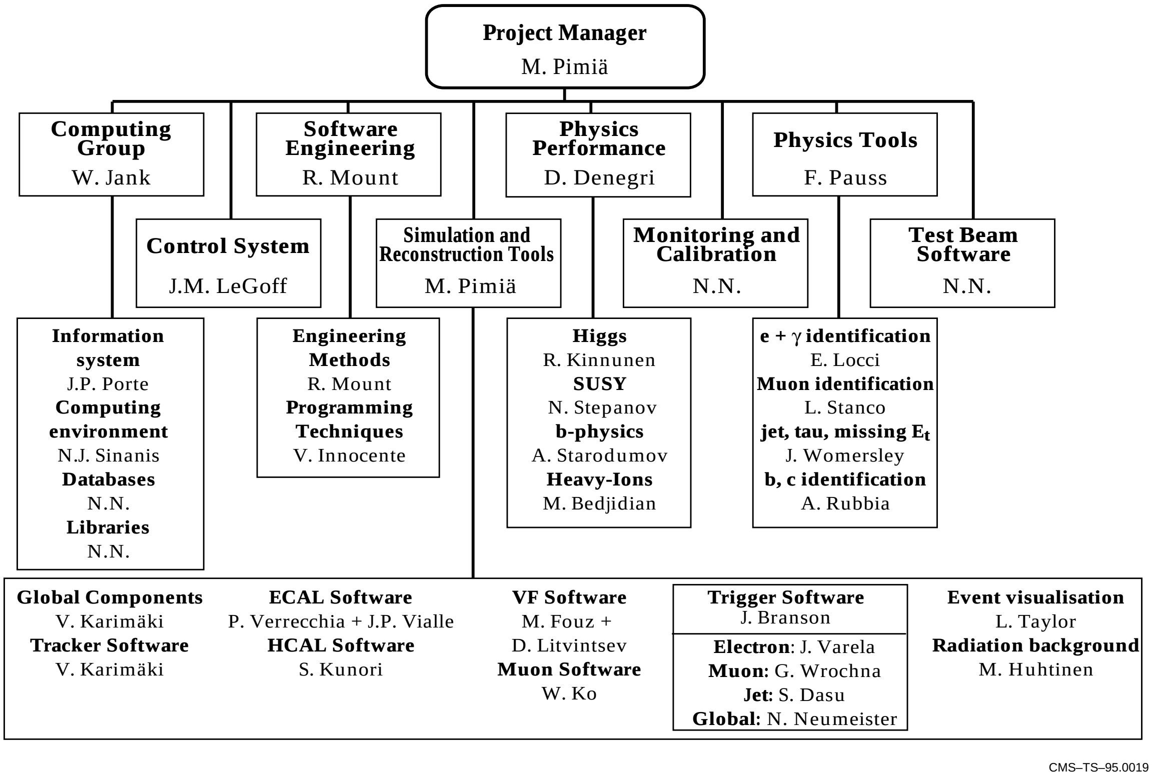


Fig. III-13

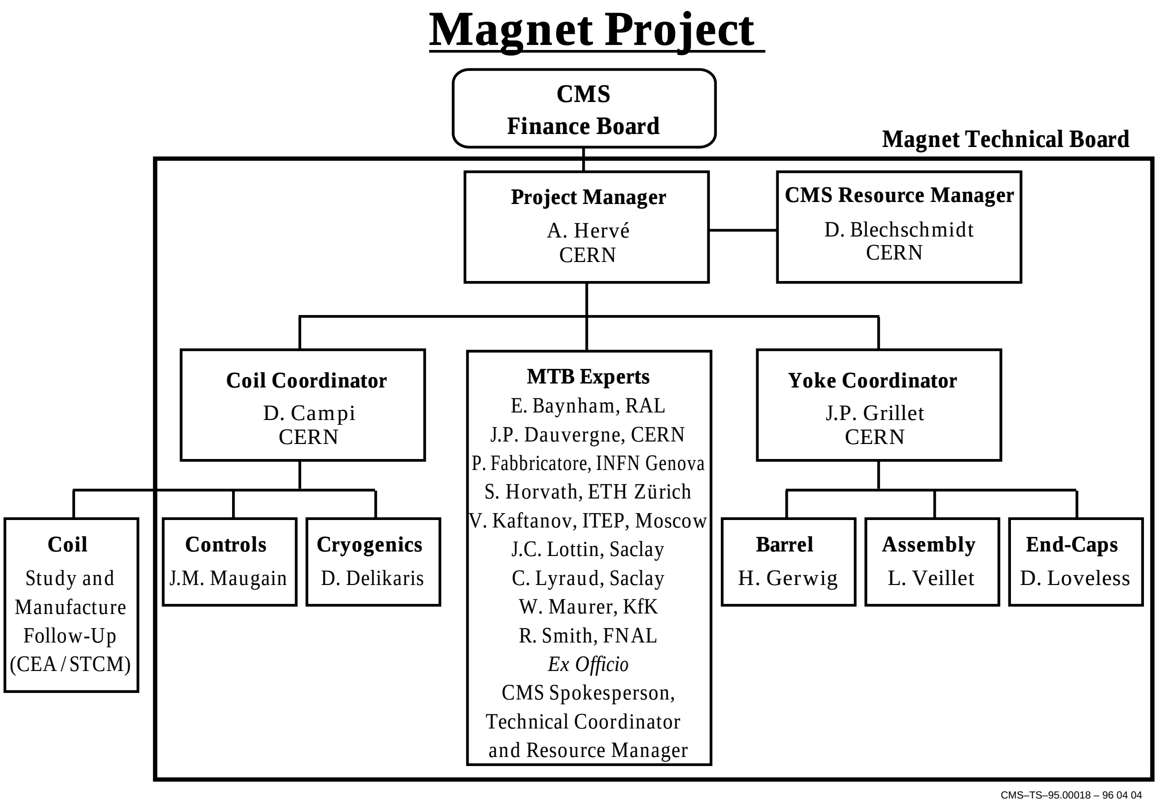

Magnet Project
CMS
Finance Board
Magnet Technical Board
Project Manager
A. Hervé
CERN
CMS Resource Manager
D. Blechschmidt
CERN
Coil Coordinator
D. Campi
CERN
MTB Experts
E. Baynham, RAL
J.P. Dauvergne, CERN
P. Fabbricatore, INFN Genova
S. Horvath, ETH Zürich
V. Kaftanov, ITEP, Moscow
J.C. Lottin, Saclay
C. Lyraud, Saclay
W. Maurer, KfK
R. Smith, FNAL
Ex Officio
CMS Spokesperson,
Technical Coordinator
and Resource Manager
Yoke Coordinator
J.P. Grillet
CERN
Coil
Study and
Manufacture
Follow-Up
(CEA / STCM)
Controls
J.M. Maugain
Cryogenics
D. Delikaris
Barrel
H. Gerwig
Assembly
L. Veillet
End-Caps
D. Loveless
CMS–TS–95.00018 – 96 04 04

Fig. III-14

Section IV

Work Plan

IV. Work Plan

A. Introduction

In this chapter, the work to be performed in the US CMS Project is described in Section IV.B, and the methodology to be used in the execution of the work is described in Section IV.C. The research and development (R&D) program connected with the US CMS Project is described in Section IV.D. System tests and commissioning are discussed in Section IV.E. The final two sections of this chapter describe the programs to be utilized by the US CMS Project for Quality Assurance (Section IV.F) and for Safety Analysis and Compliance and Environmental Compliance (Section IV.G).

B. Work Description

This project provides for the construction of elements of an experiment to be performed at CERN, designated the US CMS Project. The purpose of the project is described in Section II.A. The salient features of the work that needs to be done are briefly described in Section II of this plan, and in considerable detail in the CMS Technical Design Reports.

C. Work Execution

[to be completed after full project scope is known]

Design and Engineering

Construction, Fabrication, Assembly, and Installation

Inspection and Acceptance

D. Research and Development Program

A program of R&D in support of the US CMS construction project has already been initiated. This program will provide for the design and development of new detector components and for the fabrication and testing of prototypes. R&D directed towards the optimization of performance and cost will continue through the early years of construction. The DOE funded efforts in R&D will be done largely in FY96 and FY97. The NSF funded efforts will occur largely FY96, FY97, and FY98. The scope of the FY96 efforts in R&D undertaken by the US CMS collaboration are discussed in the US CMS Letter of Intent. The R&D program has been developed to interface with the construction project milestones.

The R&D effort will be managed by the US CMS Project Manager. Coordination of the R&D work with the construction schedule will be the responsibility of the US CMS Project Manager with the advice and consent of the US CMS Management Board.

E. System Tests and Commissioning

[to be completed after full project scope is known]

F. Quality Assurance Program

Quality assurance is an integral part of the design, procurement, fabrication, and construction phases of the US CMS Project. Special attention is being devoted to items that will affect the performance capability and operation of the CMS detectors.

It is the policy of the US CMS project that all activities shall be performed at a level of quality appropriate to achieving the technical, cost, and schedule objectives of the project. To implement this policy, the US CMS project will develop a SQIP that is based on the QA criteria established by DOE and NSF. The responsible person for the QAP for the US CMS is the US CMS Project Manager.

The US CMS project SQIP is based upon the ten criteria of DOE Order 5700.6C (Quality Assurance) and the ER DOE 5700.6C (Implementation Guide). As such it will define the management policies in regard to 1) QA program, 2) Personnel Training and Qualification, 3) Quality Improvement, 4) Documents and Records, 5) Work Processes, 6) Design, 7) Procurement, 8) Inspection and Acceptance Testing, 9) Management Assessment, and 10) Independent Verification.

Vendors will implement quality assurance programs appropriate to the services being furnished. These programs, as well as implementing procedures, are subject to review and audit by the US CMS Project Office at Fermilab.

G. Environment, Safety and Health Analysis and Compliance

Implementation of the project ES&H program is the responsibility of the US CMS Project Manager and the line managers in the US CMS organization. The US CMS Project Manager has appointed the US CMS Project Administrator to be the US CMS ES&H Supervisor with the responsibility to monitor the implementation of the total US CMS project ES&H program to ensure conformance and to be responsible for coordination of the project-wide ES&H program.

All project activities will be conducted in compliance with the applicable DOE and NSF ES&H directives.

Section V

Work Breakdown Structure

V. Work Breakdown Structure

All work required for successful completion of the US CMS Project is organized into a WBS. The WBS contains a complete definition of the scope of the project and forms the basis for planning, execution, and control of the US CMS Project. Specifically, the WBS provides the framework for the following activities:

Budgeting

Each element of the WBS is assigned a budgeted cost (BC). The budgeted cost of the project can be seen at any level by performing a sum over contributing lower levels.

Cost Estimating

The WBS supports a systematic approach to preparation of the cost estimate for the project. The WBS structure is extended to a level sufficient to allow definition of individual components for which a cost can be reasonably estimated. The BC and cost estimate are equal for the lowest level in each branch of the WBS.

Scheduling

The WBS also supports a systematic approach to preparation of the project schedule. Again each WBS element at the lowest level of the structure is assigned a schedule duration. The project schedule is created by establishing the interdependencies between the various elements.

Support Requirements

The WBS, in conjunction with the associated schedule and cost estimates, provides the framework for projecting funding and manpower requirements over the life of the project.

Configuration Control

The detailed scope of the project is specified within the WBS. Impacts of proposed changes to the scope are readily evaluated within the WBS framework.

Performance Measurement

The WBS supports the monitoring, control, and reporting of cost and schedule performance. Since each element of the WBS, and by association each work element, has a well defined BC and schedule a view of the progress of the project at any level is available at any time.

A. Organization of the WBS

The levels of the WBS reflect the logical breakdown of the work required to complete the project with lower levels providing progressively higher levels of detailed description. The number of levels is established by extending the description down to a level at which individual components can be identified and associated into a well defined piece of equipment or structure.

B. Project Summary WBS

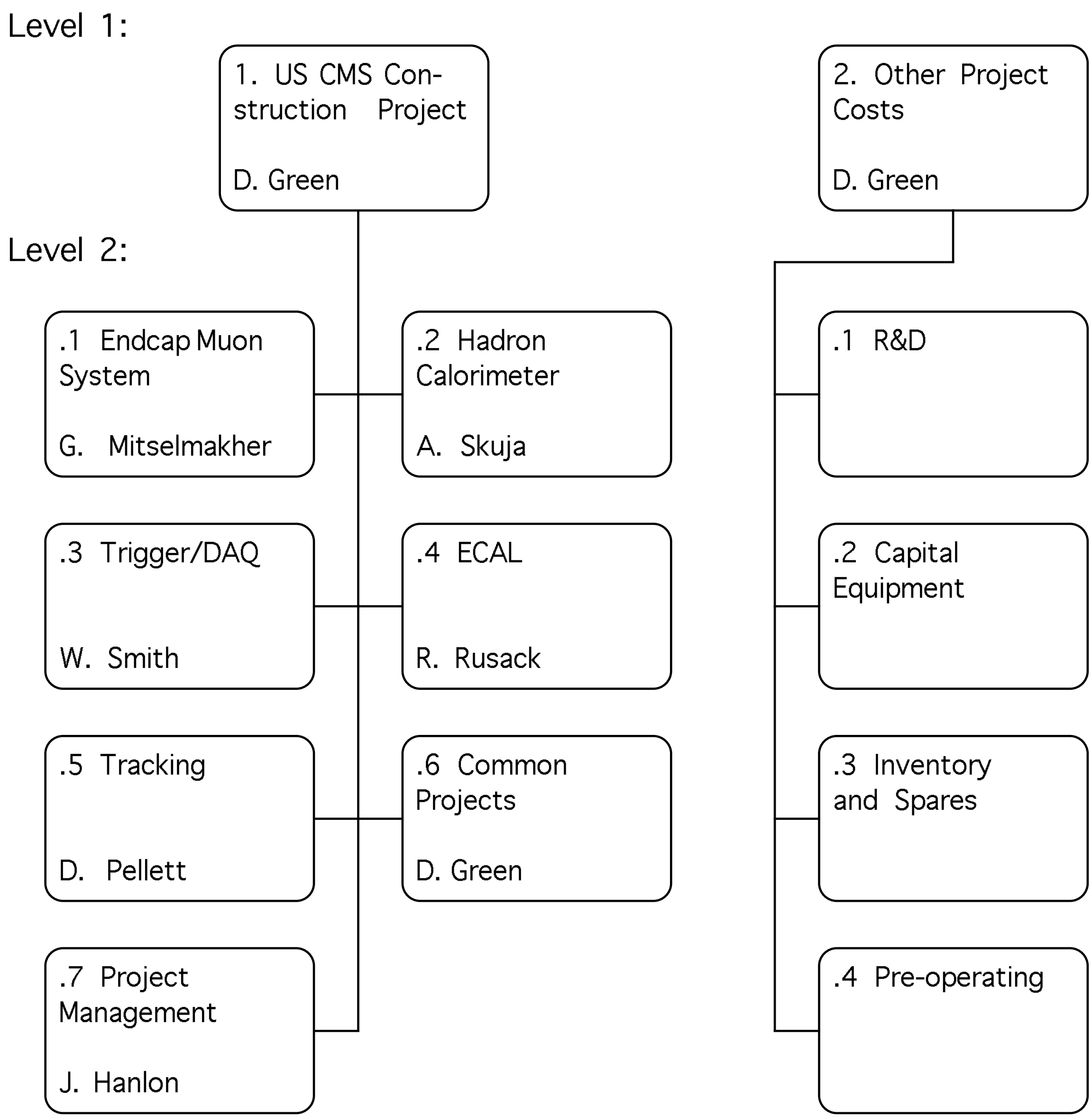
The DOE has designated the Project Summary WBS as a consolidation of the top three levels of the US CMS Construction Project WBS, and the top two levels associated with Other Project Costs - R&D, Capital Equipment, Inventories and Spares, and Pre-operating costs. The specific Project Summary WBS is given below.

1. US CMS Construction Project
    - 1.1 Endcap Muon Systems
        - 1.1.1 Muon Measurement System
        - 1.1.2 Endcap Design
    - 1.2 Hadron Calorimeter
        - 1.2.1 Barrel Hadron Calorimeter
        - 1.2.2 Endcap Hadron Calorimeter
        - 1.2.3 Very Forward Calorimeter
    - 1.3 Trigger/DAQ
        - 1.3.1 Endcap Muon Level 1 Trigger
        - 1.3.2 Calorimeter Level 1 Trigger
        - 1.3.3 Luminosity Monitor
        - 1.3.4 Data Acquisition
    - 1.4 Electromagnetic Calorimeter
        - 1.4.1 Barrel Photodetectors
        - 1.4.2 Veyr Front-end Electronics
        - 1.4.3 Crystal Processing
        - 1.4.4 Monitoring Light Source
    - 1.5 Tracking
        - 1.5.1 Pixel Tracker
    - 1.6 Common Projects
    - 1.7 Project Management
        - 1.7.1 Project Administration
        - 1.7.2 Technical Coordination

2. Other Project Costs
    - 2.1 R&D
    - 2.2 Capital Equipment
    - 2.3 Pre-operating
    - 2.4 Inventories and Spares

The highest levels of the Project Summary WBS are shown in Table V-1.

Table V-1: Project Summary WBS, and WBS Level 2 Managers



C. WBS Dictionary

The WBS Level 2 Managers are shown in Table V-1. A narrative description of the third level elements is given below for the construction portion of the project, and of the second level elements for other project costs.

1.1.1 Muon Measurement System

Includes the design, procurement, fabrication, and contract labor required to construct detection elements of the CMS endcap muon measurement system.

1.1.2 Endcap Design

Includes the design, procurement, fabrication, and contract labor required to design the CMS endcap steel return yoke.

1.2.1 Barrel Hadron Calorimeter

Includes the design, procurement, fabrication, and contract labor required to construct the CMS barrel hadron calorimeter system.

1.2.2 Endcap Hadron Calorimeter

Includes the design, procurement, fabrication, and contract labor required to construct elements of the CMS endcap hadron calorimeter system.

1.2.3 Very Forward Calorimeter

Includes the design, procurement, fabrication, and contract labor required to construct elements of the CMS very forward calorimeter system.

1.3.1 Endcap Muon Level 1 Trigger

Includes the design, procurement, fabrication, and contract labor required to construct the CMS endcap muon level 1 trigger system.

1.3.2 Calorimeter Level 1 Trigger

Includes the design, procurement, fabrication, and contract labor required to construct the CMS calorimeter level 1 trigger system.

1.3.3 Data Acquisition

Includes the design, procurement, fabrication, and contract labor required to construct elements of the CMS data acquisition system.

1.3.4 Luminosity Monitor

Includes the design, procurement, fabrication, and contract labor required to construct the CMS luminosity monitor system.

1.4.1 Photodetectors

Includes the design, procurement, fabrication, and contract labor required to construct elements of the CMS ECAL photodetector system.

1.4.2 Electronics

Includes the design, procurement, fabrication, and contract labor required to construct elements of the CMS ECAL electronics system.

1.4.3 Crystals

Includes the design, procurement, fabrication, and contract labor required to construct the CMS ECAL crystal laser monitoring system.

1.5.1 Pixel Tracker

Includes the design, procurement, fabrication, and contract labor required to construct the CMS forward pixel tracker system.

1.6.1 Magnet

Includes the design, procurement, fabrication, and contract labor required to construct elements of the CMS magnet system for which the US is responsible.

1.6.2 Offline Systems

Includes the design, procurement, fabrication, and contract labor required to construct elements of the CMS offline system for which the US is responsible.

1.7.x Project Management

Includes management of the US CMS Project.

2.1 Direct R&D Operating Costs

Provides for the design and development of new detector components and for the fabrication and testing of prototypes. R&D directed toward the optimization of performance and cost will continue through the early years of construction.

2.2 Capital Equipment

Includes test instruments, electronics and other general equipment.

2.3 Inventories and Spares

Provides for spares for the major technical components.

2.4 Pre-operating Costs

Includes personnel costs for a commissioning period.

Section VI

Project Schedule and Milestones

VI. PROJECT SCHEDULE AND MILESTONES

A. Schedule Baseline

The schedule baseline sets forth the major activities, decision points and activity interfaces essential for completion of the US CMS Project.

The baseline schedule includes interpretation and optimization of activities related to the design, procurement, fabrication, assembly, testing, installation and checkout of detector elements. The Project Master Schedule will be developed to include major activities and decision points. It is composed of major WBS level 3 elements with significant milestones included. This schedule will be the top level project schedule and is the basis for baseline development in all lower level project schedules.

Work package schedules at the lowest WBS level will be assembled into an interconnected activity logic diagram by integrating construction activities within each respective WBS element. Schedule interfaces with other WBS elements will be made. This integrated schedule provides a total project critical path. Summarization of these lower level activities allows status to be rolled up through the various WBS levels to provide intermediate level and master level working schedules. These working schedule dates are compared to the established baseline dates and any variances addressed in the Progress Reports. Consistency of data from work packages through intermediate schedules to the master schedule will be traced through control and event milestones. All milestones contained in the Project Master Schedule are reflected in the lower level schedules.

The schedule management and monitoring system will be developed using commercially available software. The schedule status is summarized at the various WBS levels, to provide project schedule reporting at the master, intermediate, and detailed levels by WBS and across functional organizations. The master level schedule will also include a critical path.

Periodic schedule status meetings with level 3 managers will be conducted to allow for the exchange of information to ensure accurate and complete updates for reporting of progress. This integrated effort will enable the schedule to be used as a primary tool to ensure that the US CMS Project will be completed in line with the approved baseline and funding constraints.

The present highest level schedule for CMS is given in Fig. II-1.

B. Revised Baseline Milestones

A set of project milestones for 1995 to 1997 has been defined by the CMS Collaboration, in consultation with the CERN LHC experiments Committee (LHCC).

These milestones appear in the CMS Interim MOU and are included here as Table VI-1.

Table VI-1: CMS Project Milestones

(from the CMS Interim MOU Draft, September 28, 1995)

CMS Project Milestones 1995 to 1997

Solenoid Magnet and Return Yoke

04.1996	Preliminary Design Review of coil
10.1996	Technical Design Report (coil + yoke)
06.1997	Contract for barrel yoke

Tracking System

12.1997	Technical Design Report

(a) Si-Strip Detector:

12.1996	Engineered prototypes of single sided modules
06.1997	Partially equipped barrel and forward structures
12.1997	Engineered prototypes of double sided modules

(b) MSGC/MGC Detectors:

12.1996	Engineered prototypes of single sided modules
12.1996	Choice of microstrip gas technology for stereo measurement
06.1997	Prototypes of sectors of a wheel and a disk partially equipped with engineered single sided prototype modules

(c) Pixel Detector:

12.1997	Readout architecture decision
12.1997	Prototype module with LHC adequate analog block

(d) Mechanical structure:

06.1996	Prototype of a silicon wheel in carbon fiber
12.1996	Prototype of an octant of a MSGC wheel
12.1996	Prototype of a large mechanical structure ("big wheel")

(e) Electronics:

06.1996 Final decision on choice of optical technology
12.1997 Full readout chain operational

Electromagnetic Calorimeter

12.1997 Technical Design Report

(a) Crystals:

12.1996 Definition of specification for preproduction
1997 Preproduction

(b) Avalanche Photodiodes:

06.1997 Choice of final APD's

(c) ECAL prototype performance:

12.1996 100 crystal matrix, DE/E ~ 0.6% at 100 GeV, voltage and temperature stabilized

(d) Readout Electronics:

12.1997 Global test of the full readout chain with final very front-end

Hadron Calorimeter

06.1997 Technical Design Report
09.1996 Transducer and calibration final selection
01.1997 Engineering drawings available to request bids for HB and HF
12.1997 Preproduction prototypes (HB, HF and HV).

Muon System

12.1997 Technical Design Report

(a) Barrel Drift Tubes:

Chambers:

12.1996 Full size chamber (twelve layers) meeting the performance requirement

12.1997 Final chamber suitable for mass production and final tooling

Electronics:

12.1996 Front-End prototype (amplifier + discriminator + driver)
12.1997 Mean-timer and correlator final chip for full trigger test

(b) End Cap Chambers:

MF1/1:

12.1996 Fabrication and test of a final MF1/1 large size prototype (six layers)
12.1997 Preseries sample

MF1/2, MF1/3, MF2, MF3, MF4:

12.1996 Full size large chamber (six layers)
12.1997 Final chamber suitable for mass production

Electronics:

12.1997 Front-end cards for cathodes and anodes

(c) RPC's:

Chambers:

12.1996 Definition of final detector parameters
12.1997 Final prototype suitable for mass production

Electronics:

06.1997 Final front-end chips

(d) Alignment:

12.1996 Full scale LINK system bench test
06.1997 Integrated design for LINK + BARREL + FWD
12.1997 Full scale system test

Trigger & DAQ

(a) Trigger:

11.1996 Prototypes of the basic components of Level 1 trigger

11.1997 Full chain trigger prototypes

(b) DAQ:

11.1996 DAQ basic unit prototypes (DPM, FED, switch interfacing)
11.1997 Integration of event builder structures based on commercial switches

Computing

12.1996 Technical Proposal for Computing

Section VII

Cost and Labor Estimates

VII. Cost and Labor Estimates

A. Cost Baseline

The cost baseline will be established on <date> when the Project Plan is approved. The project cost baseline is equal to the sum of the budgeted costs for each element of the Work Breakdown Structure described in Section V. Changes in cost, technical requirements, schedules, and plans are to be treated as variances to the baseline.

The TEC of the US CMS project is $170M in then-year dollars. Included in the TEC are procurement, assembly, and installation of all technical components, engineering design, inspection, and project management required to assure successful completion of the project. Contingency funds in the amount of 27% of the base cost, excluding common projects, are also included in the TEC as is a $21M allowance for escalation. The TPC is $172M which includes $2.4M of R&D, capital equipment, pre-operations and spares.

B. Obligations and Cost Plans in FY 1996 Dollars

The construction cost estimate is maintained in fixed year (FY 1996) dollars. The TEC in FY 1996 dollars is $145M.

C. Escalation

Escalation rates are based upon an assumed annual escalation rate of 3%.

D. Budget Authority and Funding Profile

The project baseline schedule, obligations and cost plan will be based on the best estimate of the funding profile. The obligation plan will be derived from the baseline schedule and cost plans given in this Project Management Plan. Similarly, application of the escalation rates given in C above will result in the cost plan.

E. Labor Requirements

Labor requirements have been estimated for each work package in the US CMS project. These estimates include the required EDIA and Fermilab-based project management, as well as manufacturing labor.

Section VIII

Work Authorization and Project Control System

VIII. Work Authorization and Project Control System

A. Introduction

This section summarizes the management systems that the US CMS Project will use to manage the cost and schedule performance and the technical accomplishments of the Project relative to this PMP. The significant interfaces that exist among the various management systems are noted in the individual narrative descriptions below. Although these systems are described separately they are mutually supportive and will be employed in an integrated manner in order to achieve the project objectives. As conditions change during the evolution of the project, the management systems will be modified appropriately so as to remain responsive to the needs for project control and reporting. Consequently, while the policy and objectives of each management system will remain fixed, the methods, techniques, and procedures that will be employed by the US CMS Project are expected to change as conditions dictate, over the life of the project.

The Work Authorization and Contingency Management System and the Project Control System described in this chapter defines the management and control procedures which are needed to comply with the requirements of DOE and NSF.

B. Guidelines and Policies

The Work Authorization and Contingency Management System and the Project Control System employed by the US CMS Project will be consistent with DOE guidelines prescribed in the following DOE Orders:

- DOE 4700.1, Project Management System.
- DOE 5700.2D, Cost Estimating, Analysis, and Standardization.
- DOE N4700.5, Project Control System Guidelines.
- DOE 1332.1A, Uniform Reporting System based on the guidance provided in the foregoing documents.

The following policies are applicable for the US CMS:

- All Project work is organized in accordance with the WBS.
- Formal (and informal) reviews by experts are used to obtain official specifications and designs.
- Written cost, schedule, and technical baselines will be established and will be used for measuring project performance.

- A summary of the US CMS Engineering Change Request (ECR) process is provided below.

- A project management system, which features earned-value performance measurement and critical-path scheduling, is used to control the project and to provide forecast and feedback information to management.

- The decision making apparatus will involve regular meetings among the US CMS organizational elements. These meetings will serve to identify and resolve interface issues within the project.

- Quality assurance, safety analysis and review, and environment assessment are integral parts of the Work Authorization and Project Control.

C. Work Authorization and Contingency Management

Funds will be made available to the DOE and NSF for support of the US CMS project on an annual basis following passage of legislation in the U.S. Congress. Funds will be made available by DOE and NSF following requests for specific amounts, identified at level 3 of the WBS, prepared by the US CMS Project Manager. Each such request will include a description of the work to be performed, the requested funds, the forecast cost of the work, and the currently projected contingency requirement at WBS level 3, over the life of the project. Funds will then be released to the institutions who are part of the US CMS Collaboration. A management reserve of no more than 20% of the annual budget will be held by the Project Manager and will be applied during the fiscal year on the basis of performance and need, as discussed in Section III.D.1.

At any time the project contingency is the difference between the project TEC and the sum of the current Estimates at Completion (EAC) at level 3 of the WBS. The contingency funds are allocated through the funding requests as reflected by a projected request for funds in excess of the baseline budgeted cost.

The principles of contingency management that the US CMS project will follow are as follows:

- Each funding request will include a projection of the required use of contingency funds, at level 3, over the life of the project. The projection is based on periodic updates of the EAC by the level 3 managers and reflects both a comparison of expenditures to date with budgeted costs, and an assessment of future requirements.

- The actual expenditure of contingency at level 3 of the WBS will be reflected in the difference between the BCWP and ACWP as reported.

- The DOE Project Manager will approve all ECRs that will require future utilization of contingency. A log of such approved requests will be maintained by the US CMS project office.

- The initial funding request of each fiscal year may, at the discretion of the DOE Project Manager, assign 25% of the contingency available in that year to US CMS for application within the following guidelines:

  The US CMS Project Manager may adjust the budgeted cost of any WBS level 3 package by 10% or $2M, which ever is less, as long as the Project TEC is not exceeded.

- All changes from baseline cost shall be traceable.

The funds included in each funding request are under the authority of the US CMS Project Manager. Subject to the above conditions the US CMS Project Manager can approve change requests without further DOE Project Manager approval.

D. Project Control System

DOE N4700 requires that the Project Control System include the three categories listed below:

- Baseline Development: This includes management actions necessary to define project scope and responsibilities, establish baselines, and plan the project.

- Project Performance: This includes management actions after work commences that are necessary to monitor project status, report and analyze performance, and manage risk.

- Change Management: This includes management actions necessary to ensure adequate control of project baselines, including the performance measurement baseline.

1. <u>Baseline Development</u>

The cost and schedule baseline development has been described in previous sections, and so will not be repeated here.

2. <u>Project Performance</u>

Standard accounting practices and the Project Control System will collect costs for completed work. Performance analysis of costs, schedule, and work scope performance will provide a determination of project status.

3. Change Management

The US CMS Management Board will control changes in requirements, cost, and schedule in consultation and agreement with CMS management. Any change that affects the interaction between detector subsystems or that significantly impacts the performance, schedule, or safety of the detector must be referred to the CMS Technical and/or Management Board. Cost control of the US CMS funds is maintained through the work authorization and contingency management system described above.

Section IX

Reporting And Review

IX. Reporting And Review

The CMS experiment reports to CERN as the responsible host of the experiment. In turn, the US CMS collaboration reports on technical progress to the full CMS collaboration.

The institutions and personnel which comprise the US CMS collaboration are listed in Table IX-1.

The structure of tracking and reporting is shown in Fig. III-7. It begins with a report by the individual US CMS institution to the US CMS Management Board in the person of the relevant subsystem coordinator. The reporting is passed to the project office which is responsible for tracking all US CMS funds.

The US CMS Project Office is responsible for tracking and reporting all US CMS Project activities. The project office shall prepare and issue periodic reports of earned value and cost and schedule variance for the US CMS Project.

The US CMS Project office reports to the CMS Management Board on the status of the US CMS Project, and in addition reports to the US funding agencies, DOE and NSF. In turn, the CMS Management Board reports to the CERN Resource Review Board, whose members include DOE and NSF representatives.

The US CMS Management Board has full access to all tracking and reporting. This information will form the basis for continuing annual authorization of funds to a particular institution by the Project Manager with the advice and consent of the US CMS Management Board.

Memoranda of Understanding will exist both within the CMS collaboration as a whole, and for the US CMS collaboration.

A Memorandum of Understanding (MOU) is to be negotiated between CERN as the host laboratory, the collaborating CMS institutions (represented by the CMS Collaboration Board) and their funding agencies (DOE and NSF in the US). A draft of an Interim MOU covering the initial phase of the CMS experiment has been prepared for discussion with the funding agencies.

Within the US CMS Project, a second detailed MOU will be executed. A draft version of this MOU and of the annual MOU Amendment have been written, and appear here as Tables IX-2 and IX-3. The signatories of this MOU are threefold: Fermilab as host laboratory, the US CMS collaborating institution, and the US CMS Project Office. By means of the mechanism of the MOU, the US CMS Project Manager will establish reporting by each institution which is part of the US CMS collaboration.

In turn, the US CMS Project reports cost, labor, schedule, and performance data to cognizant management. The objective of the reporting and review activity is to provide for the collection and integration of essential technical, cost, schedule, and performance progress data into the reports and reviews needed for managing and monitoring the US CMS Project. The following paragraphs describe the status and technical reports that will be provided.

A. Status Reporting

Project reporting and review will be divided into external and internal categories. All reports will be generated in accordance with DOE Order 1332.1A on "Uniform Reporting System."

Status Reports will be prepared on a periodic basis. These reports are designed to portray the technical, cost, and schedule status of the Project at that particular point in time. In general, the reports will contain the following: Project cost trends; schedule accomplishments; critical items; commitment status; status of major procurements; budget versus cost projections; management assessments; variance analysis results and planned corrective action. The US CMS Project Manager intends to report at level 3 of the WBS. The report will be issued to DOE/CH/BAO and NSF by the 25th calendar day following the period being reported.

B. Design Reports

Design reports will be prepared and updated at the completion of a major system or component. The content of these design reports will be consistent with the requirements of DOE Order 4700.1 on "Project Management Systems." The major phases are the Conceptual Design, Title I design, Title II Design, and as-built. The design reports will be prepared by the responsible level 2 manager and approved by the US CMS Project Manager.

C. Meeting and Reviews

1. Internal US CMS Meetings

The US CMS Project Office will meet regularly with the US CMS Management Board to assess the current status of the Project, management issues, and proposed major charges.

2. Meetings with DOE and NSF

Monthly Meeting

A monthly meeting is held between the BAO and the US CMS Project Manger to review the current status of Project work, to discuss outstanding issues, and to update previously identified action items.

Quarterly Meeting

A quarterly meeting is held between the ER, BAO, NSF and the US CMS Project Manager which summarizes the Project status and updates all outstanding issues and action items.

Annual Review

Approximately every twelve months, a comprehensive review of the Project's cost, schedule, and technical status will be held by ER and NSF. Presentations by key US CMS Project personnel will address issues on an agenda agreed to in advance by ER, BAO, NSF, and the US CMS Project Manager.

Table IX-1: US CMS Institutions and Members

University of Alabama
L. Baksay*, B. Rouchouse, H. Tuchscherer, G. Zilizi

Boston University
E. Booth, R. Carey, S. Doulas, E. Hazen, O.C. Johnson, F. Krienen, J. Miller, D. Osborne, B.L. Roberts, J. Rohlf, A. Rosowsky, L. Sulak*, J. Sullivan, W. Worstell

Brookhaven National Laboratory
J. Kierstead, P. Levy, S. Stoll, C. Woody*

University of California, Davis
R. Breedon, Y. Fisyak, G. Grim, B. Holbrook, W. Ko*, R. Lander, S. Mani, D. Pellett, J. Rowe, J. Smith

University of California, Los Angeles
K. Arisaka, M. Atac, Y. Bonushkin, F. Chase, D. Cline, J. Hauser*, J. Kubic, M. Lindgren, R. Ojha, S. Otwinowski, D. Sanders, P. Schlein, Y. Shi, X. Zeng

University of California, Riverside
D. Chrisman, J.W. Gary, P. Giacomelli, W. Gorn, J.G. Layter*, P. Schenk, B.C. Shen

University of California, San Diego
J.G. Branson*, I. Fisk, H. Kobrak, G. Masek, M. Mojaver, H. Paar, G. Raven, M. Sivertz, R. Swanson, A. White

California Institute of Technology
J. Hanson, W. Lu, R. Mount, H. Newman*, S. Shevchenko, A. Shvorob, R. Zhu

Carnegie Mellon University
I.C. Brock, R. Edelstein, A. Engler, T. Ferguson*, R. Kraemer, M. Procario, J. Russ, R. Sutton, H. Vogel

Fairfield University
C.P. Beetz, S. Hellerman, J. Iosifidis, P. McLoughlin, V. Podrasky, M. Saganich, C. Sanzeni, H. Silvestri, T. Toohig, D. Winn*

Fermi National Accelerator Laboratory
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Florida State University
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Florida State University (SCRI)
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University of Iowa
N. Akchurin, M. Aykac, M. Kaya, E. McCliment, J. McPherson, M. Miller, Y. Onel*, E. Ozel, S. Ozkorucuklu, L. Pasquali, E. Ruth, R. Winsor

Iowa State University
E.W. Anderson*, J. Hauptman, J. Wightman

Johns Hopkins University
B. Barnett, C.Y. Chien*, D. Gerdes, A. Gougas, A. Pevsner

Lawrence Livermore National Laboratory
O. Alford, B. Fuchs, S. Hibbs, D. Klem, M. Kreisler, M. Libkind, X. Shi, K. van Bibber, T. Wenaus, D. Wright, C. Wuest*, R. Yamamoto

Los Alamos National Laboratory
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University of Maryland
A. Baden, A. Ball, R. Bard, S.C. Eno, D. Fong, N.J. Hadley, R.G. Kellogg, S. Kunori, M. Murbach, A. Skuja*

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G. Bauer, J. Friedman, E. Hafen, A. Korytov, S. Pavlon, L. Rosenson, P. Sphicas*, S. Sumorok, S. Tether

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University of Mississippi
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G. Alverson, H. Fenker, J. Moromisato, S. Reucroft*, J. Swain, L. Taylor, E. von Goeler, T. Yasuda

Northwestern University
B. Gobbi*, P. Rubinov, R. Tilden

University of Notre Dame
B. Baumbaugh, J.M. Bishop, N. Biswas, J. Marchant, R. Ruchti*, J. Warchol, M. Wayne

Ohio State University
D. Acosta, B. Bylsma, L.S. Durkin, D. Fisher, J. Hoftiezer, M. Johnson, D. Larson, P. Lennous, T.Y. Ling*, C.J. Rush, V. Sehgal

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C. Bopp, P. Denes, V. Gupta, D. Marlow, P. Piroue*, D. Stickland, H. Stone, C. Tully, R. Wixted

Purdue University
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University of Rochester
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University of Texas at Dallas
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Texas Tech University
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Virginia Polytechnic Institute and State University
K. Blankenship, B. Lu, L.W. Mo*, T.A. Nunamaker

University of Wisconsin
T. Alexopoulos, D. Carlsmith, S. Dasu, A. Erwin, F. Feyzi, C. Foudas, M. Jaworski, J. Lackey, R. Loveless, S. Lusin, D. Panescu, D. Reeder, W.H. Smith*, M. Thompson

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* Institutional Representative

† Joint Appointment with Fermilab

Table IX-2

Memorandum of Understanding
between

<Institution>

and

US CMS Collaboration
Project Management
at Fermilab

<date signed>

1. Introduction

This Memorandum of Understanding describes the collaboration by members of <Institution> in the Compact Muon Solenoid (CMS) Project in the United States. The purpose of this collaboration is the design, fabrication, operation and scientific exploitation of the CMS Detector. The detector is described in the CMS Technical Proposal, December 15, 1994, the Technical Design Reports, and subsequent technical documents elaborating that design. The contribution of the US CMS Collaboration to the CMS Detector Project is described in the US CMS Letter of Intent, September 15, 1995, in the CMS Interim Memorandum of Understanding draft, <date>, in the US CMS Project Management Plan draft, August 13, 1996, and [other documents to be referenced here].

It is understood that successful collaboration in construction and operation of the CMS detector rests on implementation of a clear management plan for CMS. In the US, the US CMS Project Management Plan, <date2> (plus amendments as needed) is the basis for meeting this requirement and is accepted as part of this memorandum. The US CMS project management infrastructure (US CMS Project Office) resides at Fermilab, and the responsibility for US CMS project management resides in the US CMS Spokesperson, acting with the advice and consent of the US CMS Management Board.

The role of Fermilab as host institution and seat of the US CMS project management infrastructure is separate and distinct from Fermilab as a US CMS collaborating institution. The organization, leadership, operating procedures and present membership of the US CMS Collaboration are described in the US CMS Project Management Plan. The Plan will be updated as necessary and will constitute the main policy basis for managing the US CMS detector efforts.

This Memorandum of Understanding describes the anticipated long-term contributions of <Institution> to the design, construction and operation of the CMS Detector. It is understood that the anticipated contributions of <Institution> may later be modified or that additional responsibilities may be added to those described here.

Periodic amendments to this Memorandum of Understanding will detail the contributions of <Institution> as the detector construction proceeds and will contain the specific activities, deliverables and funding required. The normal period of performance will be the U.S. fiscal year (October 1-September 30).

This Memorandum of Understanding is made between <Institution> and US CMS Project Management at Fermilab. It does not constitute a legal contractual obligation on the part of either of the parties. It reflects an arrangement that is currently satisfactory to the parties involved. The parties agree to negotiate amendments to this memorandum as required to meet the evolving requirements of the CMS research and development and detector construction program.

2. Personnel

2.1. List of Scientific Personnel

Participating scientists committed to CMS over the full project period are expected to be:

Name	CMS Fraction	Other Research Commitments/Comments

*Time devoted to CMS over and above the indicated CMS research fraction is considered to be <Institution> service effort in support of CMS.

2.2. Collaboration Board Representative

<Name> is the present representative of <Institution> on the US CMS Collaboration Board.

2.3. List of Technical Personnel

Participating technical staff members foreseen to participate over the full project period are:

Engineers

Designers

Technical Specialists

Programmers

Others

2.4. Other Key Personnel

The Environment, Safety and Health officer for <Institution> responsible for compliance with applicable ES&H policies associated with CMS participation by this institution is currently <name> of <Institution>. The Quality Assurance officer for <Institution> responsible for QA compliance of tasks performed by this institution is currently <name> of <Institution>.

3. Design, Fabrication and Installation Responsibilities

3.1. Design and Fabrication Responsibilities - Construction Period

3.1.1 *Description of Items Provided:*

WBS	Description

3.1.2 *Deliverables*

WBS	Deliverable

3.1.3 *Transportation*

Unless specifically indicated otherwise here, items produced by <Institution> for use in the CMS detector or subsystems shall be transported by the providing institution to the agreed upon point of delivery. <Institution> shall be responsible for safe transport of all items to these delivery points.

3.1.4 *Installation and Commissioning*

<Institution> will participate in the installation and commissioning of their contributed items as listed:

<Item 1>
<Item 2>...

3.2. Coordination and Reporting

The US CMS Coordinator for the <subsystem> subsystem is <name1>. The institution contact person for <subsystem> activities at <Institution> is <name2>. The task managers for <subsystem> activities carried out at <Institution> are as follows:

[Repeat as necessary for other subsystems in which <Institution> is participating.]

The progress of the design, fabrication, and testing of these components will be reported by the above-named task managers on a quarterly basis, by WBS element, to the US CMS Subsystem Coordinator, who in turn will report subsystem progress to the US CMS Spokesperson. All status reports will be assembled and made public to the US CMS collaboration.

Technical reporting to CMS project management will be coordinated by the US CMS Subsystem Coordinator. Financial reporting to CMS will be made by the US members of the CMS Finance Board.

3.3. Collaboration with Other Groups and Institutions

Design, construction and installation related to the <subsystem> subsystem will be carried out in close communication and collaboration with other groups working on this and related subsystems.

WBS / Task	Collab. Group	Responsibility with <Institution>

[Repeat as necessary for other subsystems in which <Institution> is participating.]

4. Contribution of Effort, Services and Facilities

4.1. Effort

Subject to adequate funding by DOE or NSF, <Institution> will provide support for the scientific and technical personnel as indicated in section 2.

4.2. Services

The services of the <Institution> Purchasing, Expediting, and Receiving Departments and the Administrative Staff will be available to the CMS project to the degree required to carry out the fabrication responsibilities of <Institution>.

4.3. Facilities and Equipment

The following <Institution> facilities and equipment will be made available to the CMS project to the degree necessary to carry out the design and fabrication responsibilities of the group:

4.4. Operating Costs

<Institution>, subject to adequate funding from DOE or NSF, will support the normal research operating expenses (such as physicists' salaries, travel expenses, miscellaneous supplies, administrative support, etc.) of the <Institution> group

working on the CMS project. These normal operating expenses are not considered as part of the CMS detector cost estimate.

5. Expected Fermilab (as host institution) Effort, Services and Facilities

Subject to agreement, to be negotiated annually with the Fermilab Director, <Institution> expects the following Fermilab resources to be available in support of <Institution's> design, fabrication, and installation responsibilities:

5.1. Administrative and Technical Personnel

Participating Fermilab staff members foreseen to be available to the project are:

Administrative Staff

Engineers

Designers

Technical Specialists

Programmers

Others

Administrative and technical staff salary support may be paid by the US CMS Project, or may be provided by Fermilab as project host. The salary support of Fermilab staff contributing to <Institution’s> responsibilities must be negotiated annually with the Fermilab Director. Support provided by Fermilab will be tracked and reported to the Fermilab Director.

5.2. Services

The services of the Fermilab Purchasing, Expediting, and Receiving Departments are expected to be available to <Institution> for the procurement of the following items:

<Item 1>
<Item 2>...

5.3. Facilities and Equipment

<Institution> expects that the following Fermilab facilities, equipment, and laboratory space will be available during the course of the project:

6. Costs and Funding

6.1. Tasks and Costs

<Institution> will carry out the following list of detector design, procurement, fabrication and installation tasks:

WBS	Item	Cost. Est. (K $)
	Total:	

Note: These costs do not include funds to be spent for procurement of <item>.

The US CMS Project Office at Fermilab will procure the following items:

WBS	Item	Cost. Est. (K $)
	Total:	

6.2. Expected Sources of Funding

Total project funds required from DOE or NSF is approximately <$x,xxxK>.

7. Administration

7.l. Method of Funding Transfers and Purchasing

The expenditures by <Institution> are to be covered by funds provided by DOE or NSF, upon the allocation decision of the US CMS Spokesperson with the advice and consent of the US CMS Management Board. Purchases may be made in any of several ways:

a) Purchase Orders written by <Institution> against funds provided directly to <Institution> by DOE or NSF.

b) Purchase Orders written by <Institution> against a subcontract to <Institution> from the US CMS Project Office at Fermilab.

c) Purchase Orders written by the US CMS Project Office at Fermilab to <Institution> to cover specific equipment items agreed upon in this document.

d) Purchase Orders written by the US CMS Project Office at Fermilab to specific vendors, requesting the material to be delivered to <Institution>.

e) Purchase Orders written by the US CMS Project Office at Fermilab to cover fabrication work described in this document while specifying technical direction of the work by <Institution>.

Funds to cover work described in this document may be provided directly to <Institution> by DOE or NSF, or by subcontract from the US CMS Project Office at Fermilab. <Institution> may also choose to use Fermilab purchasing services as in c), d) and e) above. The choice of funding method shall be at the option of <Institution>, provided the arrangement is satisfactory to the funding authority.

Expenditures at <Institution> covered by purchase orders written by the US CMS Project Office at Fermilab to <Institution> will be reimbursed on a quarterly basis. Reimbursement will be based upon an invoice of actual costs incurred and submitted to the US CMS Project Office at Fermilab by <Institution>.

7.2. Procurement Authorization

Item purchases exceeding the delegated limit (currently <$xxK>) must be authorized by the US CMS Subsystem Coordinator. Major procurements (currently <$xxK>) must in addition have the written authorization of the US CMS Spokesperson. Items purchased as CMS Common Project items must be explicitly authorized by the US CMS Spokesperson and approved by the CMS Finance Board Chair, regardless of the cost.

7.3. Reporting to US CMS Project Management

<Institution> will report all CMS related expenditures and labor charges together with associated technical progress in each item of work by Work Breakdown Structure (WBS) category (level <n>) on a quarterly basis through the appropriate US Subsystem Coordinator(s) to the US CMS Spokesperson. Cost reporting will apply to US CMS Project funds related to detector fabrication. Other, non-DOE and non-NSF costs will be reported in a manner that is agreed to by the Subsystem Coordinator, the US Spokesperson and <Institution>.

Technical progress will be reported by WBS element to the Subsystem Coordinator and the Spokesperson on a quarterly basis and will cover all activities covered in this Memorandum of Understanding regardless of the specific nature of the funding support. All status reports will be assembled and made public to the US CMS collaboration.

7.4. Overhead Charges

[The terms of this subsection remain to be negotiated...]

7.5. Component Ownership

All equipment items bought or fabricated using DOE or NSF funds will be properly marked as the property of DOE or NSF. Any other equipment furnished by <Institution> as part of the detector will remain <Institution> property. In either case, the equipment will remain part of the CMS detector until it is dismantled or the detector element in question is replaced.

8. General Considerations

8.1. Safety and Engineering Practices

The experimenters from <Institution> agree to familiarize themselves with DOE safety policies and to adhere to them. All detector components must be designed, fabricated, installed and operated in conformity with DOE and CERN safety policies and practices as well as DOE and CERN engineering standards. All engineering, design, quality assurance, safety, and other activities shall be in compliance with ISO standards. All major components will undergo appropriate design, safety, and engineering reviews.

8.2. Operations

<Institution> agrees to maintain, to the best of their ability, equipment provided for the CMS detector as long as <Institution> is a member of the CMS collaboration.

9. Schedules and Milestones

<Institution> will make every effort to carry out their institutional responsibilities consistent with the schedule for the fabrication of the CMS detector. These schedules may have to be changed as the project progresses. Changes that affect <Institution> will be noted in Amendments to this Memorandum.

9.1. Design, Fabrication and Installation Milestones

The key milestones relevant to <Institution> are listed here:

Key Milestones	Baseline Date	Current Date

10. Makers and Concurrence

The following persons concur in the terms of this Memorandum of Understanding. These terms will be updated as appropriate in Amendments to this Memorandum.

Makers of this Memorandum:

<Name> US CMS Spokesperson	date	Administrative Officer <title> <Institution>	date
<Name> US Subsystem Coordinator <Subsystem> Subsystem	date	Institution Representative <Name> <Institution>	date

Concurrence:

<Name> Director Fermilab	date	<Name> CMS Technical Representative	date

Table IX-3

Amendment <n>
to
Memorandum of Understanding
between

<Institution>

and

US CMS Collaboration
Project Management
at Fermilab

<date signed>

1. Introduction

This Amendment is made to provide details of the work agreed to between the parties making the Memorandum of Understanding covering the specific period of performance from October 1, <start year> through September 30, <end year>. It is subject to all the points of agreement and conditions in the current version of the parent Memorandum and the current version of the US CMS Project Management Plan.

2. Personnel

2.1. List of Scientific Personnel

Participating scientists with anticipated fraction of their research time committed to CMS during this period of performance are:

Name	CMS Fraction	Other Research Commitments/Comments

*Time devoted to CMS over and above the indicated CMS research fraction is considered to be <Institution> service effort in support of CMS.

2.2. Collaboration Board Representative

<Name> is the present representative of <Institution> on the US CMS Collaboration Board.

2.3. List of Technical Personnel

Participating technical personnel with the anticipated fraction of their time committed to CMS during this period of performance and their source(s) of support are:

Engineers

Name	CMS Fraction	Source of Support

Designers

Name	CMS Fraction	Source of Support

Technical Specialists

Name	CMS Fraction	Source of Support

Programmers

Name	CMS Fraction	Source of Support

Others

Name	CMS Fraction	Source of Support

2.4. Other Key Personnel

The Environment, Safety and Health officer for <Institution> currently responsible for compliance with applicable ES&H policies associated with CMS participation by this institution is <ES&H Name> of <Institution>. The Quality Assurance officer for <Institution> currently responsible for QA compliance of tasks performed by this institution is <QA Name> of <Institution>.

3. Design, Fabrication and Installation Responsibilities

3.1. Design and Fabrication Responsibilities for this Period of Performance

3.1.1. *Description of items (or partial completion of items) provided in this period (Statements of Work):*

WBS	Statement of Work text

3.1.2 *Deliverables:*

WBS	Deliverable

3.2. Coordination and Reporting

The US CMS Coordinator for the <subsystem> subsystem is <name1>. The institution contact person for <subsystem> activities at <Institution> is <name2>. The task managers for <subsystem> activities carried out at <Institution> are as follows:

[Repeat as necessary for other subsystems in which <Institution> is participating.]

3.3. Collaboration with Other Groups and Institutions

Design, construction and installation related to the <subsystem> subsystem will be carried out in close communication and collaboration with other groups working on this and related subsystems.

WBS / Task	Collab. Group	Responsibility with <Institution>

[Repeat as necessary for other subsystems in which <Institution> is participating.]

4. Contribution of Effort, Services and Equipment

4.1. Effort

Subject to adequate funding by DOE or NSF, <Institution> will provide support for the scientific and technical personnel as indicated in section 2 during this period of performance.

5. Fermilab (as host institution) Effort, Services and Facilities

Tracking of Fermilab CMS support, whether provided by Fermilab or paid by the US CMS Project, will be done using appropriate effort reporting codes. The costs incurred will be reported to the Fermilab Director.

5.1. Administrative and Technical Personnel

Contributing Fermilab personnel with the anticipated fraction of their time committed to CMS during this period of performance and their source(s) of support are:

Administrative Staff

Name	CMS Fraction	Source of Support

Engineers

Name	CMS Fraction	Source of Support

Designers

Name	CMS Fraction	Source of Support

Technical Specialists

Name	CMS Fraction	Source of Support

Programmers

Name	CMS Fraction	Source of Support

Others

Name	CMS Fraction	Source of Support

6. Costs and Funding

6.1. Tasks and Costs

<Institution> will carry out the following list of detector design, fabrication and installation tasks during this period of performance:

WBS	Task	Cost. Est. (K $)	DOE Funds (NSF) (K $)
	Total:		

The cost of the detector elements covered under the US CMS WBS are taken in detail from the current US CMS Cost Estimate (<Date>). DOE (NSF) Funds indicate the project funds to be provided in this period of performance.

6.2. Expected Sources of Funding

WBS	Task	DOE Funds (NSF) (K $)
	Total DOE (NSF) Funds:	

An amount of $<x,xxx>K will be provided for the period <Date1> - <Date2> to cover work for the first six months. The remaining funds needed to complete the tasks described in 6.1 will be provided subject to availability of funding and performance during the first half year.

7. Administration (no amendments are included in this section)

8. General Considerations (no amendments are included in this section)

9. Schedules and Milestones

<Institution> will make every effort to carry out their institutional responsibilities consistent with the overall CMS schedule. In this amendment are listed the program milestones for this period of performance.

9.1. Design, Fabrication and Installation Milestones

The program milestones for this period of performance relevant to <Institution> are listed here:

Program Milestones	Baseline Date	Current Date

10. Makers and Concurrence

The following persons concur in the terms of this Amendment These terms will be updated as appropriate in later Amendments to this Memorandum.

Makers of this Memorandum:

<Name> date US CMS Spokesperson	Administrative Officer date <title> <Institution>
<Name> date US Subsystem Coordinator <Subsystem> Subsystem	Institution Representative date <Name> <Institution>

Concurrence:

<Name> date Director Fermilab	<Name> date CMS Technical Representative

Annex I

Advance Acquisition or Assistance Plan for the US CMS Project

Advance Acquisition or Assistance Plan for the US CMS Project

A. Introduction

This Advanced Acquisition or Assistance Plan (AAAP) describes how the US CMS Project procures the goods and services required for the detector construction project described in Sections I and II of the Project Management Plan (PMP). Procurements for the US CMS Project will be placed through the purchasing departments of US CMS collaborating institutions.

B. Responsibilities

US CMS Project organization and responsibilities are defined in Section III of the US CMS PMP. This includes a listing of the specific responsibilities of the US CMS Project Manager. Aspects that are important to the AAAP are listed below.

1. Technical

Responsibility for technical definition of project procurements resides with the US CMS Project Manager.

2. Procurement

Authorization to approve procurement requests will be controlled by the US CMS procurement authorization system. Procurements estimated at $50,000 or more must be approved by the relevant US CMS subsystem coordinator. Procurements estimated at $100,000 or more must be approved by the US CMS Project Manger. All procurements must comply with the relevant DOE or NSF procurement policies.

C. Procurement Plans

1. Procurement Schedules

The schedules for each of the major procurement actions will be established as the individual Advance Procurement Plans (APP) are developed.

2. Procurement Planning

Advance Procurement Plans

The US CMS Project will utilize APP to supplement this AAAP.

A specific procurement plan will be developed for each significant procurement to show the critical activities and time requirements of the procurement process, and thereby establish procurement start dates. By developing these individual procurement plans, the potential for schedule problems associated with the procurement process is reduced.

Significant and/or critical procurements

APP applies specifically to critical, complex, high-dollar or long-lead requirements of significant importance to the Project objectives. APP is not intended to apply to common items of supply, such as "off-the-shelf" items, although all procurements require some degree of planning. Any procurement estimated at $500,000 or more must have an APP.

D. Risk Management

Cost risk will be minimized by maximizing the use of fixed-price subcontracts and competition.

Technical risk will be minimized by preparation of clear and concise specifications, judicious determination of subcontractor responsibility and approval of proposed lower tier sub-subcontractors, and implementation of QA provisions.

Schedule risk will be minimized by realistic planning, verification of subcontractor's credit and capacity during evaluation, close surveillance of subcontractor performance, advance expediting, and incremental awards to multiple subcontractors when necessary to assure total quantity or required delivery.

Cost-type subcontracts shall be used only when determination is made that such a subcontract is appropriate and when consideration of the elements of the procurement work scope that directly affects the cost, time, risk and profit incentives bearing on the performance justifies such a subcontract. No cost-type subcontract shall be used unless it has been determined that the proposed subcontractor's accounting system is adequate to develop necessary cost data and allocate cost in accordance with accepted cost accounting standards and the US CMS Cost Control System.

Incentive subcontracts, such as fixed-price with incentive or cost plus incentive, will be considered when a reasonably firm basis for pricing does not exist or the nature of the requirement is such that the subcontractor's assumption of a degree of cost risk will provide a positive profit incentive for effective cost and/or schedule control and performance.

E. Source Selection

1. Competition

To the extent practicable, fixed-price purchase orders and subcontracts for supplies, equipment and services will be awarded on the basis of competitive solicitations to responsive and responsible offerors. Awards made on a non-competitive basis will include adequate justification to support such award.

For critical components required in quantity, incremental awards may be made to different sub-contractors to obtain total quantity on required delivery dates. The volume ordered from each subcontractor will be adjusted according to price and delivery.

Sole Source Procurement - A purchase order or subcontract for a supply, service, or construction item may be awarded without competition when the delegated levels of signature authority determine in writing that there is only one reasonable source for the required supply, service, or construction item.

2. Solicitation Documents and Evaluation Criteria

The means of soliciting offers will be the Request for Quotation (RFQ), and the Request for Proposal (RFP). The nature, complexity and/or dollar value of each procurement will determine the means of solicitation to be used.

All major or highly technical procurements will, when appropriate, have a plan for evaluating proposals and evaluation criteria for ranking of prospective vendors or subcontractors who are competing. Criteria for evaluation will be based on technical, business and cost factors including technical capability, capacity, and delivery, as well as subcontractor responsiveness to the solicitation and subcontractor financial condition.

These evaluation criteria will relate directly to the specification and/or Statement of Work. The plan will include the criteria for the technical evaluation and will be as detailed as possible. Where evaluation criteria is used technical review and approval of proposed subcontracts shall be obtained.

Evaluation criteria will be established prior to the distribution of the RFP/RFQ to the prospective offerors. The criteria will become a part of the RFP/RFQ so that prospective offerors will know in general how their proposals are evaluated.

3. Statement of Work

A Statement of Work (SOW) is required for all procurement actions. The contents and detail of each SOW must fully define or describe the proposed procurement.

Use of functional or performance specifications.

The PMP anticipates that a major portion of the procurements will consist of fabricated items, state-of-the-art items, and off-the-shelf items. Functional or performance specifications shall be used, to the extent practicable, for procurement of supplies and services.

Consolidation and standardization.

It is the intent of the project to consolidate off-the-shelf standard like-items in order to reduce the number of orders handled, and to obtain quantity or volume discounts consistent with acceptable delivery.

4. Special Provisions

Except for long-lead items, the Project does not anticipate that special contractual provisions will be required for this project that have not been discussed in other parts of the AAAP.

F. Anticipated Subcontractors and Participants

Involvement of subcontractors and participants in the US CMS Project are described in Section III of the PMP. If circumstances change, this plan will be modified.

G. Socio-economic Programs

The Project will provide, to the maximum extent practicable, the opportunity for participation of small, small-disadvantaged, and women-owned businesses in the competitive contracting process.

H. Incorporation of Special Requirements

1. Government Furnished Goods

In the event there is the need for Government or third-party-furnished equipment or supplies for the performance of Project subcontracts, contract/purchasing administrators shall assure that appropriate articles and clauses (e.g., special tooling, title, government property, as applicable) are included in procurement documents that will specify accountability requirements for

Government-owned property. Property management provisions assure that all property acquired for this Project is accounted for to the extent required by Federal Property Regulations.

2. DOE Orders

All flowdown provisions of applicable DOE or NSF orders will be incorporated into US CMS procurements.

I. Conflict of Interest

The project does not anticipate any transactions wherein an organizational conflict of interest will exist. To avoid such a situation, and under certain conditions, specific solicitation provisions will be included to require prospective subcontractors to disclose pertinent information bearing upon any possible conflict of interest. When a conflict of interest exists or may exist with respect to an offeror or subcontractor, no award will be made until the issue has been adequately resolved.

J. Patents and Data

Where appropriate, subcontracts will include articles covering patents, data and copyright.

K. Reporting Requirements

Project purchase orders and subcontracts, where appropriate, will include status reporting requirements. The extent of reporting is commensurate with the value of the procurement. Major project purchase orders and subcontracts will require general management, schedule/labor/cost, exception, performance, financial, and technical status reports which are consistent with this type of procurement. The type (technical/cost/schedule) and frequency of progress information and follow-up required will depend on such factors as the complexity of the procurement and how critical the work is to the project schedule. These periodic reports, along with on-site visits, will be the major tool for evaluating progress. The Project will maintain a comprehensive procurement follow-up program tracking all aspects of the procurement cycle.