Preliminary
DOE Project Execution Plan

for

Run IIb CDF and DØ
Detector Projects

at

Fermi National Accelerator Laboratory

Run IIb CDF and DØ Detector Projects
Project Execution Plan

[Signatures will not be required on the Preliminary PEP, but will be on the final PEP.]

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Run IIb CDF and DØ Detector Projects
PROJECT EXECUTION PLAN

1. Introduction

1.1 Purpose and Context of This Document

This DOE Project Execution Plan (PEP) for the Run IIb CDF and DØ Detector Projects describes the mission need and justification of the projects, their objectives and scopes, the Department of Energy (DOE) management structure, the resource plan, and the environmental, safety, and health (ES&H) requirements. In addition, it establishes the technical, cost, and schedule baselines against which project performance will be measured by the DOE. DOE Baseline Change Control thresholds are also established in this document.

The projects are being carried out by the Universities Research Association, which operates Fermi National Accelerator Laboratory (Fermilab) under contract with DOE. The Run IIb CDF and DØ Detector Project Management Plans (PMPs) describe the organization and systems that Fermilab will employ to manage the execution of these projects and report to DOE. The PMPs also establish the more detailed lower-tier milestones against which Fermilab and the DOE Run II Project Manager will measure project performance.

1.2 Approval and Revision

The PEP is approved by the Associate Director, Office of High Energy and Nuclear Physics (SC-20) as a prerequisite of Critical Decision 2, Approval of Performance Baseline. Revisions to the PEP that are required to incorporate baseline change actions are considered to be approved by virtue of the corresponding baseline change. The DOE Run II Project Manager is authorized to approve non-substantive changes to the PEP without higher level approval.

The Run IIb CDF and DØ Detector Project Management Plans are approved by the DOE Run II Project Manager.

2. Justification of Mission

2.1 Programmatic Mission

The High Energy Physics program of the DOE Office of Sciences conducts basic research at Fermi National Accelerator Laboratory (Fermilab) utilizing the Tevatron Collider, which collides protons and antiprotons with center of mass energy of 2 TeV. Two detectors, CDF and DØ, observe these collisions. These studies address some of the most fundamental issues in particle physics. In the recently started “Run II” of the Tevatron Collider, it is expected that both detectors have good prospects for making major new discoveries, perhaps including the first observation of the Higgs boson.

2.2 Project Support of Program Mission

The Tevatron Collider Run II program is one of the highest priority activities in the U.S. high-energy physics program with probably the best opportunity to make important discoveries in the next several years. A program of accelerator improvements is planned at Fermilab to maximize the luminosity of the Tevatron Collider. Ultimately, it is expected that during the period 2002-

2007 it will be possible to collect data corresponding to an integrated luminosity of 15 inverse femtobarns.

3. Project Description

The Run IIb upgrades of the CDF and DØ detectors will provide the necessary capability to make sensitive searches for the Higgs Boson and maximize the physics opportunities in Run IIb. The largest part of the Run IIb projects is to replace the silicon detectors in the CDF and DØ experiments. These detectors are capable of identifying short-lived particles, such as b-quarks, that travel a small distance before decaying into other particles. The Higgs Boson is expected to decay into a pair of b-quarks and efficiently detecting them is crucial to the Run IIb goals. The CDF Run IIb project also includes a central preradiator detector with the capability of improving electron and photon identification, and an upgraded event builder with the capability of increasing the data throughput. The DØ Run IIb project includes upgrades to the Level 1 and Level 2 triggers to improve the selectivity in what data is recorded, and an upgrade to the online computing to provide the necessary computing infrastructure needed for Run IIb.

3.1 Scientific Objectives

The Fermilab Tevatron provides the highest energy particle beams in the world, enabling unique opportunities for scientific discovery. One such opportunity is the search for the Higgs Boson, which is thought to be responsible for breaking the Electro-Weak symmetry and giving rise to particle masses. Understanding the mechanism for Electro-Weak Symmetry Breaking has been identified as the highest priority of the US High Energy Physics (HEP) program by the HEPAP sub-panel assessing the long-range future of the field. There are strong indications that the Higgs mass is likely to be within the range where CDF and DØ experiments are sensitive to it provided the experiments collect sufficient integrated luminosity. The purpose of this acquisition is to provide technical components to upgrade the CDF and DØ experiments to enable them to accumulate sufficient integrated luminosity to maximize the chance for discovering the Higgs Boson.

Fermilab will continue to operate at the “Energy Frontier” until the Large Hadron Collider (LHC) at CERN begins operation with a much higher beam energy at the earliest in late FY2007. Thus, the Fermilab Tevatron Collider has a window of opportunity for making a major scientific discovery before handing off the baton to CERN and minimizing the procurement time for the Run IIb upgrades is a significant consideration in the project planning process. Estimates indicate that, due to radiation damage, the current silicon detectors will only be useful up to 4 fb^{-1}, which is expected to occur in FY2005 or FY2006. The original CDF and DØ Detectors underwent upgrades for Run IIa at a cost of approximately $210 million. The accelerator complex also underwent upgrades for Run II at a cost of approximately $300 million. To maximize the usefulness of this high-energy physics investment, the Run IIb CDF and DØ Detector Projects are essential. The detector components provided by the Run IIb upgrades will allow the experiments to operate at high luminosity and meet the laboratory’s goal of acquiring an integrated luminosity of 15 fb^{-1}. Designs will take advantage of advances in radiation resistant electronics to enable the new components to handle 3 to 4 times as much radiation. This is a significant increase above the Run IIa goal of 2 fb^{-1} and will enable a sensitive search for the Higgs Boson, which has been identified as a top priority in the President’s budget request for High Energy Physics.

3.2 Technical Goals

The critical technical goals of the Run IIb CDF and DØ Detector Projects are listed in Table 3.1. The commissioning without beam goals are the parameter values that must be achieved for approval of project closeout (Critical Decision 4). The operational goals, that are necessary for the experiments to accomplish their scientific objectives, are expected to be reached after approximately a year of operation.

Table 3.1
Run IIb CDF and DØ Detector Projects
Technical Goals

Subsystem	Technical Goal
Run IIb CDF Detector Project	
Silicon Detector	Channels read out on one 30° wedge
Central Preradiator	Pulse height distribution for each 15° module
Calorimeter timing	Time distribution on one 15° wedge
Data Acquisition and Trigger	Successful bench test of Level 2 decision crate, track trigger boards, and TDCs using simulated inputs
Run IIb DØ Detector Project	
Silicon	System test of partially populated inner layer 30 degree sector, and a minimum of five staves.
Level 1 Calorimeter Trigger	Full functionality of production custom boards bench tested using simulated inputs, verifying outputs and observing acceptable bit error rates (approximately 1 fatal error per day).
Level 1 Central Track Trigger	DFEA daughter cards assembled and bench tested by loading test vectors and verifying Level 1 output, Level 2 output, and required timing characteristics.
Level 1 Calorimeter/Track Match	Production cards assembled and loop-tested on bench, which consists of exercising input combinations and verifying an exact match of the output data with the expected output.
Level 2 beta	Processors procured and input/output tested for correct beta-to-beta communication in a test crate.

3.3 Project Scope

Run IIb CDF Project

- Replacement of the inner silicon detector with a device capable of b tagging and triggering.
- Upgrade of the central calorimetry, to provide improved time measurement of electromagnetic energy deposition and a replacement for the obsolete central preradiator chambers.
- Replacement of obsolete portions of the data acquisition system that prevent the experiment from collecting data at the rates needed in Run IIb.

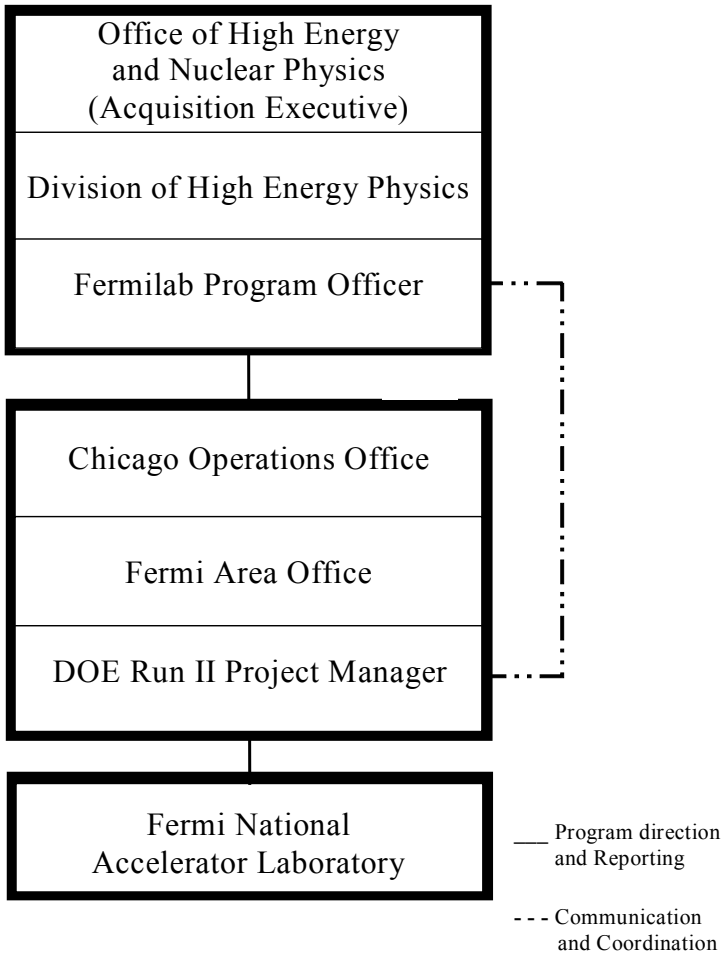
Run IIb DØ Project

- Replacement of the silicon microstrip tracker with a new, more radiation-resistant version that has improved capabilities for physics measurements.
- Upgrade of the Level 1 and Level 2 trigger systems to accommodate the higher luminosities from the Tevatron.
- Replacement of obsolete portions of the online and data acquisition systems that would otherwise prevent the experiment from taking data at rates necessary to achieve the physics objectives of Run IIb.

4. Management Structure and Responsibilities

The DOE organization for the Run IIb CDF and DØ Detector Projects is shown in Figure 4.1. Each of the major organizational elements is discussed below the figure.

Figure 4.1
Run IIb CDF and DØ Detector Projects
Project Management Organization



4.1 Office of High Energy and Nuclear Physics

Within the Office of Science, the Office of High Energy and Nuclear Physics has overall DOE responsibility for the development of high energy and nuclear physics. The Associate Director, Office of High Energy and Nuclear Physics will serve as the Acquisition Executive for these projects. The Division of High Energy Physics (DHEP) is the lead program organization for the Run IIb CDF and DØ Detector Projects. The prime headquarters point of contact for the project will be the DOE Fermilab Program Officer, a DHEP employee who is appointed by the Director of the DHEP.

The responsibilities of DHEP relating to the projects include the following:

- participates in annual budget process;
- reviews the PEP and substantive changes to it;
- reviews the initial cost, schedule, and technical baselines;
- performs project management reviews on a roughly semiannual basis;
- ensures that funding is provided on a timely basis;
- coordinates project needs within DOE headquarters;
- and coordinates with the DOE Run II Project Manager.

4.2 Chicago Operations Office

The DOE Chicago Operations Office (CH) has the contract management responsibility for DOE's performance-based management contract with URA. The Fermi Area Office (FAO) is the responsible DOE office on site at Fermilab that administers the contract and provides day-to-day DOE oversight of the laboratory. The FAO Manager has assigned the DOE Run II Project Manager the authority for day-to-day implementation and direction of the project. The FAO Manager will provide the DOE Run II Project Manager with support from FAO staff when appropriate.

4.3 DOE Run II Project Manager

The management responsibility, authority, and accountability for day-to-day execution of the project has been assigned to the DOE Run II Project Manager. The DOE Run II Project Manager is a DOE employee who is appointed by the FAO Manager, subject to the approval of the Director of the DHEP. The DOE Run II Project Manager receives guidance and direction from the DHEP and serves as the principal point of contact for DOE headquarters on issues specific to the project.

Specific responsibilities of the DOE Run II Project Manager are:

- Generate the Project Execution Plan in cooperation with the DHEP.
- Review and approve the Project Management Plans and subsequent revisions.
- Implement procedures for baseline management and control, approve baseline changes at Level 2 and recommend changes or corrective action to baselines above Level 2.
- Maintain close contact with the activities of Fermilab to assure that the goals and schedules are met in a timely and effective manner. Review project performance monthly and keep the DHEP informed of cost, schedule, and technical progress and problems in a timely manner.
- Control the project contingency funds and authorize its use within levels established in the Project Execution Plan.
- Coordinate with the FAO Manager regarding approval of subcontract procurement actions performed by Fermilab.
- Oversee the preparation and review of the safety analysis documents.
- Direct the updating of the Project Execution Plans and the Project Management Plans.
- Coordinate updates of the budget.
- Participate in and provide support for the program peer reviews, reviews by oversight committees and validation of the project.

- Submit quarterly reports and other reports on the status of the project for DOE management as required in this Project Execution Plan and applicable DOE requirements.
- Aid in the compliance by the Run IIb CDF and DØ Detector Projects with appropriate DOE requirements, and contracting regulations.

5. Resource Plan

The planned funding for the Run IIb CDF and DØ Detector Projects is shown in Table 5.1. The planned DOE staffing are presented in Table 5.2. The Fermilab and collaboration staffing is presented in the Run IIb CDF and DØ PMPs.

Table 5.1
Planned DOE Funding for the Run IIb CDF and DØ Detector Projects ($ in thousands)

	Prior Years	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	Total
Run IIb CDF Detector Project							
DOE Equipment							
DOE R&D							
Non-DOE							
CDF Total							
Run IIb DØ Detector Project							
DOE Equipment							
DOE R&D							
Non-DOE							
Other							
DØ Total							

Table 5.2
DOE Staffing (in FTE)

	CH/FAO	HQ
Management	1.1 FTE DOE Project Manager Contracting Officer	0.2 FTE Program Manager Acquisition Executive
Misc. Support	1.5 FTE ES&H Procurement FTE Legal FTE Other	N/A

Run IIb DØ Detector Project Funding Discussion

In addition to DOE funding, the DØ Run IIb project is partially supported by NSF and DØ collaborating institutions. As a result of this outside support, some procurements will be performed by these collaborating institutions. Further details are given below.

An NSF Major Research Instrument (MRI) grant of $1,683,566 has been awarded to a consortium of eight US universities that provides partial funding for the Silicon Tracker Replacement. In addition to the NSF funding, a total of $791,635 in cost sharing funds have been committed to the project by the collaborating universities and two foreign institutions. To ensure that procurements made as part of the MRI award meet the requirements of the project, Memoranda of Understanding (MOU) will be executed between Fermilab and the universities listed above that detail the work to be performed by each institution. The MOU will also describe the approval process for procurements to ensure full oversight by the Project Manager.

A second NSF MRI proposal is being considered that requests approximately $450 thousand in funding for the Central Track Trigger Upgrade. The proposal has been submitted by a consortium of seven US universities. In addition to the requested NSF funding, approximately $115 thousand in cost sharing funds have been committed to the project by the collaborating universities should the MRI be awarded. As with the silicon MRI, MOU will be executed between Fermilab and the universities that detail the work to be performed by each institution and describe the approval process for procurements.

Run IIb CDF Detector Project Funding Discussion

In addition to DOE funding, the CDF Run IIb Detector Project is partially supported by contributions from collaborating institutions, including foreign sources from Japan, Italy,

Taiwan, and Canada. As a result of this outside support, some procurements will be performed by these collaborating institutions.

Japanese support from the Ministry of Science, Culture and Education of Japan in the amount of approximately $2.2 million is expected for the procurement of silicon sensors, low mass signal cables, and photomultiplier tubes used in the silicon detector and calorimeter upgrade projects. CDF collaborators at the University of Tsukuba play an active role is assuring that the requirements of the project are satisfied by these procurements. Similarly, support from the Istituto Nazionale di Fisica Nucleare of Italy, the National Science Council of the Republic of China, and the Engineering Research Council of Canada contribute through collaborating institutions as well. Memoranda of Understanding (MOU) will be executed between the project and the collaborating institutions to assure that these contributions are consistent with the needs of the project, and that project management can control the technical specifications of these contributions. Total foreign contribution to the CDF project is expected to reach approximately $3 million.

6. Project Monitoring and Reporting

The DOE Run II Project Manager will provide quarterly reports on the Run IIb CDF and DØ Detector Projects to HQ and monthly updates to the Project Assessment and Reporting System (PARS). Monitoring of the Run IIb CDF and DØ Detector Projects will occur through established mechanisms among project participants. Reviews of the projects status will be conducted by the Director of High Energy Physics approximately semiannually. Fermilab will provide formal project monthly reports to the DOE Run II Project Manager. The requirements of the monthly reports will be included in the Run IIb CDF and DØ Detector Projects PMPs.

7. Safety/Hazard Analysis Report

7.1 National Environmental Policy Act (NEPA)

The Run IIb CDF and DØ Detector Projects are upgrades to existing detectors, and therefore, should be covered by a Categorical Exclusion.

7.2 Preliminary Safety Assessment Document

The original CDF and DØ Detectors were designated as Low Hazard Radiological Facilities and the Safety Envelopes were approved by DOE in November 1994 and November 1995, following submission of the Safety Assessment Documents (SADs). Addendums to the SADs were submitted and approved for the Run IIa Upgrades, and the radiological facility designations remained unchanged. In compliance with the Fermilab ES&H Manual, the Directorate, through the ES&H Section, has determined that a Run IIb addenda to the existing CDF and DØ SADs should be prepared. No aspect of the Run IIb CDF and DØ Detector Projects will increase the hazards of the experiments for either radiological or conventional hazards. Consequently, a complete reanalysis of the Safety Assessment Documents is not warranted.

7.3 Integrated Safety Management

The Run IIb CDF and DØ Detector Projects will be constructed and operated under the Integrated Safety Management (ISM) plan developed by Fermilab in consultation with DOE. The Fermilab ES&H Section, the Fermilab Particle Physics Division, and the project teams work together to assure effective application of the ISM plan. Each project team has committees with specific oversight responsibilities for the advice and ES&H approval process.

8. Project Baselines and Control Levels

The project baselines and control levels are defined in a hierarchical manner that provides change control authority at the appropriate management level. The highest level of baseline change control authority is defined as Level 0. Changes at Level 0 are approved by the DOE Deputy Secretary. Changes below Level 0 are approved as follows: Level 1—Acquisition Executive (Associate Director, Office of High Energy and Nuclear Physics); Level 2—DOE Run II Project Manager; and Level 3—Fermilab as specified in the Run IIb CDF and DØ Detector Project PMPs.

The technical, cost, and schedule baselines and the associated control levels down to Level 2 are given in Table 8.1. The project technical baseline is defined by Section 3 of this document. The cost baseline is given in Table 8.2. Control level 0 and 1 milestones are given in Table 8.3.

The change control levels and procedures at Level 3 and below are addressed in the Project Management Plan.

Table 8.1
Run IIb CDF and DØ Detector Projects
Technical, Schedule, and Cost Baseline Control Levels*

	Deputy Secretary** (Level 0)	Acquisition Executive (Level 1)	DOE Run II Project Manager (Level 2)
Technical	Decrease in scope to maintain cost.	Changes to scope that affect mission need.	
Schedule		Three months increase (cumulative) in a project-level schedule milestone date.	Any change to level 2 milestones (see PMPs).
Cost	Any increase in TPC.		Any use of contingency that would take the contingency as

			percentage of ETC below 40%.

* Changes must be recommended at all applicable lower levels prior to being forwarded to the next higher level for consideration.

** September 19, 2001, memo from Francis S. Blake, subject: Project Management

Table 8.2

Run IIb CDF and DØ Detector Projects
Change Control Level and
Project Cost by WBS Element
($ in Millions)

Control Level	WBS Element	Item	Prelimary Cost Range
Run IIb CDF Detector Project			
3	1.1	Silicon Detector	12-15
3	1.2	Calorimeter Upgrades	1.5-2
3	1.3	Data Acquisition Upgrades	3-6
3	1.4	Administration	1-2
2		Contingency	8-10
0		TOTAL PROJECT COST	$25-35
Run IIb DØ Detector Project			
3	1.1	Silicon Detector	15-17
3	1.2	Level 1 Trigger Upgrade	3-4
3	1.3	Level 2 Trigger Upgrade	0.5-1
3	1.4	Online Computing	0.5-1
3	1.5	Administration	1-2
2		Contingency	8-10
0		TOTAL PROJECT COST	$25-35

Table 8.3
Run IIb CDF and DØ Detector Projects
Controlled Milestones

Level 0 Milestones

Milestone	Description	Preliminary Baseline Date
0.0	CD-0: Approve Mission Need	May 2001
0.1	CD-1: Approve Preliminary Baseline	August 2002
0.2	CD-2: Approve Performance Baseline	September 2002
0.3	CD-3: Approve Start of Construction	September 2002
0.4	CD-4: Approve Project Closeout	November 2006

Level 1 Milestones

Milestone	Description	Baseline Date
Run IIb CDF Detector Project		
CDF 1.1	Silicon Stave Production Begun	June 2004
CDF 1.2	Silicon Outer Detector Completed	March 2006
CDF 1.3	Silicon Ready for Installation into ISL	November 2006
CDF 1.4	Calorimeter Upgrades Ready for Installation	January 2006
CDF 1.5	Data Acquisition and Trigger Upgrades Ready for Installation	January 2006
Run IIb DØ Detector Project		
DØ 1.1	All Silicon Sensors Delivered and Tested	July 2005
DØ 1.2	Silicon Stave Production Complete	April 2006

DØ 1.3	Silicon Ready to Move to DZero Assembly Building	November 2006
DØ 1.4	Level 1 Trigger Production and Testing Complete	June 2006
DØ 1.5	Level 2 Trigger Production and Testing Complete	April 2006