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Fermi Group
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SUBJECT: CDF AND D-ZERO SILICON REPLACEMENT JUSTIFICATION OF MISSION NEED

Attached are the Justification of Mission Need documents for the CDF and D-Zero Silicon Replacement projects. On the third page of each document a line is provided for your signature. Please forward to Peter Rosen for his approval and return a copy of the approved documents to me.

Jane L. Monhart
Area Manager

Enclosures:
As Stated

cc: Jack Ritchie, SC-22, GTN, w/encl.

Post-It™ brand fax transmittal memo 7671	# of pages ▸ 7
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Justification of Mission Need (CD-0)

for the

CDF Silicon Tracker Replacement

Office of High Energy and Nuclear Physics
Office of Science

A. Mission Need

1. Division of High Energy Physics Program 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 D-Zero, 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.

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.

2. Project Purpose and Justification:

The CDF detector is a complex device recently upgraded at a total cost of $112 M. It consists of several detector subsystems which exploit the interactions of charged and neutral particles with matter to observe and measure the properties of these particles. The detector was built at Fermilab under Fermilab project management by a collaboration of about 400 physicists from several universities, other laboratories, and foreign institutes, in addition to Fermilab physicists as well.

The inner most part of the CDF detector is the silicon tracker system, which provides high resolution measurements of the positions of charged particles as they emerge from the collision point. This information, when combined with other information from other detector subsystems, permits events to be reconstructed. The silicon tracker, being closest to the collisions, is subjected to the largest radiation dose. The resulting radiation damage degrades performance. Current best estimates indicate that the onset of radiation damage to the existing silicon tracker will occur somewhat above 2 inverse femtobarns and will seriously degrade performance below 5 inverse femtobarns. Therefore, to fully exploit the physics potential of 15 inverse femtobarns, it will be necessary to replace the existing silicon tracker with a new radiation hard silicon tracker

3. Project Description:

The proposed project is to build a new radiation hard silicon tracker for the CDF detector. It will consist of approximately six layers of active silicon sensors, associated cables, readout chips, cooling systems, and related components. It will provide high precision charge particle tracking with negligible radiation damage up to at least 15 inverse femtobarns of integrated luminosity.

B. Preliminary Project Cost

Preliminary cost estimates have been made, based on a simple conceptual design of the system, but there are many uncertainties that may affect the ultimate cost. The current preliminary Total Estimated Cost (TEC) is approximately $15 M.

C. Preliminary Project Schedule and Funding Profile

The preliminary schedule is as follows:

Design Start: 1st Quarter FY 2002
Construction Start: 3rd Quarter FY 2002
Construction Complete: 1st Quarter FY 2005

The preliminary funding levels needed to meet this schedule are:

FY 2002 $3.5 M
FY 2003 $7.5 M
FY 2004 $4.0 M

D. Acquisition Strategy

Fermilab will have the responsibility for execution of the project. It will provide project and construction management, engineering, management of procurement of components, and quality assurance. Assembly will be performed by a combination of Fermilab staff and university users at Fermilab. Some components will be fabricated in industry according to Fermilab's specifications.

E. Project Organization

The Division of High Energy Physics of the Office of High Energy and Nuclear Physics has responsibility for the programmatic and technical oversight of the Project. The Manager of the DOE/CH Fermilab Area Office (FAO) will assign a DOE Project Manager with responsibility to ensure that the Project is properly managed by Fermilab.

F. Environmental Strategy

Fermilab will comply with all requirements of the National Environmental Policy Act (NEPA) and its implementing regulations. Because of the small size of this device, to be located inside a larger detector, no impacts to the environment are anticipated.

G. Integration With Site Activities

The project will be coordindated with other Fermilab activities by a Project Management Group (PMG) that will include personnel from all involved/affected parts of the laboratory. The PMG will be chaired by the Fermilab Director or his designated alternate.

H. Feasibility of Other Alternatives and Risk of Doing Nothing

- Partial replacement options have been investigated and found to be technically impossible.
- Risk of not proceeding with the project would be to severely limit the physics potential of the CDF detector by making it unable to operate beyond at most 5 inverse femtobarns of integrated luminosity.

Submitted by:

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Date

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Dr. John O'Fallon
Director, Division of High Energy Physics
Date

Approval

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