Memorandum of Understanding

between

California Institute of Technology

and

Fermi National Accelerator Laboratory

for

NOvA Experiment R&D and Construction Work

April 17, 2008 (revised)

I. Preamble

This Memorandum of Understanding is made between the California Institute of Technology on behalf of the High Energy Physics (HEP) Division (Caltech) and the Fermi National Accelerator Laboratory Particle Physics Division (Fermilab). This document represents an understanding between Caltech and Fermilab in connection with NOvA detector mechanical engineering and development work. This document 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.

II. Responsibilities

1. Activities

The Caltech HEP will perform testing and development work of photo-detectors the NOvA experiment. This MOU covers work for NOvA WBS 1.6 and 2.6 (Electronics and Photodetectors). The Caltech HEP group will also maintain apparatus and perform work to evaluate light output performance of detector materials, including PVC, Scintillator, WLS fiber, and any other components. This work continues the use of the techniques developed during R&D period of NOvA detector development. This work involves materials and supplies from many WBS elements and will be administered by the cost account and WBS elements of the electronics and photodetector subsystem, 1.6, and 2.6. This MOU will cover work from October 1, 2007 until construction of the NOvA experiment is complete. The work outlined below will be performed jointly with personnel at Fermilab and other NOvA collaborating institutions.

a) Photo-detector characterization of prototype devices.
b) Testing, assembly, and qualification of photo-detector arrays
c) Storage and shipping of completed photo-detector modules.
d) Light output effects and tests of materials, including Liquid scintillator, PVC extrusions, sealing materials, WLS fiber, and any other materials that may contact these components.

2. Personnel

The technical contact person for NOvA activities at Caltech is Leon Mualem.

3. Payment Authorization

The appropriate Cost Account Manager will notify the Caltech administrative contact named below when funds have been approved for specific tasks covered by this MOU. This notification will usually consist of a Fermilab purchase order. Caltech will not commit resources to NOvA tasks covered by this MOU until such notification has been received. The administrative contact is Gayle F. Lund, Associate Director, OSR, MC 201-15, Caltech, Pasadena, CA 91125-1500.

4. Deliverables

Caltech will manage the production, testing, and delivery of APD arrays for the NOvA experiment. Caltech will work with Fermilab procurement to purchase the APD arrays.

Caltech will test components of the detector as supplied by other NOvA collaborators, prepare as needed, and determine the effect on light output of the NOvA detector. The results of these tests will be documented in articles submitted to the nova-docdb archive system.

5. Institutional Contribution of Services and Equipment

1) Services
   The services of Caltech HEP Staff will be available to the NOvA experiment to the degree required to carry out the work described in this document.

2) Facilities and Equipment
   The following Caltech facilities and equipment will be made available to the degree necessary to carry out the work described above.
   a) Lab and workshop areas,
   b) Computers,
   c) Normal test equipment.

3) Operating Costs
   Caltech, subject to adequate funding from DOE, will support the normal research operating expenses (such as physicist salaries, physicist travel expenses, miscellaneous supplies, administrative support, etc.) of the Caltech group working on the NOvA experiment.

6. Fermilab Resources Required

In addition to the costs listed in annual Statements of Work, Fermilab will provide funds for Caltech technician travel and for materials and equipment purchases necessary to perform this work. Large purchases will usually be made through the Fermilab Procurement department but some purchases may be made through Caltech procurement, as specified in annual Statements of Work.

Caltech performance of the photo-detector and light output tests described in this MOU will require a substantial commitment Fermilab M&S funds, as described in the NOvA Project resource loaded schedule. This includes management, ASIC engineering and technical effort from the Particle Physics Division.

7. Resources Required from Other Institutions

The successful completion of the Caltech tasks covered by this MOU depends upon many contributions to this work by institutions other than Caltech and Fermilab. These include

a) University of Minnesota: test stand materials and programs, currently under development.
b) Indiana University: production of photo-detector housings.
c) NOvA Collaboration: Detector materials as needed to assess light output effects of various detector components including PVC extrusions, sealing materials, liquid scintillator, WLS fibers.

III. Reporting, Costs and Schedule

1. Reporting

Caltech will document as NOvA docdb notes the procedures, analyses and results obtained as this work progresses. Caltech will provide material for NOvA Project monthly reports in a timely fashion, including descriptive material, financial reporting, monthly task status reports and information needed for the NOvA Project's monthly earned value management analysis.

2. Estimated Costs and Schedule

Caltech and Fermilab will jointly develop annual Statements of Work to provide detailed descriptions of the work covered by this MOU, including cost and schedule estimates. Caltech will monitor the progress of this work in order to provide ample notice of projected deviations from the cost and schedule estimates. If it is determined that additional funds will be needed, the Fermilab NOvA Project Manager will evaluate available options and, in consultation with Caltech, determine the best means of supplying the required resources.

IV. Other Considerations

1. Safety and Engineering Practices

All work will be conducted in conformity with Caltech safety policies and practices, Caltech engineering standards and Caltech ES&H policies and practices. Equipment and operating procedures provided by Caltech will conform to the NOvA Project ES&H and Integrated Safety Management policies and practices. Any Caltech equipment used at Fermilab and at Ash River will conform to all Fermilab safety policies and practices.

2. Equipment Ownership

All items purchased or fabricated wholly with funds supplied by Fermilab will remain the property of Fermilab. Such items will be properly identified with Fermilab property tags as required by Fermilab policy. All items owned by Caltech will be identified by Caltech property tags as required by Caltech policy.

IV. Approvals

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

Institutional Approvals

4/17/2008

L. Mualem – NOvA Group Leader, California Institute of Technology - date

4/17/08

H. Newman – Principal Investigator, California Institute of Technology - date

6/12/08

~~Richard Seligman – V.P for Research~~, California Institute of Technology
GAYLE F. LUND
Assistant Director of Sponsored Research

6/03/08

J. Cooper – NOvA Project Manager, Fermilab - date

4/23/08

J. Strait – Particle Physics Division Head, Fermilab

6/23/2008

H. Montgomery – Associate Director for Research, Fermilab