

Memorandum of Understanding

between

University of Minnesota, Twin Cities

and

Fermi National Accelerator Laboratory

for

**NOvA Experiment R&D
and Construction Work**

October 11, 2007

I. Preamble

This Memorandum of Understanding is made between the High Energy Physics Group of the University of Minnesota, Twin Cities (Minnesota) and the Fermi National Accelerator Laboratory Particle Physics Division (Fermilab). This document represents an understanding between Minnesota and Fermilab in connection with NOvA detector design, production, and assembly. 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

Minnesota will perform detector design, production, and assembly work for the NOvA experiment. This MOU covers work for NOvA WBS 1.5 and 2.5 (detector module), 1.6 and 2.6 (photodetector), 1.7 and 2.7 (data acquisition system), and 1.8 and 2.9 (detector assembly) 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) Design, produce, and test the parts necessary to convert PVC extrusions into detector modules.
- b) Design and test the factory procedures to assemble the detector modules.
- c) Design and test QA and QC procedures to ensure the quality, structure, and stability of the detector modules.
- d) Produce detector modules for the integration prototype near detector (IPND) and other tests required to qualify the detector.
- e) Lease, set up, and operate the detector module factory.
- f) Procure and manufacture machines and tooling necessary for module production at the module factory.
- g) Deliver finished detector modules to the near and far detector site.
- h) Design and produce QA facility for APDs in collaboration with CalTech.
- i) Test initial APDs.
- j) Determine specs and interface with APD manufacturer during development phase.
- k) Design, test, and build APD cooling system.
- l) Help design and test data acquisition system software.
- m) Help determine far detector assembly procedures and integrate these procedures with the designs of far detector hall and detector components.
- n) Hire and help manage the far detector assembly crew and associated administrative personnel, as described in the NOvA Project resource loaded schedule.
- o) Provide personnel to manage WBS Level 3 tasks for WBS 1.5 and 2.5, 1.6 and 2.6, and 1.8 and 2.9.

2. Personnel

The contact person and supervisor for NOvA activities at Minnesota is Kenneth Heller.

3. Payment Authorization

The appropriate Cost Account Manager will notify Minnesota when funds have been approved for specific tasks covered by this MOU. This notification will usually consist of a Fermilab

purchase order. Minnesota will not commit resources to NOvA tasks covered by this MOU until such notification has been received.

4. Deliverables

Minnesota will develop and document detector module assembly procedures, photodetector test and cooling procedures, data acquisition software, far detector assembly procedures. These documents will be controlled in a way that is understood by Minnesota staff and the NOvA Project Office. Minnesota will hire the crew of workers and administrative staff needed to assemble detector modules and the far detector from components produced or procured by Minnesota or provided by other NOvA Project tasks. The primary deliverable is the assembled and operating NOvA far detector at Ash River.

5. Institutional Contribution of Services and Equipment

1) Services

The services of Minnesota Administrative Staff will be available to the NOvA experiment to the degree required to carry out the work described in this document.

2) Operating Costs

Minnesota, subject to adequate funding from DOE, will support the normal research operating expenses (such as physicists' salaries, physicist travel expenses, miscellaneous supplies, administrative support, etc.) of the Minnesota 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 Minnesota technical personnel 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 Minnesota procurement, as specified in annual Statements of Work.

Minnesota performance of the work described in this MOU will require a substantial commitment Fermilab effort and M&S funds, as described in the NOvA Project resource loaded schedule. This includes management, mechanical engineering and technical effort from the Particle Physics Division.

7. Other Resources Required

The successful completion of the Minnesota detector assembly tasks covered by this MOU depends upon tasks performed by Minnesota under the terms of other NOvA Project MOUs, and by contributions by institutions other than Minnesota and Fermilab. These include

- a) Minnesota Cooperative Agreement: construction and operation of the far detector hall and associated infrastructure.
- b) Argonne: PVC extrusions.
- c) Argonne: engineering design of detector assembly equipment; detector assembly prototype studies; the adhesive dispenser and other detector assembly equipment.

- d) Indiana: liquid scintillator supply and handling equipment, design assistance for the photodetector interface.
- e) Michigan State: optical fiber.
- f) Far detector components and quality assurance test equipment from:
 - i. Detector modules: University of Minnesota – TC, WBS 2.5
 - ii. Detector photodetectors and readout electronics: Caltech, Harvard, Indiana, Virginia

III. Reporting, Costs and Schedule

1. Reporting

Minnesota will document as NOvA notes the designs and procedures developed as this work progresses. Minnesota 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 earned value management analysis.

2. Estimated Costs and Schedule

Minnesota 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. Minnesota 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 Minnesota, determine the best means of providing the required resources.

IV. Other Considerations

1. Safety and Engineering Practices

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

2. Equipment Ownership

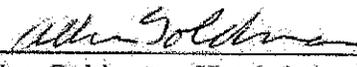
All items purchased or fabricated wholly with funds supplied by Fermilab will remain the property of Fermilab. Such items will be properly identified with Fermilab property tags as required by Fermilab policy. All items owned by Minnesota will be identified by Minnesota property tags as required by Minnesota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

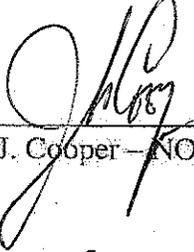
IV. Approvals

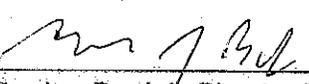
The following concur in the terms of this Memorandum of Understanding. These terms will be updated as appropriate in Amendments to this document.

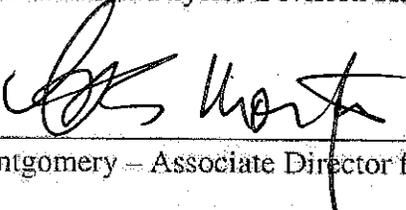
Institutional Approvals


K. Heller – Professor, School of Physics and Astronomy, University of Minnesota - date


Allen Goldman – Head, School of Physics and Astronomy, University of Minnesota - date

 2/14/08
J. Cooper – NOVA Project Manager, Fermilab - date

 2/17/08
J. Strait – Particle Physics Division Head, Fermilab - date

 2/18/2007
H. Montgomery – Associate Director for Research, Fermilab - date