NOVA-doc-2954

NOνA Key Assumptions

Key Cost, Schedule, Technical, and Programmatic Assumptions for the NOνA Project

May 8, 2008

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These are the key project cost and schedule assumptions for the NOvA Project. This list contains the key assumptions and is not meant to be all inclusive.

1. Key Cost Assumptions

1.1 Cost Estimating Procedure Guidance Given to CAMs

- NOvA Cost Account Managers (CAMs) are instructed by the Project Manager to make honest estimates for each task.
    - M&S costs are to be supported by quotes or previous work and not have any hidden contingency.
    - Labor hours are to be supported by documented estimates without any hidden or embedded contingency.
    - All M&S and Labor information is to be captured in a Basis of Estimate (BOE) document for each task.
- Contingency for each task is to be calculated using NOvA Cost Contingency rules as documented in NOvA-Doc-2774.
    - Contingency reflects risk.
    - The Deputy Project Manager must verify contingency & associated risk estimates on all items over $ 1 M. Contingency for many of these large items involves a Monte Carlo analysis described in NOVA-doc-681.

1.2 Labor Cost Assumptions

- Labor hours are estimated for each task and are documented in the NOvA BOEs.
    - FTEs are calculated assuming 1 FTE=1768 hours, but 1768 hours of labor is costed as 2080 hours of SWF and labor rates are applied for all 2080 hours. This 85% "available for work" fraction allows for vacations, training and breaks.
- Labor contingency is applied for each task as described in Section 1.1 above.

- Scientists at Fermilab and at all NOvA Collaboration institutions are included as FTE's at no cost to the project.
    - Reference: M. Procario, March 25, 2008, NOVA-doc-3083.
- Fermilab ES&H support is off-project. This amounts to ~ 0.5 – 1.5 FTEs per year and is described in the BOE for WBS 2.10. This assumption ensures that NOvA ES&H support is integrated into the relevant divisions and sections at Fermilab and follows Integrated Safety Management. NOvA G&A charges are partially recovered by the project via this support.
- Fermilab Business Services Section Procurement support for NOvA is off- project. This amounts to ~ 0.9 FTE per year and is described in the BOE for WBS 2.10. This assumption ensures that NOvA procurements follow Fermilab procedures. NOvA G&A charges are partially recovered by the project via this support.
- Fermilab Particle Physics Division Alignment Group support for NOvA is off-project. NOvA G&A charges are partially recovered by the project via this support.
- Fermilab Technical Division provides off-project support from several groups: procurement support from the TD Acquisition Group, material handling support from the

TD Component Storage Group (except overtime), magnet measurements (except kicker magnets and except for overtime). NOvA G&A charges are partially recovered by the project via this support.

- All other effort is on-project and captured in the Resource Loaded Schedule (RLS) in Open Plan. Engineers, Computing Professionals, Technicians, Field Financial officer, Scheduler(s), and Particle Physics Division Administrative support are all on-project.

- The resource types used by NOvA are contained in the NOvA Guide to Open Plan Views of the NOvA schedule.
    - Reference: NOVA-doc-2690
- Rates for each type of labor resource are captured in the Resource Breakdown Structure file in Open Plan and in the rate files in Cobra.
    - Reference: This is document held only by Fermilab Financial Field Officers – see Suzanne Saxer if further information is required.

1.3 Materials & Services Cost Assumptions

- M&S costs are estimated for each task and are documented in the NOvA BOEs.
- M&S costs estimates are in FY07 $.
- M&S contingency is applied as described in Section 1.1 above.

1.4 Escalation Assumptions

- The base year is FY07 and thus escalation rates are used for out years. NOvA assumed escalation rates are in Table 1.1 and come to the project from OMB via the Fermilab Budget Office.
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Table 1.1 NOvA Escalation Rates for M&S and SWF

OMB Escalation for M&S			
FY	**Inflation Rate**	**Multiplier (by year)**	**Cumulative Multiplier**
2007	0.00%	1.00000	1.000000
2008	2.20%	1.02200	1.022000
2009	2.10%	1.02100	1.043500
2010	2.10%	1.02100	1.065400
2011	2.10%	1.02100	1.087800
2012	2.20%	1.02200	1.111700
2013	2.20%	1.02200	1.136200
2014	2.20%	1.02200	1.161200
Continued on next page			

OMB Escalation for Labor			
FY	Inflation Rate	Multiplier (by year)	Cumulative Multiplier
2007	0.00%	1.00000	1.000000
2008	4.80%	1.04800	1.048000
2009	4.80%	1.04800	1.098300
2010	4.80%	1.04800	1.151000
2011	4.80%	1.04800	1.206200
2012	4.80%	1.04800	1.264100
2013	4.80%	1.04800	1.324800
2014	4.80%	1.04800	1.388400

  - Reference: June, 2006 FY2009-2013 Field Budget Call, Attachment D, NOVA-doc-3033.

- Special escalation rates are used for the civil construction at Ash River. These rates are in Table 1.2, and are based on information from three independent cost estimates for the Ash River construction.
  - Reference: NOvA-doc-2511.

Table 1.2 NOvA Escalation Rates for Construction at Ash River

FY	Inflation Rate	Multiplier (by year)	Cumulative Multiplier
2007	0.00%	1.00000	1.0000
2008	4.87%	1.04867	1.0487
2009	5.42%	1.05423	1.1055
2010	5.42%	1.05420	1.1655
2011	5.46%	1.05460	1.2291

1.5 Cost Assumption Guidance from DOE

- The TPC includes all NOvA costs starting at CD-0.

- The TPC includes the part of the DOE Cooperative Agreement with the University of Minnesota that designs and builds the access road and Far Detector Building.

- The TPC does not include the part of the DOE Cooperative Agreement with the University of Minnesota to operate the Far Detector site and building following beneficial occupancy. Estimates of operating costs at Ash River have been made in the NOvA Conceptual Design Report. See the NOvA CDR, Chapter 22 (NOVA-doc-536).

- The NOvA obligations funding profile for the TPC must fit within the funding profile shown in Table 4.1 in section 4.1 of this document.

1.6 Indirect Cost Assumptions on Funds at Fermilab

- Fermilab allocates indirect expenses (overhead) for Materials/Services Acquisition, Common Site Support, Program Support and General & Administrative Expenses to all final cost objectives.
    - The Budget Office and the Accounting Department develop the provisional rates each year and there is a retroactive adjustment to actual (variance distribution) at least annually at September 30.
    - The NOvA Cost estimate uses the provisional rates from March, 2007.
- Fermilab labor costs receive overhead for common site support, program support (divisions only), and general & administrative expenses.
    - FY07 provisional labor indirect rates vary among the Fermilab divisions as indicated below.
        - Particle Physics Division = 54.40%
        - Accelerator Division = 73.03%
        - Computing Division = 73.03%
        - Technical Division = 75.69%

- Fermilab materials and services (M&S) costs receive overhead for material services acquisition and general & administrative.
    - The overhead on M&S costs are applied to the first $500,000 dollars of direct costs on each purchase order. Any direct costs on a purchase order above the $500,000 cap are exempt from further overhead.
    - Certain types of purchase orders to Universities and other National Laboratories in excess of $100,000 may receive a special pass through overhead rate of 1.5% on the direct costs up to $500,000.
    - FY07 provisional M&S indirect rate is 15.5%.

- Reference: March 5, 2007 memo from the Fermilab Chief Accounting Officer, NOVA-doc-3034.

1.7 Indirect Cost Assumptions at Universities

- NOvA has several Universities and one DOE National laboratory involved in R&D, design and construction of the experiment. Each of these institutions has its own method of allocating indirect expenses. For the purpose of the resource loaded cost & schedule NOvA considers all of the university overheads to be part of the direct cost of the resource. Fermilab M&S overheads are then applied to these direct costs.
    - For University and DOE National Laboratory purchase orders in excess of $100,000 Fermilab may grant a special pass-thru rate of 1.5% on the first $500,000.
    - Amounts in excess of $500,000 per purchase order are exempt from further overhead.

2. Key Schedule Assumptions

2.1 Scheduling Guidelines Given to CAMs

- CAMs are instructed by the NOvA Project Manager to provide their best estimate for the duration of every task.
- There should be no hidden contingency in the schedule.
- Tasks with schedule uncertainty should have cost contingency designed to speed up the work commensurate with the risk.

2.2 Project Critical Path Guidance Given to CAMs

- The NOvA Project Manager has provided overall schedule guidance to the CAMs in NOVA-doc-2951.
    - NOvA is a simple linear project with two parallel paths built into the Open Plan schedule.
        - The NOvA Far Detector must be assembled at Ash River in the Far Detector building and therefore construction of the Far Detector building is on the technical critical path. All other assumptions (warehousing) have additional costs and detract from the ultimate mass the project can construct within the TPC.
        - The Accelerator and NuMI Upgrades (ANU) part of the NOvA Project must use a Fermilab Accelerator Division workforce and this workforce has operational responsibilities to the current Fermilab accelerator complex and program. Thus ANU is dealing with a resource leveled to match estimated availability as stipulated from outside the project. The estimated time to complete ANU with this workforce is ~ 4 of the 5 years scheduled for the project. Given the labor force uncertainties we must start the ANU portion as soon as possible and keep the workforce employed by NOvA whenever possible.
- The Project Manager has deliberately put the Building and the ANU portions of the project in the first project years with highest priority.

2.3 Critical Path Analysis

- The Open Plan RLS is used for a true critical path analysis.
- The Project Manager and Project Office use the Open Plan critical path analysis to understand the impact of delays to parts of the project and to understand how the project might be completed earlier with the application of additional resources.

2.4 DOE Critical Decision Dates Assumed in the NOvA Schedule

- CD-2 is assumed on October 1, 2008. (Milestone 1.9.4.3)
    - This is an early date based on estimates to complete the DOE work procedures (OHEP-IPR, OECM-EIR, EA, ESAAB,…)
    - A risk analysis on CD-2 approval delay is in the NOvA Risk Register.
        - Any date during calendar 2008 has no effect since the FY08 Omnibus funding bill does not allow NOvA funding in FY08 and OHEP has instructed the project to plan for no additional funding before Feb 1, 2009.
- CD-3a is assumed on February 2, 2009. (Milestone 2.10.8.1)
    - A risk analysis on CD-3a approval delay is in the NOvA Risk Register.
- CD-3b is assumed on October 1, 2009. (Milestone 2.10.8.2)
    - A risk analysis on CD-3a approval delay is in the NOvA Risk Register.

- CD-4 is assumed at 10 months beyond the "Detector Complete" date. (Milestone 2.10.8.3)
    - A risk analysis for the project not meeting this date is discussed in Section 4.3 and in the NOvA Risk Register. This risk has been categorized as a high risk and the details are documented in NOVA-doc-3069.

2.5 Assumptions about the Fermilab Schedule

- Accelerator Shutdowns assumed:
    - 2009 shutdown: April 6, 2009 for at least 10 weeks. (Milestone 2.10.10.3)
        - The Lab uses this shutdown for initial construction of GPP buildings (see section 3) which will eventually be needed for NOvA, but are also needed for the use of the Gap Clearing Kicker in the MI. See Section 4.5.
        - Associated risks (both low) that the shutdown would be delayed to impact the GPP and NOvA are # 97 and # 102 in the NOvA Risk Registry.
    - Accelerator Upgrades shutdown: July 19, 2011 (Milestone 2.10.10.5) to May 15, 2012, ten months.
        - NOvA uses this shutdown to install the accelerator components for 700kW.
        - Associated risk (medium) that the laboratory might delay this shutdown and NOvA is #238 in the NOvA Risk Registry.
    - NuMI Upgrades shutdown: June 3, 2013 (Milestone 2.10.10.7) to Sept 3, 2013, three months.
        - NOvA uses this shutdown to install the NuMI beamline components for 700 kW.
        - No particular risk identified since this shutdown is determined by NOvA readiness and the length is determined by NOvA tasks.

- Tevatron Collider running is assumed not to extend beyond July 19, 2011.
    - This date allows for a possible 1.8 year extension of the Tevatron Collider run beyond the presently planned run end date of October 1, 2009.

3. Key Technical Assumptions

3.1 Fermilab Proton Plan

- The NOvA Accelerator and NuMI Upgrades (ANU) designs are upgrades to the existing Fermilab accelerator complex. That complex is the sum of already operating machines and a set of Proton Plan upgrades presently being implemented. These Proton Plan upgrades have a wider use than NOvA and are therefore not part of the NOvA Project, while ANU contains accelerator upgrades specifically for NOvA and are on-project.

- To assure that ANU operations meet expectations, the project will monitor the progress of key Proton Plan upgrades and determine whether their performance is adequate for ANU. Proton Plan items of particular impact to NOvA are as follows:
    - Booster performance in terms of proton delivery rate, protons per pulse, and longitudinal emittance is to be improved by the Proton Plan.
    - The MI-8 collimators need to remove large amplitude (transverse and longitudinal) particles in the transfer between the Booster and Main Injector.
    - 11-batch slip stacking in the Main Injector must perform at the necessary intensity and efficiency.
    - New collimators installed in the MI will intercept beam loss occurring at the extended period at 8 GeV and the loss occurring at acceleration from uncaptured beam. In ANU the collimators must also intercept the acceleration loss. Once 11-batch slip stacking and the collimators are implemented, the utility of the collimators for ANU can be well estimated.

- Reference: Details of the needed parameters for ANU are contained in the NOvA TDR (NOvA-doc-2896) Sections 8.7.1.3 and 8.7.2 and Table 8.3.

- The NOvA Associate Project Manager also oversees the Accelerator Division's Proton Plan. This dual role ensures that the on- and off-project parts essential to NOvA mesh properly in the NOvA RLS.

3.2 NOvA Kickers

- Design, prototyping and construction of the Gap Clearing Kicker System will be executed by AD MI Department as a separate off-project activity. This program is proceeding so that the kicker system can be installed in the Main Injector and used for some period of time before the NOvA Accelerator Upgrades shutdown in 2011.
- The NOvA ANU subproject schedule assumes NOvA can remove the Gap Clearing Kicker System from the Main Injector and install it in the Recycler during the Accelerator Upgrades shutdown. It will no longer be needed in the MI at that point.
- Construction of additional injection, extraction, and abort line kickers are part of the NOvA Project since they are NOvA-specific.

- Reference: A MOU between the NOvA Project and the Directorate describes this in more detail (see NOvA-doc-2795). Justification for this work being off-project is documented in the appendices to NOVA-doc-2795. Moving this work off-project has been formally agreed to by the DOE Fermi Site Office as documented in the appendices to NOVA-doc-2795.

3.3 NOvA Application Specific Integrated Circuit

- NOvA requires a custom Application Specific Integrated Circuit (ASIC) for readout of the commercial Avalanche Photodiode photodetectors. This is a very low noise amplifier ASIC and state-of-the-art. Custom ASICs in general have a somewhat checkered history requiring multiple designs to reach the performance specifications. To mitigate this risk,
    - The NOvA device is based on an existing design.
    - The NOvA device has been extensively prototyped during NOvA R&D and is in its final design cycle.
    - Tests of the final chip are planned and there is time in the NOvA project for design iteration if required.
    - References: NOvA TDR, Chapter 14, section 14.7 (NOVA-doc-2896). The delay risk is documented as Risk #190 (low) for WBS 1.6 in NOVA-doc-2841.

3.4 NOvA PVC Structure

- The NOvA Far Detector is unique in its composition and scale, using 4.5 kilotons of PVC plastic to hold 10.5 kilotons of liquid in a structure 53 feet high, 53 feet wide, and 257 feet long.
    - The structure is equivalent to a 5 story high building made of PVC plastic
    - The PVC is under stress from the pressure of the liquid inside the plastic and such plastics creep under stress.
        - NOvA mitigates this creep property by limiting the stress during assembly and in the final configuration of the detector.
        - The NOvA design includes the assumption that the structure can be filled with liquid scintillator during construction of adjacent empty PVC structures as assembly of the structure proceeds from south to north in the Far Detector hall.
    - Structure risks have been documented in the NOvA Risk Registry (NOVA-doc-1323 and 2841, and in NOVA-doc-813).
    - The creep properties of the NOvA PVC and structure have been extensively studied and this is documented in the NOvA TDR, Chapter 17. (NOVA-doc-2896). This is a 175 page chapter in the TDR.
        - A safety factor of ~ 5 has been calculated for the structure.
        - Calculations indicate the structure will have a lifetime greater than 20 years.
        - Test structures have confirmed these calculations.
    - Properties of the NOvA PVC continue to be studied and evaluations of the structure will continue as new results become available.

- An outside expert review of the structure was held in January 2005 (see NOvA-doc-496) and another outside review will be held before construction.

3.5 Integration Prototype Near Detector (IPND)

- The IPND is a 90 ton version of the NOvA detectors and is identical to the NOvA Near Detector. Construction of the IPND during NOvA R&D forces the detector design integration to a close.
  - The current RLS shows the IPND complete during the second half of FY2010. (Milestone 1.8.5.7.12)

- The IPND will operate in the existing MINOS service building on the surface at Fermilab and see an off-axis neutrino beam during current Fermilab operations for the MINOS experiment.
  - Operational experience with the IPND will allow assessment of the R&D designs prior to final procurements for the NOvA Near and Far Detector.
  - The NOvA RLS includes a task for labor during operations of the IPND. (Task 1.7.6)
  - All other costs for operating the IPND (e.g., power) are assumed to be off-project.

- Reference: NOvA TDR, Chapter 5, Section 5.6.1. NOVA-doc-2896.

4. Key Programmatic Assumptions

4.1 DOE Funding Profile

- The assumed funding profile is shown in Table 4.1 below.
    - Reference: M. Procario OHEP guidance in May 8, 2008 email to John Cooper, NOvA-doc-3031.

Table 4.1
Planned Funding Profile
to Support Performance Baseline TPC (AY $M)

Fiscal Year	**NOvA Total**
Prior Year 2006	4.388
Prior Year 2007	12.470
2008, Q1 before Omnibus Bill	1.600
2009	37.000
2010	68.000
2011	71.220
2012	51.245
2013	32.077
Total Project Cost	**278.000**

4.2 DOE Funding Availability

- FY08 R&D funds are assumed available only to cover expenses in FY08 incurred prior to passage of the FY08 Omnibus funding bill late December, 2007.
    - Carry over R&D funds from FY07 may allow some additional progress during FY08, but the RLS assumes only the effort required to complete CD-2.
    - CD-2 MIE and Cooperative Agreement funds were authorized in FY07 and are allowed for use in completing NOvA final designs. Carry over of unobligated FY07 funds in these categories can be used in FY08 and are not subject to the FY08 Omnibus funding bill restrictions on NOvA.

- CD-3a funds are assumed available on February 1, 2009.
    - This OHEP direction was given to the project in the January 17, 2008 IPT meeting and is documented in the IPT minutes for that date.
    - No NOvA procurements are scheduled prior to February 1, 2009.
    - The risk analysis for CD-3a delay is in the NOvA Risk Register.
    - In FY09 the start of the critical path for the project in construction of the Ash River access road still depends on having ~ $ 8 – 10 M available in Spring 2009

or the project will lose some of the prime construction season in northern Minnesota. CD-3a is required by February 1, 2009 to start the procurement cycle for this construction.

        - A delay in funds availability beyond about March 2009 is a risk to the project documented in NOvA-doc-3508. Once the road is in place, year-round construction can proceed with occasional weather impact delays during winter months.

- CD-3b funds are assumed available October 1, 2009.
    - No CD-3b NOvA procurements are scheduled prior to this date.
    - The distinction between CD-3a and CD-3b in the schedule allows for a possible Fermilab EVMS certification delay beyond February 1, 2009 due to currently unforeseen circumstances.
        - OECM indicated in the November 2007 EIR review that an exception to certification could be agreed to for a limited set of CD-3a procurements.
            - Reference: Brian Kong, private communication.
    - The risk analysis for CD-3b delay is in the NOvA Risk Register.

- FY10-FY13 funding is assumed available November 1 each year.
    - Continuing resolutions in these years will have less impact since the 1/12th per month funding rate will be based on non-zero funding in the previous year.
    - Large procurements requiring more than $ 3 M are offset in the RLS to January 1 (start of Q2 in the given FY). This allows accumulation of funds from 1/12th per month funding before placing such orders.
    - The risk analysis for funding delays in any FY is documented in NOVA-doc-3070.
        - One special risk for construction of the Ash River Far Detector Building due to delayed funding in FY10 is documented in the NOvA Risk Register. This is a high risk with details documented in NOVA-doc-3509.

- A change in the DOE funding profile in table 4.1 is NOT assumed.
    - The risk analysis for a profile change is in the NOvA Risk Register. This is a high risk with details captured in NOVA-doc-3071.

4.3 CD-4

- The CD-4 date is defined by 10 months of float between the RLS schedule date of “14 kt detector complete” and CD-4.

- The CD-4 date comes partially from OHEP and partially from a NOvA Project risk analysis of the float on the project between “Detector Complete” and CD-4. This Risk analysis is documented in NOVA-doc-3069.
    - The NOvA Project risk analysis looks at the DOE Programmatic risks for CD-4, at risks due to construction delays at Ash River, at risks due to detector

construction, and at risks in the accelerator portion of the project. Four improbable delay scenarios emerged:
    - A delay in EA / FONSI / CD-3a.
    - A delay in EVMS certification.
    - A delay if the Ash River building construction were to lengthen.
    - A delay if the Ash River PVC structure cannot take the full scintillator load as planned without a second bookend in place.
  - Overall, the project analysis indicates the 10 months of float from "detector complete" to CD-4 is adequate to cover the worst case of 3 of these delays occurring in series.

4.4 DOE Cooperative Agreement with the University of Minnesota

- The University of Minnesota (UM) has received a DOE Cooperative Agreement (CA) grant for the Far Detector building in Ash River.
  - UM will acquire the land and an easement for the access road
  - UM will own and operate the building

- One component of the Cooperative Agreement requires an MOU between the University of Minnesota and Fermilab.
  - This MOU exists (reference: NOVA-doc-2824)and has the following key assumptions:
    - There will be an Integrated Construction Team involving the University of Minnesota's Capital Planning and Project Management Office and Fermilab's Facility Engineering Services Section as represented by the NOvA CAM for the Building WBS 2.1.
    - The Cooperative Agreement will use UM procurement rules, but we agree to consensus between UM and the NOvA Project on larger questions, e.g. choice of the AE design firm, choice of major contractors, …
    - UM will report monthly to Project Office with a narrative and financial information even though such reporting is not required by DOE in a CA. This means Earned Value computation can be done for the building portion of the project.

- The Project constructs the detector inside the building as part of the MIE funding.

- The operation of the Ash River building and site within the CA is NOT part of the NOvA TPC.

4.5 Fermilab Programmatic Assumptions

- Accelerator Shutdowns are assumed as outlined in section 2.5.

- Commissioning of the Accelerator and NuMI Upgrades portion of the project with beam is not part of the project since commissioning is an operational activity that needs to be integrated into the accelerator operating schedule.
    - This integration is the responsibility of the Fermilab Directorate and Accelerator Division, not the NOvA Project.
    - Reference: MOU between NOvA and the Fermilab Director, NOVA-doc-2795.

- The service buildings that will house the NOvA kicker magnet support systems and an anode power supply room are being designed and constructed under a General Plant Project (GPP) known as Main Injector Neutrino Upgrades (MINU) Project.
    - The work includes construction of two new service buildings (one at MI-14 and one at MI-39) with associated penetrations into the Main Injector tunnel, which need to be constructed prior to beginning installation and testing of the Recycler Ring Injection kickers (MI-14) and of the Recycler Ring Abort and Gap Clearing Kickers (MI-39). The MI-39 building is also needed in order to use the Gap Clearing Kicker System in the Main Injector (see Section 4.2). The project also includes construction of a 4th Anode Power Supply Room at MI-60 that will be needed for NOvA.
    - The NOvA/ANU subproject expects that Fermilab will do all it can to construct these facilities in time to meet the requirements of the NOvA project schedule. The Fermilab Directorate supports this assumption. The assumed beneficial occupancy date for these buildings in the NOvA schedule is September 1, 2009 for MI-14 and MI-39 and the anode power supply room. See NOVA-doc-2317 for a risk analysis (low risk).
    - Reference: the MOU between the NOvA Project and the Directorate describes this in more detail (see NOvA-doc-2795). The justification for this work being off-project is documented in the appendices to NOVA-doc-2795.

- The underground cavern construction for the NOvA Near Detector requires offsetting square feet to satisfy DOE spacebank requirements.
    - Approximately 1200 square feet are involved.
    - The area can come from the existing Fermilab spacebank which currently has approximately 10,000 sq ft available.
        - Reference: email to John Cooper from R. Ortgiesen (Fermilab spacebank controller) on August 30, 2007, NOVA-doc-3032.

- The NOvA Project assumes that parts from the Tevatron and other beamlines can be used for the NOvA project once the Tevatron shuts down.
    - The Project will work with Accelerator Division to make sure that the means of removing such components minimizes negative impacts with regard to possible subsequent Tevatron operations.

- In the event that it ultimately does not prove possible to release such components the laboratory will work with the project to minimize the cost/schedule impact on NOvA.
- The list of items assumed available for NOvA use is documented in NOVA-doc-2518. These parts are assumed to be available at the start of the Accelerator Upgrades Shutdown.
- Reference: the MOU between the NOvA Project and the Directorate describing this agreement is posted in NOvA-doc-2795.

- Several Fermilab Accelerator Division Proton Plan upgrades are planned for near term implementation because they are necessary for improved operation of the NuMI Facility.
  - They are also critical for the successful completion of NOvA and are assumed to be complete for the NuMI Upgrades Shutdown.
  - Reference: the MOU between the NOvA Project and the Directorate describes these tasks (see NOvA-doc-2795).

4.6 CD-4 Definition

- An upgraded accelerator complex capable of 700 kW operations is a CD-4 deliverable as outlined in the NOνA Project Execution Plan and the NOνA Project Management Plan.
  - The capability is achieved with completed installation and testing of the upgraded devices and with the approved safety documentation in place for operations with beam.
  - The NOvA Project MOU with the Directorate (NOVA-doc-2795) documents why <u>beam commissioning</u> of the 700 kW capability is not included in the NOvA Project scope.
  - Reference: NOvA Start-Up Plan in NOvA-DOC-2646.

- Working Near and Far NOvA Detectors are also CD-4 deliverables.
  - In this case CD-4 requires observation of charged current neutrino events in each detector
  - Reference: PEP, PMP, Startup Plan in NOvA-DOC-2646.

4.7 Decommissioning and Decontamination Assumptions

- D&D is not part of the NOvA Project.
  - D&D of items on the Fermilab site would be covered by Fermilab operating funds.
  - D&D of items at Ash River are covered in the DOE Cooperative Agreement with the University of Minnesota.
- Estimates of D&D costs have been made in the NOvA Conceptual Design Report. See the NOvA CDR, Chapter 22 (NOVA-doc-536).