NOνA Schedule – Activity Notes

Construction

CD-2/3a Director's Review
June 4-6, 2007

Nova Project
WBS 2.x - Construction
Activity Notes

CD-2/3a Director's Review
June 4-6, 2007

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2	**Construction Project**	**WBS 2.0 is for the final design and construction of the NOvA Near and Far Detectors and the Far Detector Hall.**			
2.0	**ANU Construction**				
2.0.1	**Recycler Upgrades**	**This summary task for the work to convert the Recycler Ring from an anti-proton storage ring to a proton pre-injector, includes refurbishment of existing magnets, procurement and fabrication of new magnets, installation of injection, extraction, and RR-30 SS beamlines, procurement, fabrication, and installation of the new 53 MHz RF system, and procurement and fabrication of instrumentation upgrades.**			
2.0.1.1	**Recycler Ring Modifications**	**This summary task covers procurement and fabrication for new and refurbishing of existing magnets for the Injection, Extraction, and RR-30 SS beamlines, as well as installation of the beamlines. It also includes procurement, fabrication and installation for the new 53 Mhz RF system. It also covers modifications to existing cooling systems.**			
2.0.1.1.1	**Beam Lines (Transfer, Abort & RR 30 Straight)**				
2.0.1.1.1.1	**Common Tooling for Permanent Magnet Assembly**	**This summary task covers the common tooling for the permanent magnet construction and refurbishment. Included are procure, receive, inspect and assemble new tooling.**			
2.0.1.1.1.1.1	Prep Req & Award PO for Tooling Parts			1809	1809
2.0.1.1.1.1.2	Receive & Inspect Tooling Parts			1809	1809
2.0.1.1.1.1.3	Assemble Tooling			1809	1809
2.0.1.1.1.2	**RR Magnet & Instrumentation Stands**	**This summary task covers the procurement, delivery, unpacking and inspection of new installation stands for magnets and other devices in the RR and MI rings.**			
2.0.1.1.1.2.1	Prep Req & Award PO for IL Magnet Stands			1788	1788
2.0.1.1.1.2.2	Vendor Fab & Receive IL Magnet Stands			1788	1788
2.0.1.1.1.2.3	Prep Req & Award PO for EL Magnet Stands			1788	1788
2.0.1.1.1.2.4	Vendor Fab & Receive EL Magnet Stands			1788	1788
2.0.1.1.1.2.5	Prep Req & Award PO for RR-30 SS Magnet Stands		18 stands @ $2K per stand. Outside fab	1788	1788
2.0.1.1.1.2.6	Vendor Fab & Receive RR-30 Magnet Stands			1788	1788
2.0.1.1.1.2.7	Prep Req & Award PO for BA Kicker Stands		10 @ $2K each	1788	1788
2.0.1.1.1.2.8	Vendor Fab & Receive BA Kicker Magnet Stands			1788	1788
2.0.1.1.1.2.9	Prep Req & Award PO for RR Instrumentation Stands			1528	1528

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2.0.1.1.1.2.10	Vendor Fab & Receive RR Instrumentation Stands			1528	1528
2.0.1.1.1.3	**Vertical Dipole Magnets**	**This summary task coverst the procurement and refurbishment of the ADC magnets into the ADCW magnets and the procurement, fabrication, and installation of the power supplies and cables for the ADCW magnets. Three magnets will be refurbished and installed, one in the injection line as the main switcher magnet, two in the extraction line. The switcher magnet requires a FNAL design power supply. The extraction line magnets use commercial supplies with a FNAL designed regulator.**			
2.0.1.1.1.3.1	Prep Req & Award PO for ADC_W Parts		M&S for parts, stacking tooling & potting tooling. 1/7 for spares (See UID 1684)	1842	1842
2.0.1.1.1.3.2	Receive ADC_W Parts		M&S for parts, stacking tooling & potting tooling. 1/7 for spares (See UID 1684)	1842	1842
2.0.1.1.1.3.3	Refurbish Bending Magnets (Currently in Storage)		Rebuild the 5' B1's to aperature of 2" (4 magnets total). 1 spare (1/4). See UID 1686 for spares..	1842	1842
2.0.1.1.1.3.4	**Vertical Dipole Magnet Power Supplies**				
2.0.1.1.1.3.4.1	Prep Req & Award PO for Spang Power Supplies		Quad trims refurbished from existing transfer lines. Dipole trims refurbished from existing transfer lines. Major bends (4) need new PS. Spang PS = $150,000 Fermi Regulators for Spangs = $18,000 Switching Power Supply Parts = $100,000 Corrector RAW Power Supplies = $2,000	1733	1733
2.0.1.1.1.3.4.2	Receive Spang Power Supplies			1733	1733
2.0.1.1.1.3.4.3	Purchase Regulator Parts for Spang			1733	1733
2.0.1.1.1.3.4.4	Fabricate Regulators			1733	1733
2.0.1.1.1.3.4.5	Prep Req & Award PO for Switcher Parts			1733	1733
2.0.1.1.1.3.4.6	Receive Switcher Parts			1733	1733
2.0.1.1.1.3.4.7	Fabricate Switcher Supply			1733	1733
2.0.1.1.1.3.4.8	Install Vertical Dipole Magnet Power Supplies		3 PS in new MI-14 bldg, 2 in MI-31 old ECool bldg.	1752	1752
2.0.1.1.1.3.4.9	Install Vertical Dipole Magnet PS Cables for Injection Line			1752	1752
2.0.1.1.1.3.4.10	Install Vertical Dipole Magnet PS Cables for Extraction Line			1752	1752
2.0.1.1.1.4	**RR Permanent Quadrupoles**	**This summary task covers the refurbishment of existing permanent magnet quadrupoles, removed from the Recycler Electron cooling insert and transfer lines. It includes procurement of parts prior to the installation shutdown. The magnets themselves are not available until this shutdown. 43 magnets will be refurbished.**			
2.0.1.1.1.4.1	**RR Permanent Magnet Retrimming/Rebuilding**				
2.0.1.1.1.4.1.1	Prep Purch Req & Award PO for Parts		New seals, brick cutting, etc.	1812	1812

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2.0.1.1.1.4.1.2	Receive & Inspect Parts			1812	1812
2.0.1.1.1.4.1.3	Fabricate New Magnet			1812	1812
2.0.1.1.1.4.1.4	Access Magnets from Storage		Quads were removed from MI-30 straight section.	1812	1812
2.0.1.1.1.4.1.5	Access Magnets Removed from Tunnel		Quads were removed from MI-30 straight section.	1812	1812
2.0.1.1.1.4.1.6	Fabricate, Assemble & Test Magnets			1812	1812
2.0.1.1.1.5	**IL PDD Magnets**	**This summary task covers the fabrication of 3 PDD dipoles for the injection line. Included are the procurement, receive, and assembly tasks necessary.**			
2.0.1.1.1.5.1	Prep Req & Award PO for IL PDD Parts			1793	1793
2.0.1.1.1.5.2	Receive IL PDD Parts			1793	1793
2.0.1.1.1.5.3	Assemble & Trim IL PDD Magnets			1793	1793
2.0.1.1.1.6	**IL PDDW Magnets**	**This summary task covers the fabrication of 2 PDDW (reduced field PDD) dipoles for the injection line. Included are the procurement, receive, and assembly tasks necessary.**			
2.0.1.1.1.6.1	Prep Req & Award PO for IL PDDW Parts			1795	1795
2.0.1.1.1.6.2	Receive IL PDDW Parts			1795	1795
2.0.1.1.1.6.3	Assemble & Trim IL PDDW Magnets			1795	1795
2.0.1.1.1.7	**Trim Magnets**	**This summary task covers the effort needed to assign locations of trim power supplies in the MI14 and MI30 service buildings for the injection and extraction lines.**			
2.0.1.1.1.7.1	Power Supply Placement			1905	1905
2.0.1.1.1.8	**Mirror Magnets**	**This summary task covers the fabrication of 3 PDD mirror magnet dipoles for the injection line. Included are the procurement, receive, and assembly tasks necessary.**			
2.0.1.1.1.8.1	Prep Req & Award PO for Mirror Magnet PDD Parts		Assumes no significant new tooling is needed.	1794	1794
2.0.1.1.1.8.2	Vendor Fab & Receive Mirror Magnet PDD Parts			1794	1794
2.0.1.1.1.8.3	Fabricate Mirror Magnet PPDs & Trim		Assume tooling for $30,000	1794	1794
2.0.1.1.1.9	**Vacuum System**	**This summary task covers the procurement of all miscellaneous vacuum equipment for the new installations in RR and MI rings, including vacuum pumps, vacuum instrumentation, beam tubes, flanges, and preliminary subassembly welding work.**			
2.0.1.1.1.9.1	Procure IL Misc Mechanical Equip		Beam tubes (non ceramic), stands, bellows, ion pumps, seals, valves, guages. ($10K) $15k for RICO (Recycler magnet mover)	1825	1825
2.0.1.1.1.9.2	Procure EL Misc Mechanical Equip		Beam tubes (non ceramic), stands, bellows, ion pumps, seals, valves, guages. ($10K)	1825	1825
2.0.1.1.1.9.3	Procure RR-30 SS Misc Mechanical Equipment		Vacuum pipe, flanges, bellows, supports	1825	1825

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2.0.1.1.1.9.4	Procure Beam Abort Misc Mechanical Equipment			1825	1825
2.0.1.1.1.10	**Lambertson, 8GEV**	**This summary task covers the fabrication of two wide gap Lambertson magnets (MLAW) for the injection line. Included are the procurement, receive, and assembly tasks necessary.**			
2.0.1.1.1.10.2	Prep Req & Award PO for MLA_W Parts			1813	1813
2.0.1.1.1.10.3	Receive & Inspect MLA_W Parts			1813	1813
2.0.1.1.1.10.4	Fabricate & Assemble MLA_W Magnets			1813	1813
2.0.1.1.1.11	**Controls/Timing**	**This summary task covers the installation tasks for the controls and timing systems for the injection line, the extraction line, and the beam abort kickers.**			
2.0.1.1.1.11.1	Install IL Controls/Timing (incl Kicker)			1484	1484
2.0.1.1.1.11.2	Install EL Controls/Timing (incl Kicker)			1484	1484
2.0.1.1.1.11.3	Install BA Mods Controls/Timing			1484	1484
2.0.1.1.1.12	**MGS Mirror Magnets**	**This summary task covers the identification and purchase from SPS of 1 MGS magnet (dispersion suppressor mirror magnet) for the extraction line.**			
2.0.1.1.1.12.1	MSG Mirror Magnets Identify Accceptable Spare SGD Magnets & Purch Spare from SPS			1800	1800
2.0.1.1.1.13	**Instrumentation & Cables**	**This summary task covers the procurement of cables for the transfer line trim magnets and instrumentation.**			
2.0.1.1.1.13.1	Procure IL Magnet Cables & Instrumentation Cables		Instrumentation cables for BPMs and Toroids and Multiwires Toroids (RG-58 Green) - 436 ft @ $1.00/ft = $436 Multiwires (25 Pair F.R.) - 1927 ft @ $2.15/ft = $4143 Multiwires (4C#18) - 1927 ft @ $0.21/ft = $405 Multiwires (2 T.S. #22) - 1927 ft @ $0.50/ft = $964 BPMs (LMR-195) - 1927 ft @ $1.00/ft = $1927 Total = $7875	1753	1753
2.0.1.1.1.13.2	Procure EL Magnet Cables & Instrumentation Cables		Instrumentation cables for BPMs and Toroids and Multiwires Toroids (RG-58 Green) - 250 ft @ $1.00/ft = $250 Multiwires (25 Pair F.R.) - 1304 ft @ $2.15/ft = $2804 Multiwires (4C#18) - 1304 ft @ $0.21/ft = $274 Multiwires (2 T.S. #22) - 1304 ft @ $0.50/ft = $652 BPMs (LMR-195) - 1090 ft @ $1.00/ft = $1090 Total = $5070	1753	1753
2.0.1.1.1.14	**Installation**	**This summary task covers all planning, layout drawing work, and installation of all magnets and other devices in the RR, MI and transfer lines, including stands installation, vacuum system makeup and leak checking.**			
2.0.1.1.1.14.2	Intermediate IL Installation Planning			1707	1707
2.0.1.1.1.14.3	Pre-Shutdown IL Installation Planning			1707	1707
2.0.1.1.1.14.4	Install IL Magnets (incl pre-align)		$10K for misc	1723	1723

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2.0.1.1.1.14.5	Install IL Instrumentation			1724	1724
2.0.1.1.1.14.7	Intermediate EL Installation Planning			1707	1707
2.0.1.1.1.14.8	Pre-Shutdown EL Installation Planning			1707	1707
2.0.1.1.1.14.9	Install EL Magnets (incl pre-align)		$10K for misc	1723	1723
2.0.1.1.1.14.10	Install EL Instrumentation Cables		Multiwires and toroids. 72 hours electricians to pull cables @$80 per hour. Techs to terminate.	1898	1898
2.0.1.1.1.14.11	Install EL Instrumentation			1724	1724
2.0.1.1.1.14.13	Intermediate RR-30 SS Installation Planning			1707	1707
2.0.1.1.1.14.14	Pre-Shutdown RR-30 SS Installation Planning			1707	1707
2.0.1.1.1.14.15	Install RR-30 SS Magnets (incl pre-align)		$10K M&S	1723	1723
2.0.1.1.1.14.16	Install RR-30 SS Instrumentation			1724	1724
2.0.1.1.1.14.17	Install BA Mods Kicker Magnet w/Stands, Pull RG220 Cables			1484	1484
2.0.1.1.1.14.18	Install IL Vacuum System		Includes 80 hours of Welder time @$80/hr. Includes 44 hours of Electrician time @$80/hr.	1826	1826
2.0.1.1.1.14.19	Install EL Vacuum System		Includes 80 hours of Welder time @$80/hr. Includes 44 hours of Electrician time @$80/hr.	1826	1826
2.0.1.1.1.14.20	Install RR-30 SS Vacuum		Includes 80 hours of Welder time @$80/hr. Includes 160 hours of Electrician time @$80/hr.	1826	1826
2.0.1.1.1.14.21	Beam Abort Installation Planning			1707	1707
2.0.1.1.1.14.22	Install BA Mods Vacuum		Includes 8 hours of Welder time @$80/hr. $5K for flanges	1826	1826
2.0.1.1.1.14.23	Install IL Instrumentation Cables		Includes 72 hours of Electrician time @$80/hr.	1898	1898
2.0.1.1.2	**RR 53 Mhz System**	**This summary task covers the procurement, fabrication, and installation for the Recycler 53 MHz RF system. It includes the 3 cavities (2 + 1 hot spare), the ceramic gaps, and the vacuum components to install in the ring.**			
2.0.1.1.2.1	RR Prep Req & Award PO for 53 Mhz RF System Copper		This note covers all 53 Mhz non-spare procurements. 2 cavities will be installed. $83,869 each X 2 = $167,738 + 2 tuner supplies ($40K) = $207,738. See UID 2727 for spare.	1687	1687
2.0.1.1.2.2	RR Receive 53 Mhz RF System Copper		2 cavities will be installed. $83,869 each X 2 = $167,738 + 2 tuner supplies ($40K) = $207,738. See UID 2727 for spare.	1687	1687
2.0.1.1.2.3	RR Procure 53 Mhz Flanges			1687	1687
2.0.1.1.2.4	RR Procure 53 Mhz Tetrodes			1687	1687
2.0.1.1.2.5	RR Procure 53 Mhz Ceramics			1687	1687
2.0.1.1.2.6	RR Procure 53 Mhz Misc Material			1687	1687
2.0.1.1.2.7	RR Fabricate 53 Mhz RF System		2 cavities (1 spare). See UID 2727 for spares	1687	1687
2.0.1.1.2.8	RR Install 53 Mhz RF System		Includes 824 hours of Electrician time @$80/hr. Includes 160 hours of Rigger time @$80/hr. Includes 240 hours of Pipefitter time @$80/hr.	1687	1687
2.0.1.1.2.9	RR Reconsitute 53 Mhz RF System Vacuum			1687	1687

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2.0.1.1.3	**Ovesight to TD Magnet Modifications**	**This level of effort oversight task provides for AD oversight of TD work on magnet modifications, including construction, testing, and installation.**			
2.0.1.1.3.1	FY08 Oversight of TD Magnet Construction - RR Mods Beamlines			1456	1456
2.0.1.1.3.2	FY09 Oversight of TD Magnet Construction - RR Mods Beamlines			1456	1456
2.0.1.1.3.3	FY10 Oversight of TD Magnet Construction - RR Mods Beamlines			1456	1456
2.0.1.1.4	**Recycler Ring Cooling System Modifications**				
2.0.1.1.4.1	**Injection Line Water System Mods Installation**	**This summary task includes the procurement, installation, and start-up for cooling system mods in the Injection Line area, including piping and bus moves, magnet connection, and new lines to MI-14 for the power supplies and flourinert skids.**			
2.0.1.1.4.1.1	Procurement & Fab of Piping Components		Misc ftgs, hangers, parts, Q100 region: $5,000; Piping, ftgs, MI-14: $3,000; Instrumentation, MI-14: $3,000; Total: $11,000.	1540	1540
2.0.1.1.4.1.2	Relocate Piping & Bus Work, Q-100 Area			1540	1540
2.0.1.1.4.1.3	Install Piping to MI-14		Consumables and incidentals: $1,500; Radiography: $4,000; Total: $5,500	1540	1540
2.0.1.1.4.1.4	Connect Power Supplies & Flourinert Skids in MI-14		Consumables and incidentals: $1,000.	1540	1540
2.0.1.1.4.1.5	Test & Troubleshoot MI-14 Water System			1540	1540
2.0.1.1.4.2	**Extraction Line Water System Mods Installation**	**This summary task includes the procurement, installation, and start-up for all cooling system mods in the Extraction Line area, including piping and bus moves, magnet connection, any new connections for MI-30 power supplies and flourinert skids.**			
2.0.1.1.4.2.1	Procure Piping Components		Piping, fittings, hardware, Q300 area:$3,000; Piping, fittings, hardware, MI-30: $3,000; Total: $6,000.	1818	1818
2.0.1.1.4.2.2	Complete Q300 Area Pipe & Bus Relocation Work		Consumables and incidentals: $1,500.	1818	1818
2.0.1.1.4.2.3	Connect Power Supplies & Flourinert Skids in MI-30		Consumables and incidentals: $1,000.	1818	1818
2.0.1.1.4.2.4	Test & Troubleshoot MI-30 Water System		Consumables and incidentals: $1,000.	1818	1818
2.0.1.1.4.3	**Abort Line Water System Mods Installation**	**This summary task includes the procurement, installation, and start-up for all cooling system mods in the Abort Line area, including piping and bus moves, magnet connection, and new lines to MI-39 for the power supplies and flourinert skids.**			
2.0.1.1.4.3.1	Procure Piping Components		Piping, fittings, hardware, Q400 area: $3,000; Piping, fittings, hardware, MI-39: $4,000; Total: $7,000.	1819	1819
2.0.1.1.4.3.2	Complete Q403 Area Pipe & Bus Relocation Work		Consumables and incidentals: $1,500.	1819	1819
2.0.1.1.4.3.3	Connect Power Supplies & Flourinert Skids in MI-39		Consumables and incidentals: $1,000.	1819	1819

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2.0.1.1.4.3.4	Install Piping to MI-39		Consumables and incidentals:$1,500; Radiography: $4,000; Total: $5,500.	1819	1819
2.0.1.1.4.3.5	Test & Troubleshoot MI-40 & MI-39 Water Systems		Consumables and incidentals: $1,000.	1819	1819
2.0.1.1.4.4	**Install RF Cavity Water System Mods**	**This summary task includes the procurement, installation, and start-up for all cooling system mods for the RF Cavities, for both the 95°F and 55°F LCW systems.**			
2.0.1.1.4.4.1	Procure Piping Components			1823	1823
2.0.1.1.4.4.2	Complete Q600 Area Cavity & Magnet Relocation Work			1823	1823
2.0.1.1.4.4.3	Install Piping Drops for RF Cavities Q600 Region			1823	1823
2.0.1.1.4.4.4	Install Piping Drops for RF Power Supplies MI-60 Gallery			1823	1823
2.0.1.1.4.4.5	Test & Troubleshoot RF Cavity Water System			1823	1823
2.0.1.1.4.5	**Install MI-8 Pump Room LCW System**	**This summary task includes the procurement, installation, and start-up for an additional pump room installation at MI-8, and the subsequent design of the LCW system and pump room equipment, as well as required mods to the Pond Water system at PV-9.**			
2.0.1.1.4.5.1	Relocate Horn Welder Machine			1851	1851
2.0.1.1.4.5.2	Prep Req & Award PO for Pond Pumps			1851	1851
2.0.1.1.4.5.3	Vendor Fab & Receive Pond Pumps			1851	1851
2.0.1.1.4.5.4	Prep Req & Award PO for Heat Exchanger			1851	1851
2.0.1.1.4.5.5	Vendor Fab & Receive Heat Exchanger			1851	1851
2.0.1.1.4.5.6	Prep Req & Award PO for Control Valve Components			1851	1851
2.0.1.1.4.5.7	Vendor Fab & Receive Control Valve Components			1851	1851
2.0.1.1.4.5.8	Prep Req & Award PO for Filtration Components			1851	1851
2.0.1.1.4.5.9	Vendor Fab & Receive Filtration Components			1851	1851
2.0.1.1.4.5.10	Procure Instrumentation			1851	1851
2.0.1.1.4.5.11	Procure Piping Components & Hardware			1851	1851
2.0.1.1.4.5.12	Install Pond Pump Upgrades PV9			1851	1851
2.0.1.1.4.5.13	Upgrade Pond Pump Electrical Service PV9 & MI-62			1851	1851
2.0.1.1.4.5.14	Install MI-8 Pump Room Piping & Components			1851	1851
2.0.1.1.4.5.15	Install MI-8 Electrical Service Upgrades			1851	1851
2.0.1.1.4.5.16	Install MI-8 Instrumentation			1851	1851

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2.0.1.1.4.5.17	Test & Troubleshoot MI-8 LCW Cooling System			1851	1851
2.0.1.1.5	**Recycler Ring Mods Milestones**				
2.0.1.1.5.1	RR 53 Mhz RF Ready for Beam	53 MHz cavities installed and power tested. Vacuum in the area has been reconstituted.			
2.0.1.1.5.2	RR Permanent Magnet Quad Refurbished & Mapped	38 permanent magnet quadrupoles will be removed from the tunnel, taken to TD, refurbished (to accommodate requested strength), and measured. This milestone marks the point where all magnets have gone through the process.			
2.0.1.1.5.3	RR Orders Placed for Copper for 53 Mhz RF	Placed order to purchase copper to be used in the construction of the RR 53 MHz cavities.			
2.0.1.1.5.4	RR ADCW Magnet Refurbish Complete	The ADCW is a wide gap ADC magnet. All necessary magnets (3+1 hot spare) have had their gaps widened, been power tested, and mapped.			
2.0.1.1.5.5	RR LCW System Mods Complete	RR LCW Systems on line and operational			
2.0.1.2	**Recycler Kicker System**	**This summary task covers procurement, fabrication, and installation for the five new kicker systems: RR Injection, Injection Gap Clearing, RR Extraction to MI, MI Injection, and RR Abort. This includes magnets, power supplies, and Fluorinert cooling systems for each of the 5 systems.**			
2.0.1.2.1	**RR Injection & Gap Clearing Production Kicker Magnet**	**This summary task covers procurement, fabrication, and installation for the five new kicker systems: RR Injection, Injection Gap Clearing, RR Extraction to MI, MI Injection, and RR Abort. This includes magnets, power supplies, and Fluorinert cooling systems for each of the 5 systems.**			
2.0.1.2.1.1	**Procurement of RR Injection & Gap Clearing Production Kicker**	**This summary task covers the procurement of all parts for the 2 pre-production and 12 final design (aka production) RR Injection and Gap Clearing kicker magnets, including ferrites, the selection of 35 ceramic beam tubes, preparation and brazing of 25 ceramic beam tubes, procurement of parts for a fluorinert cooling skid, and the procurement and selection of load resistors and load resistor parts for 19 loads for all kicker systems. The time delay for delivery of parts after placement of orders varies depending on the type of parts, and unpacking and inspection of parts is included in the receiving tasks.**			
2.0.1.2.1.1.1	RR Inject & Gap Clearing Prod Kicker Prep Req & Award PO for All Magnet Ferrites (Sole Source)			1778	1778
2.0.1.2.1.1.2	RR Inject & Gap Clearing Prod Kicker Receive Ferrites for All Magnets			1778	1778
2.0.1.2.1.1.3	RR Inject & Gap Clearing Prod Kicker Prep Req & Award PO for all Load Resistor Parts for All Systs		For 18 loads, resistors are one lot sole source.	1778	1778
2.0.1.2.1.1.4	RR Inject & Gap Clearing Prod Kicker Receive all Load Resistor Parts for All		19 loads @ $6,000 = $114,000 + 5 load adaptors @ $6,000 = $30,000 for a total of $144,000.	1778	1778
2.0.1.2.1.1.5	Procure 35 Beamtubes for RR Inj & Gap Clearing from TD Inventory			1462	1462

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.0.1.2.1.1.6	RR Injection Select Ceramic Tubes & Cut		$500 per tube @35 tubes = $17,500. Need 25 good tubes. $2,000 for travel	1462	1462
2.0.1.2.1.1.7	Prep Req & Award PO for Kovar Braze on 25 Ceramic Beam Tubes		$4K brazing @ 25 tubes = $100,000	1462	1462
2.0.1.2.1.1.8	Receive Kovar Brazed Ceramic Tubes		Receiving, unpacking, inspecting for damage and measuring the ceramic tubes.	1462	1462
2.0.1.2.1.1.9	Prep Req & Award PO for Parts for 2 Pre-production Magnets			1778	1778
2.0.1.2.1.1.10	Receive Parts for 2 Pre-production Magnets			1778	1778
2.0.1.2.1.1.11	Prep Req & Award PO for Parts for 12 Other Magnets		12 magnets. $29,000 per magnet. See UID 2732 for spares.	1778	1778
2.0.1.2.1.1.12	Receive Parts for 12 Other Magnets		12 magnets. $29,000 per magnet. See UID 2732 for spares.	1778	1778
2.0.1.2.1.1.13	Prep Req & Award PO for Parts for Another Fluorinert Cooling Skid		$50K parts, $50K installation T&M pipefitters.	1784	1784
2.0.1.2.1.1.14	Receive Parts for Another Fluorinert Cooling Skid			1784	1784
2.0.1.2.1.1.15	RR Prep Req & Award PO for Resistors			1778	1778
2.0.1.2.1.1.16	RR Receive & Measure Resisitors for 19 loads		Order 150% of resistors needed, measure resistance, sort and select matched sets.	1778	1778
2.0.1.2.1.2	**Assembly & Testing of RR Injection & Gap Clearing Production Kicker**	**This summary task covers the welding of end flanges on ceramic beam tubes, assembly and testing of 2 pre-production and 12 production kicker magnets and loads, and the assembly and testing of a second fluorinert cooling skid for the RR Injection and Gap Clearing kicker systems.**			
2.0.1.2.1.2.1	Weld Bellows & Vacuum Flanges on Ceramic Beam Tube Ends		17 tubes	1462	1462
2.0.1.2.1.2.2	Assemble 2 Pre-production Magnets & Loads			1777	1777
2.0.1.2.1.2.3	Low voltage testing of 2 Pre-production Magnets			1776	1776
2.0.1.2.1.2.4	HV Testing of 2 Pre-production Magnets		Need building space. Testing in MI-14	1776	1776
2.0.1.2.1.2.5	Life testing of 2 Pre-production Magnets			1776	1776
2.0.1.2.1.2.6	Assemble 12 RR injection & cleanup kicker magnets		1 MT and .25 ET @ 20 days per magnet, assume 5 magnets on 5 build stations at any time, need 14 magnets in the tunnel, see UID 2331 for pre-production and UID 1739 for spares.	1777	1777
2.0.1.2.1.2.7	Low voltage testing 12 magnets		12 magnets. See UID 1739 for spares.	1776	1776
2.0.1.2.1.2.8	Assemble 2nd Fluorinert Cooling Skid			1784	1784
2.0.1.2.1.2.9	Apply Resistive Coating Inside Ceramic Beam Tubes			1462	1462
2.0.1.2.2	**RR Injection & Gap Clearing Production Kicker Power Supply**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.0.1.2.2.1	**Procurement of RR Injection & Gap Clearing Production Kicker Power Supply**	**This summary task covers the procurement of all parts for 2 pre-production and 12 final production design RR Injection and Gap Clearing Power Supply pulsers and controls, including thyratrons, and also 4 bumper pulsers. The time delay for delivery of parts after placement of orders varies depending on the type of parts, and unpacking and inspection of parts is included in the receiving tasks.**			
2.0.1.2.2.1.1	Prep Req & Award PO for Parts for 12 Other Power Supply Controls			1782	1782
2.0.1.2.2.1.2	Receive Parts for 12 Other Power Supply Controls			1782	1782
2.0.1.2.2.1.3	Prep Req & Award PO for 2 Pre-production HV power supply pulsers		Includes 2 thyratrons. $120,000 per pulser.	1782	1782
2.0.1.2.2.1.4	Receive Parts for 2 Pre-production HV Power Supply Pulsers		Includes 2 thyratrons. $120,000 per pulser.	1782	1782
2.0.1.2.2.1.5	RR Inject & Gap Clearing Prod Kicker PS Prep Req & Award PO for Thyratrons for 8 Other Pulsers		Includes 16 thyratrons.	1782	1782
2.0.1.2.2.1.6	RR Inject & Gap Clearing Prod Kicker PS Receive Thyratrons for 8 Other Pulsers			1782	1782
2.0.1.2.2.1.7	Prep Req & Award PO for 4 Bumper Pulsers & Energy Storage (PFL		System price is 134K each.	1782	1782
2.0.1.2.2.1.8	Receive 4 Bumper Pulsers & Energy Storage (PFL Substitute)		System price is 134K each.	1782	1782
2.0.1.2.2.1.9	Prep Req/Issue PO for Parts for 8 Other Pulsers			1782	1782
2.0.1.2.2.1.10	RR Inject & Gap Clearing Prod Kicker PS Deliver Parts for 8 Other Pulsers			1782	1782
2.0.1.2.2.2	**Assembly & Testing RR Injection & Gap Clearing Production Kicker Power Supply**	**This summary task covers the assembly and testing of two pre-production RR Injection pulsers, assembly and testing of controls modules and racks for 12 pulsers and 4 bumpers, assembly and final testing of the 12 production pulsers and 4 bumper pulsers, and installation and final testing of the RR Injection and Gap Clearing pulser systems in the MI-14 and MI-39 service buildings. Also included are assembly of the 16 production loads and installation of the fluorinert cooling system to the tunnel and final testing of the system.**			
2.0.1.2.2.2.1	RR Injection & Gap Clearing PS Assemble 2 Pre-production HV Pulsers			1782	1782
2.0.1.2.2.2.2	RR Injection & Gap Clearing PS Assemble Controls Modules & Racks for 8 Pulsers & 4 Bumpers			1782	1782
2.0.1.2.2.2.3	RR Injection & Gap Clearing PS Assemble 8 Pulser Housing			1782	1782
2.0.1.2.2.2.4	RR Injection & Gap Clearing PS Assemble 4 Bumper Systems			1782	1782
2.0.1.2.2.2.5	RR Injection & Gap Clearing PS Measure & Assemble 14 Loads			1782	1782

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.0.1.2.2.3	RR Injection & Gap Clearing Checkout Pulsers into Dummy Load in SB		Need building occupancy (MI-14 for Injection, MI-39 for Gap Clearing)	1783	1783
2.0.1.2.2.4	RR Injection & Gap Clearing Install Magnets & Fluorinert Piping in Tunnel & Checkout 2 Systems		Need shutdown - cable pulling 128 hours of electrians, similar to ME374838, 374849. T&M pipefitters 1600 hours,. (9) RR Injection kickers at Q101 (7) PS Pulsers, (2) Bumpers, (9) PFLs and (1) Fluornert skid at MI-14 (9) Gap Clearing kickers at Q400 (7) PS Pulsers, (2) Bumpers, (9) PFLs and (1) Fluorinert skid at MI-39	1786	1786
2.0.1.2.3	**RR Extraction Line Kicker Magnets**				
2.0.1.2.3.1	**RR Extraction Kicker System**	**This summary task covers the procurement of parts and the refurbishment of 3 existing magnets with modifications to reconfigure them for their new function as RR Extraction kickers. The time delay for delivery of parts after placement of orders varies depending on the type of parts, and unpacking and inspection of parts is included in the receiving tasks.**			
2.0.1.2.3.1.1	Extraction Line Kicker Magnet Procure Parts to Rebuild 3 Magnet		1 RR Extraction Kicker and 1 Bumper magnet, refurbish existing 374021 magnets with new HV connections.	1773	1773
2.0.1.2.3.1.2	RR Extraction Line Kicker System, Refurbish 3 Recycler Magnets			1773	1773
2.0.1.2.3.2	**MI Injection Kicker System Procurement**	**This summary task covers the procurement of all parts for 5 new MI Injection kicker magnets, including selection of 10 ceramic beam tubes, preparation and brazing of 5 ceramic beam tubes, procurement of ferrites for 5 magnets, procurement of all parts for 1 HV pulser, 1 flattop pulser and 1 tail bumper pulser for the MI Injection system, 2 sets of fluorinert cooling skid parts, and 12 PFL frames for the MI Injection kicker system. The time delay for delivery of parts after placement of orders varies depending on the type of parts, and unpacking and inspection of parts is included in the receiving tasks.**			
2.0.1.2.3.2.1	Procure 10 Beamtubes for MI Inj from TD Inventory			1462	1462
2.0.1.2.3.2.2	MI Injection Select Ceramic Tubes & Cut		$500 per tube @10 tubes = $5,000. Need 7 good tubes.	1462	1462
2.0.1.2.3.2.3	Prep Req & Award PO for All Magnet Ferrites for MI Inject Kicker Magnet		Test magnet for prototyping, bumper PS becomes spare.	1771	1771
2.0.1.2.3.2.4	Receive MI Inject Kicker Ferrites			1771	1771
2.0.1.2.3.2.5	MI Inject Kicker Prep Req & Award PO for All Other Parts for 3 Magnets		$97K per magnet include ferrite & loads. Prototype test magnet becomes spare.	1771	1771
2.0.1.2.3.2.6	MI Inject Kicker Receive All Other Parts for 3 Magnets		$97K per magnet include ferrite & loads. Prototype test magnet becomes spare.	1771	1771
2.0.1.2.3.2.7	MI Inj Kicker Pre Purch Req & Award PO for Parts & Fluorinert for 2 Fluorinert Cooling System Skids			1784	1784
2.0.1.2.3.2.8	MI Inject Kicker Receive Parts & Fluorinert for 2 Fluorinert Cooling System Skids			1784	1784
2.0.1.2.3.2.9	Prep Req & Award PO for Parts for MI Inject HV, Flatop & Tail Bumper Pulsers			1774	1774
2.0.1.2.3.2.10	Receive Parts for MI Inject Flatop & Tail Bumper Pulsers			1774	1774

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.0.1.2.3.2.11	MI Injection Kicker PS Prep Req & Award PO for 12 PFL Frames		$1,500 each X 12 = $18,000. See UID 2847 for spares.	1785	1785
2.0.1.2.3.2.12	MI Injection Kicker PS Receive 12 PFL Frames		$1,500 each X 12 = $18,000. See UID 2847 for spares.	1785	1785
2.0.1.2.3.2.13	MI Inj Kicker PS Procure 2 Spare PFL Frames			1785	1785
2.0.1.2.3.2.14	MI Inject Kicker Magnet Kovar Braze Ceramic Beam Tubes		Brazing 7 tubes @ $5,000each = $35,000 plus estimate an additional $15K setup charge for longer length. Already have spare to be used for prototype.	1462	1462
2.0.1.2.3.3	**MI Injection Kicker System Fabrication & Asssembly & Test**	**This summary task covers the welding of end flanges and application of resistive coating to 5 ceramic beam tubes for the MI Injection kickers, also the assembly and testing of the MI Injection kickers, winding and installation of 12 PFLs in the MI-30 service building, assembly and installation of 2 fluorinert cooling skids, assembly of the flattop and tail bumper pulsers, and installation and checkout of the MI Injection kicker system.**			
2.0.1.2.3.3.1	MI Injection Kicker PS Wind Cables on 12 PFL frames		See UID 3152 for spares.	1785	1785
2.0.1.2.3.3.2	MI Inj Kicker PS Wind Cables on 2 Spare PFL Frames			1785	1785
2.0.1.2.3.3.3	MI Injection Kicker Apply Resistive Coating, Weld Flanges & Bellows			1462	1462
2.0.1.2.3.3.4	MI Injection Kicker Magnet Assemble 3 New magnet bodies		2ET, 2MT, 10 days per magnet NOT FOR THIS MAGNET	1771	1771
2.0.1.2.3.3.5	MI Injection Kicker Magnet Assemble 5 loads		3 loads are for MI injection kicker system, 2 loads are for RR extraction kicker system, all 5 installed in MI-30.	1771	1771
2.0.1.2.3.3.6	MI Injection Kicker Magnet Attach 6 Cable Adaptors onto Magnets			1771	1771
2.0.1.2.3.3.7	MI Inject Kicker Magnet Assemble 2 Fluorinert Cooling Skids for RR Extract & MI Inject Kicker Systs		Separate later.	1784	1784
2.0.1.2.3.3.8	MI Injection Kicker Magnet LV Testing New Magnet			1772	1772
2.0.1.2.3.3.9	MI Injection Kicker HV Testing of 3 Magnets			1772	1772
2.0.1.2.3.3.10	MI Injection Kicker Life testing			1772	1772
2.0.1.2.3.3.11	Assemble MI Inject HV Flatop & Tail Bumper Pulsers			1774	1774
2.0.1.2.3.3.12	MI Injection Kicker PS Install 12 PFL Frames in MI-30		See UID 2850 for spares.	1785	1785
2.0.1.2.3.3.13	MI Injection Kicker PS Install 2 Spare PFL Frames in MI-30 Bldg		See UID 2845 for production units.	1785	1785
2.0.1.2.3.4	Extraction Line Kicker Checkout Pulsers into Dummy Load		Need building occupancy (can't use MI-30 or MI-31). Need testing bldg.	1775	1775
2.0.1.2.3.5	Extraction Line Kicker Install Magnets & Fluorinert Piping in Tunnel & Checkout System		1600 hours pipefitters and 128 hours electricians. (5) MI Injection kickers at Q309 (1) PS Pulsers, (2) Bumpers, (20) PFLs and (1) Fluorinert skid at MI-30 (1) RR Extraction kicker at Q232 (1) PS Pulser and (1) Fluorinert skid at MI-30	1786	1786

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.0.1.2.4	**RR Extraction Line Kicker Power Supply System**				
2.0.1.2.4.1	**RR Extraction Line Kicker Power Supply System Procurement**	**This summary task covers the procurement of thyratrons and all other parts for 2 RR Extraction HV pulsers and a bumper pulser, as well as 12 PFL frames, and all cable for the RR Extraction and MI Injection kicker systems. The time delay for delivery of parts after placement of orders varies depending on the type of parts, and unpacking and inspection of parts is included in the receiving tasks.**			
2.0.1.2.4.1.1	RR Extraction Line Kicker PS Prep Req & Award PO for Thyratrons for 2 HV			1774	1774
2.0.1.2.4.1.2	RR Extraction Line Kicker PS ReceiveThyratrons for 2 HV Pulsers			1774	1774
2.0.1.2.4.1.3	RR Extract Line Kicker PS Prep Req & Award PO for All Other Parts for 2 HV			1774	1774
2.0.1.2.4.1.4	RR Extract Line Kicker PS Receive All Other Parts for 2 HV Pulsers			1774	1774
2.0.1.2.4.1.5	RR Extract Line Kicker PS Prep Req & Award PO for 1 Bumper Pulser			1774	1774
2.0.1.2.4.1.6	RR Extract Line Kicker PS Receive 1 Bumper Pulser			1774	1774
2.0.1.2.4.1.7	RR Extraction Line Kicker PS Prep Req & Award PO for 12 PFL Frames		12 spools @ $1,500 ea = $18,000. See UID 1736 for spares.	1785	1785
2.0.1.2.4.1.8	RR Extraction Line Kicker PS Receive 12 PFL Frames		See UID 1736 for spares.	1785	1785
2.0.1.2.4.1.9	RR Extraction Line Kicker Power Supply System Procure 2 Spare PFL Frames		2 PFL frames @ $1,500 each = $3,000. See UID 2389 & 2830 for production units.	1785	1785
2.0.1.2.4.1.10	MI Injection/RR Extraction/Beam Abort Line Kicker Prep Req/Issue PO for All Cable		600 ft ea spool @ $16/ft = $9,600/spool. 12 spools for MI Injection, 12 for beam abort and 12 for RR Extraction. 36 spools X $9,600/spool = $345,600. See UID 2751 for RR Extraction spares.	1785	1785
2.0.1.2.4.1.11	MI Injection/RR Extraction/Beam Abort Line Kicker Receive All Cable		600 ft ea spool @ $16/ft = $9,600/spool. 12 spools for MI Injection, 12 for beam abort and 12 for RR Extraction. 36 spools X $9,600/spool = $345,600. See UID 2751 for RR Extraction spares.	1785	1785
2.0.1.2.4.1.12	MI Injection Kicker PS Procure Spare Cable (2 spools)			1785	1785
2.0.1.2.4.1.13	RR Extraction Line Kicker PS System Procure Spare Cable (2 Spools)		2 spools @ $9,600/spool = $19,200. See UID 2390 and 2391 for production units.	1785	1785
2.0.1.2.4.1.14	Beam Abort Kicker PS Procure Spare Cable (2 spools)			1785	1785
2.0.1.2.4.2	**RR Extraction Line Kicker Power Supply System Assembly**	**This summary task covers the assembly of the RR Extraction and MI Injection pulsers and controls, assembly of the bumper pulsers, and the winding and installing of 12 PFLs in the MI-30 service building.**			
2.0.1.2.4.2.1	MI Injection/RR Extraction Kicker PS Assemble 2 HV pulsers (Incl Controls)			1774	1774
2.0.1.2.4.2.2	RR Extraction Kicker PS Assemble 1 bumper pulser			1774	1774
2.0.1.2.4.2.3	RR Extraction Kicker PS Wind 12 cables on PFL frames		24 total, 3 spares. See UID 1649 for spares	1785	1785

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.0.1.2.4.2.4	Extraction Line Kicker PS Wind Cable on 2 Spare PFL Frames			1785	1785
2.0.1.2.4.2.5	RR Extraction Kicker PS Install 12 PFL Frames in MI-30 Bldg		See UID 2862 for spares.	1785	1785
2.0.1.2.4.2.6	Extraction Line Kicker PS Install 2 Spare PFL Frames in MI-30 Bldg		See UID 2396 for production units.	1785	1785
2.0.1.2.5	**Beam Abort Kicker Magnet**				
2.0.1.2.5.1	**Beam Abort Kicker Magnet Procurement**	**This summary task covers the procurement of parts for refurbishment of an existing magnet with modifications to reconfigure it for the Beam Abort kicker, also procurement of parts for a fluorinert cooling skid, and procurement of 12 PFL frames. The time delay for delivery of parts after placement of orders varies depending on the type of parts, and unpacking and inspection of parts is included in the receiving tasks.**			
2.0.1.2.5.1.1	Beam Abort Kicker Procure Parts for Refurbishing 1 Magnet		Magnet & pulser covered in extraction line kicker section.	1769	1769
2.0.1.2.5.1.2	Beam Abort Kick Prep Req & Award PO for Parts & Flourinert for Fluorinert Cooling Syst Skid			1784	1784
2.0.1.2.5.1.3	Beam Abort Kicker Receive Parts & Flourinert for Fluorinert Cooling System			1784	1784
2.0.1.2.5.1.4	Beam Abort Kicker PS Prep Req & Award PO for 12 PFL Frames		See UID 1737 for spares.	1785	1785
2.0.1.2.5.1.5	Beam Abort Kicker PS Receive 12 PFL Frames		See UID 1737 for spares.	1785	1785
2.0.1.2.5.1.6	Beam Abort Kicker Procure 2 Spare PFL Frames		See UIDs 2851 and 2852 for production units.	1785	1785
2.0.1.2.5.2	**Beam Abort Kicker Assembly & Test**	**This summary task covers the refurbishment of an existing magnet for the Beam Abort kicker system, assembly of a new load, assembly of a fluorinert cooling skid, Low Voltage and High Voltage testing of the magnet, installation of the fluorinert cooling system and piping to the tunnel, and checkout of the Beam Abort kicker system.**			
2.0.1.2.5.2.1	Beam Abort Kicker Refurbish 1 Magnet Body		2 ET, 2 MT, 10 days per magnet. Shutdown related, need magnet.	1769	1769
2.0.1.2.5.2.2	Beam Abort Kicker Assemble 1 Load		Load for Beam Abort Kicker System, installed in MI-40.	1769	1769
2.0.1.2.5.2.3	Beam Abort Kicker Attach 2 Cable Adaptors onto Magnet			1769	1769
2.0.1.2.5.2.4	Assemble Fluorinert Cooling Skid for RR Abort Kicker System			1784	1784
2.0.1.2.5.2.5	Beam Abort Kicker LV Testing			1770	1770
2.0.1.2.5.2.6	Beam Abort Kicker HV Testing		Testing in MI-40	1770	1770
2.0.1.2.5.2.7	Beam Abort Kicker Life Testing		Testing in MI-40	1770	1770
2.0.1.2.5.2.8	Beam Abort Kicker Install & Checkout Pulser into Dummy Load			1775	1775
2.0.1.2.5.2.9	BA Kicker Install Fluorinert Skid & Piping to Mag in Tunnel, Connect Cables &			1786	1786

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.0.1.2.6	**Beam Abort Kicker Power Supplies**	**This summary task covers the procurement of parts and assembly of a Beam Abort HV pulser, winding of cables on 12 PFL frames and installation of PFLs in the MI-39 service building. The time delay for delivery of parts after placement of orders varies depending on the type of parts, and unpacking and inspection of parts is included in the receiving tasks.**			
2.0.1.2.6.1	Beam Abort Kicker Prep Req & Award PO for Parts for 1 Pulser			1774	1774
2.0.1.2.6.2	Beam Abort Kicker Receive Parts for 1 Pulser			1774	1774
2.0.1.2.6.3	Beam Abort Kicker Assemble 1 HV Pulser (Incl Controls)			1774	1774
2.0.1.2.6.4	Beam Abort Kicker Wind Cables on 12 PFL Frames		See UID 3154 for spares.	1785	1785
2.0.1.2.6.5	Beam Abort Kicker Wind Cables on 2 Spare PFL Frames			1785	1785
2.0.1.2.6.6	Beam Abort Kicker Install 12 PFL Frames in MI-39 Bldg		See UID 2854 for spares.	1785	1785
2.0.1.2.6.7	Beam Abort Kicker Install 2 Spare PFL Frames in MI-39 Bldg		See UID 2418 for production units.	1785	1785
2.0.1.2.7	**Oversight of TD Kicker Magnet Construction**	**This level of effort oversight task provides for AD oversight of TD work on kicker magnets, including construction, testing, and installation.**			
2.0.1.2.7.1	FY08 Oversight of TD Magnet Construction - Recycler Kickers			1456	1456
2.0.1.2.7.2	FY09 Oversight of TD Magnet Construction - Recycler Kickers			1456	1456
2.0.1.2.7.3	FY10 Oversight of TD Magnet Construction - Recycler Kickers			1456	1456
2.0.1.2.8	**Recycler Kicker System Milestones**				
2.0.1.2.8.1	RR Ready to start Final Procurement for Kicker Magnets	After the final high voltage testing of two pre-production RR Injection & Gap Clearing magnets, the L4 manager decides to accept the design as final and go ahead with ordering parts for all production magnets, or to revise the design again.			
2.0.1.2.8.2	RR Extraction MI Injection Line Kicker Checkout Complete	This Milestone is complete after the RR Extraction & MI Injection Line kicker magnets are installed with all cable and fluorinert piping, and tested with the pulser system, the checkout is complete and the kicker system is ready for beam.			
2.0.1.2.8.3	RR Beam Abort Kicker Checkout Complete	This Milestone is complete after the RR Beam Abort Line kicker magnet is installed with all cable and fluorinert piping, and tested with the pulser system, the checkout is complete and the kicker system is ready for beam.			
2.0.1.2.8.4	RR Injection & Gap Clearing Magnets & Fluorinert Piping in Tunnel Checkout Complete	This Milestone is complete after the RR Injection Line and Gap Clearing Line kicker magnets are installed with all cable and fluorinert piping, and tested with the pulser systems, the checkout is complete and the kicker systems are ready for beam.			

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.0.1.2.8.5	RR All Kicker Systems Ready for Beam	This Milestone is complete when all kicker systems are ready for beam. This includes the RR Injection, RR Gap Clearing, RR Extraction, MI Injection, and the RR Beam Abort kicker systems.			
2.0.1.3	**Recycler Instrumentation**	**This summary task covers the procurement, testing, and installation of upgrades to the existing Recycler BPM system, beam intensity monitors, and damper systems.**			
2.0.1.3.1	**BPMs**	**This summary task covers the procurement and installation tasks necessary for the upgrade of the Recycler BPM system. Included are procurement of the necessary 275,000 feet of cable, connectors, 216 transition boards, testing of the transition boards, and the installation of the cables (M&S electricians) and boards.**			
2.0.1.3.1.1	Procure BPM Cables/Connectors		275,000 ft of cable approx $2/ft, connectors 500 @$5/connector = $2500	1897	1897
2.0.1.3.1.2	Procure BPM Transition Boards		$3000/board, 6 houses @12 boards/house = $216000	1906	1906
2.0.1.3.1.3	Test BPM Transition Boards			1906	1906
2.0.1.3.1.4	Recycler Instrumentation - Install Cables & Boards		Includes 2400 hours of Electrician time @$80/hr. Need Davis - Bacon waiver. Labor is for techs for termination.	1897	1897
2.0.1.3.2	**DCCT/Toroids**	**This summary task covers the procurement and installation of beam intensity monitors, a DCCT for the circulating beam in the Recycler and toroids for the transfer lines.**			
2.0.1.3.2.1	**DCCT**				
2.0.1.3.2.1.1	Procure DCCT, Cables & Connectors			1868	1868
2.0.1.3.2.1.2	Recycler Instrumentation - Install DCCT		24 hours electricians	1867`	1867
2.0.1.3.2.2	Recycler Instrumentation - Relocate Toroids to Injection Line		Cables bought and pulled in modification section. Move & modify stand.	1862	1862
2.0.1.3.2.3	Recycler Instrumentation - Relocate Toroids to Extraction Line		Cables bought and pulled in modification section. Move & modify stand.	1862	1862
2.0.1.3.3	**Dampers**	**This summary task covers the procurement, test, and installation of the Recycler damper systems. As we are using existing pickups and kickers, we will be installing new damper boards (1 longitudinal, 2 transverse) and power amplifiers.**			
2.0.1.3.3.1	**Longitudinal**				
2.0.1.3.3.1.1	Procure Longitudinal Dampers		M&S includes contract electrician work.	1865	1865
2.0.1.3.3.1.2	Test Longitudinal Dampers			1865	1865
2.0.1.3.3.1.3	Recycler Instrumentation - Install Longitudinal Dampers			1864	1864
2.0.1.3.3.2	**Transverse**				
2.0.1.3.3.2.1	Procure Transverse Dampers (incl Move 240V outlet)		5 Power amplifiers @$32,000 each. Boards $20,000. Misc $5,000. Includes 8 hours of Electrician time @$80/hr.	1866	1866
2.0.1.3.3.2.2	Test Transverse Dampers			1866	1866
2.0.1.3.3.2.3	Recycler Instrumentation - Install Transverse Dampers			1863	1863

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.0.1.3.4	**Recycler Instrumentation Milestones**				
2.0.1.3.4.1	RR DCCT Order Finalized	DCCT specifications complete, documented and order ready to be placed.			
2.0.1.3.4.3	RR DCCT Ready for Installation	DCCT in hand, inspected, calibrated, cleaned, and ready for installation.			
2.0.1.3.4.5	RR BPM System Procurement Complete	Purchased, received and inspected cables/connectors/transiton boards for the RR BPM upgrade project.			
2.0.1.3.4.6	RR BPM Transition Boards Ready for Installation	All 216 BPM transition boards passed testing and ready for installation.			
2.0.2	**Main Injector Upgrades**	**This summary task covers the procurement and installation for upgrades to the existing vertical quad bus of MI. It also includes communication infrastructure for the 2 new service buildings. Also included is the procurement, fabrication, and installation of the 2 new RF stations, and the modifications to associated cooling systems.**			
2.0.2.1	**MI Modifications**	**This summary task includes the procurement and installation of new transformer and modifications for MI vertical quad bus. It also covers procurement and installation of communications infrastructure for the 2 new service buildings at MI14 and MI39.**			
2.0.2.1.1	**Upgrade V Quad Bus w/New Transformer**	**This sumary task covers the purchase of a new transformer and the modifications of the corresponding supply for the Vertical Quad bus of Main Injector.**	**des 2 wks...**		
2.0.2.1.1.1	MI Mods Prep Req & Award PO for Transformer			1684	1684
2.0.2.1.1.2	MI Mods Vendor Fab & Receive Transformer			1684	1684
2.0.2.1.1.3	MI Mods Build New Power Supply Components			1684	1684
2.0.2.1.1.4	MI Mods Install New Power Supply Components		Could occur in any earlier SD	1684	1684
2.0.2.1.1.5	MI Mods Commission New Power Supply Components			1684	1684
2.0.2.1.2	**MI-14 Communications Infrastructure**	**This summary task covers the installation of the infrastructure required for the controls (including the racks and cables) in the MI-14 building.**			
2.0.2.1.2.1	MI-14 Prep Req & Submit PO for Equip Racks & Cable			1743	1743
2.0.2.1.2.2	MI-14 Receive Equip Racks & Cable			1743	1743
2.0.2.1.2.3	MI-14 Install Equip Racks & Connect Electrical Power			1743	1743
2.0.2.1.2.4	MI-14 Pull & Terminate Communications Cables			1743	1743
2.0.2.1.2.5	MI-14 Recover & Build Controls Hardware			1743	1743
2.0.2.1.2.6	MI-14 Install Controls Hardware			1743	1743

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.0.2.1.3	**MI-39 Communications Infrastructure**	**This summary tasks covers the installation of the infrastructure(including the racks and cables) required for the controls in the MI-39 building.**			
2.0.2.1.3.1	MI-39 Prep Req & Submit PO for Equip Racks & Cable			1747	1747
2.0.2.1.3.2	MI-39 Receive Equip Racks & Cable			1747	1747
2.0.2.1.3.3	MI-39 Install Equip Racks & Connect Electrical Power			1747	1747
2.0.2.1.3.4	MI-39 Pull & Terminate Communications Cables			1747	1747
2.0.2.1.3.5	MI-39 Recover & Build Controls Hardware			1747	1747
2.0.2.1.3.6	MI-39 Install Controls Hardware			1747	1747
2.0.2.1.4	**MI Modifications Milestones**				
2.0.2.1.4.1	MI Vertical Quad Bus Upgrade Complete	The new transformer has been installed, the power supply modifications are complete.			
2.0.2.2	**MI RF Cavities**	**This summary task covers procurement, fabrication, and installation for the 2 new MI RF stations.**			
2.0.2.2.1	**MI RF Cavities Bus Bar**	**This summary task covers the procurement of the material for the fabrication and installation of the bus bars for the two extra MI rf cavities.**			
2.0.2.2.1.1	MI RF Cavities Bus Bar Raw Material Procurement			1509	1509
2.0.2.2.1.2	MI RF Cavities Bus Bar Fab & Install		Includes 16 hours of Welder time @$80/hr. $5K M&S	1512	1512
2.0.2.2.2	**MI RF Cavities Equip Gallery Install/Modification**	**This summary tasks covers the purchase and the installation (non tunnel) of the equipment required for the operation of the two extra MI rf cavities.**			
2.0.2.2.2.1	**MI RF Cavities Equip Purchase/Fabrication**				
2.0.2.2.2.1.1	**MI RF Cavities Series Tube Modulators**		**Engineering part of Booster upgrade.**		
2.0.2.2.2.1.1.1	Prep Req & Award PO for Parts for Series Tube Modulators			1711	1711
2.0.2.2.2.1.1.2	Receive Parts for Series Tube Modulators			1711	1711
2.0.2.2.2.1.1.3	Assemble Series Tube Modulators			1711	1711
2.0.2.2.2.1.1.4	Electrical Testing of Completed Series Tube Modulators			1711	1711
2.0.2.2.2.1.2	**MI RF Cavities Power Amplifier**		**2 MI RF Cavity PAs @ $82,000 each.**		
2.0.2.2.2.1.2.1	Prep Req & Award PO for Parts for MI RF Cavities Power Amplifier			1710	1710
2.0.2.2.2.1.2.2	Receive Parts for MI RF Cavitities Power Amplifier			1710	1710
2.0.2.2.2.1.2.3	Assembly of MI RF Cavities Power Amplifier			1710	1710
2.0.2.2.2.1.2.4	Electrical Testing of Completed MI RF Cavities Power Amplifier			1710	1710
2.0.2.2.2.1.3	**MI RF Cavities Controls**		**Build 2 station control racks.**		

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.0.2.2.2.1.3.1	MI RF Cavity Prep Req & Award PO for Parts for Controls Rack			1713	1713
2.0.2.2.2.1.3.2	MI RF Cavity Receive Parts for Control Rack			1713	1713
2.0.2.2.2.1.3.3	MI RF Cavity Assemble Control Rack			1713	1713
2.0.2.2.2.1.3.4	MI RF Cavity Electrical Testing of Completed Control Rack			1713	1713
2.0.2.2.2.1.4	**MI RF Cavities Solid State Amplifiers**		**SS Amplifiers come from 4 TEV Stations**		
2.0.2.2.2.1.4.1	Prep Req & Award PO for Parts for MIF RF Cavities Solid State Amplifiers			1712	1712
2.0.2.2.2.1.4.2	Receive Parts for MI RF Cavities Solid State Amplifiers			1712	1712
2.0.2.2.2.1.4.3	Assemble MI RF Cavities Solid State Amplifiers			1712	1712
2.0.2.2.2.1.4.4	Electrical Testing of Completed MI RF Cavities Solid State Amplifiers			1712	1712
2.0.2.2.2.1.5	MI RF Cavities Software Programming		I25 and I3 modification, LLRF modification, device names 1 month to modify low level RF(RF Eng) 1 week for entering ACNET devices (EE) Modifications of I3 and I25 console applications - 2 weeks (controls)	1498	1498
2.0.2.2.2.1.6	**MI RF Cavities Ferrite Bias Supplies**				
2.0.2.2.2.1.6.1	Prep Req & Award PO for Parts for Ferrite Bias Supply			1714	1714
2.0.2.2.2.1.6.2	Receive Parts for Ferrite Bias Supply			1714	1714
2.0.2.2.2.1.6.3	Assembly of Ferrite Bias Supply			1714	1714
2.0.2.2.2.1.6.4	Electrical Testing of Completed Ferrite Bias Supply			1714	1714
2.0.2.2.3	**MI RF Cavities Cavity Installation**	**This summary task covers the tunnel instalation of the two extra rf cavities and the final high voltage testing.**			
2.0.2.2.3.1	MI RF Cavities Cabling			1479	1479
2.0.2.2.3.2	MI RF Move Cavities 4 & 15		Bus bar modification, IPM vacuum tube, move few inches	1478	1478
2.0.2.2.3.3	MI RF Install			1477	1477
2.0.2.2.3.4	MI RF Align Cavities			1476	1476
2.0.2.2.3.5	MI RF Cavities Final System Test			1475	1475
2.0.2.2.4	**MI RF Cavity Cooling System Mods Installation**	**This summary task includes the procurement, installation, and start-up for all cooling system mods for the RF Cavities, for both the 95°F and 55°F LCW systems.**			
2.0.2.2.4.1	Procure Power Supply Piping, Hoses & Ftgs MI-60 Gallery			1506	1506
2.0.2.2.4.2	Install Power Supply Connections MI-60 Gallery		Consumables, misc.	1506	1506
2.0.2.2.4.3	Procure Cavity Piping, Hoses & Ftgs Q600 Area			1506	1506

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.0.2.2.4.4	Install Cavity Connections Q600 Area			1506	1506
2.0.2.2.4.5	Test & Troubleshoot Cavity Cooling Systems			1506	1506
2.0.2.2.5	**MI RF Cavities Milestones**				
2.0.2.2.5.1	MI RF Cavities Bus Bar Fabrication & Installation Complete	The bus bars for the 2 new rf stations have been fabricated and installed.			
2.0.2.2.5.2	MI RF Cavities Fabrication of Ferrite Bias Supplies Complete	The fabrications of the two new bias supplies have been completed.			
2.0.2.2.5.3	MI RF Cavities Fabrication of Modulators Complete	The fabrications of the two new modulator supplies have been completed.			
2.0.2.2.5.4	MI RF Cavities (2) Installation & Testing Complete	The two MI rf cavities have been installed in the tunnel and have been tested with no beam.			
2.0.2.2.5.5	MI LCW System Mods Complete	MI LCW Systems on line and operational			
2.0.3	**NuMI Upgrades**	**This summary task covers the procurement, fabrication and installation of the modifications to the NuMI Beamline to support 700kW NOvA operation in the medium energy neutrino beam configuration. It includes the primary beam upgrades to support a higher beam cycle time, upgrades to the cooling systems throughout the beamline for the increases power, and electrical infrastructure to support the additional power needs. Also included is the medium energy target, baffle and carrier and an upgraded hadron monitor. Procurement, fabrication and installation of operations equipment in support of moving horn 2 and procurement, fabrication and assembly of the stripline, stripline block and chase temperature monitoring equipment are included also. Installation of the hadron monitor and target/carrier/baffle are included.**			
2.0.3.1	**NuMI Primary Proton Beam**	**This summary task covers the procurement, engineering and technician efforts needed to upgrade the NuMI kicker power supply for increased pulsing repetition rate, to upgrade the 6 NuMI major dipole supplies, and to upgrade the NuMI primary bema profile monitors. It also includes the effort to replace the NuMI quads with the more robust, recovered quads from the A150 line and their power supplies.**			
2.0.3.1.1	**NuMI Extraction Kicker**	**This summary task covers the procurement, engineering and technician efforts needed to upgrade the NuMI kicker power supply for increased pulsing repetition rate. This is needed for reduced cycle time operation. This includes procurement and installation of parts to upgrade the Fluorinert to water heat exchanger.**			
2.0.3.1.1.1	**Upgraded Charging Power Supply**				
2.0.3.1.1.1.1	NuMI Extract Kicker Charging PS Upgrades Procurement			1754	1754
2.0.3.1.1.1.2	NuMI Extract Kicker Charging PS Upgrades Installation			1754	1754

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.0.3.1.1.1.3	NuMI Extract Kicker Charging PS Upgrades Testing			1754	1754
2.0.3.1.1.2	NuMI Extract Kicker Procure Upgrade for Fluorinert to Water Heat Exchanger			1754	1754
2.0.3.1.1.3	NuMI Extract Kicker Install Upgrade for Fluorinert to Water Heat Exchanger		Installing new heat exchanger in existing Fluorinert system.	1754	1754
2.0.3.1.2	**NuMI Dipole Power Supply**	**This summary task covers the procurement, engineering and technician efforts needed to upgrade the 6 NuMI major dipole power supplies for reduced cycle time and improved precision readout and regulation.**			
2.0.3.1.2.1	NuMI Procure BuLB System			1755	1755
2.0.3.1.2.2	NuMI Implement & Test (BuLB) Regulation Systs for 6 Major PS		Needs interim shutdowns. 2 weeks per bulb system.	1755	1755
2.0.3.1.2.3	NuMI PS Changes for Improved Cycle Time		Includes testing. 3-5 days per PS, 6 power supplies.	1755	1755
2.0.3.1.3	**3Q120 Quadrupoles**	**This summary task covers the efforts needed to replace the 5 highest current QQM style 3Q120 quadrupoles with more robustly cooled QQB style quads. This is important for reliable operaation at shorter cycle times. Included is the procurement and installation of higher current cables, 75 kW power supplies, and installation of QQB magnets.**			
2.0.3.1.3.1	Prep Req & Award PO for 5 Spang 75KW Power Supplies & Regulation Unit Parts		Off the shelf PS (sole source).	1757	1757
2.0.3.1.3.2	Vendor Fab & Receive 5 Spang 75KW Power Supplies & Regulation Unit Parts			1757	1757
2.0.3.1.3.3	Fabricate Spang Regulation Units			1757	1757
2.0.3.1.3.4	Prep Req & Order 3Q120 Quad Cables			1803	1803
2.0.3.1.3.5	Receive 3Q120 Quad Cables			1803	1803
2.0.3.1.3.6	Install & Terminate 3Q120 Quad Cables			1803	1803
2.0.3.1.3.9	3Q120 Quads Install 5 Recovered Magnets		Riggers 5 days @32 hours/day = 160 hours. 2 magnets/day = 10 magnets.	1804	1804
2.0.3.1.3.10	3Q120 Quads Hook-up & Checkout for 5 New PS			1757	1757
2.0.3.1.3.11	3Q120 Quads Reconnect Water			1804	1804
2.0.3.1.4	**Upgrade Primary Beam Transport Profile Monitors**				
2.0.3.1.4.3	Procurements for Profile Monitors Upgrade			1756	1756
2.0.3.1.4.13	Assembly of Foils on Ceramic Boards			1756	1756
2.0.3.1.4.14	Assembly of Detectors			1756	1756
2.0.3.1.4.15	Modify Motion Control from DC to AC			1756	1756
2.0.3.1.4.16	Vacuum Leak Check & Bake Out			1756	1756
2.0.3.1.4.17	Alignment Referencing			1756	1756
2.0.3.1.4.18	NuMI Stub profile Monitor Installation			1756	1756
2.0.3.1.4.19	Pretarget profile Monitor Installation			1756	1756

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.0.3.1.4.20	NuMI Stub Rough Alignment			1756	1756
2.0.3.1.4.21	Pretarget Rough Alignment			1756	1756
2.0.3.1.4.22	NuMI Stub Vacuum Hookup & Leak Check			1756	1756
2.0.3.1.4.23	Pretarget Vacuum Hookup & Leak Check			1756	1756
2.0.3.1.4.24	NuMI Stub Final Alignment			1756	1756
2.0.3.1.4.25	Pretarget Final Alignment			1756	1756
2.0.3.1.5	**NuMI Primary Proton Beam Milestones**	**This summary task covers the procurement, engineering and technician efforts needed to upgrade the NuMI primary beam transport profile monitors to enable use during high intensity beam operation. The updated design makes use of the best features of the current NuMI Ti foil monitors and proven Fermilab mechanical drive systems. Fabrication, testing and installation of 10 monitors is included.**			
2.0.3.1.5.1	NuMI Charging PS Upgrades Testing Complete	The upgraded charging power supply for the NuMI extraction kicker has been assembled, tested, and approved for operational use.			
2.0.3.1.5.2	NuMI Primary Beamline Ready for Faster Cycle Time	The NuMI Primary Beamline is capable of operating at a 1.33 second repetition rate. This includes the upgrade to the NuMI extraction kicker, the installation of the replacement quadrupole magnets, and the operation of the improved regulation of the dipole power supplies.			
2.0.3.2	**NuMI Target Hall Technical Components**	**This summary task includes purchasing of a medium energy target and baffle from IHEP, purchase and construction of a target carrier and the assembly of all three of these pieces into a single unit ready which is then installed. This task also includes the purchasing of a hadron monitor from University of Texas, Austin and replacing the existing one in the tunnel.**			
2.0.3.2.1	**ME Target, Carrier & Baffle**				
2.0.3.2.1.1	**Medium Energy Target**	**This summary task is for the purchasing of a medium energy target from IHEP, Protvino. The tasks include the labor to write the accord between Fermilab and IHEP for the construction of a medium energy target and the labor to inspect the target upon delivery to Fermilab. The task includes M&S for the purchase of the target from IHEP under the agreement in the accord. The task does not inlude the R&D and engineering for the design of the medium energy target.**			
2.0.3.2.1.1.1	Write Accord w/IHEP for ME Target		Design Mods for ME Target Provide full engineering spec & dwg package Review of dwg package Construct 2 ME targets (include QA travelers)	1729	1729
2.0.3.2.1.1.2	Construct ME Target at IHEP		Russian built.	1729	1729
2.0.3.2.1.1.3	Inspection & Testing (at Fermilab) ME Target			1729	1729

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.0.3.2.1.2	**Target Carrier**	**This summary task includes the labor and M&S for the construction of a target carrier and the assembly of the target, baffle, and carrier into a single unit ready for installation in the target chase. The labor includes the time needed to write purchase requisitions, receive the parts and assemble the carrier. The task includes the M&S cost of parts for the target carrier. Upon completion of this task a target,baffle, and carrier unit will be ready for connection to a target module and then ready for installation into the target chase. This task does not include R&D or design of the target, baffle, or carrier.**			
2.0.3.2.1.2.1	Prep Reqs & Award POs for Target Carrier Parts			1709	1709
2.0.3.2.1.2.2	Receive Parts & Assemble Target Carrier			1709	1709
2.0.3.2.1.2.3	Target Carrier trouble-shooting			1709	1709
2.0.3.2.1.3	**Baffle**	**This summary task is for the purchasing of a target baffle from IHEP, Protvino. The tasks include the labor to write the accord between Fermilab and IHEP for the construction of a baffle and the labor to inspect the baffle upon delivery to Fermilab. The task includes M&S for the purchase of the baffle from IHEP under the agreement in the accord. The task does not inlude the R&D and engineering for the design of the baffle.**			
2.0.3.2.1.3.1	Write Accord w/IHEP for Baffle			1730	1730
2.0.3.2.1.3.2	Construct Baffle at IHEP		Includes Fermi supplied graphite costs ($2000). Baffle expected to survive 700kW, need reference document. Ask Jim Hylen? See UND 608 for spare baffle. Russian build	1730	1730
2.0.3.2.1.3.3	Inspect & Test Baffle (at FNAL)			1730	1730
2.0.3.2.1.4	Final assy & installation Production Target & Baffle into new carriers			1709	1709
2.0.3.2.1.5	Installation to existing Target Module /Installation in Chase.			1709	1709
2.0.3.2.2	**Hadron Monitor**	**This summary task is for the purchasing of a hadron monitor from the University of Texas, Austin (UTA). It includes the labor to write the purchase requisition and to replace the hadron monitor in the tunnel. It includes the M&S to purchase the hadron monitor from the University of Texas. The purchase includes the design, fabrication, and delivery of a Hadron Monitor from the UTA to Fermilab.**			
2.0.3.2.2.1	Prep Req & Award PO for Construction of Replacement Hadron Monitor (UT MOU)			1722	1722
2.0.3.2.2.2	Vendor Fab & Receive Replacement Hadron Monitor (UT MOU)		Assumes UTA will do QA. Consider a spare monitor.	1722	1722
2.0.3.2.2.3	Install hadron monitor in tunnel			1722	1722
2.0.3.2.2.4	Store Used Hadron Monitor (Off Project UID 824)				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.0.3.2.3	**NuMI Target Hall Technical Components Milestones**				
2.0.3.2.3.1	NuMI Begin Baffle Procurement	The design of the target baffle has been completed with signed off drawings and a design review and the procurement of the baffle can begin.			
2.0.3.2.3.2	NuMI Baffle Delivered	The baffle for the medium energy target has been delivered to Fermilab and has been inspected and accepted for installation into the target carrier			
2.0.3.2.3.3	NuMI ME Target/Carrier/Baffle Assembly Complete	The medium energy target, the baffle, and the target carrier have been assembled into a single unit that is ready for installation into the target chase.			
2.0.3.2.3.4	NuMI Target Carrier Delivered	The target carrier has been delivered to Fermilab, inspected, and approved.			
2.0.3.2.3.7	NuMI IHEP ME Target Accord Signed	An accord for the construction and delivery of a medium energy target has been written, approved, and signed by IHEP, Protvino and Fermilab.			
2.0.3.2.3.8	Replacement Hadron Monitor Delivered	The repacement Hadron Monitor has been delivered from UTA to Fermilab, and has been inspected, and approved for installation.			
2.0.3.2.4	**Hadron Monitor Beam Abort**				
2.0.3.2.4.1	Prep Req & Award PO for Hadron Monitor Beam Abort			1494	1494
2.0.3.2.4.2	Receive Parts for Hadron Monitor Beam Abort			1494	1494
2.0.3.2.4.3	Fabricate Hadron Monitor Beam Abort			1494	1494
2.0.3.2.4.4	Install Hadron Monitor Beam Abort			1494	1494
2.0.3.3	**NuMI Target Hall Infrastructure**	**This summary task covers the procurement, fabrication, and installation of operations equipment in the target hall for the NovA upgrades. It also includes procurement, fabrication, assembly and installation of the stripline extension and shielding blocks needed to support the movement of horn 2 to the medium energy location. Also included procurement, fabrication, installation, testing and troubleshooting of target chase cooling equipment and temperature monitoring equipment for the chase. Finally, it includes procurement, fabrication and assembly of new Horn 1 stripline cooling components. Installation of horn 1 and module and horn 2 and module are not on project, but operations tasks.**			
2.0.3.3.1	**Target Hall Operations Space Planning**	**This summary task covers the procurement, fabrication, and installation of operations equipment in the target hall. The procurement tasks include labor and M&S for purchase req preparation and PO placement, fabrication and delivery time, receipt and inspection/QA, and final installation of the equipment in the target hall. Also included in the M&S are trip costs to the vendor site. The installation task includes a welder and rigging crew and M&S to cover miscellaneous expenses during the installation.**			
2.0.3.3.1.1	Prep Req & Award PO for Target Hall Operations Space Planning Equip			1768	1768

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.0.3.3.1.2	Vendor Fab & Receive Target hall Operations Space Planning Equip			1768	1768
2.0.3.3.1.3	Install new operations equipment in Target Hall			1768	1768
2.0.3.3.2	**Horn2 Re-location to Medium Energy**				
2.0.3.3.2.1	**Stripline Extension**	**This summary task covers the procurement, fabrication, assembly, and installation of stripline components required to extend the existing Horn 2 stripline and fence to the medium energy position. The stripline components include the following items: conductors with silver plating, fasteners, tooling, support stand parts, fence parts. The procurement tasks include labor and M&S for purchase req preparation and PO placement, fabrication and delivery time, receipt/inspection/QA and storage, followed by final assembly of all the components. The assembly and installation tasks include a welder and rigging crew, and cover installation of the stripline extension, stands, and fence in the target hall.**			
2.0.3.3.2.1.1	Procurement & fabrication of stripline extension parts		Includes $14000 for stands and fence.	1796	1796
2.0.3.3.2.1.2	Inspection & Handling of Parts			1796	1796
2.0.3.3.2.1.3	Assembly of stripline extension		Upstairs work.	1796	1796
2.0.3.3.2.1.4	Installation of stripline extension & fence		Includes shunts. Riggers 32 hours	1796	1796
2.0.3.3.2.2	**Shielding Reconfiguration**	**This summary task covers the procurement, fabrication, and installation of shielding components required to re-locate Horn 2 to the medium energy position. Also included are upgrades to the remote lifting system. The procurement tasks include labor and M&S for purchase req preparation and PO placement, fabrication and delivery time, receipt/inspection/QA, and storage of the following: - 73 tons of steel for shielding blocks (T-Blocks/Stripline Block plus support tubes) - Remote lifting system components and misc parts plus Blue-Block lifting fixture upgrades - Dummy module and Carriage support - Fabrication, including associated welding, machining, and tech time to create finished parts - Also included are trip costs for site visits to vendors Installation task includes mounting the carriage, rails, and T-block support tubes at the ME position, followed by placement of the dummy module and shield blocks.**			
2.0.3.3.2.2.1	Prep Req & Award PO for Shielding Blocks			1731	1731
2.0.3.3.2.2.2	Vendor Fab & Receive Shielding Blocks			1731	1731
2.0.3.3.2.2.3	Prep Req & Award PO for Remote Lifting System Components			1731	1731

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.0.3.3.2.2.4	Receive Remote Lifting System Components			1731	1731
2.0.3.3.2.2.5	Prep Req & Award PO for Dummy Module & Carriage Support		Needs air seals.	1731	1731
2.0.3.3.2.2.6	Vendor Fab & Receive Dummy Module & Carriage Support			1731	1731
2.0.3.3.2.2.7	Install of Rails, Carriage, T-Block Supports, Dummy Module & Shield Blocks in DS Position			1744	1744
2.0.3.3.2.3	Re-locate Horn 2 to Medium Energy Position (Off Project UID 59)				
2.0.3.3.3	**Target Chase Upgrades**				
2.0.3.3.3.1	**Target Chase Air Cooling**	**This summary task covers the procurement, fabrication, installation, testing and troubleshooting of the target chase cooling equipment. The procurement tasks include labor and M&S for purchase req preparation and PO placement, fabrication and delivery time, receipt/inspection/QA, and storage of the following: - (Qty. 1) Water Chiller Surface unit plus associated instrumentation - (Qty. 2) Heat Exhanger Cooling Coil units plus associated instrumentation Installation of the new water chiller surface unit and instrumentation will be on the existing chiller pad just west of MI 65. Installation of the cooling coil unit will be in the target hall and will include modifications to the existing coil box plus installing instrumentation and read backs. Consulting fees have been included in the M&S of the Test and Troubleshoot task.**			
2.0.3.3.3.1.1	Prep Req & Award PO for Target Chase Cooling Equip		From Andy Stefanik notes. Coils and instrumentation.	1466	1466
2.0.3.3.3.1.2	Vendor Fab & Receive Target Chase Cooling Equip			1466	1466
2.0.3.3.3.1.3	Install New Water Chiller Surface Unit		M&S includes cost of piping.	1466	1466
2.0.3.3.3.1.4	Modify Coil Box & Install Cooling Coils			1466	1466
2.0.3.3.3.1.5	Install Instrumentation & Read Backs for Cooling Coils		Includes modifications of PLC programming. Cables, etc… Installation of instrumentation T&M = $3000, Electricians = $4000	1466	1466
2.0.3.3.3.1.6	Test & Troubleshoot Cooling Equip			1466	1466

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.0.3.3.3.2	**Horn 1 Stripline Block**	**This summary task covers the procurement, fabrication, and assembly of new Horn 1 stripline cooling components. The procurement tasks include labor and M&S for purchase req preparation and PO placement, fabrication and delivery time, receipt/inspection/QA, and storage of the following: - 100-200 scfm regenerative blower - Piping and duct material - Mounting hardware - Also included is in-house machining and fabrication of custom duct/piping and modifications to the existing stripline block assembly. Assembly of the new cooling components on the stripline block is also included. However, this task does not include mounting the stripline block assembly to the radioative Horn 1 module.**			
2.0.3.3.3.2.1	Prep Req & Award PO for New Stripline Cooling Components		$60000 for new stripline block blank, $89900 for water/air cooling mods. Need to include spares.	1720	1720
2.0.3.3.3.2.2	Vendor Fab & Receive New Stripline Cooling Components			1720	1720
2.0.3.3.3.2.3	Horn 1 Stripline Block Assemble		Includes assy of stripline and remote clamp. Some onsite M&S costs include welder & machine shop. Need to modify existing spare.	1720	1720
2.0.3.3.3.3	**Radiant Heat Loads**	**This summary task covers the procurement, fabrication, and assembly of chase temperature monitoring equipment. The procurement tasks include labor and M&S for purchase req preparation and PO placement, fabrication and delivery time, receipt/inspection/QA, and storage of the following: - Radiation hard thermocouples and cabling - Mounting hardware - Instrumentation The installation includes mounting the temperature monitoring equipment in the target chase together with readbacks.**			
2.0.3.3.3.3.1	Procure & Fabricate Additional Chase Temperature Monitoring Equip			1798	1798
2.0.3.3.3.3.2	Install additional temp monitoring Equip & Readbacks		$5000 M&S	1798	1798
2.0.3.3.4	**NuMI Target Hall Infrastructure Milestones**				
2.0.3.3.4.1	NuMI Shielding Blocks, Dummy Module & Carriage Complete	This milestone defines the receipt of shielding & support components after fabrication from the vendor. These components are now ready for installation in the target hall. It includes fabrication completion and installation readiness of the following items: 1. Shielding blocks (T-blocks, end block & stripline block) 2. Dummy Module 3. Carriage Assembly.			
2.0.3.3.4.2	NuMI Installation of Target Chase Cooling Complete	This milestone defines the completion of the Target Chase Cooling upgrades installation and succesful test & troubleshoot of all components with all systems online and operational.			
2.0.3.3.4.3	NuMI Stripline Assembly Complete	This milestone defines the completion of the Horn 2 stripline extension and stand components assembly. The stripline assembly is now ready for installation in the target hall.			

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.0.3.4	**NuMI Decay Pipe/Hadron Absorber/Utilities**	**This task includes the procurement, installation, and start-up for all cooling system modifications for the NuMI cooling systems (RAW and non-RAW) for NOvA operation. It also includes the procurement, installation, and testing of Electrical Infrastructure equipment related to all RAW and Non-RAW Cooling System Modifications.**			
2.0.3.4.1	**NuMI RAW Systems**				
2.0.3.4.1.1	**Target RAW**	**This summary task includes the procurement, installation, and start-up for all cooling system mods for the Target RAW system instrumentation.**			
2.0.3.4.1.1.1	Procure/Fab Target RAW Instrumentation Upgrade			1715	1715
2.0.3.4.1.1.2	Install Target RAW Instrumentation Upgrade		Welder 8 hours	1715	1715
2.0.3.4.1.1.3	Test & Troubleshoot Target RAW Instrumentation Upgrade			1715	1715
2.0.3.4.1.2	**Horns RAW**	**This summary task includes the procurement, installation, and start-up for all cooling system mods for the Horn 1 and Horn 2 RAW systems, including additional instrumentation, ejector pump upgrades, and any associated system pump, heat exchanger, and piping upgrades.**			
2.0.3.4.1.2.1	Procure Horn 1 RAW Skid Upgrade Parts		Heat exchanger $6000, pumps $3000, instrumention & other parts $6000.	1727	1727
2.0.3.4.1.2.2	Fabricate/Install Horn 1 RAW Skid Upgrade		$5000 for supplies, consumables.	1727	1727
2.0.3.4.1.2.3	Test & Troubleshoot Horn 1 RAW Skid		$1000 for supplies, consumables.	1727	1727
2.0.3.4.1.2.4	Procure Horn 2 RAW Skid Upgrade Parts		Heat exchanger $6000, pumps $3000, instrumention & other parts $6000.	1727	1727
2.0.3.4.1.2.5	Fabricate/Install Horn 2 RAW Skid Upgrade		$5000 for supplies.	1727	1727
2.0.3.4.1.2.6	Test & Troubleshoot Horn 2 RAW Skid		$1000 for supplies, consumables.	1727	1727
2.0.3.4.1.3	**Horn 2 RAW Piping**	**This summary task includes the procurement, installation, and start-up for all cooling system piping mods for the relocation of Horn 2 RAW system.**			
2.0.3.4.1.3.1	Procurement & fab of piping extension parts			1728	1728
2.0.3.4.1.3.2	Installation of piping extension incl Radiography		80 hours pipefitters. 2 techs @ 50% each. Radiography = $4000	1728	1728
2.0.3.4.1.3.3	Test & Troubleshoot Horn 2 RAW Skid			1728	1728
2.0.3.4.1.4	**Decay Pipe RAW**	**This summary task includes the procurement, installation, and start-up for all cooling system mods for the Upstream and Downstream Decay Pipe RAW systems, including additional instrumentation, and any associated system pump, heat exchanger, and piping upgrades.**			

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.0.3.4.1.4.1	Procure/Fabricate US & DS Decay Pipe RAW Upgrade		Heat exchangers $12,000, pumps $6,000, instrumentation & other parts $12,000.	1735	1735
2.0.3.4.1.4.2	Install Decay Pipe US RAW skid upgrade		$5000 for supplies, consumables.	1735	1735
2.0.3.4.1.4.3	Install Decay Pipe DS RAW skid upgrade		$5000 for supplies, consumables.	1735	1735
2.0.3.4.1.4.4	Test & Troubleshoot Decay Pipe RAW		$1000 for supplies, consumables.	1735	1735
2.0.3.4.1.5	**Hadron Absorber RAW & Intermediate**	**This summary task includes the procurement, installation, and start-up for all cooling system mods for the Hadron Absorber RAW and Intermediate Cooling systems, including additional instrumentation, and any associated system pump, heat exchanger, and piping upgrades.**			
2.0.3.4.1.5.1	Procure/Fabricate Hadron Absorber skids		Heat exchanger $12,000, pumps $6,000, instrumentation & other parts $12,000.	1739	1739
2.0.3.4.1.5.2	Install Hadron Absorber skids upgrade		$5,000 for supplies, consumables.	1739	1739
2.0.3.4.1.5.3	Test & Troubleshoot Hadron Absorber Skids		$4,000 for supplies, consumables.	1739	1739
2.0.3.4.2	**NuMI Cooling Water (Non RAW)**				
2.0.3.4.2.1	**NuMI LCW**	**This summary task includes the procurement, installation, and start-up for all cooling system mods for the MI-62 LCW Cooling System, including additional instrumentation, and any associated system pump, heat exchanger, and piping upgrades.**			
2.0.3.4.2.1.1	NuMI Procure LCW Upgrade Parts		$7,000 for instrumentation, supplies, consumables.	1742	1742
2.0.3.4.2.1.2	NuMI Install LCW Upgrade Parts		$1,000 for supplies, consumables.	1742	1742
2.0.3.4.2.1.3	NuMI Test & Troubleshoot LCW Upgrade		$1,000 for supplies, consumables.	1742	1742
2.0.3.4.2.2	**CUB**	**This summary task includes the procurement, installation, and start-up for all cooling system mods for the ICW Cooling System, which supplies cooling water form CUB, including additional instrumentation, and any associated system pump, heat exchanger, and piping upgrades.**			
2.0.3.4.2.2.1	Procure CUB Upgrade Parts		$7,000 for instrumentation, supplies, consumables.	1758	1758
2.0.3.4.2.2.2	Install CUB Upgrade Parts		$1,000 for supplies, consumables.	1758	1758
2.0.3.4.2.2.3	Test & Troubleshoot CUB Upgrade		$1,000 for supplies, consumables.	1758	1758
2.0.3.4.2.3	**NuMI Sump Cooling Water Syst**	**This summary task includes the procurement, installation, and start-up for all cooling system mods for the NuMI Ground Water system, including additional instrumentation, and any associated system pump, heat exchanger, and piping upgrades.**			
2.0.3.4.2.3.1	Procure NuMI Sump Cooling Water Syst Upgrade Parts		$7,000 for instrumentation, $3,000 for pumps, piping.	1759	1759
2.0.3.4.2.3.2	Install NuMI Sump Cooling Water Syst Upgrade Parts		$5,000 for supplies, consumables.	1759	1759
2.0.3.4.2.3.3	Test & Troubleshoot NuMI Sump Cooling Water Syst Upgrade		$1,000 for supplies, consumables.	1759	1759

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.0.3.4.2.4	**MI-65 Secondary Chilled Water System**	**This summary task includes the procurement, installation, and start-up for all cooling system mods for the Secondary Chilled Water system, located in MI-65, including additional instrumentation, and any associated system pump, heat exchanger, and piping upgrades.**			
2.0.3.4.2.4.1	MI-65 Secondary Chilled Water Syst Procure Skid Upgrade Parts		$5000 for heat exchanger, pumps (2) $2500 each, $7,000 for instrumentation.	1760	1760
2.0.3.4.2.4.2	MI-65 Secondary Chilled Water Syst Install Skid Upgrade		$3,000 for supplies, consumables.	1760	1760
2.0.3.4.2.4.3	MI-65 Secondary Chilled Water Syst Test & Troubleshoot		$1,000 for supplies, consumables.	1760	1760
2.0.3.4.3	**NuMI Electrical Infrastructure**	**This summary task covers the procurement, installation, and testing of Electrical Infrastructure equipment related to all RAW and Non-RAW Cooling System Modifications.**			
2.0.3.4.3.1	Procurement for Electrical Capacity Upgrades, for 700kW, Upstream Systems			1806	1806
2.0.3.4.3.2	Install Electrical Upgrades, Upstream			1806	1806
2.0.3.4.3.3	Test & Troubleshoot Electrical Upgrades, Upstream			1806	1806
2.0.3.4.3.4	Procurement for Electrical Capacity Upgrades, for 700kW, Downstream			1806	1806
2.0.3.4.3.5	Install Electrical Upgrades, Downstream			1806	1806
2.0.3.4.3.6	Test & Troubleshoot Electrical Upgrades, Downstream			1806	1806
2.0.3.4.4	**NuMI Decay Pipe/Hadron Absorber/Utilities Milestones**				
2.0.3.4.4.2	NuMI RAW Systems Mods Complete	NuMI RAW Systems on line and operational			
2.0.3.4.4.3	NuMI Cooling Water (Non-RAW) Mods Complete	NuMI Non-RAW Systems on line and operational			
2.0.4	**Project Management**	**This WBS details the management and administrative resources required by ANU during FY08-FY12. It includes administrative costs such as travel, computers, training, reviews. Labor for PM, deputy PM, L3, L4 mgrs, project engineers. It also includes funds for contract engineering & drafting to cover labor shortages.**			
2.0.4.1	**Accelerator Shutdowns**				
2.0.4.1.1	2007 Shutdown Begun	This milestone defines the start of the FNAL 2007 accelerator shutdown as defined by laboratory management.			
2.0.4.1.2	2007 Shutdown Complete	This milestone defines the finish of the FNAL 2007 accelerator shutdown as defined by laboratory management.			
2.0.4.1.3	2008 Shutdown Begun	This milestone defines the start of the FNAL 2008 accelerator shutdown as defined by laboratory management.			
2.0.4.1.4	2008 Shutdown Complete	This milestone defines the finish of the FNAL 2008 accelerator shutdown as defined by laboratory management.			
2.0.4.1.5	Accelerator Shutdown Begun	This milestone defines the start of the accelerator shutdown in FY2011 used to install the accelerator upgrades and start the NuMI upgrades as defined by NOvA management.			

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.0.4.1.6	Accelerator Shutdown Complete	This milestone defines the end of the accelerator shutdown in FY2011 used to install the accelerator upgrades and start the NuMI upgrades as defined by NOvA management.			
2.0.4.1.7	NuMI Upgrades Shutdown Begun	This milestone defines the start of the NuMI shutdown in FY2012 used to install the remainder of the NuMI upgrades and change to the medium energy neutrino beam configuration as defined by NOvA management.			
2.0.4.1.8	NuMI Upgrades Shutdown Complete	This milestone defines the end of the NuMI shutdown in FY2012 used to install the remainder of the NuMI upgrades and change to the medium energy neutrino beam configuration as defined by NOvA management.			
2.0.4.2	**Fermi Management & Administration**	**This WBS details the management and administrative resources required by ANU during FY08-FY12. It includes administrative costs such as travel, computers, training, reviews. Labor for PM, deputy PM, L3, L4 mgrs & project engineers. It also includes funds for contract engineering & drafting to cover labor shortages.**			
2.0.4.2.1	FY08 Management & Administration	This details the management and administrative resources required by the Project for the applicable fiscal year.	Contingency factor includes additional personnel needs if zero-cost labor becomes costed labor. It also includes additional contingency, above the NSF-funded contingency, on the NSF MRI tasks.	1683 - Admin costs such as computers, software, Review preparation, etc. - $5,000 Travel for inspections, meetings, Reviews, training, etc. - $10,000 Overall having to hire contract techs:assume 2 MT full time - $158,000	1683- FNAL Physicists = 5 L2 managers@30%, plus PM @ 100% Budget Officer = A. Nestander Scheduler = K. Domann Mechanical Engineer at 30% = R. Reilly Electrical Engineer at 30% = B. Ducar
2.0.4.2.2	FY09 Management & Administration	This details the management and administrative resources required by the Project for the applicable fiscal year.		1683 - Admin costs such as computers, software, Review preparation, etc. - $5,000 Travel for inspections, meetings, Reviews, training, etc. - $10,000 Overall having to hire contract techs:assume 2 MT full time - $158,000	1683 - FNAL Physicists = 5 L2 managers@30%, plus PM @ 100% Budget Officer = A. Nestander Scheduler = K. Domann Mechanical Engineer at 30% = R. Reilly Electrical Engineer at 30% = B. Ducar
2.0.4.2.3	FY10 Management & Administration	This details the management and administrative resources required by the Project for the applicable fiscal year.		1683 - Admin costs such as computers, software, Review preparation, etc. - $5,000 Travel for inspections, meetings, Reviews, training, etc. - $10,000 Overall having to hire contract techs:assume 2 MT full time - $158,000	1683 - FNAL Physicists = 5 L2 managers@30%, plus PM @ 100% Budget Officer = A. Nestander Scheduler = K. Domann Mechanical Engineer at 30% = R. Reilly Electrical Engineer at 30% = B. Ducar
2.0.4.2.4	FY11 Management & Administration	This details the management and administrative resources required by the Project for the applicable fiscal year.		1683 - Admin costs such as computers, software, Review preparation, etc. - $5,000 Travel for inspections, meetings, Reviews, training, etc. - $10,000 Overall having to hire contract techs:assume 2 MT full time - $158,000	1683 - FNAL Physicists = 5 L2 managers@30%, plus PM @ 100% Budget Officer = A. Nestander Scheduler = K. Domann Mechanical Engineer at 30% = R. Reilly Electrical Engineer at 30% = B. Ducar
2.0.4.2.5	FY12 Management & Administration			1683	1683
2.0.4.2.7	As-built Documentation				
2.0.4.3	**ANU Subproject Milestones**				
2.0.4.3.1	ANU Approval to Proceed with Project	This marks the date at which the original efforts on ANU were authorized to proceed (this was before ANU was incorporated into NOVA).			
2.0.4.3.2	ANU FY07 Funds Available				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.0.4.3.3	FY07 TEC Funds Available				
2.0.4.3.4	FY08 CD3b Funds Available				
2.0.4.3.5	FY08 Funds Available				
2.0.4.3.6	FY08 CD3A Funds Available				
2.0.4.3.7	FY09 Funds Available				
2.0.4.3.8	FY10 Funds Available				
2.0.4.3.9	FY11 Funds Available				
2.0.4.3.10	FY12 Funds Available				
2.0.4.3.11	Start of ANU Accounting	This is the date at which accounting on the TPC began.			
2.0.4.3.12	ANU Shielding Assessment Updates Complete	This milestone is defined as the point at which the MI and NuMI/MINOS Shielding Assessments have been updated/appeneded for NOvA operation and approved as defined in FESHM 2010.			
2.0.4.3.13	Ready for Shutdown to Install Accelerator Upgrades	All necesssary preparation and planning work complete in order to begin the Accelerator Upgrades Shutdown.			
2.0.4.3.14	MI Ring Modifications Ready for Beam Transport	All the NOvA Main Injector modifications of the have been completed and the machine is ready for beam transport.			
2.0.4.3.15	RR Modifications Ready for Beam Transport	This milestone is defined as the completion of the NOvA Recycler Ring modifications for beam transport. It includes the installation, alignment, and vacuum certification of all the beamline elements (magnets, instrumentation, kickers) for injection into the REcycler from the MI8 line and extraction from the Recycler to the Main Injector.			
2.0.4.3.17	Ready to Commission Upgrades with Medium Energy Neutrino Beam	Milestones for RR and MI ready for beam transport completed. The Target Hall has been reconfigured to the medium energy optics and thus the medium energy target has been installed in the target chase and tested and Horn 2 has been relocated to the medium energy position, connected to the extended stripline and tested. Also all NOvA upgrades for higher beam power down the NuMI line have been completed.			
2.0.4.3.21	ANU Subproject Complete	This milestone is defined as the completion of milestone Ready to Commission Upgrades with Medium Energy Neutrino Beam and the tasks under project management for closing out cost accounts (Project Mamangement task in FY12) and completing as-built documents as necessary.			
2.0.4.4	**Off Project MS**				
2.0.4.4.1	**Recycler**				
2.0.4.4.1.3	Off-Project: Receive & Inspect ceramic beamtubes for RR Inj, Gap Clearing & MI Magnets	Ceramic beamtubes purchased off-project have been received at Fermilab, inspected, and accepted for use.	MC363831 Rev A Cross Section 50 tubes @ $3,000 each for RR Inj and MI Inj Inspections for dimensional and vacuum leak check		
2.0.4.4.1.4	Off-Project:: MI-14 SB Construction Complete	Beneficial Occupancy for MI-14 executed and technical component installation may begin.			
2.0.4.4.1.5	Off-Project:: MI-39 SB Construction Complete	Beneficial Occupancy for MI-39 executed and technical component installation may begin.			
2.0.4.4.1.6	Off-Project:: MI-60 Anode Supply Room Construction Complete	Beneficial Occupancy for MI-60 APS Room executed and technical component installation may begin.			
2.0.4.4.2	**NuMI Upgrades**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.0.4.4.2.8	Off-Project: NuMI Horn 1 Modules Installed in Chase Complete	The Horn 1 (ANU) has been attached to the Horn 1 Module, installed in the target chase. The stripline, water, and electrical connections have all been completed.	Includes assembly of horn to module in work cell and installation into chase.		
2.0.4.4.2.11	Off-Project: Work Cell & Equipment Ready for ANU Operation	The Work Cell and Equipment has been assembled in the target hall and is ready for use.	Only if permanent installation is not possible.		
2.0.4.4.2.12	Off-Project:: RCRP Equipment & Procedures Ready for ANU Operations	The RCRP (Radioactive Component Repair/Removal Plan) has been completed and is ready for ANU operations.			
2.0.4.4.2.20	Off-Project:: NuMI Modified Horn 1 Ready for Installation	The Horn 1 (ANU) has been assembled, tested on the test stand, and the magnetic field mapping has been completed.			
2.0.4.4.2.39	Off-Project:: Radioactive Component Repairs/Removal Conceptual Design Review Complete	A review of the Radioactive Component Repair/Removal Conceptual Design Review has been completed.			
2.0.4.4.2.40	Off Project: Profile Monitor Conceptual Design Complete	The Conceptual Design for the Profile Monitor has been completed			
2.1	**Site and Building**	**This level 2 summary element covers the design and construction of the Site Preparation Package and the Far Detector Building**			
2.1.1	**Site Preparation Package**				
2.1.1.1	**Title 2 (Design) Phase**	**This phase will develop the Advanced Technical Design document started under WBS 1.1.2.1 into a set of documents suitable for competive bidding**		**A/E firm EDIA for Title 2 Phased based on 3% of estimated construction cost**	**FESS/E support based on 1.3 FTEs per month for a duration of 8 months at the current chargeback rate.**
2.1.1.1.1	Prepare request for proposal for A/E	Design Criteria Professional: A a registered professional Architect or Engineer who develops the facility program, design criteria, outline performance specification and other project specific material to provide to potential design-build offerors.			
2.1.1.1.2	Issue request for proposal to A/E				
2.1.1.1.3	Review received proposal				
2.1.1.1.4	Prepare requisition				
2.1.1.1.5	Circulate for signature				
2.1.1.1.6	Prepare purchase order				
2.1.1.1.7	PO released - design phase				
2.1.1.1.8	Hold kickoff meeting				
2.1.1.1.9	Prepare drawings				
2.1.1.1.10	Prepare specifications				
2.1.1.1.11	Prepare cost estimate/schedule				
2.1.1.1.12	Assemble, print, and distribute documents				
2.1.1.1.13	Comment and compliance review				
2.1.1.1.14	Revise drawings				
2.1.1.1.15	Revise specifications				
2.1.1.1.16	Revise cost estimate/schedule				
2.1.1.1.17	Assemble, print, and distribute documents				
2.1.1.1.18	Perform quality assurance review				
2.1.1.1.19	Finalize documents				
2.1.1.1.20	Assemble, print, and distribute documents				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.1.1.1.21	Design phase completed				
2.1.1.2	**Wetland Mitigation**	**This task will complete the wetland mitigation process begun in WBS 1.1.1.3 including submitting required permits and obtaining wetland banking credits**			
2.1.1.2.1	Review preliminary wetland permit applications				
2.1.1.2.2	Wetland permit submitted				
2.1.1.2.3	Review period				
2.1.1.2.4	Incorporate comments				
2.1.1.2.5	Purchase wetland credits			Wetland Credit purchases based on 10 acres at $10,000 per acre	
2.1.1.2.6	Permit issued				
2.1.1.3	**Procurement Phase**	**This task will solict and review proposals for the subcontractor and issue a Purchase Order for the work.**			
2.1.1.3.1	Write requisition				
2.1.1.3.2	Circulate requisition				
2.1.1.3.3	Prepare request for proposal				
2.1.1.3.4	Issue request for proposal				
2.1.1.3.5	Review received proposals				
2.1.1.3.6	Prepare purchase order				
2.1.1.3.7	Site preparation purchase order released				
2.1.1.4	**Build Phase**	**This phase will construct the Site Preparation work**			
2.1.1.4.1	Notice to proceed - far detector site preparation package	This marks the point where the subcontractor may begin to procure materials and mobilize at the project site			
2.1.1.4.2	Mobilize	Include costs for mobilization/demobilization of the equipment, work force, establishing staging area, etc… Also included in this category is the survey work and construction of survey monuments.			
2.1.1.4.3	Clear and grub/erosion control	This task includes general site clearing of vegetation and trees and the installation of erosion control devices			
2.1.1.4.4	Build access road	This category should include costs associated with constructing the Brightstar access road including road bed construction, drainage structures, etc..			
2.1.1.4.5	Excavate site	This task includes costs associated with the area adjacent to the Far Detector building including establishment of stockpiles and rock excavation, water treatment devices/structures, rock support and temporary construction drainage system.			
2.1.1.4.6	Utilities work	This task includes the electric service upgrade from Northstar Electric and the data/communication service from Black Duck. These costs will be provided to the estimator. This category should include the cost of the domestic water well.		See NOVA-doc-1881 for Electrical Service Upgrade cost and NOVA-doc-1914 fpr data/communication costs	
2.1.1.4.7	Benefical occupancy - far detector site preparation package	This milestone marks the point where the Site Prepartion work is ready for use by the project and/or subsequent work activities			
2.1.1.4.8	Perform punch list - far detector site preparation package				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.1.1.4.9	Final acceptance - far detector site preparation package	This milestone marks the point where the Site Prepartion work is complete.			
2.1.1.5	**EDIA**	**EDIA is Engineering Design Inspection and Administration. ED&I activities include the engineering and design activities in Titles 1 and II, the inspection activities associated with Title III. The descriptions are based on DOE Directive G430.1-1, Chapter 6. In addition, DOE Directive G430.1-1, Chapter 25 was used as guidance in estimating the ED&I costs for this project. Administration activities include those defined by DOE Directive G430.1-1, Chapter 6 as Project Management (PM) and Construction Management (CM).**			
2.1.1.5.1	**Title 2/Procurement Phase Support**				
2.1.1.5.1.1	CM/PM Fee	The CM/PM Fee is used to support the Owner's Representative retained by the University of Minnesota		See NOVA-doc-2081 for calculation	
2.1.1.5.1.2	Fermilab	This task includes the Fermilab support of the Title 2/Procurment Phase of the work			See NOVA-doc-2081
2.1.1.5.2	**Title 3 Phase Support**	**Title 3 support includes the oversight of construction activities**			
2.1.1.5.2.1	**Cooperative Agreement Recepient**				
2.1.1.5.2.1.1	CM/PM Fee	The CM/PM Fee is used to support the Owner's Representative retained by the University of Minnesota		See NOVA-doc-2081 for calculation	
2.1.1.5.2.1.2	**A/E Firm**	**This task includes the support of the design firm during Title 3 to respond to design questions and general support of the construction activities**		**See NOVA-doc-2081 for calculation**	
2.1.1.5.2.1.2.1	Office support	This includes shop drawing review, responding to request for information and general adminsitration		See NOVA-doc-2081 for calculation	
2.1.1.5.2.1.2.2	Resident engineer support	This task includes the costs of a on-site resident engineer at the project site.		See NOVA-doc-2081 for calculation	
2.1.1.5.2.2	Fermilab	This task includes the Fermilab support of the Title 3 Phase of the work			See NOVA-doc-2081 for calculation
2.1.2	**Far Detector Building**	**Also known as “design-construct” or “single responsibility”, Design-Build is a system of contracting under which one entity performs both architecture/engineering and construction under one single contract.**			
2.1.2.1	**Design Phase**	**This phase will document the physics requirements of the spaces. Currently, the design includes spaces that have been sized by rule of thumb and historical parameters. This phase will examine each of the elements of the facility and document the basis for the design in terms of square footage, access, utilities and relationship to other spaces. This process will allow us to examine all spaces to make sure we are not overbuilding or underbuilding to meet the requirements. This task will complete the design criteria to produce a set of documents suitable for use in a competive bid solicitation**		**See NOVA-doc-2081 for calculation**	**See NOVA-doc-2081 for calculation**
2.1.2.1.1	Prepare request for proposal for A/E				
2.1.2.1.2	Issue request for proposal to A/E				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.1.2.1.3	Review received proposal				
2.1.2.1.4	Prepare requisition				
2.1.2.1.5	Circulate for signature				
2.1.2.1.6	Prepare purchase order				
2.1.2.1.7	PO released - design phase				
2.1.2.1.8	Hold kickoff meeting				
2.1.2.1.9	Prepare drawings				
2.1.2.1.10	Prepare specifications				
2.1.2.1.11	Prepare cost estimate/schedule				
2.1.2.1.12	Assemble, print, and distribute documents				
2.1.2.1.13	Comment and compliance review				
2.1.2.1.14	Revise drawings				
2.1.2.1.15	Revise specifications				
2.1.2.1.16	Revise cost estimate				
2.1.2.1.17	Assemble, print, and distribute documents				
2.1.2.1.18	Perform quality assurance review				
2.1.2.1.19	Finalize documents				
2.1.2.1.20	Assemble, print, and distribute documents				
2.1.2.1.21	Design phase completed				
2.1.2.2	**Procurement Phase**	**This task will solict and review proposals for the subcontractor and issue a Purchase Order for the work.**			
2.1.2.2.1	Write requisition				
2.1.2.2.2	Circulate requisition				
2.1.2.2.3	Prepare request for proposal				
2.1.2.2.4	Issue request for proposal				
2.1.2.2.5	Review received proposals				
2.1.2.2.6	Prepare purchase order				
2.1.2.2.7	Purchase order released - far detector building				
2.1.2.3	**Build Phase**	**This is the Build Phase of the work**			
2.1.2.3.1	Notice to proceed - far detector building construction	This marks the point where the subcontractor may begin to procure materials and mobilize at the project site			
2.1.2.3.2	Mobilize	Includes costs for mobilization/demobilization of the equipment, work force, establishing staging area, etc… A concrete batch plant, rock crushing operations and temporary electrical service should be included in this task. This task includes temporary construction stairs and lighting.			
2.1.2.3.3	**Detector Enclosure/Assembly Area Concrete**				
2.1.2.3.3.1	Construct concrete base slab	This task should include costs associated with installing the cast-in-place concrete base slab. This should include embedded items (trenches, plates, sump basins, etc,) as well as control joints.			

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.1.2.3.3.2	Construct concrete walls in rock	This task includes costs associated with installing the cast-in-place concrete enclosure walls to the design height of the top of competent rock for the Detector Enclosure, Assembly Area, Fire Protection Room and fire protection water reservoir. Embedded items (unistruts, plates, etc. are included). This task includes groundwater collection and transport systems.			
2.1.2.3.3.3	Construct concrete walls above rock	This task includes costs associated with installing the cast-in-place concrete enclosure walls to the final design height the Detector Enclosure, Assembly Area, Fire Protection Room and fire protection water reservoir. Embedded items (unistruts, plates, etc.) are included. This category also includes groundwater collection and transport systems.			
2.1.2.3.3.4	Install precast plank roof	This task includes the procurement, delivery and installation of the precast concrete roof planks for the Detector Enclosure and Assembly Area.			
2.1.2.3.3.5	Install concrete roof topping slab	This task includes the procurement, delivery and installation of the cast-in-place concrete roof topping for the Detector Enclosure and Assembly Area.			
2.1.2.3.3.6	Detector enclosure/assembly area concrete completed				
2.1.2.3.4	**Service Building**				
2.1.2.3.4.1	Construct service building foundations	This task includes the costs of the concrete foundations for the Service Building			
2.1.2.3.4.2	Construct service building shell				
2.1.2.3.4.3	Structural support for cranes	This task includes the costs associated with installing the structural steel components in the Service Building, Assembly Area and Detector Enclosure. This includes crane support steel, crane rail, access platform system and exit stairs			
2.1.2.3.4.4	Service building shell completed				
2.1.2.3.5	**Outfitting**				
2.1.2.3.5.1	**Building Finishes**	**This task includes the cost of installing the architectural finishes. This includes construction of interior partitions, painting, toilet accessories, kitchenette, door hardware etc.. The raised access floor for the Computer Room and Control Room is includes in this task. Also included is the specialty items associated with the Loading Dock equipment (lights, door seals, etc..**			
2.1.2.3.5.1.1	Access walkways	This task includes the costs associated with installing the structural steel components for the access platform system and the exit stairs in the Assembly Area and Detector Enclosure.			
2.1.2.3.5.1.2	Secondary containment	This task includes the cost of installing the secondary containment system to the walls of the Assembly Area and Detector Enclosure.			

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.1.2.3.5.1.3	Architectural finishes	This task includes the cost of installing the architectural finishes. This includes construction of interior partitions, painting, toilet accessories, kitchenette, door hardware etc.. The raised access floor for the Computer Room and Control Room is includes in this category. Also included is the specialty items associated with the Loading Dock equipment (lights, door seals, etc..			
2.1.2.3.5.2	**Detector Enclosure/Assembly Area Electrical**				
2.1.2.3.5.2.1	Rough-ins	This task includes the cost of roughing in the electrical components in the Detector Enclosure and Assembly Area as well as the adjacent support spaces located in the alcoves			
2.1.2.3.5.2.2	Trim-outs	This task includes the cost of trim out of the electrical components in the Detector Enclosure and Assembly Area as well as the adjacent support spaces located in the alcoves			
2.1.2.3.5.3	**Service Building Electrical**				
2.1.2.3.5.3.1	Rough-ins	This task includes the cost of roughing in the electrical components in the Service Building as well as the adjacent support spaces. Site lighting is included in this category.			
2.1.2.3.5.3.2	Trim-outs	This task includes the cost of trimming out the electrical components in the Service Building as well as the adjacent support spaces. Site lighting is included in this category.			
2.1.2.3.5.4	**Detector Enclosure/Assembly Area Mechanical**				
2.1.2.3.5.4.1	Rough-ins	This task includes the cost of roughing in the mechanical components in the Detector Enclosure and Assembly Area as well as the adjacent support spaces located in the alcoves			
2.1.2.3.5.4.2	Trim-outs	This task includes the cost of trim out of the mechanical components in the Detector Enclosure and Assembly Area as well as the adjacent support spaces located in the alcoves			
2.1.2.3.5.5	**Service Building Mechanical**				
2.1.2.3.5.5.1	Rough-ins	This task includes the cost of roughing in the mechanical components in the Service Building as well as the adjacent support spaces.			
2.1.2.3.5.5.2	Trim-outs	This task includes the cost of trimming out the mechanical components in the Service Building as well as the adjacent support spaces.			
2.1.2.3.5.6	**Detector Enclosure/Assembly Area Fire Protection**				
2.1.2.3.5.6.1	Rough-ins	This task includes the cost of roughing in the fire protection components in the Detector Enclosure and Assembly Area as well as the adjacent support spaces located in the alcoves			
2.1.2.3.5.6.2	Trim-out	This task includes the cost of trimming out the fire protection components in the Detector Enclosure and Assembly Area as well as the adjacent support spaces located in the alcoves			
2.1.2.3.5.7	**Service Building Fire Protection**				
2.1.2.3.5.7.1	Rough-ins	This task includes the cost of roughing in the fire protection components in the Service Building as well as the adjacent support spaces.			

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.1.2.3.5.7.2	Trim-out	This task includes the cost of trimming out the fire protection components in the Service Building as well as the adjacent support spaces.			
2.1.2.3.5.8	**Conveying Equipment**	**This task includes the cost of installing the conveying equipment for Far Detector Building including the elevator, 25 ton overhead crane, 5 ton overhead crane and (2) moveable access platforms.**			
2.1.2.3.5.8.1	Procure elevator				
2.1.2.3.5.8.2	Install elevator				
2.1.2.3.5.8.3	Procure module handiling crane				
2.1.2.3.5.8.4	Install module handiling crane				
2.1.2.3.5.8.5	Procure general building crane				
2.1.2.3.5.8.6	Install general building crane				
2.1.2.3.5.8.7	Procure movable access platforms				
2.1.2.3.5.8.8	Install movable access platforms				
2.1.2.3.5.9	Outfitting completed				
2.1.2.3.6	**Site Work**				
2.1.2.3.6.1	**Shielding**				
2.1.2.3.6.1.1	Procure barite roof ballast			See NOVA-doc-1933 for barite cost information	
2.1.2.3.6.1.2	Install barite roof ballast	This category includes the cost of installing the barite roof ballast on the roof of the Detector Enclosure/Assembly Area			
2.1.2.3.6.1.3	Granite shielding berm	This task includes the cost of installing the shielding berm around the walls of the Detector Enclosure and Assembly Area. The material is assumed to be shot rock recycled from the excavation.			
2.1.2.3.6.2	**Paving**	**This category should include the cost associated with installing the bituminous pavement for the Brightstar access road and parking areas**			
2.1.2.3.6.2.1	Road pavement/signs/markings				
2.1.2.3.6.2.2	Parking lots				
2.1.2.3.6.3	Landscaping/site restoration				
2.1.2.3.6.4	Security measures				
2.1.2.3.20	Benefical occupancy - far detector building construction	This milestone marks the point where the Far Detector Building is ready for use by the project and/or subsequent construction activities			
2.1.2.3.25	Perform punch list - far detector building construction				
2.1.2.3.30	Final acceptance - far detector building construction				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.1.2.4	**EDIA**	**EDIA is Engineering Design Inspection and Administration. ED&I activities include the engineering and design activities in Titles 1 and II, the inspection activities associated with Title III. The descriptions are based on DOE Directive G430.1-1, Chapter 6. In addition, DOE Directive G430.1-1, Chapter 25 was used as guidance in estimating the ED&I costs for this project. Administration activities include those defined by DOE Directive G430.1-1, Chapter 6 as Project Management (PM) and Construction Management (CM).**			
2.1.2.4.1	**Title 2/Procurement Phase Support**				
2.1.2.4.1.1	CM/PM Fee	The CM/PM Fee is used to support the Owner's Representative retained by the University of Minnesota		See NOVA-doc-2081 for calculation	
2.1.2.4.1.2	Fermilab	This task includes the Fermilab support of the Title 2/Procurment Phase of the work			See NOVA-doc-2081
2.1.2.4.2	**Title 3 Phase Support**	**Title 3 support includes the oversight of construction activities**			
2.1.2.4.2.1	**Cooperative Agreement Recepient**				
2.1.2.4.2.1.1	CM/PM Fee	The CM/PM Fee is used to support the Owner's Representative retained by the University of Minnesota		See NOVA-doc-2081 for calculation	
2.1.2.4.2.1.2	**A/E Firm**	**This task includes the support of the design firm during Title 3 to respond to design questions and general support of the construction activities**		**See NOVA-doc-2081 for calculation**	
2.1.2.4.2.1.2.1	Office support	This includes shop drawing review, responding to request for information and general adminsitration		See NOVA-doc-2081 for calculation	
2.1.2.4.2.1.2.2	Resident engineer support	This task includes the costs of a on-site resident engineer at the project site.		See NOVA-doc-2081 for calculation	
2.1.2.4.2.2	Fermilab	This task includes the Fermilab support of the Title 3 Phase of the work			See NOVA-doc-2081 for calculation
2.1.3	**Site Logistics**	**Site Logistics is the process of planning, implementing and controlling the support functions of the project site during the construction phase including site utilities, maintenance, safeguards and security.**			
2.1.3.1	**Field Office Support (during Construction)**				
2.1.3.1.1	Truck	Ford 750 with plow, insurance, gas upkeep.		45,000 truck + 4000 Plow + 4 yrs insurance @ 1000 + 4 yrs upkeep and gas @ 1000 = $57,000	
2.1.3.1.2	Field trailer rental	Space for Resident Engineer on Site.		$500 per month Yr rental=18000	
2.1.3.1.3	Supplies and equipment			$100 per month+$3600	
2.1.3.1.4	Computers and internet service			$50 / mo Internet= $1,800; 3 computers at $5,000 ea; Printer at $1000=$7,800	
2.1.3.2	**Utilities**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.1.3.2.1	**Electric**	**This is the electric service to the site.**	**Building without operating detector experiences about half the load estimated with the full detector operating. As detector blocks become operational, the total power demand goes up, but the detector power demand is all on operating money, as is a prorated portion of the detector-off building power demand. Thus the construction project power budget decreases. We assume the effective rate decreases as each 5 Kt of detector turns on.**	**5rs @ $500/mo. 03/22/06 updated budget to reflect latestinfo from vendor 3/24/06 - assumes $25k per month power demand with no detector operating or $25k/22 days = $1,136.4 per working day. Effective rate decreases by 20% as each 5 Kt becomes operational. ref (e-mail from J. Cooper describing the model to be assumed; combined with load estimates from power company**	
2.1.3.2.1.1	Electric-Full rate				
2.1.3.2.1.2	Electric-80% rate				
2.1.3.2.1.3	Electric-60% rate				
2.1.3.2.1.4	Electric-40% rate				
2.1.3.2.1.5	Electric-20% rate				
2.1.3.2.2	Propane / gas	This is the cost to provide propane.		5 yrs @ $400/mo	
2.1.3.2.3	Telephone	This is telephone service.		5 yrs @ 200/mo	
2.1.3.2.4	Trash pick-up (non detector trash, normal waste only)	This is trash service.		5 yrs @ $100/mo	
2.1.3.3	**Roads and Grounds Maintenance**				
2.1.3.3.1	**Snow Plowing**				
2.1.3.3.1.1	Snow plowing 08/09			30 trips @ 4 Hrs @ $75.	
2.1.3.3.1.2	Snow plowing 09/10			30 trips @ 4 Hrs @ $75.	
2.1.3.3.1.3	Snow plowing 10/11			30 trips @ 4 Hrs @ $75.	
2.1.3.3.1.4	Snow plowing 11/12			30 trips @ 4 Hrs @ $75.	
2.1.3.3.2	**Grounds Keeping**				
2.1.3.3.2.1	Grounds keeping FY 09			5 months site maintance at $600/month	
2.1.3.3.2.2	Grounds keeping FY 10			5 months site maintance at $600/month	
2.1.3.3.2.3	Grounds keeping FY 11			5 months site maintance at $600/month	
2.1.3.3.2.4	Grounds keeping FY 12			5 months site maintance at $600/month	
2.1.3.4	**Building Maintenance**				
2.1.3.4.1	Basic building maintenance for 2 years	Maintain Exterior Closure, Roofing, Interior Construction Stairways, Interior Finishes, Conveying Systems, Plumbing, HVAC Systems, Fire Protection, Electrical, Equipment. From Whitestone Building Maintenance and Repair Cost Reference 2005-2006 (Research Hospital).		Yr. 1 $1.81; Yr 2 $2.23; Yr 3 $1.86; (Yr 4 if used $3.44) * 53, 940 SF= $318,257	
2.1.3.4.2	Cleaning service	Interior cleaning service.		3 Yrs @ $300 per week= $46800	
2.1.3.4.3	Building supplies, tools and equipment			Estimated at $30,000	
2.1.3.5	**Safeguards and Security**				
2.1.3.5.1	Fire watch				
2.1.4	**Management**				
2.1.4.1	**Permits**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.1.4.1.1	Environmental permits	Environmental Operation Permits		Assumed to be $25,000	
2.1.4.1.2	Site prep permits			Estimated at 3% of construction costs	
2.1.4.1.3	Far detector building permits			Estimated at 3% of construction costs	
2.1.4.4	**Quality Control**	**Quality control is the operational techniques and activities used to fulfill requirements for quality.**			
2.1.4.4.1	Concrete testing	This is the testing of concrete test clyinders by a consultant testing firm.		Assumption based on quantity of materials	Support for the testing service inlcuding review of results
2.1.4.4.2	Structural steel testing	This is the testing of structural steel by a consultant testing firm.		Assumption based on quantity of materials	Support for the testing service inlcuding review of results
2.1.4.4.3	HVAC commissioning	This is the verification of the HVAC systems by a consultant testing firm.		Assumption based on quantity of materials	Support for the testing service inlcuding review of results
2.1.4.4.4	Electrical system commissioning	This is the testing of electrical systems by a consultant testing firm.		Assumption based on quantity of materials	Support for the testing service inlcuding review of results
2.1.4.4.5	Fire protection system commissioning	This is the testing of fire protection systems by a consultant testing firm.		Assumption based on system complexity	Support for the testing service inlcuding review of results
2.1.4.5	**Change Control Activities**				
2.1.4.5.1	Change control actions				
2.2	**Liquid Scintillator**	**This level 2 summary element covers the procurement, production, QA and shipping of the 5.7 million gallons of liquid scintillator required by the project for both the Near and Far Detectors.**			
2.2.1	**Mineral Oil**				
2.2.1.1	Prepare RFP				
2.2.1.2	Evaluate proposals and negotiate				
2.2.1.3	Prepare purchase req and PO				
2.2.1.4	Mineral oil PO issued				
2.2.1.5	**Mineral Oil Production and Delivery**				
2.2.1.5.1	Mineral oil production and delivery begins				
2.2.1.5.2	Produce, deliver and store mineral oil - FY10 (1.3 M Gal)	This task covers Stage 1 preproduction which requires 1 ISO tanker per week; total of 4 delivered during Stage 1.			
2.2.1.5.3	Produce, deliver, and store mineral oil - FY11 (1.3 M Gal)	This task covers Stage 2 preproduction which requires 1 ISO tanker per day; total of 23 tankers delivered during Stage 2.			
2.2.1.5.4	Produce and deliver mineral oil - FY12 (1.3 M Gal)	This task covers Stage 2 preproduction which requires 1 ISO tanker per day; total of 23 tankers delivered during Stage 2.			
2.2.1.5.5	Mineral oil production and delivery 25% completed				
2.2.1.5.6	Mineral oil production and delivery 50% completed				
2.2.1.5.7	Mineral oil production and delivery 75% completed				
2.2.1.5.8	Mineral oil production and delivery completed				
2.2.1.6	**QC-Mineral Oil**				
2.2.1.6.1	QC hardware - FY09				
2.2.1.6.2	QC mineral oil - FY10				
2.2.1.6.3	QC mineral oil - FY11				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.2.1.6.4	QC mineral oil - FY12				
2.2.2	**Pseudocumene**				
2.2.2.1	Prepare RFP				
2.2.2.2	Evaluate proposals and negotiate				
2.2.2.3	Prepare purchase req and PO				
2.2.2.4	Pseudocumene PO issued				
2.2.2.5	**Pseudocumene Production and Delivery**				
2.2.2.5.1	Pseudocumene production and delivery begins				
2.2.2.5.2	Produce, deliver, and store pseudocumene - FY10	This task covers Stage 2 preproduction which requires 1 ISO tanker per day during Stage 2.			
2.2.2.5.3	Produce, deliver, and store pseudocumene - FY11	This task covers Stage 2 preproduction which requires 1 ISO tanker per day during Stage 2.			
2.2.2.5.4	Produce, deliver, and store pseudocumene - FY12	This task covers Full rate production which requires 3 ISO tanker per day during Full rate production.			
2.2.2.5.5	Pseudocumene production and delivery 25% completed				
2.2.2.5.6	Pseudocumene production and delivery 50% completed				
2.2.2.5.7	Pseudocumene production and delivery 75% completed				
2.2.2.5.8	Pseudocumene production and delivery completed				
2.2.2.6	**QC-Pseudocumene**				
2.2.2.6.1	QC pseudocumene - FY10				QC effort on this task is covered by QC effort assigned to mineral oil and scintillator.
2.2.2.6.2	QC pseudocumene - FY11				QC effort on this task is covered by QC effort assigned to mineral oil and scintillator.
2.2.2.6.3	QC pseudocumene - FY12				QC effort on this task is covered by QC effort assigned to mineral oil and scintillator.
2.2.3	**Waveshifters and Stadis 425**		**Assumes 12 deliveries of PPO and bis-MSB spaced 6 weeks apart for a total delivery duration of 330 days**	**based on: quote from Curtiss labs for 20 kt quantity-** **PPO 17,885 kg @ $189 per kg = $3,380,265** **bis-MSB 250 kg @ $1160 per kg = $290,000** **----------** **total = $3,670,265**	
2.2.3.1	Prepare RFP				
2.2.3.2	Evaluate proposals				
2.2.3.3	Prepare purchase req and PO				
2.2.3.4	Waveshifter PO issued				
2.2.3.5	**Waveshifter Production and Delivery**				
2.2.3.5.1	Waveshifter production and delivery begins				
2.2.3.5.2	Produce and deliver waveshifters - low-rate - FY08	This task covers Stage 1 preproduction which requires 1 ISO tanker per week during Stage 1.			

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.2.3.5.3	Produce and deliver waveshifters - full-rate - FY09	This task covers Stage 2 preproduction which requires 1 ISO tanker per day during Stage 2.			
2.2.3.5.4	Waveshifter production 15% completed				
2.2.3.5.5	Waveshifter production completed				
2.2.3.6	**QC-Waveshifters**				
2.2.3.6.1	QC-waveshifter - FY08				
2.2.3.6.2	QC-waveshifter - FY09				
2.2.3.7	Stadis-425 PO issued				
2.2.3.8	Deliver Stadis-425 FY11				
2.2.3.9	Stadis-425 delivery completed				
2.2.4	**Blending**				
2.2.4.1	**Toll Blending Contract**				
2.2.4.1.1	Prepare RFP				
2.2.4.1.2	Evaluate proposals and negotiate				
2.2.4.1.3	Prepare purchase req and contract				
2.2.4.1.4	Toll blending contract signed				
2.2.4.2	**Fluors**				
2.2.4.2.1	Prepare preproduction batch of fluor concentrate	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.	550 gal of concentrate - batch 1		Effort on this task is covered by QC effort assigned to mineral oil and scintillator.
2.2.4.2.2	QC preproduction batch of fluor concentrate				QC effort on this task is covered by QC effort assigned to mineral oil and scintillator.
2.2.4.2.3	**Production Blending of Fluor Concentrate**	**This task covers Full rate production which requires 3 ISO tanker per day during Full rate production.**			
2.2.4.2.3.1	Prepare production batch 1 of fluor concentrate	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.			
2.2.4.2.3.2	Prepare production batch 2 of fluor concentrate	This task covers Stage 2 which requires 1 ISO tanker per day during Stage 2.			
2.2.4.2.3.3	Prepare production batch 3 of fluor concentrate	This task covers Stage 2 which requires 1 ISO tanker per day during Stage 2.			
2.2.4.2.3.4	Prepare production batch 4 of fluor concentrate	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.			
2.2.4.2.3.5	Prepare production batch 5 of fluor concentrate	This task covers Stage 2 which requires 1 ISO tanker per day during Stage 2.			
2.2.4.2.3.6	Prepare production batch 6 of fluor concentrate	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.			
2.2.4.2.3.7	Prepare production batch 7 of fluor concentrate	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.			
2.2.4.2.3.8	Prepare production batch 8 of fluor concentrate	This task covers Stage 2 which requires 1 ISO tanker per day during Stage 2.			
2.2.4.2.3.9	Prepare production batch 9 of fluor concentrate	This task covers Stage 2 which requires 1 ISO tanker per day during Stage 2.			
2.2.4.2.3.10	Prepare production batch 10 of fluor concentrate	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.			
2.2.4.2.3.11	Prepare production batch 11 of fluor concentrate	This task covers Stage 2 which requires 1 ISO tanker per day during Stage 2.			

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.2.4.2.3.12	Prepare production batch 12 of fluor concentrate	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.			
2.2.4.2.3.13	Prepare production batch 13 of fluor concentrate	This task covers Stage 2 which requires 1 ISO tanker per day during Stage 2.			
2.2.4.2.3.14	Prepare production batch 14 of fluor concentrate	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.			
2.2.4.2.4	**QC - Production Fluor Concentrate**				
2.2.4.2.4.1	QC production batch 1 of fluor concentrate				
2.2.4.2.4.2	QC production batch 2 of fluor concentrate				
2.2.4.2.4.3	QC production batch 3 of fluor concentrate				
2.2.4.2.4.4	QC production batch 4 of fluor concentrate				
2.2.4.2.4.5	QC production batch 5 of fluor concentrate				
2.2.4.2.4.6	QC production batch 6 of fluor concentrate				
2.2.4.2.4.7	QC production batch 7 of fluor concentrate				
2.2.4.2.4.8	QC production batch 8 of fluor concentrate				
2.2.4.2.4.9	QC production batch 9 of fluor concentrate				
2.2.4.2.4.10	QC production batch 10 of fluor concentrate				
2.2.4.2.4.11	QC production batch 11 of fluor concentrate				
2.2.4.2.4.12	QC production batch 12 of fluor concentrate				
2.2.4.2.4.13	QC production batch 13 of fluor concentrate				
2.2.4.2.4.14	QC production batch 14 of fluor concentrate				
2.2.4.3	**Scintillator Blending**				
2.2.4.3.1	Prepare preproduction batch of scintillator blend	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.			
2.2.4.3.2	QC preproduction batch of scintillator blend				
2.2.4.3.3	**Production Blending of Scintillator**	**This task covers Full rate production which requires 3 ISO tanker per day during Full rate production.**			
2.2.4.3.3.1	Prepare production batch 1 of scintillator blend	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.			
2.2.4.3.3.2	Prepare production batch 2 of scintillator blend	This task covers Stage 2 which requires 1 ISO tanker per day during Stage 2.			
2.2.4.3.3.3	Prepare production batch 3 of scintillator blend	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.			

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.2.4.3.3.4	Prepare production batch 4 of scintillator blend	This task covers Stage 2 which requires 1 ISO tanker per day during Stage 2.			
2.2.4.3.3.5	Prepare production batch 5 of scintillator blend	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.			
2.2.4.3.3.6	Prepare production batch 6 of scintillator blend	This task covers Stage 2 which requires 1 ISO tanker per day during Stage 2.			
2.2.4.3.3.7	Prepare production batch 7 of scintillator blend	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.			
2.2.4.3.3.8	Prepare production batch 8 of scintillator blend	This task covers Stage 2 which requires 1 ISO tanker per day during Stage 2.			
2.2.4.3.3.9	Prepare production batch 9 of scintillator blend	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.			
2.2.4.3.3.10	Prepare production batch 10 of scintillator blend	This task covers Stage 2 which requires 1 ISO tanker per day during Stage 2.			
2.2.4.3.3.11	Prepare production batch 11 of scintillator blend	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.			
2.2.4.3.3.12	Prepare production batch 12 of scintillator blend	This task covers Stage 2 which requires 1 ISO tanker per day during Stage 2.			
2.2.4.3.3.13	Prepare production batch 13 of scintillator blend	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.			
2.2.4.3.3.14	Prepare production batch 14 of scintillator blend	This task covers Stage 2 which requires 1 ISO tanker per day during Stage 2.			
2.2.4.3.3.15	Prepare production batch 15 of scintillator blend	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.			
2.2.4.3.3.16	Prepare production batch 16 of scintillator blend	This task covers Stage 2 which requires 1 ISO tanker per day during Stage 2.			
2.2.4.3.3.17	Prepare production batch 17 of scintillator blend	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.			
2.2.4.3.3.18	Prepare production batch 18 of scintillator blend	This task covers Stage 2 which requires 1 ISO tanker per day during Stage 2.			
2.2.4.3.3.19	Prepare production batch 19 of scintillator blend	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.			
2.2.4.3.3.20	Prepare production batch 20 of scintillator blend	This task covers Stage 2 which requires 1 ISO tanker per day during Stage 2.			
2.2.4.3.3.21	Prepare production batch 21 of scintillator blend	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.			
2.2.4.3.3.22	Prepare production batch 22 of scintillator blend	This task covers Stage 2 which requires 1 ISO tanker per day during Stage 2.			
2.2.4.3.3.23	Prepare production batch 23 of scintillator blend	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.			
2.2.4.3.3.24	Prepare production batch 24 of scintillator blend	This task covers Stage 2 which requires 1 ISO tanker per day during Stage 2.			
2.2.4.3.3.25	Prepare production batch 25 of scintillator blend	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.			
2.2.4.3.3.26	Prepare production batch 26 of scintillator blend	This task covers Stage 2 which requires 1 ISO tanker per day during Stage 2.			
2.2.4.3.3.27	Prepare production batch 27 of scintillator blend	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.			
2.2.4.3.3.28	Prepare production batch 28 of scintillator blend	This task covers Stage 2 which requires 1 ISO tanker per day during Stage 2.			

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.2.4.3.3.29	Prepare production batch 29 of scintillator blend	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.			
2.2.4.3.3.30	Prepare production batch 30 of scintillator blend	This task covers Stage 2 which requires 1 ISO tanker per day during Stage 2.			
2.2.4.3.3.31	Prepare production batch 31 of scintillator blend	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.			
2.2.4.3.3.32	Prepare production batch 32 of scintillator blend	This task covers Stage 2 which requires 1 ISO tanker per day during Stage 2.			
2.2.4.3.3.33	Prepare production batch 33 of scintillator blend	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.			
2.2.4.3.3.34	Prepare production batch 34 of scintillator blend	This task covers Stage 2 which requires 1 ISO tanker per day during Stage 2.			
2.2.4.3.3.35	Prepare production batch 35 of scintillator blend	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.			
2.2.4.3.3.36	Prepare production batch 36 of scintillator blend	This task covers Stage 2 which requires 1 ISO tanker per day during Stage 2.			
2.2.4.3.3.37	Prepare production batch 37 of scintillator blend	This task covers Stage 1 which requires 1 ISO tanker per week during Stage 1.			
2.2.4.3.3.38	Prepare production batch 38 of scintillator blend	This task covers Stage 2 which requires 1 ISO tanker per day during Stage 2.			
2.2.4.3.4	**QC - Production Scintillator Blend**				
2.2.4.3.4.1	QC production batch 1 of scintillator blend				
2.2.4.3.4.2	QC production batch 2 of scintillator blend				
2.2.4.3.4.3	QC production batch 3 of scintillator blend				
2.2.4.3.4.4	QC production batch 4 of scintillator blend				
2.2.4.3.4.5	QC production batch 5 of scintillator blend				
2.2.4.3.4.6	QC production batch 6 of scintillator blend				
2.2.4.3.4.7	QC production batch 7 of scintillator blend				
2.2.4.3.4.8	QC production batch 8 of scintillator blend				
2.2.4.3.4.9	QC production batch 9 of scintillator blend				
2.2.4.3.4.10	QC production batch 10 of scintillator blend				
2.2.4.3.4.11	QC production batch 11 of scintillator blend				
2.2.4.3.4.12	QC production batch 12 of scintillator blend				
2.2.4.3.4.13	QC production batch 13 of scintillator blend				
2.2.4.3.4.14	QC production batch 14 of scintillator blend				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.2.4.3.4.15	QC production batch 15 of scintillator blend				
2.2.4.3.4.16	QC production batch 16 of scintillator blend				
2.2.4.3.4.17	QC production batch 17 of scintillator blend				
2.2.4.3.4.18	QC production batch 18 of scintillator blend				
2.2.4.3.4.19	QC production batch 19 of scintillator blend				
2.2.4.3.4.20	QC production batch 20 of scintillator blend				
2.2.4.3.4.21	QC production batch 21 of scintillator blend				
2.2.4.3.4.22	QC production batch 22 of scintillator blend				
2.2.4.3.4.23	QC production batch 23 of scintillator blend				
2.2.4.3.4.24	QC production batch 24 of scintillator blend				
2.2.4.3.4.25	QC production batch 25 of scintillator blend				
2.2.4.3.4.26	QC production batch 26 of scintillator blend				
2.2.4.3.4.27	QC production batch 27 of scintillator blend				
2.2.4.3.4.28	QC production batch 28 of scintillator blend				
2.2.4.3.4.29	QC production batch 29 of scintillator blend				
2.2.4.3.4.30	QC production batch 30 of scintillator blend				
2.2.4.3.4.31	QC production batch 31 of scintillator blend				
2.2.4.3.4.32	QC production batch 32 of scintillator blend				
2.2.4.3.4.33	QC production batch 33 of scintillator blend				
2.2.4.3.4.34	QC production batch 34 of scintillator blend				
2.2.4.3.4.35	QC production batch 35 of scintillator blend				
2.2.4.3.4.36	QC production batch 36 of scintillator blend				
2.2.4.3.4.37	QC production batch 37 of scintillator blend				
2.2.4.3.4.38	QC production batch 38 of scintillator blend				
2.2.4.3.5	Scintillator blending begins				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.2.4.3.6	Scintillator production for superblock 1 completed				
2.2.4.3.7	Scintillator production for superblock 2 completed				
2.2.4.3.8	Scintillator production for superblock 3 completed				
2.2.4.3.9	Scintillator production for superblock 4 completed				
2.2.4.3.10	Scintillator production for superblock 5 completed				
2.2.4.3.11	Scintillator production for superblock 6 completed				
2.2.4.3.12	Scintillator production for superblock 7 completed				
2.2.4.3.90	Scintillator production for all superblocks completed				
2.2.4.4	**Production Blending Development**				
2.2.4.4.1	Production Blending Development - FY08				
2.2.4.4.2	Production Blending Development - FY09				
2.2.4.4.3	Production Blending Development - FY10				
2.2.5	**Transport**				
2.2.5.1	Storage				
2.2.5.2	Near detector				
2.2.5.3	**Far Detector Scintillator Transport**			**Shipping: $0.36 per gal x 6341 gal/tank x 713 tanks = $1,627,608 ==> $2283 per tank 36,991 per block**	**assumes approx 1 hour tech labor needed per tank shipped, i.e about 1 hour per day.**
2.2.5.3.1	Deliver scintillator for block 1				assumes approx 1 hour tech labor needed per tank shipped i.e about 1 hour per day.
2.2.5.3.2	Deliver scintillator for block 2				
2.2.5.3.3	Deliver scintillator for block 3				
2.2.5.3.4	Deliver scintillator for block 4				
2.2.5.3.5	Deliver scintillator for block 5				
2.2.5.3.6	Deliver scintillator for block 6				
2.2.5.3.7	Deliver scintillator for block 7				
2.2.5.3.8	Deliver scintillator for block 8				
2.2.5.3.9	Deliver scintillator for block 9				
2.2.5.3.10	Deliver scintillator for block 10				
2.2.5.3.11	Deliver scintillator for block 11				
2.2.5.3.12	Deliver scintillator for block 12				
2.2.5.3.13	Deliver scintillator for block 13				
2.2.5.3.14	Deliver scintillator for block 14				
2.2.5.3.15	Deliver scintillator for block 15				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.2.5.3.16	Deliver scintillator for block 16				assumes approx 1 hour tech labor needed per tank shipped i.e about 1 hour per day.
2.2.5.3.17	Deliver scintillator for block 17				
2.2.5.3.18	Deliver scintillator for block 18				
2.2.5.3.19	Deliver scintillator for block 19				
2.2.5.3.20	Deliver scintillator for block 20				
2.2.5.3.21	Deliver scintillator for block 21				
2.2.5.3.22	Deliver scintillator for block 22				
2.2.5.3.23	Deliver scintillator for block 23				
2.2.5.3.24	Deliver scintillator for block 24				
2.2.5.3.25	Deliver scintillator for block 25				
2.2.5.3.26	Deliver scintillator for block 26				
2.2.5.3.27	Deliver scintillator for block 27				
2.2.5.3.28	Deliver scintillator for block 28				
2.2.5.3.29	Deliver scintillator for block 29				
2.2.5.3.30	Deliver scintillator for block 30				
2.2.5.3.31	Deliver scintillator for block 31				
2.2.5.3.32	Deliver scintillator for block 32				
2.2.5.3.33	Deliver scintillator for block 33				
2.2.5.3.34	Deliver scintillator for block 34				
2.2.5.3.35	Deliver scintillator for block 35				
2.2.5.3.36	Deliver scintillator for block 36				
2.2.5.3.37	Deliver scintillator for block 37				
2.2.5.3.38	Deliver scintillator for block 38				
2.2.5.3.39	Scintillator delivery for first superblock completed				
2.2.5.3.40	Scintillator delivery for all blocks completed				
2.2.6	**Management - Construction Phase**	**This WBS includes the tasks required to support and manage WBS 2.2 activities including quality assurance, value management, risk management, monitoring of vendor performance and schedule, preparation of reports and other related activities.**			
2.2.6.1	**FY08**				
2.2.6.1.1	Labor				
2.2.6.1.2	Travel			10 trips x $0.5k per trip to FNAL = $5k 2 vendor trips x $1.5k per trip = $3k	
2.2.6.1.3	Equipment				
2.2.6.1.4	Materials and supplies				
2.2.6.2	**FY09**				
2.2.6.2.1	Labor				
2.2.6.2.2	Travel			10 trips x $0.5k per trip to FNAL = $5k 2 vendor trips x $1.5k per trip = $3k	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.2.6.2.3	Equipment				
2.2.6.2.4	Materials and supplies				
2.2.6.3	**FY10**				
2.2.6.3.1	Labor				
2.2.6.3.2	Travel			10 trips x $0.5K per trip to FNAL = $5k 1 vendor trips x $1.5k per trip = $1.5k	
2.2.6.3.3	Equipment				
2.2.6.3.4	Materials and supplies				
2.2.6.4	**FY11**				
2.2.6.4.1	Labor				
2.2.6.4.2	Travel			10 trips x $0.5k per trip to FNAL = $5k 1 vendor trip x $1.5k per trip = $1.5k	
2.2.6.4.3	Equipment				
2.2.6.4.4	Materials and supplies				
2.2.6.5	**FY12**				
2.2.6.5.1	Labor				
2.2.6.5.2	Travel			3 trips x $0.5k per trip to FNAL = $1.5K	
2.2.6.5.3	Equipment				
2.2.6.5.4	Materials and supplies				
2.3	**Wave-Length-Shifting Fiber**	**This level 2 summary element covers the procurement, QA and shipping of the 22,000 km of wavelength shifting fiber required by the project.**			
2.3.1	**Procurement**	**This WBS provides for producing a list of acceptable vendors after reviewing vendor R&D performance, preparation of RFPs, evaluation of vendor proposals and selection of vendors.**			
2.3.1.1	**Near Detector**				
2.3.1.1.1	Prepare and issue RFP				
2.3.1.1.2	Evaluate proposals and select vendors				
2.3.1.1.3	Prepare and approve purchase orders				
2.3.1.1.4	Conduct production readiness review				
2.3.1.1.5	Release purchase orders-near detector				
2.3.1.2	**Far Detector**				
2.3.1.2.1	Prepare and issue RFP				
2.3.1.2.2	Evaluate proposals and select vendors				
2.3.1.2.3	Prepare and approve purchase orders				
2.3.1.2.4	Conduct production readiness review				
2.3.1.2.5	Release purchase orders-far detector				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.3.2	**Production**	**This WBS provides for production and distribution of fiber QA testing equipment to the module assembly factories as well as the development of procedures, documentation and reporting requirements. Delivery of fiber spools directly to the module factories on a schedule consistent with factory schedules and available storage must also be organized and managed.**			
2.3.2.1	**Near Detector**				
2.3.2.1.1	WLS fiber production - Near Detector		3 additional blocks + 10 planes in muon catcher	$0.63 per meter from Kurary quote = 47,061 74,700 meters taken from production fiber run	
2.3.2.1.2	Quality assurance- Near detector				
2.3.2.2	**Far Detector**				
2.3.2.2.1	**WLS Fiber Production - Far Detector**			**0.75 dollars per meter FOB FNAL per quote form Kuraray dated 1/10/2006; RFP 183356-LAM 17,333 km**	
2.3.2.2.1.1	FY08 WLS fiber production			450,000 x .63 = 283,500	
2.3.2.2.1.2	FY09 WLS fiber production	assumes full rate production.		4500000m x .63 = $2,835,000	
2.3.2.2.1.3	FY10 WLS fiber production			4500000m x .63 = $2,835,000	
2.3.2.2.1.4	FY11 WLS fiber production			4500000m x .63 = $2,835,000	
2.3.2.2.1.5	FY12 WLS fiber production			3975300 x 0.63=	
2.3.2.2.2	WLS fiber production begins				
2.3.2.2.3	WLS fiber production for superblock 1 completed				
2.3.2.2.4	WLS fiber production for superblock 2 completed				
2.3.2.2.5	WLS fiber production for superblock 3 completed				
2.3.2.2.6	WLS fiber production for superblock 4 completed				
2.3.2.2.7	WLS fiber production for superblock 5 completed				
2.3.2.2.8	WLS fiber production for superblock 6 completed				
2.3.2.2.9	WLS fiber production for superblock 7 completed				
2.3.2.2.10	WLS fiber production for superblock 8 completed				
2.3.2.2.11	All WLS fiber production completed				
2.3.2.2.12	**Quality Assurance**				
2.3.2.2.12.1	Quality Assurance - FY08			$2500 per FY for consumables, including glue and ferrules for holding fiber.	
2.3.2.2.12.2	Quality Assurance - FY09			$2500 per FY for consumables, including glue and ferrules for holding fiber.	
2.3.2.2.12.3	Quality Assurance - FY10			$2500 per FY for consumables, including glue and ferrules for holding fiber.	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.3.2.2.12.4	Quality Assurance - FY11			$2500 per FY for consumables, including glue and ferrules for holding fiber.	
2.3.2.2.12.5	Quality Assurance - FY12			$2500 per FY for consumables, including glue and ferrules for holding fiber.	
2.3.2.2.13	**Shipping**				
2.3.2.2.13.1	Ship fiber to module factory - shipment 1				
2.3.2.2.13.2	Ship fiber to module factory - shipment 2				
2.3.2.2.13.3	Ship fiber to module factory - shipment 3				
2.3.2.2.13.4	Ship fiber to module factory - shipment 4				
2.3.2.2.13.5	Ship fiber to module factory - shipment 5				
2.3.2.2.13.6	Ship fiber to module factory - shipment 6				
2.3.2.2.13.7	Ship fiber to module factory - shipment 7				
2.3.2.2.13.8	Ship fiber to module factory - shipment 8				
2.3.3	**Management - Construction Phase**	**This WBS includes the tasks required to support and manage WBS 2.3 activities including quality assurance, value management, risk management, monitoring of vendor performance and schedule, preparation of reports and other related activities.**			
2.3.3.2	**FY08**				
2.3.3.2.1	Labor				oversight, reporting
2.3.3.2.2	Travel			1 foreign trip per year @ 2500 per trip	
2.3.3.2.3	Equipment			computer and software	
2.3.3.2.4	Materials and supplies			miscellaneous supplies	
2.3.3.3	**FY09**				
2.3.3.3.1	Labor				
2.3.3.3.2	Travel			1 foreign trip per year @ 2500 per trip	
2.3.3.3.3	Equipment				
2.3.3.3.4	Materials and supplies			miscellaneous supplies	
2.3.3.4	**FY10**				
2.3.3.4.1	Labor				
2.3.3.4.2	Travel			1 foreign trip per year @ 2500 per trip	
2.3.3.4.3	Equipment				
2.3.3.4.4	Materials and supplies			miscellaneous supplies	
2.3.3.5	**FY11**				
2.3.3.5.1	Labor				
2.3.3.5.2	Travel			1 foreign trip per year @ $2.5k per trip	
2.3.3.5.3	Equipment				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.3.3.5.4	Materials and supplies			miscellaneous supplies $0.5K	
2.3.3.6	**FY12**				
2.3.3.6.1	Labor				
2.3.3.6.2	Travel				
2.3.3.6.3	Equipment				
2.3.3.6.4	Materials and supplies			miscellaneous supplies $0.25k	
2.4	**PVC Extrusions**	**This level 2 summary element covers the procurement, QA and shipping of the 7000 tons of PVC extrusions required by the project.**			
2.4.1	**Procurement**	**This WBS element includes developing a list of vendors capable of producing the NOvA PVC compound and extruders capable of producing the NOvA profiles. Preparation of RFPs, evaluation of vendor proposals and selection of vendors is also included.**			
2.4.1.1	**Extrusion Contract**				
2.4.1.1.1	Prepare and issue RFPs				
2.4.1.1.2	Evaluate proposals and select vendor(s)				
2.4.1.1.3	Prepare purchase orders and contract(s)				
2.4.1.1.4	Conduct extrusion production readiness review				
2.4.1.1.5	Release purchase orders - extrusion contract				
2.4.1.2	**Raw Material (Resin) Contract**				
2.4.1.2.1	Prepare and issue RFPs				
2.4.1.2.2	Evaluate proposals and select vendor(s)				
2.4.1.2.3	Prepare purchase orders and contract(s)				
2.4.1.2.4	Conduct raw material production readiness review				
2.4.1.2.5	Release purchase orders - raw material contract(s)				
2.4.2	**Extrusion Pre-Production**	**This WBS element includes the fabrication of dies, tooling and other hardware needed for the pre-production and production. Pre-production extrusions will be evaluated for adherence to mechanical tolerance, mechanical strength and reflectivity. Quality assurance methods for use in production and handiling procedures will be finalized. Pre-production extrusions will be provided to module assembly factories.**			

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.4.2.1	**Horizontal Extrusion Pre-production**	**This task includes the purchase of the 16-cell (thin wall) die and tooling.**	**The cost to produce 16-cell extrusions is based on an updated per-pound cost estimate from Extrutech Plastics.**	**Extruding Equipment: Die and tooling for horizontal extrusions cost: $175k Extrutech fee for fabricating the protoype die and tooling. Spare heater bands cost: $8,000. Equipment Total: $183,000 (FY06 dollars). Materials cost:Raw PVC material: (1} 4,800 lbs to proof die at die manufacturer (2) 12,000 lbs to produce extrusions for validation and possible iteration of die tuning (3) 30,000 lbs to produce 30 valid pre-production extrusions to verify shipping and handling plan. Extrusions will be sent to module factory 1. Total Extrusion weight: 46,800 lbs @0.92/lb to extrude: extrusion cost $43,056. Refer to BoE doc 2178 for cost of Equipment and extrusions per-pound. Trucking cost from Extrutech Plastics to to FNAL: $0.445k per load; 4 trucks will be used; cost of trucks:$1,780. Refer to BoE doc 2179 for cost estimate.**	
2.4.2.1.1	Vendor setup	Fabricate tooling, vendor purchase of machinery necessary for th extrusion line. The cost of any extra machinery is already included in the $0.92/lb cost.	6 months for die and tooling fabrication, 1 month for testing, and 1 month for final preparation and delivery by die manufacturer to extruder.	Included by Extrutech Plastic in the cost package resulting in a per-pound cost of $0.92. Refer to doc 2178.	
2.4.2.1.2	Obtain PVC resin for test and preproduction		Pre-production requires PVC resin for several reasons: (1) to test the die [4,8000 lbs], (2) to produce test extrusions to tune the die and related downstream tooling [12,000 lbs], (3) and to make pre-production PVC extrusions for evaluation of the process and for use in setting up the module factories (WBS 2.5) [30,000 lbs] for a total of 46,800 lbs.	The cost of PVC resin is $0.98/lb, obtained from Aurora Plastics' response the an RFP. This cost is consistent with the $ 0.984/lb Aurora charged NOvA in May 2007 for 130,000 lbs. of N-27 related to prototype work. Cost: 46,800 lbs x 0.98 = $45,864. Refer to doc 1342 for N-27 resin cost.	
2.4.2.1.3	Produce test extrusions			$5880 pvc resin (6,000 lbs) + $5,520 extruding cost as described in 2.4.2.1 and 2.4.2.1.2.	
2.4.2.1.4	First horizontal extrusions available for evaluation				
2.4.2.1.5	Evaluate extrusions				
2.4.2.1.6	Feedback QC info to vendor				
2.4.2.1.7	Adjust horizontal die				
2.4.2.1.8	Produce additional test extrusions			$5,880 pvc resin (6,000 lbs) + $5,520 extruding cost as described in doc 1342 (resin) and doc 2178 (extruding).	
2.4.2.1.9	Evaluate additional extrusions				
2.4.2.1.10	Feedback QC info to vendor				
2.4.2.1.11	Final adjustment of horizontal die				
2.4.2.1.12	Conduct pre-production horizontal extrusion review				
2.4.2.1.13	Pre-production horizontal extrusions authorized				
2.4.2.1.14	**Preproduction Extrusion Fabrication-Horizontal**			**30,000 lbs PVC resin $29,400 +$27,600 extruder labor + $1,780 shipping = $58,780. Refer to doc 1342 for resin cost, doc 2178 for extruding cost and doc 2179 for trucking cost.**	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.4.2.1.14.1	Produce PVC extrusions		The cost of extruding is taken from an update to the bid by Extrutech Plastics, Inc. in response to an RFP from Fermilab. The quoted cost to extrude N-27 16-cell exytrusions is $0.92/pound. Refer to doc 2178		
2.4.2.1.14.2	Ship PVC extrusions		A shipping pallet system will be provided by WBS 2.4.5. The pallet system will be re-used for production extrusions, therefore the only cost is to ship two sets of pallets to the extruder. A total of four trucks will be needed for pre-production: two to deliver test extrusions extrusions from the extruder to FNAL and another two trucks to ship the pre-production extrusions.	Four trucks cost $1,780 based on quote of $445/truck. Refer to cost quote in doc 2179.	
2.4.2.1.15	Evaluate preproduction horizontal extrusions				
2.4.2.1.16	Documentation	Document vendors and procedures leading to successful pre-production extrusions.			
2.4.2.2	**Vertical Extrusion Pre-production**	**This task includes the purchase of the 16-cell (thick wall) die and tooling.**	**The cost to produce 16-cell extrusions is based on an updated per-pound cost estimate from Extrutech Plastics.**	**Extruding Equipment: Die and tooling for vertical extrusions cost: $175k. This is based on the Extrutech fee for fabricating the protoype die and tooling. Spare heater bands cost: $8,000, for a total of $183,000. Escaling to FY07 dollars the amount is 185,562. Refer to doc 2178. Raw PVC material: (1) 7,200 lbs to proof die at die manufacturer (2) 16,800 lbs to produce extrusions for validation and possible iteration of die tuning (3) 42,000 lbs to produce 30 valid pre-production extrusions to verify shipping and handling plan. Extrusions will be sent to module factories. Extrusion weight: 66,000 lbs @0.92/lb to extrude: extrusion cost $60,720 Refer to doc 2178 for extruding costs. Trucking cost from Extrutech Plastics to to FNAL: $0.445k per load; 4 trucks will be used; cost of trucks:$1,780. refer to doc 2179.**	
2.4.2.2.1	Vendor setup	Fabricate tooling, vendor purchase of machinery necessary for th extrusion line. The cost of any extra machinery is already included in the $0.92/lb cost.	6 months for die and tooling fabrication, 1 month for testing, and 1 month for final preparation and delivery by die manufacturer to extruder.	Included by Extrutech Plastic in the cost package resulting in a per-pound cost of $0.92. Refer to doc 2178.	
2.4.2.2.2	Obtain PVC resin for test and preproduction		Pre-production requires PVC resin for several reasons: (1) to test the die [7,2000 lbs], (2) to produce test extrusions to tune the die and related downstream tooling [16,800 lbs], (3) and to make pre-production PVC extrusions for evaluation of the process and for use in setting up the module factories (WBS 2.5) [42,000 lbs] for a total of 66,000 lbs.	The cost of PVC resin is $0.98/lb; refer to doc 1342. Cost: 66,000 lbs x 0.98 = $64,680	
2.4.2.2.3	Produce test extrusions			$8,232 pvc resin (8,400 lbs) + $7,728 extruding cost as described in doc 1342 (resin) and doc 2178 (extruding).	
2.4.2.2.4	First vertical extrusions available for evaluation				
2.4.2.2.5	Evaluate extrusions				
2.4.2.2.6	Feedback QC info to vendor				
2.4.2.2.7	Adjust vertical die				
2.4.2.2.8	Produce additional test extrusions			$8,232 pvc resin (8,400 lbs) + $7,728 extruding cost as described in doc 1342 (resin) and doc 2178 (extruding).	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.4.2.2.9	Evaluate additional extrusions				
2.4.2.2.10	Feedback QC info to vendor				
2.4.2.2.11	Final adjustment of vertical die				
2.4.2.2.12	Conduct pre-production vertical extrusion review				
2.4.2.2.13	Pre-production vertical extrusions authorized				
2.4.2.2.14	**Preproduction Extrusion Fabrication-Vertical**			**42,000 lbs PVC resin $41,160 +$38,640 extruder labor + $1,780 trucking = $81,580**	
2.4.2.2.14.1	Produce PVC extrusions		The cost of extruding is taken from anupdate to the bid by Extrutech Plastics, Inc. in response to an RFP from Fermilab. The quoted cost to extrude N-27 16-cell exytrusions is $0.92/pound.	Extrusion weight: 46,800 lbs @0.92/lb to extrude: extrusion cost $43,056. Refer to doc 1342 for resin cost, doc 2178 for extruding cost and doc 2179 for trucking cost.	
2.4.2.2.14.2	Ship PVC extrusions		A shipping pallet system will be provided by WBS 2.4.5. The pallet system will be re-used for production extrusions, therefore there is no aditional cost A total of four trucks will be needed for pre-production: Two to deliver test extrusions extrusions from the extruder to FNAL and another two trucks to ship the pre-production extrusions to FNAL.	Four trucks cost $1,780 based on quote of $445/truck. Refer to trucking BoE doc 2179.	
2.4.2.2.15	Evaluate preproduction vertical extrusions				
2.4.2.2.16	Documentation	Document vendors and procedures leading to successful pre-production extrusions.			
2.4.3	**Extrusion Production**	**This WBS element provides for supervision and quality assurance monitoring of PVC extrusions.**			
2.4.3.1	**Near Detector**	**Produce and ship extrusions to Near Detector module factory.**	**The cost for dies, tooling and other extrusion line machinery has been included in Pre-production (WBS 2.4.2.1 and 2.4.2.2). Therefore the costs for Near Detector are composed of four components: (1) PVC resin cost, (2) extrusion production cost and (3) trucking cost. The pallet system does not enter into the cost because these extrusions are short.**		
2.4.3.1.1	**Horizontal Extrusion Production - ND**	**Produce sufficient number of extrusions for assembly into near-detector modules. Note that half of the near detector will be made from IPND extrusions.**	**The total weight of required PVC resin to produce all of the Horizontal Extrusions with 2% good spares is 19,019 lbs. This value includes a 6% scrap rate (bad extrusions).**	**Require 19,019 lbs resin to produce 17,943 lbs of extrusions.Cost of PVC resin is $0.98/pound and the extrusion cost is $0.92/poundl. Refer to doc 1342 and doc 2178, respectievly, for cost estimates.**	
2.4.3.1.1.1	Obtain PVC resin - ND horizontals			19,019 lbs x 0.98/pound = $16,639. See doc 1342	
2.4.3.1.1.2	Produce PVC extrusions - ND horizontals			17,943 lbs of extrusions at $0.92/lb = $16,507 refer to doc 2178.	
2.4.3.1.1.3	Ship PVC extrusions - ND horizontals			Trucking Fee:2 trucks @$445/truck= $890; refer to doc 2179.	
2.4.3.1.1.4	Quality assurance and documentation - ND horizontals		QC at extruder. QA at NOvA Institution. Cost is in other tasks.		
2.4.3.1.1.5	Near detector horizontal extrusions completed				
2.4.3.1.2	**Vertical Extrusion Production - ND**	**Produce sufficient number of extrusions for assembly into near-detector modules.**	**The total weight of required PVC resin to produce all of the Vertical Extrusions with 2% good spares is 27,860 lbs. This value includes a 6% scrap rate (bad extrusions).**	**Requires 27,861 lbs. of PVC resin. Produces 26,283 lbs of PVC extrusions. Cost of PVC resin is $0.98/pound and the extrusion cost is $0.92/poundl. Refer to doc 1342 and doc 2178, respectievly, for cost estimates.**	
2.4.3.1.2.1	Obtain PVC resin - ND verticals			PVC resin 27,861 lbs x 0.98 = $27,304 refer doc 1342 for resin cost	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.4.3.1.2.2	Produce PVC extrusions - ND verticals			26,283 lbs of extrusions at $0.92/lb = $24,180.Rrefer to doc 2178for cost of extruding.	
2.4.3.1.2.3	Ship PVC extrusions - ND verticals			Trucking Fee:2 trucks @$445/truck= $890; refer to doc 2179.	
2.4.3.1.2.4	Quality assurance and documentation - ND verticals				
2.4.3.1.2.5	Near detector vertical extrusions completed				
2.4.3.2	**Far Detector**	**Produce and ship Extrusions to Far Detector Module factories.**	**The cost for dies, tooling and other extrusion line machinery has been included in Pre-production (WBS 2.4.2.1 and 2.4.2.2). Refer to extruding doc 2178. Cost for Far Detector is composed of four components: (1) PVC resin cost, (2) extrusion production cost, (3) trucking cost and (4) pallet system.**		
2.4.3.2.1	**Extrusion Production - Block 1 (Type A)**				
2.4.3.2.1.1	**Horizontal Extrusions - Block 1H**	**Block type A consists of 15 planes of Horizontal and 16 planes of Vertical extrusions.**			
2.4.3.2.1.1.1	Production of horizontal extrusions authorized				
2.4.3.2.1.1.2	Procure PVC resin - Block 1H		Assume 6% scrap	126,308 lbs of N-27 resin @ $0.98/lb. Refer to doc 1342 for resin cost.	
2.4.3.2.1.1.3	Produce PVC extrusions - Block 1H		Extrusion weight is 6% less that of the resin.	119,159 lbs of extrusions @ $0.92/lb. Refer to doc 2178 for extruding cost.	
2.4.3.2.1.1.4	Ship PVC extrusions to FNAL module factory - Block 1H			7 trucks are needed to transport one block's worth of H extrusions. One truck costs $445 for a total of $3115. Refer to doc 2179 for trucking cost.	
2.4.3.2.1.1.5	Quality control and documentation of extrusions - Block 1H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.1.2	**Vertical Extrusions - Block 1V**	**Block type A consists of 15 planes of Horizontal and 16 planes of Vertical extrusions.**			
2.4.3.2.1.2.1	Production of vertical extrusions authorized				
2.4.3.2.1.2.2	Procure PVC resin - Block 1V		Assume 6% scrap	188,897 lbs of N-27 resin @ $0.98/lb. Refer to doc 1342 for resin cost.	
2.4.3.2.1.2.3	Produce PVC extrusions - Block 1V		Extrusion weight is 6% less that of the resin.	178,205 lbs of extrusions @ $0.92/lb. Refer to doc 2178 for extruding cost.	
2.4.3.2.1.2.4	Ship PVC extrusions to FNAL module factory - Block 1V			7 trucks are needed to transport one block's worth of V extrusions. One truck costs $445 for a total of $3115. Refer to doc 2179 for trucking cost.	
2.4.3.2.1.2.5	Quality control and documentation of extrusions - Block 1V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.2	**Extrusion Production - Block 2 (Type B)**				
2.4.3.2.2.1	**Horizontal Extrusions - Block 2H**	**Block type B consists of 16 planes of Horizontal and 15 planes of Vertical extrusions.**			
2.4.3.2.2.1.1	Procure PVC resin - Block 2H		Assume 6% scrap	134,546 lbs of N-27 resin @ $0.98/lb. Refer to doc 1342 for resin cost.	
2.4.3.2.2.1.2	Produce PVC extrusions - Block 2H		Extrusion weight is 6% less that of the resin.	126,930 lbs of extrusions @ $0.92/lb. Refer to doc 2178 for extruding cost.	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.4.3.2.2.1.3	Ship PVC extrusions to FNAL module factory - Block 2H			7 trucks are needed to transport one block's worth of H extrusions. One truck costs $445 for a total of $3115. Refer to doc 2179 for trucking cost.	
2.4.3.2.2.1.4	Quality control and documentation of extrusions - Block 2H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.2.2	**Vertical Extrusions - Block 2V**	**Block type B consists of 16 planes of Horizontal and 15 planes of Vertical extrusions.**			
2.4.3.2.2.2.1	Procure PVC resin - Block 2V		Assume 6% scrap	177,332 lbs of N-27 resin @ $0.98/lb. Refer to doc 1342 for resin cost.	
2.4.3.2.2.2.2	Produce PVC extrusions - Block 2V		Extrusion weight is 6% less that of the resin.	167,294 lbs of extrusions @ $0.92/lb. Refer to doc 2178 for extruding cost.	
2.4.3.2.2.2.3	Ship PVC extrusions to FNAL module factory - Block 2V			7 trucks are needed to transport one block's worth of H extrusions. One truck costs $445 for a total of $3115. Refer to doc 2179 for trucking cost.	
2.4.3.2.2.2.4	Quality control and documentation of extrusions - Block 2V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.3	**Extrusion Production - Block 3 (Type A)**				
2.4.3.2.3.1	**Horizontal Extrusions - Block 3H**				
2.4.3.2.3.1.1	Procure PVC resin - Block 3H			see Block 1H notes for details	
2.4.3.2.3.1.2	Produce PVC extrusions - Block 3H			see Block 1H notes for details	
2.4.3.2.3.1.3	Ship PVC extrusions to FNAL module factory - Block 3H			see Block 1H notes for details	
2.4.3.2.3.1.4	Quality control and documentation of extrusions - Block 3H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.3.2	**Vertical Extrusions - Block 3V**				
2.4.3.2.3.2.1	Procure PVC resin - Block 3V			see Block 1V notes for details	
2.4.3.2.3.2.2	Produce PVC extrusions - Block 3V			see Block 1V notes for details	
2.4.3.2.3.2.3	Ship PVC extrusions to FNAL module factory - Block 3V			see Block 1V notes for details	
2.4.3.2.3.2.4	Quality control and documentation of extrusions - Block 3V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.4	**Extrusion Production - Block 4 (Type B)**				
2.4.3.2.4.1	**Horizontal Extrusions - Block 4H**				
2.4.3.2.4.1.1	Procure PVC resin - Block 4H			see Block 2H notes for details	
2.4.3.2.4.1.2	Produce PVC extrusions - Block 4H			see Block 2H notes for details	
2.4.3.2.4.1.3	Ship PVC extrusions to FNAL module factory - Block 4H			see Block 2H notes for details	
2.4.3.2.4.1.4	Quality control and documentation of extrusions - Block 4H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.4.2	**Vertical Extrusions - Block 4V**				
2.4.3.2.4.2.1	Procure PVC resin - Block 4V			see Block 2V notes for details	
2.4.3.2.4.2.2	Produce PVC extrusions - Block 4V			see Block 2V notes for details	
2.4.3.2.4.2.3	Ship PVC extrusions to FNAL module factory - Block 4V			see Block 2V notes for details	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.4.3.2.4.2.4	Quality control and documentation of extrusions - Block 4V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.5	**Extrusion Production - Block 5 (Type A)**				
2.4.3.2.5.1	**Horizontal Extrusions - Block 5H**				
2.4.3.2.5.1.1	Procure PVC resin - Block 5H			see Block 1H notes for details	
2.4.3.2.5.1.2	Produce PVC extrusions - Block 5H			see Block 1H notes for details	
2.4.3.2.5.1.3	Ship PVC extrusions to FNAL module factory - Block 5H			see Block 1H notes for details	
2.4.3.2.5.1.4	Quality control and documentation of extrusions - Block 5H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.5.2	**Vertical Extrusions - Block 5V**				
2.4.3.2.5.2.1	Procure PVC resin - Block 5V			see Block 1V notes for details	
2.4.3.2.5.2.2	Produce PVC extrusions - Block 5V			see Block 1V notes for details	
2.4.3.2.5.2.3	Ship PVC extrusions to FNAL module factory - Block 5V			see Block 1V notes for details	
2.4.3.2.5.2.4	Quality control and documentation of extrusions - Block 5V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.6	**Extrusion Production - Block 6 (Type A)**				
2.4.3.2.6.1	**Horizontal Extrusions - Block 6H**				
2.4.3.2.6.1.1	Procure PVC resin - Block 6H			see Block 1H notes for details	
2.4.3.2.6.1.2	Produce PVC extrusions - Block 6H			see Block 1H notes for details	
2.4.3.2.6.1.3	Ship PVC extrusions to FNAL module factory - Block 6H			see Block 1H notes for details	
2.4.3.2.6.1.4	Quality control and documentation of extrusions - Block 6H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.6.2	**Vertical Extrusions - Block 6V**				
2.4.3.2.6.2.1	Procure PVC resin - Block 6V			see Block 1V notes for details	
2.4.3.2.6.2.2	Produce PVC extrusions - Block 6V			see Block 1V notes for details	
2.4.3.2.6.2.3	Ship PVC extrusions to FNAL module factory - Block 6V			see Block 1V notes for details	
2.4.3.2.6.2.4	Quality control and documentation of extrusions - Block 6V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.7	**Extrusion Production - Block 7 (Type B)**				
2.4.3.2.7.1	**Horizontal Extrusions - Block 7H**				
2.4.3.2.7.1.1	Procure PVC resin - Block 7H			see Block 2H notes for details	
2.4.3.2.7.1.2	Produce PVC extrusions - Block 7H			see Block 2H notes for details	
2.4.3.2.7.1.3	Ship PVC extrusions to FNAL module factory - Block 7H			see Block 2H notes for details	
2.4.3.2.7.1.4	Quality control and documentation of extrusions - Block 7H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.7.2	**Vertical Extrusions - Block 7V**				
2.4.3.2.7.2.1	Procure PVC resin - Block 7V			see Block 2V notes for details	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.4.3.2.7.2.2	Produce PVC extrusions - Block 7V			see Block 2V notes for details	
2.4.3.2.7.2.3	Ship PVC extrusions to FNAL module factory - Block 7V			see Block 2V notes for details	
2.4.3.2.7.2.4	Quality control and documentation of extrusions - Block 7V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.8	**Extrusion Production - Block 8 (Type A)**				
2.4.3.2.8.1	**Horizontal Extrusions - Block 8H**				
2.4.3.2.8.1.1	Procure PVC resin - Block 8H			see Block 1H notes for details	
2.4.3.2.8.1.2	Produce PVC extrusions - Block 8H			see Block 1H notes for details	
2.4.3.2.8.1.3	Ship PVC extrusions to FNAL module factory - Block 8H			see Block 1H notes for details	
2.4.3.2.8.1.4	Quality control and documentation of extrusions - Block 8H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.8.2	**Vertical Extrusions - Block 8V**				
2.4.3.2.8.2.1	Procure PVC resin - Block 8V			see Block 1V notes for details	
2.4.3.2.8.2.2	Produce PVC extrusions - Block 8V			see Block 1V notes for details	
2.4.3.2.8.2.3	Ship PVC extrusions to FNAL module factory - Block 8V			see Block 1V notes for details	
2.4.3.2.8.2.4	Quality control and documentation of extrusions - Block 8V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.9	**Extrusion Production - Block 9 (Type B)**				
2.4.3.2.9.1	**Horizontal Extrusions - Block 9H**				
2.4.3.2.9.1.1	Procure PVC resin - Block 9H			see Block 2H notes for details	
2.4.3.2.9.1.2	Produce PVC extrusions - Block 9H			see Block 2H notes for details	
2.4.3.2.9.1.3	Ship PVC extrusions to FNAL module factory - Block 9H			see Block 2H notes for details	
2.4.3.2.9.1.4	Quality control and documentation of extrusions - Block 9H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.9.2	**Vertical Extrusions - Block 9V**				
2.4.3.2.9.2.1	Procure PVC resin - Block 9V			see Block 2V notes for details	
2.4.3.2.9.2.2	Produce PVC extrusions - Block 9V			see Block 2V notes for details	
2.4.3.2.9.2.3	Ship PVC extrusions to FNAL module factory - Block 9V			see Block 2V notes for details	
2.4.3.2.9.2.4	Quality control and documentation of extrusions - Block 9V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.10	**Extrusion Production - Block 10 (Type A)**				
2.4.3.2.10.1	**Horizontal Extrusions - Block 10H**				
2.4.3.2.10.1.1	Procure PVC resin - Block 10H			see Block 1H notes for details	
2.4.3.2.10.1.2	Produce PVC extrusions - Block 10H			see Block 1H notes for details	
2.4.3.2.10.1.3	Ship PVC extrusions to FNAL module factory - Block 10H			see Block 1H notes for details	
2.4.3.2.10.1.4	Quality control and documentation of extrusions - Block 10H				02Aug06 assumes 1 tech fulltime (8 h/day)

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.4.3.2.10.2	**Vertical Extrusions - Block 10V**				
2.4.3.2.10.2.1	Procure PVC resin - Block 10V			see Block 1V notes for details	
2.4.3.2.10.2.2	Produce PVC extrusions - Block 10V			see Block 1V notes for details	
2.4.3.2.10.2.3	Ship PVC extrusions to FNAL module factory - Block 10V			see Block 1V notes for details	
2.4.3.2.10.2.4	Quality control and documentation of extrusions - Block 10V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.11	**Extrusion Production - Block 11 (Type A)**				
2.4.3.2.11.1	**Horizontal Extrusions - Block 11H**				
2.4.3.2.11.1.1	Procure PVC resin - Block 11H			see Block 1H notes for details	
2.4.3.2.11.1.2	Produce PVC extrusions - Block 11H			see Block 1H notes for details	
2.4.3.2.11.1.3	Ship PVC extrusions to FNAL module factory - Block 11H			see Block 1H notes for details	
2.4.3.2.11.1.4	Quality control and documentation of extrusions - Block 11H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.11.2	**Vertical Extrusions - Block 11V**				
2.4.3.2.11.2.1	Procure PVC resin - Block 11V			see Block 1V notes for details	
2.4.3.2.11.2.2	Produce PVC extrusions - Block 11V			see Block 1V notes for details	
2.4.3.2.11.2.3	Ship PVC extrusions to FNAL module factory - Block 11V			see Block 1V notes for details	
2.4.3.2.11.2.4	Quality control and documentation of extrusions - Block 11V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.12	**Extrusion Production - Block 12 (Type B)**				
2.4.3.2.12.1	**Horizontal Extrusions - Block 12H**				
2.4.3.2.12.1.1	Procure PVC resin - Block 12H			see Block 2H notes for details	
2.4.3.2.12.1.2	Produce PVC extrusions - Block 12H			see Block 2H notes for details	
2.4.3.2.12.1.3	Ship PVC extrusions to FNAL module factory - Block 12H			see Block 2H notes for details	
2.4.3.2.12.1.4	Quality control and documentation of extrusions - Block 12H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.12.2	**Vertical Extrusions - Block 12V**				
2.4.3.2.12.2.1	Procure PVC resin - Block 12V			see Block 2V notes for details	
2.4.3.2.12.2.2	Produce PVC extrusions - Block 12V			see Block 2V notes for details	
2.4.3.2.12.2.3	Ship PVC extrusions to FNAL module factory - Block 12V			see Block 2V notes for details	
2.4.3.2.12.2.4	Quality control and documentation of extrusions - Block 12V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.13	**Extrusion Production - Block 13 (Type A)**				
2.4.3.2.13.1	**Horizontal Extrusions - Block 13H**				
2.4.3.2.13.1.1	Procure PVC resin - Block 13H			see Block 1H notes for details	
2.4.3.2.13.1.2	Produce PVC extrusions - Block 13H			see Block 1H notes for details	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.4.3.2.13.1.3	Ship PVC extrusions to FNAL module factory - Block 13H			see Block 1H notes for details	
2.4.3.2.13.1.4	Quality control and documentation of extrusions - Block 13H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.13.2	**Vertical Extrusions - Block 13V**				
2.4.3.2.13.2.1	Procure PVC resin - Block 13V			see Block 1V notes for details	
2.4.3.2.13.2.2	Produce PVC extrusions - Block 13V			see Block 1V notes for details	
2.4.3.2.13.2.3	Ship PVC extrusions to FNAL module factory - Block 13V			see Block 1V notes for details	
2.4.3.2.13.2.4	Quality control and documentation of extrusions - Block 13V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.14	**Extrusion Production - Block 14 (Type B)**				
2.4.3.2.14.1	**Horizontal Extrusions - Block 14H**				
2.4.3.2.14.1.1	Procure PVC resin - Block 14H			see Block 2H notes for details	
2.4.3.2.14.1.2	Produce PVC extrusions - Block 14H			see Block 2H notes for details	
2.4.3.2.14.1.3	Ship PVC extrusions to FNAL module factory - Block 14H			see Block 2H notes for details	
2.4.3.2.14.1.4	Quality control and documentation of extrusions - Block 14H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.14.2	**Vertical Extrusions - Block 14V**				
2.4.3.2.14.2.1	Procure PVC resin - Block 14V			see Block 2V notes for details	
2.4.3.2.14.2.2	Produce PVC extrusions - Block 14V			see Block 2V notes for details	
2.4.3.2.14.2.3	Ship PVC extrusions to FNAL module factory - Block 14V			see Block 2V notes for details	
2.4.3.2.14.2.4	Quality control and documentation of extrusions - Block 14V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.15	**Extrusion Production - Block 15 (Type A)**				
2.4.3.2.15.1	**Horizontal Extrusions - Block 15H**				
2.4.3.2.15.1.1	Procure PVC resin - Block 15H			see Block 1H notes for details	
2.4.3.2.15.1.2	Produce PVC extrusions - Block 15H			see Block 1H notes for details	
2.4.3.2.15.1.3	Ship PVC extrusions to FNAL module factory - Block 15H			see Block 1H notes for details	
2.4.3.2.15.1.4	Quality control and documentation of extrusions - Block 15H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.15.2	**Vertical Extrusions - Block 15V**				
2.4.3.2.15.2.1	Procure PVC resin - Block 15V			see Block 1V notes for details	
2.4.3.2.15.2.2	Produce PVC extrusions - Block 15V			see Block 1V notes for details	
2.4.3.2.15.2.3	Ship PVC extrusions to FNAL module factory - Block 15V			see Block 1V notes for details	
2.4.3.2.15.2.4	Quality control and documentation of extrusions - Block 15V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.16	**Extrusion Production - Block 16 (Type A)**				
2.4.3.2.16.1	**Horizontal Extrusions - Block 16H**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.4.3.2.16.1.1	Procure PVC resin - Block 16H			see Block 1H notes for details	
2.4.3.2.16.1.2	Produce PVC extrusions - Block 16H			see Block 1H notes for details	
2.4.3.2.16.1.3	Ship PVC extrusions to FNAL module factory - Block 16H			see Block 1H notes for details	
2.4.3.2.16.1.4	Quality control and documentation of extrusions - Block 16H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.16.2	**Vertical Extrusions - Block 16V**				
2.4.3.2.16.2.1	Procure PVC resin - Block 16V			see Block 1V notes for details	
2.4.3.2.16.2.2	Produce PVC extrusions - Block 16V			see Block 1V notes for details	
2.4.3.2.16.2.3	Ship PVC extrusions to FNAL module factory - Block 16V			see Block 1V notes for details	
2.4.3.2.16.2.4	Quality control and documentation of extrusions - Block 16V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.17	**Extrusion Production - Block 17 (Type B)**				
2.4.3.2.17.1	**Horizontal Extrusions - Block 17H**				
2.4.3.2.17.1.1	Procure PVC resin - Block 17H			see Block 2H notes for details	
2.4.3.2.17.1.2	Produce PVC extrusions - Block 17H			see Block 2H notes for details	
2.4.3.2.17.1.3	Ship PVC extrusions to FNAL module factory - Block 17H			see Block 2H notes for details	
2.4.3.2.17.1.4	Quality control and documentation of extrusions - Block 17H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.17.2	**Vertical Extrusions - Block 17V**				
2.4.3.2.17.2.1	Procure PVC resin - Block 17V			see Block 2V notes for details	
2.4.3.2.17.2.2	Produce PVC extrusions - Block 17V			see Block 2V notes for details	
2.4.3.2.17.2.3	Ship PVC extrusions to FNAL module factory - Block 17V			see Block 2V notes for details	
2.4.3.2.17.2.4	Quality control and documentation of extrusions - Block 17V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.18	**Extrusion Production - Block 18 (Type A)**				
2.4.3.2.18.1	**Horizontal Extrusions - Block 18H**				
2.4.3.2.18.1.1	Procure PVC resin - Block 18H			see Block 1H notes for details	
2.4.3.2.18.1.2	Produce PVC extrusions - Block 18H			see Block 1H notes for details	
2.4.3.2.18.1.3	Ship PVC extrusions to FNAL module factory - Block 18H			see Block 1H notes for details	
2.4.3.2.18.1.4	Quality control and documentation of extrusions - Block 18H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.18.2	**Vertical Extrusions - Block 18V**				
2.4.3.2.18.2.1	Procure PVC resin - Block 18V			see Block 1V notes for details	
2.4.3.2.18.2.2	Produce PVC extrusions - Block 18V			see Block 1V notes for details	
2.4.3.2.18.2.3	Ship PVC extrusions to FNAL module factory - Block 18V			see Block 1V notes for details	
2.4.3.2.18.2.4	Quality control and documentation of extrusions - Block 18V				02Aug06 assumes 1 tech fulltime (8 h/day)

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.4.3.2.19	**Extrusion Production - Block 19 (Type B)**				
2.4.3.2.19.1	**Horizontal Extrusions - Block 19H**				
2.4.3.2.19.1.1	Procure PVC resin - Block 19H			see Block 2H notes for details	
2.4.3.2.19.1.2	Produce PVC extrusions - Block 19H			see Block 2H notes for details	
2.4.3.2.19.1.3	Ship PVC extrusions to FNAL module factory - Block 19H			see Block 2H notes for details	
2.4.3.2.19.1.4	Quality control and documentation of extrusions - Block 19H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.19.2	**Vertical Extrusions - Block 19V**				
2.4.3.2.19.2.1	Procure PVC resin - Block 19V			see Block 2V notes for details	
2.4.3.2.19.2.2	Produce PVC extrusions - Block 19V			see Block 2V notes for details	
2.4.3.2.19.2.3	Ship PVC extrusions to FNAL module factory - Block 19V			see Block 2V notes for details	
2.4.3.2.19.2.4	Quality control and documentation of extrusions - Block 19V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.20	**Extrusion Production - Block 20 (Type A)**				
2.4.3.2.20.1	**Horizontal Extrusions - Block 20H**				
2.4.3.2.20.1.1	Procure PVC resin - Block 20H			see Block 1H notes for details	
2.4.3.2.20.1.2	Produce PVC extrusions - Block 20H			see Block 1H notes for details	
2.4.3.2.20.1.3	Ship PVC extrusions to FNAL module factory - Block 20H			see Block 1H notes for details	
2.4.3.2.20.1.4	Quality control and documentation of extrusions - Block 20H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.20.2	**Vertical Extrusions - Block 20V**				
2.4.3.2.20.2.1	Procure PVC resin - Block 20V			see Block 1V notes for details	
2.4.3.2.20.2.2	Produce PVC extrusions - Block 20V			see Block 1V notes for details	
2.4.3.2.20.2.3	Ship PVC extrusions to FNAL module factory - Block 20V			see Block 1V notes for details	
2.4.3.2.20.2.4	Quality control and documentation of extrusions - Block 20V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.21	**Extrusion Production - Block 21 (Type A)**				
2.4.3.2.21.1	**Horizontal Extrusions - Block 21H**				
2.4.3.2.21.1.1	Procure PVC resin - Block 21H			see Block 1H notes for details	
2.4.3.2.21.1.2	Produce PVC extrusions - Block 21H			see Block 1H notes for details	
2.4.3.2.21.1.3	Ship PVC extrusions to FNAL module factory - Block 21H			see Block 1H notes for details	
2.4.3.2.21.1.4	Quality control and documentation of extrusions - Block 21H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.21.2	**Vertical Extrusions - Block 21V**				
2.4.3.2.21.2.1	Procure PVC resin - Block 21V			see Block 1V notes for details	
2.4.3.2.21.2.2	Produce PVC extrusions - Block 21V			see Block 1V notes for details	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.4.3.2.21.2.3	Ship PVC extrusions to FNAL module factory - Block 21V			see Block 1V notes for details	
2.4.3.2.21.2.4	Quality control and documentation of extrusions - Block 21V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.22	**Extrusion Production - Block 22 (Type B)**				
2.4.3.2.22.1	**Horizontal Extrusions - Block 22H**				
2.4.3.2.22.1.1	Procure PVC resin - Block 22H			see Block 2H notes for details	
2.4.3.2.22.1.2	Produce PVC extrusions - Block 22H			see Block 2H notes for details	
2.4.3.2.22.1.3	Ship PVC extrusions to FNAL module factory - Block 22H			see Block 2H notes for details	
2.4.3.2.22.1.4	Quality control and documentation of extrusions - Block 22H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.22.2	**Vertical Extrusions - Block 22V**				
2.4.3.2.22.2.1	Procure PVC resin - Block 22V			see Block 2V notes for details	
2.4.3.2.22.2.2	Produce PVC extrusions - Block 22V			see Block 2V notes for details	
2.4.3.2.22.2.3	Ship PVC extrusions to FNAL module factory - Block 22V			see Block 2V notes for details	
2.4.3.2.22.2.4	Quality control and documentation of extrusions - Block 22V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.23	**Extrusion Production - Block 23 (Type A)**				
2.4.3.2.23.1	**Horizontal Extrusions - Block 23H**				
2.4.3.2.23.1.1	Procure PVC resin - Block 23H			see Block 1H notes for details	
2.4.3.2.23.1.2	Produce PVC extrusions - Block 23H			see Block 1H notes for details	
2.4.3.2.23.1.3	Ship PVC extrusions to FNAL module factory - Block 23H			see Block 1H notes for details	
2.4.3.2.23.1.4	Quality control and documentation of extrusions - Block 23H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.23.2	**Vertical Extrusions - Block 23V**				
2.4.3.2.23.2.1	Procure PVC resin - Block 23V			see Block 1V notes for details	
2.4.3.2.23.2.2	Produce PVC extrusions - Block 23V			see Block 1V notes for details	
2.4.3.2.23.2.3	Ship PVC extrusions to FNAL module factory - Block 23V			see Block 1V notes for details	
2.4.3.2.23.2.4	Quality control and documentation of extrusions - Block 23V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.24	**Extrusion Production - Block 24 (Type B)**				
2.4.3.2.24.1	**Horizontal Extrusions - Block 24H**				
2.4.3.2.24.1.1	Procure PVC resin - Block 24H			see Block 2H notes for details	
2.4.3.2.24.1.2	Produce PVC extrusions - Block 24H			see Block 2H notes for details	
2.4.3.2.24.1.3	Ship PVC extrusions to FNAL module factory - Block 24H			see Block 2H notes for details	
2.4.3.2.24.1.4	Quality control and documentation of extrusions - Block 24H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.24.2	**Vertical Extrusions - Block 24V**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.4.3.2.24.2.1	Procure PVC resin - Block 24V			see Block 2V notes for details	
2.4.3.2.24.2.2	Produce PVC extrusions - Block 24V			see Block 2V notes for details	
2.4.3.2.24.2.3	Ship PVC extrusions to FNAL module factory - Block 24V			see Block 2V notes for details	
2.4.3.2.24.2.4	Quality control and documentation of extrusions - Block 24V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.25	**Extrusion Production - Block 25 (Type A)**				
2.4.3.2.25.1	**Horizontal Extrusions - Block 25H**				
2.4.3.2.25.1.1	Procure PVC resin - Block 25H			see Block 1H notes for details	
2.4.3.2.25.1.2	Produce PVC extrusions - Block 25H			see Block 1H notes for details	
2.4.3.2.25.1.3	Ship PVC extrusions to FNAL module factory - Block 25H			see Block 1H notes for details	
2.4.3.2.25.1.4	Quality control and documentation of extrusions - Block 25H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.25.2	**Vertical Extrusions - Block 25V**				
2.4.3.2.25.2.1	Procure PVC resin - Block 25V			see Block 1V notes for details	
2.4.3.2.25.2.2	Produce PVC extrusions - Block 25V			see Block 1V notes for details	
2.4.3.2.25.2.3	Ship PVC extrusions to FNAL module factory - Block 25V			see Block 1V notes for details	
2.4.3.2.25.2.4	Quality control and documentation of extrusions - Block 25V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.26	**Extrusion Production - Block 26 (Type A)**				
2.4.3.2.26.1	**Horizontal Extrusions - Block 26H**				
2.4.3.2.26.1.1	Procure PVC resin - Block 26H			see Block 1H notes for details	
2.4.3.2.26.1.2	Produce PVC extrusions - Block 26H			see Block 1H notes for details	
2.4.3.2.26.1.3	Ship PVC extrusions to FNAL module factory - Block 26H			see Block 1H notes for details	
2.4.3.2.26.1.4	Quality control and documentation of extrusions - Block 26H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.26.2	**Vertical Extrusions - Block 26V**				
2.4.3.2.26.2.1	Procure PVC resin - Block 26V			see Block 1V notes for details	
2.4.3.2.26.2.2	Produce PVC extrusions - Block 26V			see Block 1V notes for details	
2.4.3.2.26.2.3	Ship PVC extrusions to FNAL module factory - Block 26V			see Block 1V notes for details	
2.4.3.2.26.2.4	Quality control and documentation of extrusions - Block 26V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.27	**Extrusion Production - Block 27 (Type B)**				
2.4.3.2.27.1	**Horizontal Extrusions - Block 27H**				
2.4.3.2.27.1.1	Procure PVC resin - Block 27H			see Block 2H notes for details	
2.4.3.2.27.1.2	Produce PVC extrusions - Block 27H			see Block 2H notes for details	
2.4.3.2.27.1.3	Ship PVC extrusions to FNAL module factory - Block 27H			see Block 2H notes for details	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.4.3.2.27.1.4	Quality control and documentation of extrusions - Block 27H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.27.2	**Vertical Extrusions - Block 27V**				
2.4.3.2.27.2.1	Procure PVC resin - Block 27V			see Block 2V notes for details	
2.4.3.2.27.2.2	Produce PVC extrusions - Block 27V			see Block 2V notes for details	
2.4.3.2.27.2.3	Ship PVC extrusions to FNAL module factory - Block 27V			see Block 2V notes for details	
2.4.3.2.27.2.4	Quality control and documentation of extrusions - Block 27V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.28	**Extrusion Production - Block 28 (Type A)**				
2.4.3.2.28.1	**Horizontal Extrusions - Block 28H**				
2.4.3.2.28.1.1	Procure PVC resin - Block 28H			see Block 1H notes for details	
2.4.3.2.28.1.2	Produce PVC extrusions - Block 28H			see Block 1H notes for details	
2.4.3.2.28.1.3	Ship PVC extrusions to FNAL module factory - Block 28H			see Block 1H notes for details	
2.4.3.2.28.1.4	Quality control and documentation of extrusions - Block 28H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.28.2	**Vertical Extrusions - Block 28V**				
2.4.3.2.28.2.1	Procure PVC resin - Block 28V			see Block 1V notes for details	
2.4.3.2.28.2.2	Produce PVC extrusions - Block 28V			see Block 1V notes for details	
2.4.3.2.28.2.3	Ship PVC extrusions to FNAL module factory - Block 28V			see Block 1V notes for details	
2.4.3.2.28.2.4	Quality control and documentation of extrusions - Block 28V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.29	**Extrusion Production - Block 29 (Type B)**				
2.4.3.2.29.1	**Horizontal Extrusions - Block 29H**				
2.4.3.2.29.1.1	Procure PVC resin - Block 29H			see Block 2H notes for details	
2.4.3.2.29.1.2	Produce PVC extrusions - Block 29H			see Block 2H notes for details	
2.4.3.2.29.1.3	Ship PVC extrusions to FNAL module factory - Block 29H			see Block 2H notes for details	
2.4.3.2.29.1.4	Quality control and documentation of extrusions - Block 29H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.29.2	**Vertical Extrusions - Block 29V**				
2.4.3.2.29.2.1	Procure PVC resin - Block 29V			see Block 2V notes for details	
2.4.3.2.29.2.2	Produce PVC extrusions - Block 29V			see Block 2V notes for details	
2.4.3.2.29.2.3	Ship PVC extrusions to FNAL module factory - Block 29V			see Block 2V notes for details	
2.4.3.2.29.2.4	Quality control and documentation of extrusions - Block 29V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.30	**Extrusion Production - Block 30 (Type A)**				
2.4.3.2.30.1	**Horizontal Extrusions - Block 30H**				
2.4.3.2.30.1.1	Procure PVC resin - Block 30H			see Block 1H notes for details	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.4.3.2.30.1.2	Produce PVC extrusions - Block 30H			see Block 1H notes for details	
2.4.3.2.30.1.3	Ship PVC extrusions to FNAL module factory - Block 30H			see Block 1H notes for details	
2.4.3.2.30.1.4	Quality control and documentation of extrusions - Block 30H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.30.2	**Vertical Extrusions - Block 30V**				
2.4.3.2.30.2.1	Procure PVC resin - Block 30V			see Block 1V notes for details	
2.4.3.2.30.2.2	Produce PVC extrusions - Block 30V			see Block 1V notes for details	
2.4.3.2.30.2.3	Ship PVC extrusions to FNAL module factory - Block 30V			see Block 1V notes for details	
2.4.3.2.30.2.4	Quality control and documentation of extrusions - Block 30V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.31	**Extrusion Production - Block 31 (Type A)**				
2.4.3.2.31.1	**Horizontal Extrusions - Block 31H**				
2.4.3.2.31.1.1	Procure PVC resin - Block 31H			see Block 1H notes for details	
2.4.3.2.31.1.2	Produce PVC extrusions - Block 31H			see Block 1H notes for details	
2.4.3.2.31.1.3	Ship PVC extrusions to FNAL module factory - Block 31H			see Block 1H notes for details	
2.4.3.2.31.1.4	Quality control and documentation of extrusions - Block 31H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.31.2	**Vertical Extrusions - Block 31V**				
2.4.3.2.31.2.1	Procure PVC resin - Block 31V			see Block 1V notes for details	
2.4.3.2.31.2.2	Produce PVC extrusions - Block 31V			see Block 1V notes for details	
2.4.3.2.31.2.3	Ship PVC extrusions to FNAL module factory - Block 31V			see Block 1V notes for details	
2.4.3.2.31.2.4	Quality control and documentation of extrusions - Block 31V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.32	**Extrusion Production - Block 32 (Type B)**				
2.4.3.2.32.1	**Horizontal Extrusions - Block 32H**				
2.4.3.2.32.1.1	Procure PVC resin - Block 32H			see Block 2H notes for details	
2.4.3.2.32.1.2	Produce PVC extrusions - Block 32H			see Block 2H notes for details	
2.4.3.2.32.1.3	Ship PVC extrusions to FNAL module factory - Block 32H			see Block 2H notes for details	
2.4.3.2.32.1.4	Quality control and documentation of extrusions - Block 32H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.32.2	**Vertical Extrusions - Block 32V**				
2.4.3.2.32.2.1	Procure PVC resin - Block 32V			see Block 2V notes for details	
2.4.3.2.32.2.2	Produce PVC extrusions - Block 32V			see Block 2V notes for details	
2.4.3.2.32.2.3	Ship PVC extrusions to FNAL module factory - Block 32V			see Block 2V notes for details	
2.4.3.2.32.2.4	Quality control and documentation of extrusions - Block 32V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.33	**Extrusion Production - Block 33 (Type A)**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.4.3.2.33.1	**Horizontal Extrusions - Block 33H**				
2.4.3.2.33.1.1	Procure PVC resin - Block 33H			see Block 1H notes for details	
2.4.3.2.33.1.2	Produce PVC extrusions - Block 33H			see Block 1H notes for details	
2.4.3.2.33.1.3	Ship PVC extrusions to FNAL module factory - Block 33H			see Block 1H notes for details	
2.4.3.2.33.1.4	Quality control and documentation of extrusions - Block 33H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.33.2	**Vertical Extrusions - Block 33V**				
2.4.3.2.33.2.1	Procure PVC resin - Block 33V			see Block 1V notes for details	
2.4.3.2.33.2.2	Produce PVC extrusions - Block 33V			see Block 1V notes for details	
2.4.3.2.33.2.3	Ship PVC extrusions to FNAL module factory - Block 33V			see Block 1V notes for details	
2.4.3.2.33.2.4	Quality control and documentation of extrusions - Block 33V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.34	**Extrusion Production - Block 34 (Type B)**				
2.4.3.2.34.1	**Horizontal Extrusions - Block 34H**				
2.4.3.2.34.1.1	Procure PVC resin - Block 34H			see Block 2H notes for details	
2.4.3.2.34.1.2	Produce PVC extrusions - Block 34H			see Block 2H notes for details	
2.4.3.2.34.1.3	Ship PVC extrusions to FNAL module factory - Block 34H			see Block 2H notes for details	
2.4.3.2.34.1.4	Quality control and documentation of extrusions - Block 34H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.34.2	**Vertical Extrusions - Block 34V**				
2.4.3.2.34.2.1	Procure PVC resin - Block 34V			see Block 2V notes for details	
2.4.3.2.34.2.2	Produce PVC extrusions - Block 34V			see Block 2V notes for details	
2.4.3.2.34.2.3	Ship PVC extrusions to FNAL module factory - Block 34V			see Block 2V notes for details	
2.4.3.2.34.2.4	Quality control and documentation of extrusions - Block 34V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.35	**Extrusion Production - Block 35 (Type A)**				
2.4.3.2.35.1	**Horizontal Extrusions - Block 35H**				
2.4.3.2.35.1.1	Procure PVC resin - Block 35H			see Block 1H notes for details	
2.4.3.2.35.1.2	Produce PVC extrusions - Block 35H			see Block 1H notes for details	
2.4.3.2.35.1.3	Ship PVC extrusions to FNAL module factory - Block 35H			see Block 1H notes for details	
2.4.3.2.35.1.4	Quality control and documentation of extrusions - Block 35H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.35.2	**Vertical Extrusions - Block 35V**				
2.4.3.2.35.2.1	Procure PVC resin - Block 35V			see Block 1V notes for details	
2.4.3.2.35.2.2	Produce PVC extrusions - Block 35V			see Block 1V notes for details	
2.4.3.2.35.2.3	Ship PVC extrusions to FNAL module factory - Block 35V			see Block 1V notes for details	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.4.3.2.35.2.4	Quality control and documentation of extrusions - Block 35V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.36	**Extrusion Production - Block 36 (Type A)**				
2.4.3.2.36.1	**Horizontal Extrusions - Block 36H**				
2.4.3.2.36.1.1	Procure PVC resin - Block 36H			see Block 1H notes for details	
2.4.3.2.36.1.2	Produce PVC extrusions - Block 36H			see Block 1H notes for details	
2.4.3.2.36.1.3	Ship PVC extrusions to FNAL module factory - Block 36H			see Block 1H notes for details	
2.4.3.2.36.1.4	Quality control and documentation of extrusions - Block 36H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.36.2	**Vertical Extrusions - Block 36V**				
2.4.3.2.36.2.1	Procure PVC resin - Block 36V			see Block 1V notes for details	
2.4.3.2.36.2.2	Produce PVC extrusions - Block 36V			see Block 1V notes for details	
2.4.3.2.36.2.3	Ship PVC extrusions to FNAL module factory - Block 36V			see Block 1V notes for details	
2.4.3.2.36.2.4	Quality control and documentation of extrusions - Block 36V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.37	**Extrusion Production - Block 37 (Type B)**				
2.4.3.2.37.1	**Horizontal Extrusions - Block 37H**				
2.4.3.2.37.1.1	Procure PVC resin - Block 37H			see Block 2H notes for details	
2.4.3.2.37.1.2	Produce PVC extrusions - Block 37H			see Block 2H notes for details	
2.4.3.2.37.1.3	Ship PVC extrusions to FNAL module factory - Block 37H			see Block 2H notes for details	
2.4.3.2.37.1.4	Quality control and documentation of extrusions - Block 37H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.37.2	**Vertical Extrusions - Block 37V**				
2.4.3.2.37.2.1	Procure PVC resin - Block 37V			see Block 2V notes for details	
2.4.3.2.37.2.2	Produce PVC extrusions - Block 37V			see Block 2V notes for details	
2.4.3.2.37.2.3	Ship PVC extrusions to FNAL module factory - Block 37V			see Block 2V notes for details	
2.4.3.2.37.2.4	Quality control and documentation of extrusions - Block 37V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.38	**Extrusion Production - Block 38 (Type A)**				
2.4.3.2.38.1	**Horizontal Extrusions - Block 38H**				
2.4.3.2.38.1.1	Procure PVC resin - Block 38H			see Block 1H notes for details	
2.4.3.2.38.1.2	Produce PVC extrusions - Block 38H			see Block 1H notes for details	
2.4.3.2.38.1.3	Ship PVC extrusions to FNAL module factory - Block 38H			see Block 1H notes for details	
2.4.3.2.38.1.4	Quality control and documentation of extrusions - Block 38H				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.38.2	**Vertical Extrusions - Block 38V**				
2.4.3.2.38.2.1	Procure PVC resin - Block 38V			see Block 1V notes for details	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.4.3.2.38.2.2	Produce PVC extrusions - Block 38V			see Block 1V notes for details	
2.4.3.2.38.2.3	Ship PVC extrusions to FNAL module factory - Block 38V			see Block 1V notes for details	
2.4.3.2.38.2.4	Quality control and documentation of extrusions - Block 38V				02Aug06 assumes 1 tech fulltime (8 h/day)
2.4.3.2.44	**Extrusion Production Milestones**				
2.4.3.2.44.1	Far detector extrusion production started				
2.4.3.2.44.2	Extrusions for superblock 1 produced				
2.4.3.2.44.3	Extrusions for superblock 2 produced				
2.4.3.2.44.4	Extrusions for superblock 3 produced				
2.4.3.2.44.5	Extrusions for superblock 4 produced				
2.4.3.2.44.6	Extrusions for superblock 5 produced				
2.4.3.2.44.7	Extrusions for superblock 6 produced				
2.4.3.2.44.8	Extrusions for superblock 7 produced				
2.4.3.2.44.9	Extrusions for (partial) superblock 8 produced				
2.4.3.2.44.10	Far Detector extrusion production completed				
2.4.4	**Production Quality Assurance and Extrusion Evaluation**				
2.4.4.1	Procure hardware				
2.4.4.2	Setup hardware				
2.4.4.4	Data-taking and analysis - FY10				
2.4.4.5	Data-taking and analysis - FY11				
2.4.4.6	Data-taking and analysis - FY12				
2.4.4.7	Data-taking and analysis - FY13				
2.4.5	**Shipping & Handling**	**This WBS provides for the development and execution of a shipping and handling plan for delivering extrusions to module factories, for supervising trucking schedules and for managing the equipment necessary for shipping and handling.**	**Pallet System -------pallets delieved to extrusion manufacturer from pallet supplier. Eight uniformly spaced pallets support a pair of pallet bridges, which span the 51-foot length, will be made at extruder (same extrusions as produced for the Far Detector; prefer to use discards that fail NOvA specs). A double stack 30 PVC extrusions high (sixty PVC extrusions per stack) willlbe placed on the bridges and covered with plastic wrapping and banding fixtures to keep it stable. Air casters are placed beneaht the bridges and stack is pushed by a motorized pallet jack a pallet jacki into a truck. Air casters are then removed by use of air jacks. One stack is loaded per truck, shipped to module factory#1 and unloaded using another set of air casters.**		**2. Pallet system labor 320 FNAL FTE tech hours 3.**
2.4.5.1	Finalize design for pallets and motion systems				
2.4.5.2	**Pallet System**				
2.4.5.2.1	Procure commercial pallets		Pallets to be purchased: 1120 (enough to ship 10 blocks-worth of extrusions) plus 200 spares plus 800 pallets for storage of stacks. Pallets will be re-used by sending them back to the extruding vendor.	Purchase 2,120 pallets. Refer to doc 2180 for cost estimate.	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.4.5.2.2	Procure pallet assembly hardware and tools	primarily banding tools and hardware to attach pallet bridges to commerical pallets	Pallets will be assembled at the extruding vendor	Refer to doc 2180 for details and cost estimate.	
2.4.5.2.3	Obtain pallet bridges (extrusions) and assemble pallets	Pallet bridges are 51-foot NOvA extrusions. Two are placed side-by-side to span 8 equally-spaced pallets. Production-quality PVC extrusions are stacked on these bridges. Pallet bridges are included in extrusion costs (WBS 2.4.3). This WBS (2.4.5.2.3) petains to extra pallet bridges, used to store stacks of extrusions or modules for extended periods.	Pallet bridges are simply taken from the extrusion line as additional extrusions. We will utilize extrusions not suibtable for module construction, as available; M&S budget is included in extrusion costs so no addional M&S cost is included here except for the extra bridges built for storage purposes.	Produce 200 H-type extrusions to be used as bridges. Cost equals cost of PVC resin plus cost of extruding 200 324-pound extrusions: $123,044. Refer to doc 1342 for cost of resin $0.92/lb (note : no scrap is assumed because failures will be used) and doc 2178 for cost of extruding $0.92/lb	
2.4.5.3	**Pallet Motion Systems**	**This system is used to move stacks of extrusions or modules from the factory floor into or out of a truck.**	**Note: WBS 2.4 needs one pallet motion system. Other WBS tasks also need identical systems, so all of the Pallet Motion Systems for NOvA are included in this WBS. The other tasks are: Wbs 2.5 (two systems) and WBS 2.9 (one system).**		
2.4.5.3.1	**Motion System - Extrusion Vendor**	**Used in WBS 2.4**			
2.4.5.3.1.1	Procure motion system components			Refer to doc 2180 for details and cost estimate.	
2.4.5.3.1.2	Assemble pallet motion system				
2.4.5.3.2	**Motion System - FNAL Factory**	**Used in WBS 2.5**			
2.4.5.3.2.1	Procure motion system components			Refer to doc 2180 for details and cost estimate.	
2.4.5.3.2.2	Assemble pallet motion system				
2.4.5.3.3	**Motion System - Univ of Minnesota Factory**	**Usde in WBS 2.5**			
2.4.5.3.3.1	Procure motion system components			Refer to doc 2180 for details and cost estimate.	
2.4.5.3.3.2	Assemble pallet motion system				
2.4.5.3.4	**Motion System - Far Detector Site**	**Used in WBS 2.9**			
2.4.5.3.4.1	Procure motion system components			Refer to doc 2180 for details and cost estimate.	
2.4.5.3.4.2	Assemble pallet motion system				
2.4.5.4	**Pallet Systems Recirculation**	**Shipping to return pallets from Far Detector site to extrusion vendor for re-use**	**Pallets used for module delivery to the far site at Ash River will be collected and periodically recirculated back to the extrusion vendor for re-use. This item covers the cost of that return shipping on a per fiscal year basis.**		
2.4.5.4.1	Circulate pallet systems to vendor- FY10	Shipping costs to return pallets from Far Detector site to extrusion vendor for re-use		6 trucks per vendor x $1000 = $6k	
2.4.5.4.2	Circulate pallet systems to vendor- FY11	Shipping costs to return pallets from Far Detector site to extrusion vendor for re-use		Purchase one Strapping Dispensor, Tensioner, Sealer and Misc. materials: $888.35. Send 8 trucks from Ash River site to the extruding vendor in Manitowoc: $12,450. (Two trucks with pallets and 6 trucks with bridges.) Refer to doc 2179 for cost of trucking from Ash River to Manitowoc.	
2.4.5.4.3	Circulate pallet systems to vendor- FY12	Shipping costs to return pallets from Far Detector site to extrusion vendor for re-use		Send 7 trucks from Ash River site to the extruding vendor in Manitowoc: $12,450. (One truck with pallets and 6 trucks with bridges.) Refer to doc 2179 for cost of trucking from Ash River to Manitowoc.	
2.4.6	**Management - Construction Phase**	**This WBS includes the tasks required to support and manage WBS 2.4 activities including quality assurance, value management, risk management, monitoring of vendor performance and schedule, preparation of reports and other related activities.**			
2.4.6.2	**FY08**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.4.6.2.1	**Argonne Management-FY08**				
2.4.6.2.1.1	Labor				Physicist - est of 5 weeks per year (i.e slightly less than 2 days per month) spent on subproject-related management and oversight activites (project reporting, informatin gathering, personnel matters, reviews, etc.) not covered elsewhere in the project plan/schedule. Engineer -est of 2.5 weeks per year (i.e slightly less than 1 day per month) spent on subproject-related management and oversight activites (project reporting, information gathering, reviews, etc.) not covered elsewhere in the project plan/schedule.
2.4.6.2.1.2	Travel			2 domestic trips per year at 1500 per trip = 3000 4 domestic trips per year at 500 per trip = 2000 total: 5000	
2.4.6.2.1.3	Equipment				
2.4.6.2.1.4	Materials and supplies				
2.4.6.2.2	**FNAL Management-FY08**				
2.4.6.2.2.1	Labor				Engineer -est of 2.5 weeks per year (i.e slightly less than 1 day per month) spent on subproject-related management and oversight activites (project reporting, information gathering, reviews, etc.) not covered elsewhere in the project plan/schedule.
2.4.6.2.2.2	Travel			1 domestic trips per year at 1500 per trip = 1500 2 domestic trips per year at 500 per trip = 1000 total: 2500	
2.4.6.2.2.3	Equipment				
2.4.6.2.2.4	Materials and supplies				
2.4.6.3	**FY09**				
2.4.6.3.1	**Argonne Management-FY09**				
2.4.6.3.1.1	Labor				Physicist - est of 5 weeks per year (i.e slightly less than 2 days per month) spent on subproject-related management and oversight activites (project reporting, informatin gathering, personnel matters, reviews, etc.) not covered elsewhere in the project plan/schedule. Engineer -est of 2.5 weeks per year (i.e slightly less than 1 day per month) spent on subproject-related management and oversight activites (project reporting, information gathering, reviews, etc.) not covered elsewhere in the project plan/schedule.
2.4.6.3.1.2	Travel			2 domestic trips per year at 1500 per trip = 3000 4 domestic trips per year at 500 per trip = 2000 total: 5000	
2.4.6.3.1.3	Equipment				
2.4.6.3.1.4	Materials and supplies				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.4.6.3.2	**FNAL Management-FY09**				
2.4.6.3.2.1	Labor				Engineer -est of 2.5 weeks per year (i.e slightly less than 1 day per month) spent on subproject-related management and oversight activites (project reporting, information gathering, reviews, etc.) not covered elsewhere in the project plan/schedule.
2.4.6.3.2.2	Travel			1 domestic trips per year at 1500 per trip = 1500 2 domestic trips per year at 500 per trip = 1000 total: 2500	
2.4.6.3.2.3	Equipment				
2.4.6.3.2.4	Materials and supplies				
2.4.6.4	**FY10**				
2.4.6.4.1	**Argonne Management-FY10**				
2.4.6.4.1.1	Labor				Physicist - est of 5 weeks per year (i.e slightly less than 2 days per month) spent on subproject-related management and oversight activites (project reporting, informatin gathering, personnel matters, reviews, etc.) not covered elsewhere in the project plan/schedule. Engineer -est of 2.5 weeks per year (i.e slightly less than 1 day per month) spent on subproject-related management and oversight activites (project reporting, information gathering, reviews, etc.) not covered elsewhere in the project plan/schedule.
2.4.6.4.1.2	Travel			2 domestic trips per year at 1500 per trip = 3000 4 domestic trips per year at 500 per trip = 2000 total: 5000	
2.4.6.4.1.3	Equipment				
2.4.6.4.1.4	Materials and supplies				
2.4.6.4.2	**FNAL Management-FY10**				
2.4.6.4.2.1	Labor				Engineer -est of 2.5 weeks per year (i.e slightly less than 1 day per month) spent on subproject-related management and oversight activites (project reporting, information gathering, reviews, etc.) not covered elsewhere in the project plan/schedule.
2.4.6.4.2.2	Travel			1 domestic trips per year at 1500 per trip = 1500 2 domestic trips per year at 500 per trip = 1000 total: 2500	
2.4.6.4.2.3	Equipment				
2.4.6.4.2.4	Materials and supplies				
2.4.6.5	**FY11**				
2.4.6.5.1	**Argonne Management-FY11**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.4.6.5.1.1	Labor				Physicist - est of 5 weeks per year (i.e slightly less than 2 days per month) spent on subproject-related management and oversight activites (project reporting, informatin gathering, personnel matters, reviews, etc.) not covered elsewhere in the project plan/schedule. Engineer -est of 2.5 weeks per year (i.e slightly less than 1 day per month) spent on subproject-related management and oversight activites (project reporting, information gathering, reviews, etc.) not covered elsewhere in the project plan/schedule.
2.4.6.5.1.2	Travel			2 domestic trips per year at 1500 per trip = 3000 4 domestic trips per year at 500 per trip = 2000 total: 5000	
2.4.6.5.1.3	Equipment				
2.4.6.5.1.4	Materials and supplies				
2.4.6.5.2	**FNAL Management-FY11**				
2.4.6.5.2.1	Labor				Engineer -est of 2.5 weeks per year (i.e slightly less than 1 day per month) spent on subproject-related management and oversight activites (project reporting, information gathering, reviews, etc.) not covered elsewhere in the project plan/schedule.
2.4.6.5.2.2	Travel			1 domestic trips per year at 1500 per trip = 1500 2 domestic trips per year at 500 per trip = 1000 total: 2500	
2.4.6.5.2.3	Equipment				
2.4.6.5.2.4	Materials and supplies				
2.4.6.6	**FY12**				
2.4.6.6.1	**Argonne Management-FY12**				
2.4.6.6.1.1	Labor				Physicist - est of 1 week spread over over Q1 of FY12 spent on subproject-related management and oversight activites (project reporting, informatin gathering, personnel matters, reviews, etc.) as the extrusion subproject winds down.
2.4.6.6.1.2	Travel				
2.4.6.6.1.3	Equipment				
2.4.6.6.1.4	Materials and supplies				
2.4.6.6.2	**FNAL Management-FY12**				
2.4.6.6.2.1	Labor				
2.4.6.6.2.2	Travel				
2.4.6.6.2.3	Equipment				
2.4.6.6.2.4	Materials and supplies				
2.4.6.7	**FY13**				
2.4.6.7.1	**Argonne Management-FY13**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.4.6.7.1.1	Labor				Physicist - est of 1 week spread over over Q1 of FY12 spent on subproject-related management and oversight activites (project reporting, informatin gathering, personnel matters, reviews, etc.) as the extrusion subproject winds down.
2.4.6.7.1.2	Travel				
2.4.6.7.1.3	Equipment				
2.4.6.7.1.4	Materials and supplies				
2.4.6.7.2	**FNAL Management-FY13**				
2.4.6.7.2.1	Labor				
2.4.6.7.2.2	Travel				
2.4.6.7.2.3	Equipment				
2.4.6.7.2.4	Materials and supplies				
2.5	**PVC Modules**	**This level 2 summary element provides for construction and QA of the ~20,000 Far Detector PVC modules and ~400 Near Detector PVC Modules at the module factories and shipping of the completed and tested modules to their respective detector sites.**			
2.5.1	**End Seals**				
2.5.1.1	**Fiber Manifold Production**				
2.5.1.1.1	Prepare fiber manifold final design and specifications				
2.5.1.1.2	Prepare and issue bid package for fabrication				
2.5.1.1.3	Evaluate bids and choose fabricators				
2.5.1.1.4	Prepare purchase order				
2.5.1.1.5	Manifold production purchase orders released				
2.5.1.1.6	Make molds and fabricate preproduction articles				
2.5.1.1.7	Evaluate preproduction articles				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.1.1.8	Fabricate production manifold components			cost/16000 modules Description Mold Cost Part Cost Per Mod Qty Parts Total, Parts & Mold --- Manifold side seal, left $20,000 $1.50 1 $24,000 $44,000 Manifold side seal, right $20,000 $1.50 1 $24,000 $44,000 Manifold center seal $25,000 $2.00 1 $32,000 $57,000 Snout, back $20,000 $2.00 1 $32,000 $52,000 Snout, front $25,000 $2.50 1 $40,000 $65,000 Bottom raceway $40,000 $8.00 1 $128,000 $168,000 Top raceway $80,000 $12.00 1 $192,000 $272,000 Raceway pins $5,000 $.10 10 $16,000 $21,000 Fiber cover $40,000 $8.00 1 $128,000 $168,000 Distributed fill tube $20,000 $3.00 1 $48,000 $68,000 Fill tube manifold $10,000 $1.00 1 $16,000 $26,000 Manifold cover $80,000 $14.00 1 $224,000 $304,000 Fiber ring $8,000 $.25 32 $128,000 $136,000	
2.5.1.1.9	Evaluate samples from full production run				
2.5.1.2	**End Plate and Seal Production**			**$20 / plate X 500 plates = $10k**	
2.5.1.2.1	Prepare end plate and seal final design and specifications				
2.5.1.2.2	Prepare and issue bid packages for fabrication				
2.5.1.2.3	Evaluate bids and choose fabricators				
2.5.1.2.4	Prepare purchase orders				
2.5.1.2.5	End plate and seals production purchase orders released				
2.5.1.2.6	Procure edge stiffeners	This WBS element provides for the production of edge stiffeners that reinforce the outside two edges of each vertical module plane against the force of hydrostatic pressure. Each vertical plane has two edge stiffeners. In addition, edge stiffeners keep ambient light from entering white PVC modules, serve as a cable tray and a fixture to fasten instruments such as front-end readout hardware.	Edge stiffeners are extruded black PVC strips in the form of U-channel which are glued to two vertical extrusions per plane (1728 total) and one horizontal extrusion (on the top) per plane (810 total). For a total of 39,847 meters of extruded edge stiffeners.	Vendor quote $7.50/side @ 2 sides/plane @15.5 vertical planes/block = $233/block	
2.5.1.2.7	Evaluate preproduction plates and seals				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.1.2.8	Fabricate production end plates and seals			cost/16000 modules Description: End plate side seal — Mold Cost: $20,000 — Part Cost: $1.00 — Per Mod: 2 — Qty per Mod: $32,000 — Total, Parts & Mold: $52,000 Description: End plate center seal — Mold Cost: $20,000 — Part Cost: $1.50 — Per Mod: 1 — Qty per Mod: $24,000 — Total, Parts & Mold: $44,000 Description: End plates — Mold Cost: $40,000 — Part Cost: $15.00 — Per Mod: 1 — Qty per Mod: $240,000 — Total, Parts & Mold: $280,000	
2.5.1.2.9	Evaluate samples from full production run				
2.5.2	**Optical Connector Production**				
2.5.2.1	Prepare optical connector final design and specifications				
2.5.2.2	Prepare and issue bid package for fabrication				
2.5.2.3	Evaluate bids and choose fabricator				
2.5.2.4	Prepare purchase order				
2.5.2.5	Optical connector production purchase order released				
2.5.2.6	Produce optical connectors			cost/16000 modules Description: Optical connector — Mold Cost: $25,000 — Part Cost: $3.00 — Per Mod: 1 — Qty per Mod: $48,000 — Total, Parts & Mold: $73,000	
2.5.3	**Module Production**				
2.5.3.1	**Factory Machines, Tooling, & Fixtures**				
2.5.3.1.1	**Factory 1 - FNAL**				
2.5.3.1.1.1	Fabricate and deliver extrusion lifters	Floor mounted bridge crane and vacuum extrusion lifter.		2 vacuum lifters @ $20000 ea These are the same lifters used at the extrusion factory, the Minnesota factory, the far detector, and the near detector.	
2.5.3.1.1.2	Fabricate and deliver tooling and fixtures			Includes 4 abrading tools @ $1500 each = $6000 4 trim saws @ $1500 each = $6000 misc fixtures @ $8000	
2.5.3.1.1.3	Procure floor cranes				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.1.1.4	Procure material handling and storage equipment			Includes 4 gluing tables @ $8000 each = $32000 1 rolling table @ $3000 1 lifting fixture for overhead crane @$15000 8 extrusion racks @ $2000 each = $16000 Misc. parts @$14000 ---------- Total: 80,000	
2.5.3.1.1.5	Procure glue machines			2 machines made at ANL at $20,000 per machine = $40,000	
2.5.3.1.2	**Factory 2 - UMNTC**				
2.5.3.1.2.1	Fabricate and deliver extrusion lifter(s)	Floor mounted bridge crane and vacuum extrusion lifter.		4 vacuum lifters @ $20000 ea= $80,000 These are the same lifters used at the extrusion factory, the Fermilab factory, the far detector, and the near detector.	
2.5.3.1.2.2	Fabricate and deliver tooling and fixtures			6 vacuum fixtures @ $7000 each = $42000 misc. @ $18000 ---------- Total: $60,000	
2.5.3.1.2.3	Fabricate and deliver pressure testing equipment			3 pressure testers @ $33000 each 1 Minnesota factory 1 Far detector 1 Near detector	
2.5.3.1.2.4	Procure material handling and storage equipment			34 rolling tables @ $3000 each = $102000 10 module racks @ $ 4000 each = $40000 misc @ $18000 ---------- total:	
2.5.3.1.2.5	Procure gluing machines			Separate glue machines are needed for the two glues @ $20000 each This gives a total of 12 needed 2 for each workstation 2 for preparation work and optical connector. ---------- ---- total: $240,000	
2.5.3.1.2.6	Fabricate fiber spooling machine			6 stringing machines are needed @$30000 each = $180,000 1 for each of 5 workstations and 1 spare.	
2.5.3.1.2.7	Fabricate and deliver fiber checking machine			3 machines necessary @$30000 ea = $90,000 1 minnesota factory 1 far detector 1 near detector	
2.5.3.1.2.8	Procure floor cranes			4 floor cranes needed @ $30000 each = $120,000	
2.5.3.1.2.9	Fabricate fiber facing machine			3 fly cutters needed @ $20000 each = $60,000	
2.5.3.3	**Factory Setup**				
2.5.3.3.1	**Factory 1 - FNAL**				
2.5.3.3.1.1	Factory 1 (FNAL) ready for NOVA project occupancy				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.3.1.2	Prep factory space		Wide band lab is assumed location	$10,000 for miscellaneous prep work of the area prior to infrastructure setup	Labor Prepare floor for aircasters - laborers Prepare air handling system - HVAC workers Prepare electrical system - electricians Prepare mechanical infrastructure - mechanical technicians
2.5.3.3.1.3	Identify local storage space				
2.5.3.3.1.4	Local storage space (FNAL) ready for NOVA project occupancy				
2.5.3.3.1.5	Prep storage space			10k for miscellaneous prep work of the area prior to infrastructure setup	Prepare floor for aircasters - laborers Prepare electrical system - electricians Prepare mechanical infrastructure - mechanical technicians
2.5.3.3.1.7	**Infrastructure Setup**				
2.5.3.3.1.7.2	Install material handling and storage equipment		T&M electricians need to connect cranes to building power	Misc materials $10000 Air handling system $30000	Install 8 extrusion racks (10 hr each) - mechanical technicians Install air handling system for glue stations (80 hr) - HVAC workers Install floor cranes (80 hr) - mechanical technicians Install floor cranes (40 hr) - electricians Install database equipment (40 hr) - physicist
2.5.3.3.1.7.3	Fabricate tooling and fixtures-local items			Materials for stack holders ($1500 stack holder) $78000 Misc materials $10000	Labor Build 2 factory stack holders (10 hr each) - mechanical technicians Build 50 storage stack holders (10 hr each) - mechanical technicians Build tool stations (40 hr) - mechanical technicians Build tool stations (20 hr) - electricians
2.5.3.3.1.7.4	Install and setup extrusion lifters			Factory space (56000 sq ft) @ $4/sq ft + $2/sq ft (operating) + $1/sq ft (tax) = $392000/yr storage for 1 month output (20 stacks of modules, 10000 sq ft) = $70000/yr Factory for 3 years = $1.4M	
2.5.3.3.1.7.7	Install and setup gluing machines				
2.5.3.3.1.7.8	Factory 1 (FNAL) ready for module production				
2.5.3.3.2	**Factory 2 - UMNTC**				
2.5.3.3.2.1	Identify factory space				
2.5.3.3.2.2	Lease factory space			($95k per year rental + $25k per year utilities) x 3.3 yrs = $396k	
2.5.3.3.2.3	Prep factory space			Install climate control and air handling system - $150000 Misc. M&S - $20000 Contract electrical work for infrastructure (160 hr) - $16000	
2.5.3.3.2.7	**Infrastructure Setup**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.3.2.7.2	Install and setup thread spooling machines			Misc materials $30000 Air handling system $50000 Contract electrical work for installation (160 hr) - $30000	Build 4 extrusion racks (10 hr each) - mechanical technicians Install air handling system for glue stations (400 hr) - mechanical technicians Install floor cranes (600 hr) - mechanical technicians Install database equipment (120 hr) - physicist
2.5.3.3.2.7.3	Install and setup pressure testing equipment				
2.5.3.3.2.7.4	Install and setup fiber checking machine				
2.5.3.3.2.7.5	Install and setup fiber facing machines				
2.5.3.3.2.7.6	Install and setup gluing machines				
2.5.3.3.2.7.7	Install material handling and storage equipment			electrician time: 8 days x 8 hr/day x100 hr-1= 6400	
2.5.3.3.2.7.8	Install and setup extrusion lifters				
2.5.3.3.2.7.9	Fabricate tooling and fixtures-local items			Misc materials $30000 Contract electrical work for installation (160 hr) - $20000	Build pressure test station (80 hr) - mechanical technicians Build 6 stringing/threading/gluing stations (40 hr each) - mechanical technicians Build 3 optical facing stations (40 hr each)- mechanical technicians
2.5.3.3.2.7.10	Factory 2 (UMNTC) ready for module production				
2.5.3.4	**Module Assembly**				
2.5.3.4.2	**Far Detector**				
2.5.3.4.2.1	**Module Assembly - Block 1 (Type A)**				
2.5.3.4.2.1.1	**Horizontal Modules - Block 1H**				
2.5.3.4.2.1.1.1	Assemble and test far detector modules - FNAL - Block 1H			Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assume factor of 2 efficiency for learning curve including safety training = 381 people minutes/extrusion assembly Assemble 3 /day for first block = 70900 people minutes/block for a time of 62 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.1.1.2	Ship modules to UMNTC - Block 1H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.1.1.3	Assemble and test far detector modules - UMNTC - Block 1H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/extrusion assembly Assume factor of 2 efficiency for learning curve including safety training = 619 people minutes/extrusion assembly Assemble 3 /day for first block = 115072 people minutes/block for a time of 62 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.1.1.4	Ship completed far detector modules to far site - Block 1H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.1.2	**Vertical Modules - Block 1V**				
2.5.3.4.2.1.2.1	Assemble and test far detector modules - FNAL - Block 1V			Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assume factor of 2 efficiency for learning curve including safety training = 381 people minutes/extrusion assembly Assemble 3 /day for first block = 70900 people minutes/block for a time of 62 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.1.2.2	Ship modules to UMNTC - Block 1V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.1.2.3	Assemble and test far detector modules - UMNTC - Block 1V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/extrusion assembly Assume factor of 2 efficiency for learning curve including safety training = 619 people minutes/extrusion assembly Assemble 3 /day for first block = 115072 people minutes/block for a time of 62 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.1.2.4	Ship completed far detector modules to far site - Block 1V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.2	**Module Assembly - Block 2 (Type B)**				
2.5.3.4.2.2.1	**Horizontal Modules - Block 2H**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.2.1.1	Assemble and test far detector modules - FNAL - Block 2H			Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assume factor of 1.5 efficiency for learning curve including safety training = 287 people minutes/extrusion assembly Assemble 6 /day (average) for second block = 53300 people minutes/block for a time of 31 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.2.1.2	Ship modules to UMNTC - Block 2H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.2.1.3	Assemble and test far detector modules - UMNTC - Block 2H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assume factor of 1.5 efficiency for learning curve including safety training = 464 people minutes/module Assemble 6 /day (average) for first block = 86211 people minutes/block for a time of 31 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.2.1.4	Ship completed far detector modules to far site - Block 2H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.2.2	**Vertical Modules - Block 2V**				
2.5.3.4.2.2.2.1	Assemble and test far detector modules - FNAL - Block 2V			Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assume factor of 1.5 efficiency for learning curve including safety training = 287 people minutes/extrusion assembly Assemble 6 /day (average) for second block = 53300 people minutes/block for a time of 31 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.2.2.2	Ship modules to UMNTC - Block 2V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.2.2.3	Assemble and test far detector modules - UMNTC - Block 2V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/extrusion assembly Assume factor of 1.5 efficiency for learning curve including safety training = 464 people minutes/extrusion assembly Assemble 6 /day (average) for second block = 86211 people minutes/block for a time of 31 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.2.2.4	Ship completed far detector modules to far site - Block 2V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.3	**Module Assembly - Block 3 (Type A)**				
2.5.3.4.2.3.1	**Horizontal Modules - Block 3H**				
2.5.3.4.2.3.1.1	Assemble and test far detector modules - FNAL - Block 3H			Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assume factor of 1.2 efficiency for learning curve including safety training = 230 people minutes/extrusion assembly Assemble 18 /day (average) for third block = 42600 people minutes/block for a time of 10 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.3.1.2	Ship modules to UMNTC - Block 3H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.3.1.3	Assemble and test far detector modules - UMNTC - Block 3H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assume factor of 1.2 efficiency for learning curve including safety training = 371 people minutes/module Assemble 18 /day (average) for third block = 68969 people minutes/block for a time of 10 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.3.1.4	Ship completed far detector modules to far site - Block 3H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.3.2	**Vertical Modules - Block 3V**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.3.2.1	Assemble and test far detector modules - FNAL - Block 3V			Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assume factor of 1.2 efficiency for learning curve including safety training = 230 people minutes/extrusion assembly Assemble 18 /day (average) for third block = 42600 people minutes/block for a time of 10 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.3.2.2	Ship modules to UMNTC - Block 3V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.3.2.3	Assemble and test far detector modules - UMNTC - Block 3V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assume factor of 1.2 efficiency for learning curve including safety training = 371 people minutes/module Assemble 18 /day (average) for third block = 68969 people minutes/block for a time of 10 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.3.2.4	Ship completed far detector modules to far site - Block 3V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.4	**Module Assembly - Block 4 (Type B)**				
2.5.3.4.2.4.1	**Horizontal Modules - Block 4H**				
2.5.3.4.2.4.1.1	Assemble and test far detector modules - FNAL - Block 4H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.4.1.2	Ship modules to UMNTC - Block 4H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.4.1.3	Assemble and test far detector modules - UMNTC - Block 4H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.4.1.4	Ship completed far detector modules to far site - Block 4H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.4.2	**Vertical Modules - Block 4V**				
2.5.3.4.2.4.2.1	Assemble and test far detector modules - FNAL - Block 4V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.4.2.2	Ship modules to UMNTC - Block 4V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.4.2.3	Assemble and test far detector modules - UMNTC - Block 4V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.4.2.4	Ship completed far detector modules to far site - Block 4V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.5	**Module Assembly - Block 5 (Type A)**				
2.5.3.4.2.5.1	**Horizontal Modules - Block 5H**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.5.1.1	Assemble and test far detector modules - FNAL - Block 5H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.5.1.2	Ship modules to UMNTC - Block 5H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.5.1.3	Assemble and test far detector modules - UMNTC - Block 5H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.5.1.4	Ship completed far detector modules to far site - Block 5H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.5.2	**Vertical Modules - Block 5V**				
2.5.3.4.2.5.2.1	Assemble and test far detector modules - FNAL - Block 5V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.5.2.2	Ship modules to UMNTC - Block 5V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.5.2.3	Assemble and test far detector modules - UMNTC - Block 5V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.5.2.4	Ship completed far detector modules to far site - Block 5V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.6	**Module Assembly - Block 6 (Type A)**				
2.5.3.4.2.6.1	**Horizontal Modules - Block 6H**				
2.5.3.4.2.6.1.1	Assemble and test far detector modules - FNAL - Block 6H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.6.1.2	Ship modules to UMNTC - Block 6H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.6.1.3	Assemble and test far detector modules - UMNTC - Block 6H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.6.1.4	Ship completed far detector modules to far site - Block 6H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.6.2	**Vertical Modules - Block 6V**				
2.5.3.4.2.6.2.1	Assemble and test far detector modules - FNAL - Block 6V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.6.2.2	Ship modules to UMNTC - Block 6V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.6.2.3	Assemble and test far detector modules - UMNTC - Block 6V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.6.2.4	Ship completed far detector modules to far site - Block 6V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.7	**Module Assembly - Block 7 (Type B)**				
2.5.3.4.2.7.1	**Horizontal Modules - Block 7H**				
2.5.3.4.2.7.1.1	Assemble and test far detector modules - FNAL - Block 7H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.7.1.2	Ship modules to UMNTC - Block 7H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.7.1.3	Assemble and test far detector modules - UMNTC - Block 7H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.7.1.4	Ship completed far detector modules to far site - Block 7H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.7.2	**Vertical Modules - Block 7V**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.7.2.1	Assemble and test far detector modules - FNAL - Block 7V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.7.2.2	Ship modules to UMNTC - Block 7V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.7.2.3	Assemble and test far detector modules - UMNTC - Block 7V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.7.2.4	Ship completed far detector modules to far site - Block 7V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.8	**Module Assembly - Block 8 (Type A)**				
2.5.3.4.2.8.1	**Horizontal Modules - Block 8H**				
2.5.3.4.2.8.1.1	Assemble and test far detector modules - FNAL - Block 8H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.8.1.2	Ship modules to UMNTC - Block 8H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.8.1.3	Assemble and test far detector modules - UMNTC - Block 8H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.8.1.4	Ship completed far detector modules to far site - Block 8H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.8.2	**Vertical Modules - Block 8V**				
2.5.3.4.2.8.2.1	Assemble and test far detector modules - FNAL - Block 8V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.8.2.2	Ship modules to UMNTC - Block 8V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.8.2.3	Assemble and test far detector modules - UMNTC - Block 8V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.8.2.4	Ship completed far detector modules to far site - Block 8V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.9	**Module Assembly - Block 9 (Type B)**				
2.5.3.4.2.9.1	**Horizontal Modules - Block 9H**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.9.1.1	Assemble and test far detector modules - FNAL - Block 9H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.9.1.2	Ship modules to UMNTC - Block 9H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.9.1.3	Assemble and test far detector modules - UMNTC - Block 9H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.9.1.4	Ship completed far detector modules to far site - Block 9H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.9.2	**Vertical Modules - Block 9V**				
2.5.3.4.2.9.2.1	Assemble and test far detector modules - FNAL - Block 9V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.9.2.2	Ship modules to UMNTC - Block 9V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.9.2.3	Assemble and test far detector modules - UMNTC - Block 9V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.9.2.4	Ship completed far detector modules to far site - Block 9V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.10	**Module Assembly - Block 10 (Type A)**				
2.5.3.4.2.10.1	**Horizontal Modules - Block 10H**				
2.5.3.4.2.10.1.1	Assemble and test far detector modules - FNAL - Block 10H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.10.1.2	Ship modules to UMNTC - Block 10H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.10.1.3	Assemble and test far detector modules - UMNTC - Block 10H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.10.1.4	Ship completed far detector modules to far site - Block 10H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.10.2	**Vertical Modules - Block 10V**				
2.5.3.4.2.10.2.1	Assemble and test far detector modules - FNAL - Block 10V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.10.2.2	Ship modules to UMNTC - Block 10V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.10.2.3	Assemble and test far detector modules - UMNTC - Block 10V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.10.2.4	Ship completed far detector modules to far site - Block 10V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.11	**Module Assembly - Block 11 (Type A)**				
2.5.3.4.2.11.1	**Horizontal Modules - Block 11H**				
2.5.3.4.2.11.1.1	Assemble and test far detector modules - FNAL - Block 11H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.11.1.2	Ship modules to UMNTC - Block 11H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.11.1.3	Assemble and test far detector modules - UMNTC - Block 11H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.11.1.4	Ship completed far detector modules to far site - Block 11H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.11.2	**Vertical Modules - Block 11V**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.11.2.1	Assemble and test far detector modules - FNAL - Block 11V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.11.2.2	Ship modules to UMNTC - Block 11V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.11.2.3	Assemble and test far detector modules - UMNTC - Block 11V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.11.2.4	Ship completed far detector modules to far site - Block 11V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.12	**Module Assembly - Block 12 (Type B)**				
2.5.3.4.2.12.1	**Horizontal Modules - Block 12H**				
2.5.3.4.2.12.1.1	Assemble and test far detector modules - FNAL - Block 12H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.12.1.2	Ship modules to UMNTC - Block 12H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.12.1.3	Assemble and test far detector modules - UMNTC - Block 12H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.12.1.4	Ship completed far detector modules to far site - Block 12H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.12.2	**Vertical Modules - Block 12V**				
2.5.3.4.2.12.2.1	Assemble and test far detector modules - FNAL - Block 12V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.12.2.2	Ship modules to UMNTC - Block 12V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.12.2.3	Assemble and test far detector modules - UMNTC - Block 12V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.12.2.4	Ship completed far detector modules to far site - Block 12V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.13	**Module Assembly - Block 13 (Type A)**				
2.5.3.4.2.13.1	**Horizontal Modules - Block 13H**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.13.1.1	Assemble and test far detector modules - FNAL - Block 13H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.13.1.2	Ship modules to UMNTC - Block 13H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.13.1.3	Assemble and test far detector modules - UMNTC - Block 13H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.13.1.4	Ship completed far detector modules to far site - Block 13H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.13.2	**Vertical Modules - Block 13V**				
2.5.3.4.2.13.2.1	Assemble and test far detector modules - FNAL - Block 13V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.13.2.2	Ship modules to UMNTC - Block 13V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.13.2.3	Assemble and test far detector modules - UMNTC - Block 13V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.13.2.4	Ship completed far detector modules to far site - Block 13V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.14	**Module Assembly - Block 14 (Type B)**				
2.5.3.4.2.14.1	**Horizontal Modules - Block 14H**				
2.5.3.4.2.14.1.1	Assemble and test far detector modules - FNAL - Block 14H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.14.1.2	Ship modules to UMNTC - Block 14H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.14.1.3	Assemble and test far detector modules - UMNTC - Block 14H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.14.1.4	Ship completed far detector modules to far site - Block 14H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.14.2	**Vertical Modules - Block 14V**				
2.5.3.4.2.14.2.1	Assemble and test far detector modules - FNAL - Block 14V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.14.2.2	Ship modules to UMNTC - Block 14V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.14.2.3	Assemble and test far detector modules - UMNTC - Block 14V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.14.2.4	Ship completed far detector modules to far site - Block 14V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.15	**Module Assembly - Block 15 (Type A)**				
2.5.3.4.2.15.1	**Horizontal Modules - Block 15H**				
2.5.3.4.2.15.1.1	Assemble and test far detector modules - FNAL - Block 15H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.15.1.2	Ship modules to UMNTC - Block 15H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.15.1.3	Assemble and test far detector modules - UMNTC - Block 15H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.15.1.4	Ship completed far detector modules to far site - Block 15H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.15.2	**Vertical Modules - Block 15V**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.15.2.1	Assemble and test far detector modules - FNAL - Block 15V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.15.2.2	Ship modules to UMNTC - Block 15V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.15.2.3	Assemble and test far detector modules - UMNTC - Block 15V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.15.2.4	Ship completed far detector modules to far site - Block 15V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.16	**Module Assembly - Block 16 (Type A)**				
2.5.3.4.2.16.1	**Horizontal Modules - Block 16H**				
2.5.3.4.2.16.1.1	Assemble and test far detector modules - FNAL - Block 16H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.16.1.2	Ship modules to UMNTC - Block 16H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.16.1.3	Assemble and test far detector modules - UMNTC - Block 16H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.16.1.4	Ship completed far detector modules to far site - Block 16H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.16.2	**Vertical Modules - Block 16V**				
2.5.3.4.2.16.2.1	Assemble and test far detector modules - FNAL - Block 16V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.16.2.2	Ship modules to UMNTC - Block 16V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.16.2.3	Assemble and test far detector modules - UMNTC - Block 16V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.16.2.4	Ship completed far detector modules to far site - Block 16V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.17	**Module Assembly - Block 17 (Type B)**				
2.5.3.4.2.17.1	**Horizontal Modules - Block 17H**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.17.1.1	Assemble and test far detector modules - FNAL - Block 17H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.17.1.2	Ship modules to UMNTC - Block 17H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.17.1.3	Assemble and test far detector modules - UMNTC - Block 17H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.17.1.4	Ship completed far detector modules to far site - Block 17H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.17.2	**Vertical Modules - Block 17V**				
2.5.3.4.2.17.2.1	Assemble and test far detector modules - FNAL - Block 17V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.17.2.2	Ship modules to UMNTC - Block 17V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.17.2.3	Assemble and test far detector modules - UMNTC - Block 17V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.17.2.4	Ship completed far detector modules to far site - Block 17V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.18	**Module Assembly - Block 18 (Type A)**				
2.5.3.4.2.18.1	**Horizontal Modules - Block 18H**				
2.5.3.4.2.18.1.1	Assemble and test far detector modules - FNAL - Block 18H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.18.1.2	Ship modules to UMNTC - Block 18H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.18.1.3	Assemble and test far detector modules - UMNTC - Block 18H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.18.1.4	Ship completed far detector modules to far site - Block 18H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.18.2	**Vertical Modules - Block 18V**				
2.5.3.4.2.18.2.1	Assemble and test far detector modules - FNAL - Block 18V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.18.2.2	Ship modules to UMNTC - Block 18V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.18.2.3	Assemble and test far detector modules - UMNTC - Block 18V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.18.2.4	Ship completed far detector modules to far site - Block 18V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.19	**Module Assembly - Block 19 (Type B)**				
2.5.3.4.2.19.1	**Horizontal Modules - Block 19H**				
2.5.3.4.2.19.1.1	Assemble and test far detector modules - FNAL - Block 19H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.19.1.2	Ship modules to UMNTC - Block 19H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.19.1.3	Assemble and test far detector modules - UMNTC - Block 19H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.19.1.4	Ship completed far detector modules to far site - Block 19H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.19.2	**Vertical Modules - Block 19V**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.19.2.1	Assemble and test far detector modules - FNAL - Block 19V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.19.2.2	Ship modules to UMNTC - Block 19V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.19.2.3	Assemble and test far detector modules - UMNTC - Block 19V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.19.2.4	Ship completed far detector modules to far site - Block 19V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.20	**Module Assembly - Block 20 (Type A)**				
2.5.3.4.2.20.1	**Horizontal Modules - Block 20H**				
2.5.3.4.2.20.1.1	Assemble and test far detector modules - FNAL - Block 20H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.20.1.2	Ship modules to UMNTC - Block 20H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.20.1.3	Assemble and test far detector modules - UMNTC - Block 20H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.20.1.4	Ship completed far detector modules to far site - Block 20H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.20.2	**Vertical Modules - Block 20V**				
2.5.3.4.2.20.2.1	Assemble and test far detector modules - FNAL - Block 20V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.20.2.2	Ship modules to UMNTC - Block 20V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.20.2.3	Assemble and test far detector modules - UMNTC - Block 20V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.20.2.4	Ship completed far detector modules to far site - Block 20V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.21	**Module Assembly - Block 21 (Type A)**				
2.5.3.4.2.21.1	**Horizontal Modules - Block 21H**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.21.1.1	Assemble and test far detector modules - FNAL - Block 21H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.21.1.2	Ship modules to UMNTC - Block 21H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.21.1.3	Assemble and test far detector modules - UMNTC - Block 21H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.21.1.4	Ship completed far detector modules to far site - Block 21H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.21.2	**Vertical Modules - Block 21V**				
2.5.3.4.2.21.2.1	Assemble and test far detector modules - FNAL - Block 21V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.21.2.2	Ship modules to UMNTC - Block 21V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.21.2.3	Assemble and test far detector modules - UMNTC - Block 21V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.21.2.4	Ship completed far detector modules to far site - Block 21V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.22	**Module Assembly - Block 22 (Type B)**				
2.5.3.4.2.22.1	**Horizontal Modules - Block 22H**				
2.5.3.4.2.22.1.1	Assemble and test far detector modules - FNAL - Block 22H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.22.1.2	Ship modules to UMNTC - Block 22H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.22.1.3	Assemble and test far detector modules - UMNTC - Block 22H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.22.1.4	Ship completed far detector modules to far site - Block 22H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.22.2	**Vertical Modules - Block 22V**				
2.5.3.4.2.22.2.1	Assemble and test far detector modules - FNAL - Block 22V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.22.2.2	Ship modules to UMNTC - Block 22V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.22.2.3	Assemble and test far detector modules - UMNTC - Block 22V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.22.2.4	Ship completed far detector modules to far site - Block 22V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.23	**Module Assembly - Block 23 (Type A)**				
2.5.3.4.2.23.1	**Horizontal Modules - Block 23H**				
2.5.3.4.2.23.1.1	Assemble and test far detector modules - FNAL - Block 23H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.23.1.2	Ship modules to UMNTC - Block 23H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.23.1.3	Assemble and test far detector modules - UMNTC - Block 23H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.23.1.4	Ship completed far detector modules to far site - Block 23H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.23.2	**Vertical Modules - Block 23V**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.23.2.1	Assemble and test far detector modules - FNAL - Block 23V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.23.2.2	Ship modules to UMNTC - Block 23V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.23.2.3	Assemble and test far detector modules - UMNTC - Block 23V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.23.2.4	Ship completed far detector modules to far site - Block 23V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.24	**Module Assembly - Block 24 (Type B)**				
2.5.3.4.2.24.1	**Horizontal Modules - Block 24H**				
2.5.3.4.2.24.1.1	Assemble and test far detector modules - FNAL - Block 24H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.24.1.2	Ship modules to UMNTC - Block 24H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.24.1.3	Assemble and test far detector modules - UMNTC - Block 24H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.24.1.4	Ship completed far detector modules to far site - Block 24H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.24.2	**Vertical Modules - Block 24V**				
2.5.3.4.2.24.2.1	Assemble and test far detector modules - FNAL - Block 24V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.24.2.2	Ship modules to UMNTC - Block 24V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.24.2.3	Assemble and test far detector modules - UMNTC - Block 24V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.24.2.4	Ship completed far detector modules to far site - Block 24V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.25	**Module Assembly - Block 25 (Type A)**				
2.5.3.4.2.25.1	**Horizontal Modules - Block 25H**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.25.1.1	Assemble and test far detector modules - FNAL - Block 25H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.25.1.2	Ship modules to UMNTC - Block 25H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.25.1.3	Assemble and test far detector modules - UMNTC - Block 25H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.25.1.4	Ship completed far detector modules to far site - Block 25H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.25.2	**Vertical Modules - Block 25V**				
2.5.3.4.2.25.2.1	Assemble and test far detector modules - FNAL - Block 25V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.25.2.2	Ship modules to UMNTC - Block 25V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.25.2.3	Assemble and test far detector modules - UMNTC - Block 25V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.25.2.4	Ship completed far detector modules to far site - Block 25V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.26	**Module Assembly - Block 26 (Type A)**				
2.5.3.4.2.26.1	**Horizontal Modules - Block 26H**				
2.5.3.4.2.26.1.1	Assemble and test far detector modules - FNAL - Block 26H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.26.1.2	Ship modules to UMNTC - Block 26H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.26.1.3	Assemble and test far detector modules - UMNTC - Block 26H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.26.1.4	Ship completed far detector modules to far site - Block 26H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.26.2	**Vertical Modules - Block 26V**				
2.5.3.4.2.26.2.1	Assemble and test far detector modules - FNAL - Block 26V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.26.2.2	Ship modules to UMNTC - Block 26V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.26.2.3	Assemble and test far detector modules - UMNTC - Block 26V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.26.2.4	Ship completed far detector modules to far site - Block 26V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.27	**Module Assembly - Block 27 (Type B)**				
2.5.3.4.2.27.1	**Horizontal Modules - Block 27H**				
2.5.3.4.2.27.1.1	Assemble and test far detector modules - FNAL - Block 27H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.27.1.2	Ship modules to UMNTC - Block 27H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.27.1.3	Assemble and test far detector modules - UMNTC - Block 27H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.27.1.4	Ship completed far detector modules to far site - Block 27H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.27.2	**Vertical Modules - Block 27V**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.27.2.1	Assemble and test far detector modules - FNAL - Block 27V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.27.2.2	Ship modules to UMNTC - Block 27V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.27.2.3	Assemble and test far detector modules - UMNTC - Block 27V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.27.2.4	Ship completed far detector modules to far site - Block 27V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.28	**Module Assembly - Block 28 (Type A)**				
2.5.3.4.2.28.1	**Horizontal Modules - Block 28H**				
2.5.3.4.2.28.1.1	Assemble and test far detector modules - FNAL - Block 28H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.28.1.2	Ship modules to UMNTC - Block 28H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.28.1.3	Assemble and test far detector modules - UMNTC - Block 28H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.28.1.4	Ship completed far detector modules to far site - Block 28H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.28.2	**Vertical Modules - Block 28V**				
2.5.3.4.2.28.2.1	Assemble and test far detector modules - FNAL - Block 28V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.28.2.2	Ship modules to UMNTC - Block 28V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.28.2.3	Assemble and test far detector modules - UMNTC - Block 28V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.28.2.4	Ship completed far detector modules to far site - Block 28V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.29	**Module Assembly - Block 29 (Type B)**				
2.5.3.4.2.29.1	**Horizontal Modules - Block 29H**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.29.1.1	Assemble and test far detector modules - FNAL - Block 29H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.29.1.2	Ship modules to UMNTC - Block 29H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.29.1.3	Assemble and test far detector modules - UMNTC - Block 29H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.29.1.4	Ship completed far detector modules to far site - Block 29H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.29.2	**Vertical Modules - Block 29V**				
2.5.3.4.2.29.2.1	Assemble and test far detector modules - FNAL - Block 29V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.29.2.2	Ship modules to UMNTC - Block 29V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.29.2.3	Assemble and test far detector modules - UMNTC - Block 29V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.29.2.4	Ship completed far detector modules to far site - Block 29V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.30	**Module Assembly - Block 30 (Type A)**				
2.5.3.4.2.30.1	**Horizontal Modules - Block 30H**				
2.5.3.4.2.30.1.1	Assemble and test far detector modules - FNAL - Block 30H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.30.1.2	Ship modules to UMNTC - Block 30H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.30.1.3	Assemble and test far detector modules - UMNTC - Block 30H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.30.1.4	Ship completed far detector modules to far site - Block 30H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.30.2	**Vertical Modules - Block 30V**				
2.5.3.4.2.30.2.1	Assemble and test far detector modules - FNAL - Block 30V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.30.2.2	Ship modules to UMNTC - Block 30V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.30.2.3	Assemble and test far detector modules - UMNTC - Block 30V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.30.2.4	Ship completed far detector modules to far site - Block 30V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.31	**Module Assembly - Block 31 (Type A)**				
2.5.3.4.2.31.1	**Horizontal Modules - Block 31H**				
2.5.3.4.2.31.1.1	Assemble and test far detector modules - FNAL - Block 31H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.31.1.2	Ship modules to UMNTC - Block 31H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.31.1.3	Assemble and test far detector modules - UMNTC - Block 31H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.31.1.4	Ship completed far detector modules to far site - Block 31H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.31.2	**Vertical Modules - Block 31V**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.31.2.1	Assemble and test far detector modules - FNAL - Block 31V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.31.2.2	Ship modules to UMNTC - Block 31V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.31.2.3	Assemble and test far detector modules - UMNTC - Block 31V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.31.2.4	Ship completed far detector modules to far site - Block 31V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.32	**Module Assembly - Block 32 (Type B)**				
2.5.3.4.2.32.1	**Horizontal Modules - Block 32H**				
2.5.3.4.2.32.1.1	Assemble and test far detector modules - FNAL - Block 32H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.32.1.2	Ship modules to UMNTC - Block 32H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.32.1.3	Assemble and test far detector modules - UMNTC - Block 32H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.32.1.4	Ship completed far detector modules to far site - Block 32H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.32.2	**Vertical Modules - Block 32V**				
2.5.3.4.2.32.2.1	Assemble and test far detector modules - FNAL - Block 32V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.32.2.2	Ship modules to UMNTC - Block 32V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.32.2.3	Assemble and test far detector modules - UMNTC - Block 32V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.32.2.4	Ship completed far detector modules to far site - Block 32V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.33	**Module Assembly - Block 33 (Type A)**				
2.5.3.4.2.33.1	**Horizontal Modules - Block 33H**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.33.1.1	Assemble and test far detector modules - FNAL - Block 33H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.33.1.2	Ship modules to UMNTC - Block 33H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.33.1.3	Assemble and test far detector modules - UMNTC - Block 33H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.33.1.4	Ship completed far detector modules to far site - Block 33H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.33.2	**Vertical Modules - Block 33V**				
2.5.3.4.2.33.2.1	Assemble and test far detector modules - FNAL - Block 33V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.33.2.2	Ship modules to UMNTC - Block 33V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.33.2.3	Assemble and test far detector modules - UMNTC - Block 33V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.33.2.4	Ship completed far detector modules to far site - Block 33V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.34	**Module Assembly - Block 34 (Type B)**				
2.5.3.4.2.34.1	**Horizontal Modules - Block 34H**				
2.5.3.4.2.34.1.1	Assemble and test far detector modules - FNAL - Block 34H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.34.1.2	Ship modules to UMNTC - Block 34H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.34.1.3	Assemble and test far detector modules - UMNTC - Block 34H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.34.1.4	Ship completed far detector modules to far site - Block 34H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.34.2	**Vertical Modules - Block 34V**				
2.5.3.4.2.34.2.1	Assemble and test far detector modules - FNAL - Block 34V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.34.2.2	Ship modules to UMNTC - Block 34V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.34.2.3	Assemble and test far detector modules - UMNTC - Block 34V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.34.2.4	Ship completed far detector modules to far site - Block 34V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.35	**Module Assembly - Block 35 (Type A)**				
2.5.3.4.2.35.1	**Horizontal Modules - Block 35H**				
2.5.3.4.2.35.1.1	Assemble and test far detector modules - FNAL - Block 35H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.35.1.2	Ship modules to UMNTC - Block 35H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.35.1.3	Assemble and test far detector modules - UMNTC - Block 35H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.35.1.4	Ship completed far detector modules to far site - Block 35H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.35.2	**Vertical Modules - Block 35V**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.35.2.1	Assemble and test far detector modules - FNAL - Block 35V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.35.2.2	Ship modules to UMNTC - Block 35V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.35.2.3	Assemble and test far detector modules - UMNTC - Block 35V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.35.2.4	Ship completed far detector modules to far site - Block 35V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.36	**Module Assembly - Block 36 (Type A)**				
2.5.3.4.2.36.1	**Horizontal Modules - Block 36H**				
2.5.3.4.2.36.1.1	Assemble and test far detector modules - FNAL - Block 36H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.36.1.2	Ship modules to UMNTC - Block 36H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.36.1.3	Assemble and test far detector modules - UMNTC - Block 36H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.36.1.4	Ship completed far detector modules to far site - Block 36H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.36.2	**Vertical Modules - Block 36V**				
2.5.3.4.2.36.2.1	Assemble and test far detector modules - FNAL - Block 36V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.36.2.2	Ship modules to UMNTC - Block 36V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.36.2.3	Assemble and test far detector modules - UMNTC - Block 36V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.36.2.4	Ship completed far detector modules to far site - Block 36V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.37	**Module Assembly - Block 37 (Type B)**				
2.5.3.4.2.37.1	**Horizontal Modules - Block 37H**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.37.1.1	Assemble and test far detector modules - FNAL - Block 37H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.37.1.2	Ship modules to UMNTC - Block 37H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.37.1.3	Assemble and test far detector modules - UMNTC - Block 37H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.37.1.4	Ship completed far detector modules to far site - Block 37H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.37.2	**Vertical Modules - Block 37V**				
2.5.3.4.2.37.2.1	Assemble and test far detector modules - FNAL - Block 37V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.37.2.2	Ship modules to UMNTC - Block 37V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.37.2.3	Assemble and test far detector modules - UMNTC - Block 37V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.37.2.4	Ship completed far detector modules to far site - Block 37V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.38	**Module Assembly - Block 38 (Type A)**				
2.5.3.4.2.38.1	**Horizontal Modules - Block 38H**				
2.5.3.4.2.38.1.1	Assemble and test far detector modules - FNAL - Block 38H			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.38.1.2	Ship modules to UMNTC - Block 38H			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	
2.5.3.4.2.38.1.3	Assemble and test far detector modules - UMNTC - Block 38H			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.38.1.4	Ship completed far detector modules to far site - Block 38H			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.38.2	**Vertical Modules - Block 38V**				
2.5.3.4.2.38.2.1	Assemble and test far detector modules - FNAL - Block 38V			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for all further blocks = 35526 people minutes/block for a time of 7 days Glue amount = 500 ml (0.13 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $9.20/assembly = $1800/block	
2.5.3.4.2.38.2.2	Ship modules to UMNTC - Block 38V			Shipping cost per truckload of 30 assemblies = $765 Ship 6 truckloads = $4590	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.2.38.2.3	Assemble and test far detector modules - UMNTC - Block 38V			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for all blocks = 57474 people minutes/block for a time of 7 days Glue amount 1 = 400 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.2.38.2.4	Ship completed far detector modules to far site - Block 38V			Shipping cost per truckload of 30 modules = $820 Ship 6 truckloads = $4920	
2.5.3.4.2.45	**Module Assembly Milestones**				
2.5.3.4.2.45.44	Far detector module assembly started				
2.5.3.4.2.45.45	Far detector modules for superblock 1 completed				
2.5.3.4.2.45.50	Far detector modules for superblock 2 completed				
2.5.3.4.2.45.60	Far detector modules for superblock 3 completed				
2.5.3.4.2.45.70	Far detector modules for superblock 4 completed				
2.5.3.4.2.45.80	Far detector modules for superblock 5 completed				
2.5.3.4.2.45.90	Far detector modules for superblock 6 completed				
2.5.3.4.2.45.100	Far detector modules for superblock 7 completed				
2.5.3.4.2.45.110	Far detector modules for superblock 8 completed				
2.5.3.4.2.45.120	All far detector modules completed				
2.5.3.4.3	**Near Detector**				
2.5.3.4.3.1	Modify/complete tooling for near detector modules at FNAL				
2.5.3.4.3.2	Modify/complete tooling for near detector modules at UMNTC				
2.5.3.4.3.25	Near detector module fabrication started				
2.5.3.4.3.30	Assemble and test near detector modules - FNAL			Now at full production rate Extrusion assembly time including QA = 143 people minutes/extrusion assembly Assume effective 6 hrs/ 8hr shift = 191 people minutes/extrusion assembly Assemble 30 /day for near detector = 95500 people minutes/near detector for a time of 17 days Glue amount = 320 ml (0.08 gal) Devcon Plastic Welder per assembly @ $69.70/gal = $5.80/assembly = $3000/Near detector	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.3.4.3.40	Ship near detector modules to UMNTC			Shipping cost per truckload of 30 assemblies = $765 Ship 12 truckloads = $9180 Assume short modules take up 1/3 space of long ones.	
2.5.3.4.3.50	Assemble and test near detector modules - UMNTC			Module assembly time including QA = 232 people minutes/module Assume effective 6 hrs/ 8hr shift = 309 people minutes/module Assemble 30 /day for near detector = 154500 people minutes/block for a time of 17 days Glue amount 1 = 300 ml (0.11 gal) Devcon Plastic Welder per module @ $69.70/gal = $7.40/module = $1370/block Glue amount 2 = 300 ml (0.08 gal) 3M2216 per module @ $143.00/gal = $11.30/module = $2100/block	
2.5.3.4.3.60	Ship completed near detector modules to ANL			Shipping cost per truckload of 30 assemblies = $765 Ship 12 truckloads = $9180 Assume short modules take up 1/3 space of long ones.	
2.5.3.4.3.80	All near detector modules completed				
2.5.4	**Management - Construction Phase**	**This WBS element includes the tasks required to support and manage WBS 2.5 activities including quality assurance, value management, risk management, monitoring of factory performance and schedule, preparation of reports and other related activities.**			
2.5.4.2	**FY08**				
2.5.4.2.1	Labor				Physicist - est of 5 weeks per year (i.e slightly less than 2 days per month) spent on subproject-related management and oversight activites (project reporting, informatin gathering, personnel matters, reviews, etc.) not covered elsewhere in the project plan/schedule. Engineer -est of 2.5 weeks per year (i.e slightly less than 1 day per month) spent on subproject-related management and oversight activites (project reporting, information gathering, reviews, etc.) not covered elsewhere in the project plan/schedule.
2.5.4.2.2	Travel			2 domestic trips per year at 1500 per trip = 3000 total: 3000	
2.5.4.2.3	Equipment				
2.5.4.2.4	Materials and supplies				
2.5.4.3	**FY09**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.4.3.1	Labor				Physicist - est of 5 weeks per year (i.e slightly less than 2 days per month) spent on subproject-related management and oversight activites (project reporting, informatin gathering, personnel matters, reviews, etc.) not covered elsewhere in the project plan/schedule. Engineer -est of 2.5 weeks per year (i.e slightly less than 1 day per month) spent on subproject-related management and oversight activites (project reporting, information gathering, reviews, etc.) not covered elsewhere in the project plan/schedule.
2.5.4.3.2	Travel			3 domestic trips per year at 1500 per trip = 4500 total: 4500	
2.5.4.3.3	Equipment				
2.5.4.3.4	Materials and supplies				
2.5.4.4	**FY10**				
2.5.4.4.1	Labor				Physicist - est of 5 weeks per year (i.e slightly less than 2 days per month) spent on subproject-related management and oversight activites (project reporting, informatin gathering, personnel matters, reviews, etc.) not covered elsewhere in the project plan/schedule. Engineer -est of 2.5 weeks per year (i.e slightly less than 1 day per month) spent on subproject-related management and oversight activites (project reporting, information gathering, reviews, etc.) not covered elsewhere in the project plan/schedule.
2.5.4.4.2	Travel			3 domestic trips per year at 1500 per trip = 4500 total: 4500	
2.5.4.4.3	Equipment				
2.5.4.4.4	Materials and supplies				
2.5.4.5	**FY11**				
2.5.4.5.1	Labor				Physicist - est of 5 weeks per year (i.e slightly less than 2 days per month) spent on subproject-related management and oversight activites (project reporting, informatin gathering, personnel matters, reviews, etc.) not covered elsewhere in the project plan/schedule. Engineer -est of 2.5 weeks per year (i.e slightly less than 1 day per month) spent on subproject-related management and oversight activites (project reporting, information gathering, reviews, etc.) not covered elsewhere in the project plan/schedule.
2.5.4.5.2	Travel			2 domestic trips per year at 1500 per trip = 3000 total: 3000	
2.5.4.5.3	Equipment				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.5.4.5.4	Materials and supplies				
2.5.4.6	**FY12**				
2.5.4.6.1	Labor				Physicist - est of 1 week spread over over Q1 of FY12 spent on subproject-related management and oversight activites (project reporting, informatin gathering, personnel matters, reviews, etc.) as the extrusion subproject winds down.
2.5.4.6.2	Travel				
2.5.4.6.3	Equipment				
2.5.4.6.4	Materials and supplies				
2.6	**Electronics Production**				
2.6.1	**APD Module Production**	**APDs and board for mounting, delivers signals to readout board.**			
2.6.1.1	**APD Heat Sink Housing**				
2.6.1.1.1	**Injection Molded Parts**				
2.6.1.1.1.1	Prepare purchase order				
2.6.1.1.1.2	PO released- injection molded parts				
2.6.1.1.1.3	Manufacture mold				
2.6.1.1.1.4	Manufacture injection molded parts	Buy arrays from Hamamatsu.			
2.6.1.1.2	**TE Coolers**				
2.6.1.1.2.1	Prepare purchase order				
2.6.1.1.2.2	PO released-TE coolers				
2.6.1.1.2.3	Manufacture TE coolers			21120 TE coolers @$7.9each = $166,848k (for 20 kt. with ~10% spares)	
2.6.1.1.3	Assemble and test APD housings				
2.6.1.1.4	APD housings completed and tested - superblock 1				
2.6.1.1.5	APD housings completed and tested - superblock 2				
2.6.1.1.6	APD housings completed and tested - superblock 3				
2.6.1.1.7	APD housings completed and tested - superblock 4				
2.6.1.1.8	APD housings completed and tested - superblock 5				
2.6.1.1.9	APD housings completed and tested - superblock6				
2.6.1.1.10	APD housings completed and tested - superblock 7				
2.6.1.1.11	All APD housings completed and tested				
2.6.1.2	**APD Arrays**				
2.6.1.2.1	Prepare purchase order				
2.6.1.2.2	PO released-APDs				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.6.1.2.3	**APD Array Manufacturing**	**Buy arrays from Hamamatsu.**		**(14,136 + 864) * $260 = $3.9M (base cost) for 38-block detector** **includes ~6% spares, for a total of 15,000 APDs @ $260 per APD** **CMS APD failure rate experience indicates 5% spares is sufficient.**	
2.6.1.2.3.1	Manufacture and deliver APDs - Block 1				
2.6.1.2.3.2	Manufacture and deliver APDs - Block 2				
2.6.1.2.3.3	Manufacture and deliver APDs - Block 3				
2.6.1.2.3.4	Manufacture and deliver APDs - Block 4				
2.6.1.2.3.5	Manufacture and deliver APDs - Block 5				
2.6.1.2.3.6	Manufacture and deliver APDs - Block 6				
2.6.1.2.3.7	Manufacture and deliver APDs - Block 7				
2.6.1.2.3.8	Manufacture and deliver APDs - Block 8				
2.6.1.2.3.9	Manufacture and deliver APDs - Block 9				
2.6.1.2.3.10	Manufacture and deliver APDs - Block 10				
2.6.1.2.3.11	Manufacture and deliver APDs - Block 11				
2.6.1.2.3.12	Manufacture and deliver APDs - Block 12				
2.6.1.2.3.13	Manufacture and deliver APDs - Block 13				
2.6.1.2.3.14	Manufacture and deliver APDs - Block 14				
2.6.1.2.3.15	Manufacture and deliver APDs - Block 15				
2.6.1.2.3.16	Manufacture and deliver APDs - Block 16				
2.6.1.2.3.17	Manufacture and deliver APDs - Block 17				
2.6.1.2.3.18	Manufacture and deliver APDs - Block 18				
2.6.1.2.3.19	Manufacture and deliver APDs - Block 19				
2.6.1.2.3.20	Manufacture and deliver APDs - Block 20				
2.6.1.2.3.21	Manufacture and deliver APDs - Block 21				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.6.1.2.3.22	Manufacture and deliver APDs - Block 22				
2.6.1.2.3.23	Manufacture and deliver APDs - Block 23				
2.6.1.2.3.24	Manufacture and deliver APDs - Block 24				
2.6.1.2.3.25	Manufacture and deliver APDs - Block 25				
2.6.1.2.3.26	Manufacture and deliver APDs - Block 26				
2.6.1.2.3.27	Manufacture and deliver APDs - Block 27				
2.6.1.2.3.28	Manufacture and deliver APDs - Block 28				
2.6.1.2.3.29	Manufacture and deliver APDs - Block 29				
2.6.1.2.3.30	Manufacture and deliver APDs - Block 30				
2.6.1.2.3.31	Manufacture and deliver APDs - Block 31				
2.6.1.2.3.32	Manufacture and deliver APDs - Block 32				
2.6.1.2.3.33	Manufacture and deliver APDs - Block 33				
2.6.1.2.3.34	Manufacture and deliver APDs - Block 34				
2.6.1.2.3.35	Manufacture and deliver APDs - Block 35				
2.6.1.2.3.36	Manufacture and deliver APDs - Block 36				
2.6.1.2.3.37	Manufacture and deliver APDs - Block 37				
2.6.1.2.3.38	Manufacture and deliver APDs - Block 38				
2.6.1.2.3.39	Manufacture and deliver APDs - Near Detector		budget and labor for near detector APDs included in the total for the far detector APD manufacturing tasks		
2.6.1.2.4	**APD Carrier Board Machining**	**Buy arrays from Hamamatsu.**		**(14,136 + 864) * $260 = $3.9M (base cost) for 38-block detector includes ~6% spares, for a total of 15,000 APDs @ $260 per APD CMS APD failure rate experience indicates 5% spares is sufficient.**	
2.6.1.2.4.1	Machine APD carrier boards - Block 1				
2.6.1.2.4.2	Machine APD carrier boards - Block 2				
2.6.1.2.4.3	Machine APD carrier boards - Block 3				
2.6.1.2.4.4	Machine APD carrier boards - Block 4				
2.6.1.2.4.5	Machine APD carrier boards - Block 5				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.6.1.2.4.6	Machine APD carrier boards - Block 6				
2.6.1.2.4.7	Machine APD carrier boards - Block 7				
2.6.1.2.4.8	Machine APD carrier boards - Block 8				
2.6.1.2.4.9	Machine APD carrier boards - Block 9				
2.6.1.2.4.10	Machine APD carrier boards - Block 10				
2.6.1.2.4.11	Machine APD carrier boards - Block 11				
2.6.1.2.4.12	Machine APD carrier boards - Block 12				
2.6.1.2.4.13	Machine APD carrier boards - Block 13				
2.6.1.2.4.14	Machine APD carrier boards - Block 14				
2.6.1.2.4.15	Machine APD carrier boards - Block 15				
2.6.1.2.4.16	Machine APD carrier boards - Block 16				
2.6.1.2.4.17	Machine APD carrier boards - Block 17				
2.6.1.2.4.18	Machine APD carrier boards - Block 18				
2.6.1.2.4.19	Machine APD carrier boards - Block 19				
2.6.1.2.4.20	Machine APD carrier boards - Block 20				
2.6.1.2.4.21	Machine APD carrier boards - Block 21				
2.6.1.2.4.22	Machine APD carrier boards - Block 22				
2.6.1.2.4.23	Machine APD carrier boards - Block 23				
2.6.1.2.4.24	Machine APD carrier boards - Block 24				
2.6.1.2.4.25	Machine APD carrier boards - Block 25				
2.6.1.2.4.26	Machine APD carrier boards - Block 26				
2.6.1.2.4.27	Machine APD carrier boards - Block 27				
2.6.1.2.4.28	Machine APD carrier boards - Block 28				
2.6.1.2.4.29	Machine APD carrier boards - Block 29				
2.6.1.2.4.30	Machine APD carrier boards - Block 30				
2.6.1.2.4.31	Machine APD carrier boards - Block 31				
2.6.1.2.4.32	Machine APD carrier boards - Block 32				
2.6.1.2.4.33	Machine APD carrier boards - Block 33				
2.6.1.2.4.34	Machine APD carrier boards - Block 34				
2.6.1.2.4.35	Machine APD carrier boards - Block 35				
2.6.1.2.4.36	Machine APD carrier boards - Block 36				
2.6.1.2.4.37	Machine APD carrier boards - Block 37				
2.6.1.2.4.38	Machine APD carrier boards - Block 38				
2.6.1.2.4.39	Machine APD carrier boards - Near Detector		budget and labor for near detector APDs included in the total for the far detector APD manufacturing tasks		
2.6.1.2.5	**APD Array Delivery Milestones**				
2.6.1.2.5.1	APDs for superblock 1 delivered				
2.6.1.2.5.2	APDs for superblock 2 delivered				
2.6.1.2.5.3	APDs for superblock 3 delivered				
2.6.1.2.5.4	APDs for superblock 4 delivered				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.6.1.2.5.5	APDs for superblock 5 delivered				
2.6.1.2.5.6	APDs for superblock 6 delivered				
2.6.1.2.5.7	APDs for superblock 7 delivered				
2.6.1.2.5.8	All APD arrays delivered				
2.6.1.3	**APD Module Testing**	**Assemble components into modules.**			
2.6.1.3.1	**APD Module Testing - Cal Tech**	**Test modules.**			
2.6.1.3.1.1	Test APD modules - CT - Block 1	Test modules.			
2.6.1.3.1.3	Test APD modules - CT - Block 3	Test modules.			
2.6.1.3.1.5	Test APD modules - CT - Block 5	Test modules.			
2.6.1.3.1.7	Test APD modules - CT - Block 7	Test modules.			
2.6.1.3.1.9	Test APD modules - CT - Block 9	Test modules.			
2.6.1.3.1.11	Test APD modules - CT - Block 11	Test modules.			
2.6.1.3.1.13	Test APD modules - CT - Block 13	Test modules.			
2.6.1.3.1.15	Test APD modules - CT - Block 15	Test modules.			
2.6.1.3.1.17	Test APD modules - CT - Block 17	Test modules.			
2.6.1.3.1.19	Test APD modules - CT - Block 19	Test modules.			
2.6.1.3.1.21	Test APD modules - CT - Block 21	Test modules.			
2.6.1.3.1.23	Test APD modules - CT - Block 23	Test modules.			
2.6.1.3.1.25	Test APD modules - CT - Block 25	Test modules.			
2.6.1.3.1.27	Test APD modules - CT - Block 27	Test modules.			
2.6.1.3.1.29	Test APD modules - CT - Block 29	Test modules.			
2.6.1.3.1.31	Test APD modules - CT - Block 31	Test modules.			
2.6.1.3.1.33	Test APD modules - CT - Block 33	Test modules.			
2.6.1.3.1.35	Test APD modules - CT - Block 35	Test modules.			
2.6.1.3.1.37	Test APD modules - CT - Block 37	Test modules.			
2.6.1.3.1.39	Test APD modules - CT - Near Detector	Test modules.	budget and labor for near detector APDs included in the total for the far detector testing tasks		
2.6.1.3.2	**APD Module Testing - Minnesota**	**Test modules.**			
2.6.1.3.2.2	Test APD modules - UMINN - Block 2	Test modules.			
2.6.1.3.2.4	Test APD modules - UMINN - Block 4	Test modules.			
2.6.1.3.2.6	Test APD modules - UMINN - Block 6	Test modules.			
2.6.1.3.2.8	Test APD modules - UMINN - Block8	Test modules.			
2.6.1.3.2.10	Test APD modules - UMINN - Block 10	Test modules.			
2.6.1.3.2.12	Test APD modules - UMINN - Block 12	Test modules.			
2.6.1.3.2.14	Test APD modules - UMINN - Block 14	Test modules.			
2.6.1.3.2.16	Test APD modules - UMINN - Block 16	Test modules.			
2.6.1.3.2.18	Test APD modules - UMINN - Block 18	Test modules.			
2.6.1.3.2.20	Test APD modules - UMINN - Block 20	Test modules.			
2.6.1.3.2.22	Test APD modules - UMINN - Block 22	Test modules.			
2.6.1.3.2.24	Test APD modules - UMINN - Block 24	Test modules.			

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.6.1.3.2.26	Test APD modules - UMINN - Block 26	Test modules.			
2.6.1.3.2.28	Test APD modules - UMINN - Block 28	Test modules.			
2.6.1.3.2.30	Test APD modules - UMINN - Block 30	Test modules.			
2.6.1.3.2.32	Test APD modules - UMINN - Block 32	Test modules.			
2.6.1.3.2.34	Test APD modules - UMINN - Block 34	Test modules.			
2.6.1.3.2.36	Test APD modules - UMINN - Block 36	Test modules.			
2.6.1.3.2.38	Test APD modules - UMINN - Block 38	Test modules.			
2.6.1.3.30	APD modules assembled and tested				
2.6.1.4	**APD Module Shipping**	**package and ship tested module to far detector site.**		**88 shipments at $100 per shipment (packaging and shipping costs)**	**1 hr tech tiome per shipment for packing, etc.**
2.6.1.4.1	**APD Module Shipping - Cal Tech**	**Test modules.**			
2.6.1.4.1.1	Ship APD modules - CT - Block 1	Ship modules.			
2.6.1.4.1.3	Ship APD modules - CT - Block 3	Ship modules.			
2.6.1.4.1.5	Ship APD modules - CT - Block 5	Ship modules.			
2.6.1.4.1.7	Ship APD modules - CT - Block 7	Ship modules.			
2.6.1.4.1.9	Ship APD modules - CT - Block 9	Ship modules.			
2.6.1.4.1.11	Ship APD modules - CT - Block 11	Ship modules.			
2.6.1.4.1.13	Ship APD modules - CT - Block 13	Ship modules.			
2.6.1.4.1.15	Ship APD modules - CT - Block 15	Ship modules.			
2.6.1.4.1.17	Ship APD modules - CT - Block 17	Ship modules.			
2.6.1.4.1.19	Ship APD modules - CT - Block 19	Ship modules.			
2.6.1.4.1.21	Ship APD modules - CT - Block 21	Ship modules.			
2.6.1.4.1.23	Ship APD modules - CT - Block 23	Ship modules.			
2.6.1.4.1.25	Ship APD modules - CT - Block 25	Ship modules.			
2.6.1.4.1.27	Ship APD modules - CT - Block 27	Ship modules.			
2.6.1.4.1.29	Ship APD modules - CT - Block 29	Ship modules.			
2.6.1.4.1.31	Ship APD modules - CT - Block 31	Ship modules.			
2.6.1.4.1.33	Ship APD modules - CT - Block 33	Ship modules.			
2.6.1.4.1.35	Ship APD modules - CT - Block 35	Ship modules.			
2.6.1.4.1.37	Ship APD modules - CT - Block 37	Ship modules.			
2.6.1.4.1.39	Ship APD modules - CT - Near Detector	Ship modules.			
2.6.1.4.2	**APD Module Shipping - Minnesota**	**Test modules.**			
2.6.1.4.2.2	Ship APD modules - UMINN - Block 2	Ship modules.			
2.6.1.4.2.4	Ship APD modules - UMINN - Block 4	Ship modules.			
2.6.1.4.2.6	Ship APD modules - UMINN - Block 6	Ship modules.			
2.6.1.4.2.8	Ship APD modules - UMINN - Block 8	Ship modules.			
2.6.1.4.2.10	Ship APD modules - UMINN - Block 10	Ship modules.			
2.6.1.4.2.12	Ship APD modules - UMINN - Block 12	Ship modules.			
2.6.1.4.2.14	Ship APD modules - UMINN - Block 14	Ship modules.			
2.6.1.4.2.16	Ship APD modules - UMINN - Block 16	Ship modules.			

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.6.1.4.2.18	Ship APD modules - UMINN - Block 18	Ship modules.			
2.6.1.4.2.20	Ship APD modules - UMINN - Block 20	Ship modules.			
2.6.1.4.2.22	Ship APD modules - UMINN - Block 22	Ship modules.			
2.6.1.4.2.24	Ship APD modules - UMINN - Block 24	Ship modules.			
2.6.1.4.2.26	Ship APD modules - UMINN - Block 26	Ship modules.			
2.6.1.4.2.28	Ship APD modules - UMINN - Block 38	Ship modules.			
2.6.1.4.2.30	Ship APD modules - UMINN - Block 30	Ship modules.			
2.6.1.4.2.32	Ship APD modules - UMINN - Block 32	Ship modules.			
2.6.1.4.2.34	Ship APD modules - UMINN - Block 34	Ship modules.			
2.6.1.4.2.36	Ship APD modules - UMINN - Block 36	Ship modules.			
2.6.1.4.2.38	Ship APD modules - UMINN - Block 38	Ship modules.			
2.6.1.4.30	All Far Detector APD modules shipped				
2.6.2	**Readout - FEB**	**Receives APD signals, responds to run control, delivers digitized data and slow control information to DAQ.**			
2.6.2.1	**Procurements**	**Manage and make procurements.**			
2.6.2.1.1	**Far Detector ASIC Production**				
2.6.2.1.1.1	Engineering run	Procure production wafers, dicing and packaging.			
2.6.2.1.1.2	Final production run				
2.6.2.1.1.3	**Test/database**				
2.6.2.1.1.3.1	**Chip Tester Construction**				
2.6.2.1.1.3.1.1	**Interface Board Design**	**Design and produce dedicated hardware for production chip testing.**			
2.6.2.1.1.3.1.1.1	PCB design	Board Design, schematic entry.			
2.6.2.1.1.3.1.1.2	PCB layout				
2.6.2.1.1.3.1.1.3	Parts procurement	2 Boards and components, 1500 boards, 1000 components.			
2.6.2.1.1.3.1.1.4	PCB test/debug				
2.6.2.1.1.3.1.2	**Robotic Interface**				
2.6.2.1.1.3.1.2.1	Program robot	Program robot to match parts.			
2.6.2.1.1.3.1.2.2	Setup/Fixture robot				
2.6.2.1.1.3.1.2.3	Develop test program				
2.6.2.1.1.3.2	**Production Chip Testing**	**Perform production testing and database of full lot of ASICs, approximately 35k pieces.**			
2.6.2.1.1.3.2.1	Preproduction testing/analysis development				
2.6.2.1.1.3.2.2	Production testing and analysis				
2.6.2.1.1.3.2.3	Robot operation	Technician testing, operating robot.			
2.6.2.1.1.3.3	Documentation/final reports				
2.6.2.1.1.3.4	Oversight				
2.6.2.1.2	**Near Detector ASIC Production**				
2.6.2.1.2.1	Fabricate		budget for this covered under Far Detector 2.6.2.1.1		
2.6.2.1.2.2	Test				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.6.2.1.3	ADCs				
2.6.2.1.4	Commercial off-the-shelf items (COTs)	Commercial off the shelf.			
2.6.2.1.5	PC boards				
2.6.2.1.6	Procure electronics box				
2.6.2.1.7	**TEC Controller Modules**				
2.6.2.1.7.1	Procure components				
2.6.2.1.7.2	Assemble TEC controller modules				
2.6.2.1.7.3	Test TEC controller modules				
2.6.2.2	**Far Detector Fabrication and Assembly**				
2.6.2.2.1	PCB assembly				
2.6.2.2.2	Faraday cage assembly				
2.6.2.2.3	Front-end board fabrication and assembly completed				
2.6.2.3	**Near Detector Fabrication and Assembly**	**Pre-production FEB**			
2.6.2.3.1	FEB modules for near detector started				
2.6.2.3.2	Fabricate PCB				
2.6.2.3.3	Assemble	Reflow solder, wire bond, mechanical assembly as necessary			
2.6.2.3.4	Test	Bench top electrical tests, system integration tests.			
2.6.2.3.5	FEB modules for near detector completed				
2.6.2.4	Firmware maintenance	Support of firmware for duration of installation.			
2.6.2.5	**QA/QC**				
2.6.2.5.1	**Production Test Stands**	**2 test stands for 64 FEBs each.**			
2.6.2.5.1.1	Construct test stands				
2.6.2.5.1.2	**Software**				
2.6.2.5.1.2.1	Develop code for QA/QC testing				
2.6.2.5.1.2.2	Produce FEB database specification document				
2.6.2.5.2	Production testing				
2.6.2.6	FEB production oversight				
2.6.3	**Readout Infrastructure**	**Delivers power and cooling for FEB to operate, cool and bias APD.**			
2.6.3.1	**Low Voltage**				
2.6.3.1.1	Specify LV racks				
2.6.3.1.2	Procure LV racks				
2.6.3.1.3	Procure LV supplies	Buy near detector Low Voltage modules required in mainframe duration includes REQ and delivery.			
2.6.3.1.4	Test LV supplies				
2.6.3.2	**High Voltage**				
2.6.3.2.1	Procure HV supplies	includes REQ and deliver.			
2.6.3.2.2	Test HV supplies				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.6.3.4	**Cabling Hardware**				
2.6.3.4.1	Procure PDB to FEB cable			vendor quote	4 students each making 5 cables per hour and ~90 days per student (+ 30 days to deliver cables before student labor starts)
2.6.3.4.2	Procure LV supply to PDB cable				
2.6.3.4.3	Procure LV sense cables				
2.6.3.4.4	Procure HV supply to PDB cable				
2.6.3.4.5	Procure PDB to DCM cable				
2.6.3.4.6	Procure ground cable				
2.6.3.4.7	Specify cable tray				
2.6.3.4.8	Procure cable tray				
2.6.3.5	**Power Distribution Boxes**				
2.6.3.5.1	Procure PDB parts				
2.6.3.5.2	Assemble and test PDB's				
2.6.3.6	**Cooling**				
2.6.3.6.1	**Manifolds**				
2.6.3.6.1.1	**Procurement**				
2.6.3.6.1.1.1	Procure manifolds - Block 1				
2.6.3.6.1.1.2	Procure manifolds - Block 2				
2.6.3.6.1.1.3	Procure manifolds - Block 3				
2.6.3.6.1.1.4	Procure manifolds - Block 4				
2.6.3.6.1.1.5	Procure manifolds - Block 5				
2.6.3.6.1.1.6	Procure manifolds - Block 6				
2.6.3.6.1.1.7	Procure manifolds - Block 7				
2.6.3.6.1.1.8	Procure manifolds - Block 8				
2.6.3.6.1.1.9	Procure manifolds - Block 9				
2.6.3.6.1.1.10	Procure manifolds - Block 10				
2.6.3.6.1.1.11	Procure manifolds - Block 11				
2.6.3.6.1.1.12	Procure manifolds - Block 12				
2.6.3.6.1.1.13	Procure manifolds - Block 13				
2.6.3.6.1.1.14	Procure manifolds - Block 14				
2.6.3.6.1.1.15	Procure manifolds - Block 15				
2.6.3.6.1.1.16	Procure manifolds - Block 16				
2.6.3.6.1.1.17	Procure manifolds - Block 17				
2.6.3.6.1.1.18	Procure manifolds - Block 18				
2.6.3.6.1.1.19	Procure manifolds - Block 19				
2.6.3.6.1.1.20	Procure manifolds - Block 20				
2.6.3.6.1.1.21	Procure manifolds - Block 21				
2.6.3.6.1.1.22	Procure manifolds - Block 22				
2.6.3.6.1.1.23	Procure manifolds - Block 23				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.6.3.6.1.1.24	Procure manifolds - Block 24				
2.6.3.6.1.1.25	Procure manifolds - Block 25				
2.6.3.6.1.1.26	Procure manifolds - Block 26				
2.6.3.6.1.1.27	Procure manifolds - Block 27				
2.6.3.6.1.1.28	Procure manifolds - Block 28				
2.6.3.6.1.1.29	Procure manifolds - Block 29				
2.6.3.6.1.1.30	Procure manifolds - Block 30				
2.6.3.6.1.1.31	Procure manifolds - Block 31				
2.6.3.6.1.1.32	Procure manifolds - Block 32				
2.6.3.6.1.1.33	Procure manifolds - Block 33				
2.6.3.6.1.1.34	Procure manifolds - Block 34				
2.6.3.6.1.1.35	Procure manifolds - Block 35				
2.6.3.6.1.1.36	Procure manifolds - Block 36				
2.6.3.6.1.1.37	Procure manifolds - Block 37				
2.6.3.6.1.1.38	Procure manifolds - Block 38				
2.6.3.6.1.2	**Shipping**				
2.6.3.6.1.2.1	Ship manifolds - Block 1				
2.6.3.6.1.2.2	Ship manifolds - Block 2				
2.6.3.6.1.2.3	Ship manifolds - Block 3				
2.6.3.6.1.2.4	Ship manifolds - Block 4				
2.6.3.6.1.2.5	Ship manifolds - Block 5				
2.6.3.6.1.2.6	Ship manifolds - Block6				
2.6.3.6.1.2.7	Ship manifolds - Block 7				
2.6.3.6.1.2.8	Ship manifolds - Block 8				
2.6.3.6.1.2.9	Ship manifolds - Block 9				
2.6.3.6.1.2.10	Ship manifolds - Block 10				
2.6.3.6.1.2.11	Ship manifolds - Block 11				
2.6.3.6.1.2.12	Ship manifolds - Block 12				
2.6.3.6.1.2.13	Ship manifolds - Block 13				
2.6.3.6.1.2.14	Ship manifolds - Block 14				
2.6.3.6.1.2.15	Ship manifolds - Block 15				
2.6.3.6.1.2.16	Ship manifolds - Block 16				
2.6.3.6.1.2.17	Ship manifolds - Block 17				
2.6.3.6.1.2.18	Ship manifolds - Block 18				
2.6.3.6.1.2.19	Ship manifolds - Block 19				
2.6.3.6.1.2.20	Ship manifolds - Block 20				
2.6.3.6.1.2.21	Ship manifolds - Block 21				
2.6.3.6.1.2.22	Ship manifolds - Block 22				
2.6.3.6.1.2.23	Ship manifolds - Block 23				
2.6.3.6.1.2.24	Ship manifolds - Block 24				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.6.3.6.1.2.25	Ship manifolds - Block 25				
2.6.3.6.1.2.26	Ship manifolds - Block 26				
2.6.3.6.1.2.27	Ship manifolds - Block 27				
2.6.3.6.1.2.28	Ship manifolds - Block 28				
2.6.3.6.1.2.29	Ship manifolds - Block 29				
2.6.3.6.1.2.30	Ship manifolds - Block 30				
2.6.3.6.1.2.31	Ship manifolds - Block 31				
2.6.3.6.1.2.32	Ship manifolds - Block 32				
2.6.3.6.1.2.33	Ship manifolds - Block 33				
2.6.3.6.1.2.34	Ship manifolds - Block 34				
2.6.3.6.1.2.35	Ship manifolds - Block 35				
2.6.3.6.1.2.36	Ship manifolds - Block 36				
2.6.3.6.1.2.37	Ship manifolds - Block 37				
2.6.3.6.1.2.38	Ship manifolds - Block 38				
2.6.3.6.2	Procure other components				
2.6.3.6.3	Cooling system hardware delivered				
2.6.3.6.4	**Fill and Test Equipment**				
2.6.3.6.4.1	Design				
2.6.3.6.4.2	Build				
2.6.3.6.4.3	Commission				
2.6.3.6.5	**Auxiliary Panel Readout**				
2.6.3.6.5.1	Design				
2.6.3.6.5.2	Build				
2.6.3.7	**Shipping**				
2.6.3.7.1	Ship first third of power distribution system to far site				
2.6.3.7.2	Ship second third of power distribution system to far site				
2.6.3.7.3	Ship final third of power distribution system to far site				
2.6.3.7.4	Ship near detector power distribution system to Fermilab				
2.6.4	**Management - Construction Phase**	**This WBS element includes the tasks required to support and manage WBS 2.6 activities including quality assurance, value management, risk management, monitoring of performance and schedule, preparation of reports and other related activities.**			
2.6.4.2	**FY08**				
2.6.4.2.1	Labor				Physicist - est of 5 weeks per year (i.e slightly less than 2 days per month) spent on subproject-related management and oversight activites (project reporting, informatin gathering, personnel matters, reviews, etc.) not covered elsewhere in the project plan/schedule.

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.6.4.2.2	Travel			2 foreign trips @$25k per trip + 8 domestic trips at $0.5k per trip = $9k domistic trips a combo of shor trips to FNAL plus a couple of others	
2.6.4.2.3	Equipment				
2.6.4.2.4	Materials and supplies				
2.6.4.3	**FY09**				
2.6.4.3.1	Labor				Physicist - est of 5 weeks per year (i.e slightly less than 2 days per month) spent on subproject-related management and oversight activites (project reporting, informatin gathering, personnel matters, reviews, etc.) not covered elsewhere in the project plan/schedule.
2.6.4.3.2	Travel			2 foreign trips @$25k per trip + 8 domestic trips at $0.5k per trip = $9k domistic trips a combo of shor trips to FNAL plus a couple of others	
2.6.4.3.3	Equipment				
2.6.4.3.4	Materials and supplies				
2.6.4.4	**FY10**				
2.6.4.4.1	Labor				Physicist - est of 5 weeks per year (i.e slightly less than 2 days per month) spent on subproject-related management and oversight activites (project reporting, informatin gathering, personnel matters, reviews, etc.) not covered elsewhere in the project plan/schedule.
2.6.4.4.2	Travel			2 foreign trips @$25k per trip + 8 domestic trips at $0.5k per trip= $9k domistic trips a combo of shor trips to FNAL plus a couple of others	
2.6.4.4.3	Equipment				
2.6.4.4.4	Materials and supplies				
2.6.4.5	**FY11**				
2.6.4.5.1	Labor				Physicist - est of 5 weeks per year (i.e slightly less than 2 days per month) spent on subproject-related management and oversight activites (project reporting, informatin gathering, personnel matters, reviews, etc.) not covered elsewhere in the project plan/schedule.
2.6.4.5.2	Travel			2 foreign trips @$25k per trip + 8 domestic trips at $0.5k per trip = $9k domistic trips a combo of shor trips to FNAL plus a couple of others	
2.6.4.5.3	Equipment				
2.6.4.5.4	Materials and supplies				
2.6.4.6	**FY12**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.6.4.6.1	Labor				Physicist - est of 2.5 weeks in Q1 of FY12 (i.e slightly less than 2 days per month) spent on subproject-related management and oversight activites (project reporting, informatin gathering, personnel matters, reviews, etc.) not covered elsewhere in the project plan/schedule.
2.6.4.6.2	Travel			$1k + 4 domestic trips at $0.5k per trip = $3k domistic trips a combo of short trips to FNAL plus a another longer trip.	
2.6.4.6.3	Equipment				
2.6.4.6.4	Materials and supplies				
2.7	**Data Acquisition System**				
2.7.1	**DAQ Software**	**Includes software to run on buffering/triggering hardware for archival of selected time frames and required online database.**			
2.7.1.1	**Error Handling System**				
2.7.1.1.1	**Error Handling System-Second Release**				
2.7.1.1.1.1	Develop error handling system client interface	Write GUI to display error system errors and integrate with online databases.			
2.7.1.1.1.2	Update error handling system test and verification suite for second release	Update test and verification suite for the Error Handling System to include GUI display functionality.			
2.7.1.1.1.3	Update error handling system user documentation for second release	Add documentation for GUI to the Error Handling System user documentation.			
2.7.1.1.1.4	Perform error handling system tests and verification for second release	Perform the tests and verifications for the second release of the Error Handling System software.			
2.7.1.1.1.5	Review error handling system software, tests and documentation for second release	Review the code, test results and documentation for the second release of the Error Handling System.			
2.7.1.1.1.6	Error handling system for software second release	Milestone: Second release contribution of the error logger, includes GUI display for system error messages, integration with online databases, updated test and verification suite and user documentation.			
2.7.1.1.2	**Error Handling System-Third Release**				
2.7.1.1.2.1	Develop error handling system automatic error recovery	Develop automatic error recovery software for the Error Handling System.			
2.7.1.1.2.2	Update error handling system test and verification suite for third release	Update test and verification suite for the Error Handling System to include automatic recovery.			
2.7.1.1.2.3	Update error handling system user documentation for third release	Add documentation for automatic recovery to the Error Handling System user documentation.			
2.7.1.1.2.4	Perform error handling system tests and verification for third release	Perform the tests and verifications for the third release of the Error Handling System software.			
2.7.1.1.2.5	Review error handling system software, tests and documentation for third release	Review the code, test results and documentation for the third release of the Error Handling System.			
2.7.1.1.2.6	Error handling system for software third release	Milestone: Third release contribution of the Error Handling System includes automatic recovery, updated test and verification suite and user documentation.			
2.7.1.2	**Message Passing System**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.7.1.2.1	**Message Passing System-Second Release**				
2.7.1.2.1.1	Message passing system monitoring and diagnostics code	Add monitoring and diagnostics code to the Message Passing System Server and means of querying for information.			
2.7.1.2.1.2	Update message passing system test and verification suite for second release	Update test and verification suite for the Message Passing System for monitoring and diagnostics functionality.			
2.7.1.2.1.3	Update message handling system user documentation for second release	Update Message Passing System user documentation to include monitoring and diagnostics.			
2.7.1.2.1.4	Perform message passing system tests and verification for second release	Perform the tests and verifications for the second release of the Message Passing System software.			
2.7.1.2.1.5	Review message passing system software, tests and documentation for second release	Review the code, test results and documentation for the second release of the Message Passing System.			
2.7.1.2.1.6	Message passing system for software second release	Milestone: Second release contribution of the Message Passing System includes monitoring and diagnostics, updated documentation and test and verification suite..			
2.7.1.3	**Run Control System**	**Run control system for Nova DAQ. The software necessary to control data taking, initialize the system, manage starting and stopping of the acquisition of data. Includes framework for configuring runs. User interface to the control system. State manager is**			
2.7.1.3.1	**Run Control System-Second Release**				
2.7.1.3.1.1	Develop run control multi-host support	Develop code to support multiple trigger and buffer nodes at one time. Also include support to control the global triggering system.			
2.7.1.3.1.2	Update command line interface for multi-host support	Update Run Control command line interface to include support for multiple trigger and buffer nodes.			
2.7.1.3.1.3	Develop initial run control GUI	Develop the initial Run Control GUI for configuring, starting and stopping data acquisition. Still minimal functionality for the basics.			
2.7.1.3.1.4	Run control system framework integration with databases	Update framework code to integrate with the online configuration and run history databases.			
2.7.1.3.1.5	Run control system support for data & error loggers	Add support for managing data and error loggers in the Run Control Framework, command line interface and GUI.			
2.7.1.3.1.6	Update run control system test and verification suite for second release	Update the test and verification suite for the Run Control System software. Include tests and verification for multi-host support and initial GUI.			
2.7.1.3.1.7	Update run control system user documentation for second release	Update the user document for the Run Control System so application developers can use the system.			
2.7.1.3.1.8	Perform run control system tests and verification for second release	Perform the tests and verifications for the third release of the Run Control System software.			
2.7.1.3.1.9	Review run control system software, tests and documentation for second release	Review the code, test results and documentation for the third release of the Run Control System.			
2.7.1.3.1.10	Run control system for software second release	Milestone: Second release contribution of the Run Control System includes framework integration with configuration and run history databases, managing data loggers and error loggers, includes command line interface for configuring, starting and stopping.			
2.7.1.3.2	**Run Control System-Fourth Release**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.7.1.3.2.1	Run control system support for detector partitioning	Update the Run Control framework, command line interface and GUI to support partitioning of the detector. Partitioning allows a user to reserve a subset of the detector and buffer & trigger system for separate run activities.			
2.7.1.3.2.2	Update run control system test and verification suite for fourth release	Update the test and verification suite for the Run Control System software. Include tests and verification for multi-host support and initial GUI.			
2.7.1.3.2.3	Update run control system user documentation for fourth release	Update the user document for the Run Control System so application developers can use the update command line interface and the GUI.			
2.7.1.3.2.4	Perform run control system tests and verification for fourth release	Perform the tests and verifications for the fourth release of the Run Control System software.			
2.7.1.3.2.5	Review run control system software, tests and documentation for fourth release	Review the code, test results and documentation for the fourth release of the Run Control System.			
2.7.1.3.2.6	Run control system fourth release	Milestone: Fourth release of the Run Control System includes support for detector partitioning.			
2.7.1.4	**Event Buffer Farm Software**	**Software that runs on the event buffer farm nodes to receive data from the combiner nodes, buffer the data in memory, and allow for triggered events to be read out.**			
2.7.1.4.1	**Event Buffer Farm Core Software-Second Release**				
2.7.1.4.1.1	Develop process management watchdogs and master	Develop applications to monitor processes on the buffer farm nodes and restart if necessary. Should also have ability to notify error handling server and run control.			
2.7.1.4.1.2	Update event buffer farm core software test and verification suite for second release	Update the test and verification suite for the Event Buffer Farm core software for the second release.			
2.7.1.4.1.3	Update event buffer farm core software user documentation for second release	Update the user document for the Event Buffer Farm core software so application developers can use the system.			
2.7.1.4.1.4	Perform event buffer farm core software tests and verification for second release	Perform the tests and verifications for the second release of the Event Buffer Farm core software.			
2.7.1.4.1.5	Review event buffer farm core software, tests and documentation for second release	Review the code, test results and documentation for the second release of the Event Buffer Farm core software.			
2.7.1.4.1.6	Event buffer farm core software for software second release	Milestone: Second release contribution of the Event Buffer Farm core software, includes error handing and reporting, monitoring information gathering and reporting, and receiving, acting on, and replying to Run Control Commands, process management, test a.			
2.7.1.4.2	**Event Buffer Farm Server-Second Release**				
2.7.1.4.2.1	Update event buffer farm server for software second release	Update the Event Buffer Farm Server using the second release of the Event Buffer Farm core software.			
2.7.1.4.2.2	Write event buffer farm server test and verification suite for software second	Update the test and verification suite for the Event Buffer Farm server for the second release.			
2.7.1.4.2.3	Write event buffer farm server user documentation for software second release	Update the user document for the Event Buffer Farm server so application developers can use the system.			
2.7.1.4.2.4	Perform event buffer farm server tests and verification for software second release	Perform the tests and verifications for the second release of the Event Buffer Farm server.			

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.7.1.4.2.5	Review event buffer farm server, tests and documentation for software second release	Review the code, test results and documentation for the second release of the Event Buffer Farm server.			
2.7.1.4.2.6	Event buffer farm server for software second release	Milestone: Second release contribution of the Event Buffer Farm server, includes features of Event Buffer Farm core software second release, test and verification suite, user documentation.			
2.7.1.4.3	**Event Buffer Farm Server-Third Release**				
2.7.1.4.3.1	Update event buffer farm server for software third release	Update the Event Buffer Farm Server for optimizations learned in use of second release.			
2.7.1.4.3.2	Write event buffer farm server test and verification suite for software third release	Update the test and verification suite for the Event Buffer Farm server for the third release.			
2.7.1.4.3.3	Write event buffer farm server user documentation for software third release	Update the user document for the Event Buffer Farm server so application developers can use the system.			
2.7.1.4.3.4	Perform event buffer farm server tests and verification for software third release	Perform the tests and verifications for the third release of the Event Buffer Farm server.			
2.7.1.4.3.5	Review event buffer farm server, tests and documentation for software third release	Review the code, test results and documentation for the third release of the Event Buffer Farm server.			
2.7.1.4.3.6	Event buffer farm server for software third release	Milestone: Third release contribution of the Event Buffer Farm server, optimizations, test and verification suite, user documentation.			
2.7.1.5	**Data Logger**				
2.7.1.5.1	Develop initial data logging server	Write data logger server that can receive events from clients and write them to disk.			
2.7.1.5.2	Integrate error handling and monitoring support in the data logger	Write code to support integration with the error handling system, handling of error conditions, monitoring information gathering and reporting.			
2.7.1.5.3	Integrate run control support in the data logger	Write code to support receiving, acting on, and replying to Run Control commands.			
2.7.1.5.4	Write data logger server test and verification suite for second release	Write the test and verification suite for the data logger server for the second release.			
2.7.1.5.5	Write data logger server user documentation for software second release	Write the user document for the data logger server so application developers can use the system.			
2.7.1.5.6	Perform data logger server tests and verification for software second release	Perform the tests and verifications for the second release of the data logger server.			
2.7.1.5.7	Review data logger server, tests and documentation for software second release	Review the code, test results and documentation for the second release of the data logger server.			
2.7.1.5.8	Data logger server for software second release	Milestone: Second release contribution of the data logger server, includes writing data to files integration with monitoring and error handling systems and receive, act on and reply to run control commands, test and verification suite, user documentation.			
2.7.1.6	**Data File Transfer System**	**System for transferring files from local storage to the mass storage system.**			
2.7.1.6.1	**Data File Transfer System Requirements**	**Requirements for the data file transfer system.**			
2.7.1.6.1.1	Data file transfer system requirements document draft	Write data file transfer system requirements document draft.			
2.7.1.6.1.2	Review data file transfer system requirements document	Review requirements document for the data file transfer system.			

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.7.1.6.1.3	Finalize data file transfer system requirements document	Complete and update data file transfer system requirements document based on review comments.			
2.7.1.6.2	**Data File Transfer System Design**	**Design for the data file transfer system.**			
2.7.1.6.2.1	Data file transfer system design document draft	Write data file transfer system design document draft.			
2.7.1.6.2.2	Review data file transfer system design document	Review design document for the data file transfer system.			
2.7.1.6.2.3	Finalize data file transfer system design document	Complete and update data file transfer system design document based on review comments.			
2.7.1.6.3	Develop initial data file transfer agent	Use the framework code to create a basic transfer agent application defining the operations that need to be executed. This is a shell structure ready to be integrated with the mass storage system.			
2.7.1.6.4	Integrate transfer agent with the mass storage system	Integrate the transfer agent program with the mass storage system. This is the first transfer agent with the ability to move files.			
2.7.1.6.5	Integrate data file transfer system with the error handling and monitoring systems	Integrate with error handling and monitoring systems.			
2.7.1.6.6	Integrate data file transfer system with run control	Add support for receiving, acting on, and replying to Run Control commands.			
2.7.1.6.7	Write data file transfer system test and verification suite for software second release	Write the test and verification suite for the Data File Transfer System for the second release.			
2.7.1.6.8	Write data file transfer system user documentation for software second release	Write the user document for the Data File Transfer System so application developers can use the system.			
2.7.1.6.9	Perform data file transfer system tests and verification for software second release	Perform the tests and verifications for the second release of the Data File Transfer System.			
2.7.1.6.10	Review data file transfer system, tests and documentation for software second release	Review the code, test results and documentation for the second release of the Data File Transfer System.			
2.7.1.6.11	Data file transfer system for software second release	Milestone: Second release contribution of the Data File Transfer System, includes Data File Transfer Agent integrated with the mass storage system and can transfer files, Data File Transfer Agent integrated with the error handling and monitoring systems a.			
2.7.1.7	**DAQ Monitor System**				
2.7.1.7.1	Develop framework code for DAQ monitoring systems	Develop framework code for the DAQ monitoring system. Includes infrastructure for processing data but no display or GUI support yet.			
2.7.1.7.2	Integrate DAQ monitoring framework with the message passing system	Integrate the framework code for the DAQ monitoring system with the Message Passing System so that data can be requested and received.			
2.7.1.7.3	Integrate DAQ monitoring framework with the error handling system	Integrate framework for the DAQ monitoring system with the Error Handling System so that error messages can be set and retrieved.			
2.7.1.7.4	Develop generic GUI framework for the DAQ monitoring system	Build generic GUI infrastructure support into the framework for the DAQ Monitoring System, including support for data display.			
2.7.1.7.5	Integrate DAQ monitoring framework with the online monitoring database system	Integrate framework for the DAQ monitoring system with the Online Calibration Database System so that calibration data can be retrieved.			
2.7.1.7.6	Develop DAQ monitoring application	Develop a DAQ monitoring application based on the framework.			

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.7.1.7.7	Write DAQ monitoring system test and verification suite for software second release	Write the test and verification suite for the DAQ Monitoring System for the second release.			
2.7.1.7.8	Write DAQ monitoring system user documentation for software second release	Write the user document for the DAQ Monitoring System so application developers can use the system.			
2.7.1.7.9	Perform DAQ monitoring system tests and verification for software second release	Perform the tests and verifications for the second release of the DAQ Monitoring System.			
2.7.1.7.10	Review DAQ monitoring system, tests and documentation for software second release	Review the code, test results and documentation for the second release of the DAQ Monitoring System.			
2.7.1.7.11	DAQ monitoring system for software second release	Milestone: Second release contribution of the DAQ Monitoring System, includes framework code for processing data, integration with the Message Passing System so data can be requested and received, GUI and display, integration with the error handling syste.			
2.7.1.8	**Event Monitor System**	**Event monitor system to track the quality of the data during operations.**			
2.7.1.8.1	**Event Monitor System Requirements**	**Requirements for the Event Monitor System.**			
2.7.1.8.1.1	Event monitor system requirements document draft	Write Event Monitor System requirements document draft.			
2.7.1.8.1.2	Review event monitor system requirements document	Review requirements document for the Event Monitor System.			
2.7.1.8.1.3	Finalize event monitor system requirements document	Complete and update Event Monitor requirements document based on review comments.			
2.7.1.8.2	**Event Monitor System Design**	**Design for the Event Monitor System.**			
2.7.1.8.2.1	Event monitor system design document draft	Write Event Monitor System design document draft.			
2.7.1.8.2.2	Review event monitor system design document	Review design document for the Event Monitor System.			
2.7.1.8.2.3	Finalize event monitor system design document	Complete and update Event Monitor System design document based on review comments.			
2.7.1.8.3	**Event Monitor Software and Development Languages Evaluation**	**Examine existing implementations of Event Monitor software and development software they support to see if any can be used for Nova.**			
2.7.1.8.3.1	Find candidates for event monitor software and development languages	Search for existing event monitor software and development languages and identify potentially applicable candidates for evaluation.			
2.7.1.8.3.2	Evaluate event monitor software and development languages	Evaluate identified candidate event monitor software and development languages and prepare summary of how the well they address the requirements.			
2.7.1.8.3.3	Review event monitor software and development languages evaluations	Review evaluation of event monitor software and development languages and select candidate for use in Nova.			
2.7.1.8.4	Develop framework code for event monitoring software	Develop framework code for the event monitoring system. Includes infrastructure for processing data but no display or GUI support yet.			
2.7.1.8.5	Integrate event monitoring framework with the message passing system	Integrate the framework code for the event monitoring system with the Message Passing System so that data can be requested and received.			
2.7.1.8.6	Integrate event monitoring framework with the error handling system	Integrate framework for the event monitoring system with the Error Handling System so that error messages can be set and retrieved.			

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.7.1.8.7	Develop generic GUI framework for the event monitoring system	Build generic GUI infrastructure support into the framework for the event Monitoring System, including support for data display.			
2.7.1.8.8	Integrate event monitoring framework with the online monitoring database system	Integrate framework for the event monitoring system with the Online Calibration Database System so that calibration data can be retrieved.			
2.7.1.8.9	Develop event monitoring application	Develop a event monitoring application based on the framework.			
2.7.1.8.10	Update event monitoring system test and verification suite for software second release	Update the test and verification suite for the Event Monitoring System for the second release.			
2.7.1.8.11	Update event monitoring system user documentation for software second release	Update the user document for the Event Monitoring System so application developers can use the system.			
2.7.1.8.12	Perform event monitoring system tests and verification for software second release	Perform the tests and verifications for the second release of the Event Monitoring System.			
2.7.1.8.13	Review event monitoring system, tests and documentation for software second release	Review the code, test results and documentation for the second release of the Event Monitoring System.			
2.7.1.8.14	Event monitoring system for software second release	Milestone: Second release contribution of the Event Monitoring System, includes integration with the Message Passing System so data can be requested and received, monitoring application, integration with the Error Handling system so data can be requested.			
2.7.1.9	**Event Display System**	**Event display system to track the quality of the data during operations.**			
2.7.1.9.1	**Event Display System Requirements**	**Requirements for the Event Display System.**			
2.7.1.9.1.1	Event display system requirements document draft	Write Event Display System requirements document draft.			
2.7.1.9.1.2	Review event display system requirements document	Review requirements document for the Event Display System.			
2.7.1.9.1.3	Finalize event display system requirements document	Complete and update Event Display requirements document based on review comments.			
2.7.1.9.2	**Event Display System Design**	**Design for the Event Display System.**			
2.7.1.9.2.1	Event display system design document draft	Write Event Display System design document draft.			
2.7.1.9.2.2	Review event display system design document	Review design document for the Event Display System.			
2.7.1.9.2.3	Finalize event display system design document	Complete and update Event Display System design document based on review comments.			
2.7.1.9.3	**Event Display Software and Development Languages Evaluation**	**Examine existing implementations of Event Display software and development software they support to see if any can be used for Nova.**			
2.7.1.9.3.1	Find candidates for event display software and development languages	Search for existing event display software and development languages and identify potentially applicable candidates for evaluation.			
2.7.1.9.3.2	Evaluate event display software and development languages	Evaluate identified candidate event display software and development languages and prepare summary of how the well they address the requirements.			
2.7.1.9.3.3	Review event display software and development languages evaluations	Review evaluation of event display software and development languages and select candidate for use in Nova.			

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.7.1.9.4	Develop framework code for event display software	Develop framework code for the event display system. Includes infrastructure for processing data but no display or GUI support yet.			
2.7.1.9.5	Integrate event display framework with the message passing system	Integrate the framework code for the event display system with the Message Passing System so that data can be requested and received.			
2.7.1.9.6	Integrate event display framework with the error handling system	Integrate framework for the event display software with the Error Handling System so that error messages can be set and retrieved.			
2.7.1.9.7	Develop generic GUI framework for the event display software	Build generic GUI infrastructure support into the framework for the event display software, including support for data display.			
2.7.1.9.8	Integrate event display framework with the online monitoring database system	Integrate framework for the event display software with the Online Calibration Database System so that calibration data can be retrieved.			
2.7.1.9.9	Develop event display application	Develop a event display application based on the framework.			
2.7.1.9.10	Write event display software test and verification suite for software second release	Write the test and verification suite for the Event Display Software for the second release.			
2.7.1.9.11	Write event display software user documentation for software second release	Write the user document for the Event Display Software so application developers can use the system.			
2.7.1.9.12	Perform event display software tests and verification for software second release	Perform the tests and verifications for the second release of the Event Display Software.			
2.7.1.9.13	Review event display software, tests and documentation for software second release	Review the code, test results and documentation for the second release of the Event Display Software.			
2.7.1.9.14	Event display software for software second release	Milestone: Second release contribution of the Event Display Software, includes integration with the Message Passing System so data can be requested and received, integration with the Error Handling system so data can be requested and received, integration.			
2.7.1.10	**Online Databases**	**Databases used in the online DAQ system. Should include instances of production, integration and development.**			
2.7.1.10.1	**General Online Database Administration and Support**	**Covers requirements, infrastructure, procedures, etc that are common to all databases in the online system.**			
2.7.1.10.1.1	General database administration and support - FY08	DBA for the life of the databases. Includes continued monitoring and tuning of production databases. At the level of 1 month per year.			
2.7.1.10.1.2	General database administration and support - FY09	Support during construction of Nova. Includes overall database coordinator for the experiment.			
2.7.1.10.1.3	General database administration and support - FY10	DBA for the life of the databases. Includes continued monitoring and tuning of production databases. At the level of 1 month per year.			
2.7.1.10.1.4	General database administration and support - FY11	Support during construction of Nova. Includes overall database coordinator for the experiment.			
2.7.1.10.1.5	General database administration and support - FY12	Support during construction of Nova. Includes overall database coordinator for the experiment.			
2.7.1.10.2	**Database Deployment to Integration**	**Deployment of databases in the integration environment.**			

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.7.1.10.2.1	Deploy databases on integration server	Review database structure based on hardware, identify minimal database needs for initial startup, define database scripts, identify instance support level, deploy databases on integration server.			
2.7.1.10.2.2	Configure integration database servers	Configure integration database servers based on the general and specific requirements.			
2.7.1.10.2.3	Release integration database servers for use	Milestone: Second release contribution of integration databases for general use.			
2.7.1.10.3	**Database Deployment to Production**	**Deployment of databases in the production environment.**			
2.7.1.10.3.1	Deploy databases on production server	Review database structure based on hardware, identify minimal database needs for initial startup, define database scripts, identify instance support level, deploy databases on production server.			
2.7.1.10.3.2	Configure production database servers	Configure production database servers based on the general and specific requirements.			
2.7.1.10.3.3	Release production database servers for use	Milestone: Second release contribution of production databases for general use.			
2.7.1.10.4	**Database Applications**				
2.7.1.10.4.1	**Online Calibration Database Application**	**Database application and schema for online calibrations.**			
2.7.1.10.4.1.1	**Online Calibration Application Specification**	**Online calibration application specification.**			
2.7.1.10.4.1.1.1	Develop online calibration application specification	Draw ER diagram (iterative process), document overall design strategy, generate data dictionary, identify database sub-schema interactions, write data flow diagram.			
2.7.1.10.4.1.1.2	Review online calibration application specification	Review ER diagram, overall design strategy, data dictionary, database sub-schema interactions, data flow diagram.			
2.7.1.10.4.1.1.3	Finalize online calibration application specification	Complete and update online calibration specification based on review comments.			
2.7.1.10.4.1.2	**Design Online Calibration Application**	**Write application design for calibration.**			
2.7.1.10.4.1.2.1	Online calibration application design document draft	Write online calibration application design document draft.			
2.7.1.10.4.1.2.2	Review online calibration application design document	Review design document for the online calibration application.			
2.7.1.10.4.1.2.3	Finalize online calibration application design document	Complete and update online calibration application design document based on review comments.			
2.7.1.10.4.1.3	Prototype online calibration application and database access	Generate DDL, SQL scripts. Separate server functionality from client.			
2.7.1.10.4.1.4	Implement & test online calibration application in the development environment	Does ER diagram match DDL. Write code modules, write and run test suites, create test data, revise schemas, design application monitoring and diagnostic tools.			
2.7.1.10.4.1.5	Implement online calibration application in the integration environment	Integrate application with other database applications and make available for user tests in integration environment.			
2.7.1.10.4.1.6	Update online calibration application	Tune application and document changes based on user feedback from integration tests.			
2.7.1.10.4.1.7	Deploy online calibration application in production environment	Milestone: Second release contribution of online calibration application in the production environment.			

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.7.1.10.4.2	**Online Run History Database Application**	**Database application and schema for online run history.**			
2.7.1.10.4.2.1	**Online Run History Application Specification**	**Online run history application specification.**			
2.7.1.10.4.2.1.1	Develop online run history application specification	Draw ER diagram (iterative process), document overall design strategy, generate data dictionary, identify database sub-schema interactions, write data flow diagram.			
2.7.1.10.4.2.1.2	Review online run history application specification	Review ER diagram, overall design strategy, data dictionary, database sub-schema interactions, data flow diagram.			
2.7.1.10.4.2.1.3	Finalize online run history application specification	Complete and update online run history specification based on review comments.			
2.7.1.10.4.2.2	**Online Run History Application Design**	**Online run history application design document.**			
2.7.1.10.4.2.2.1	Online run history application design document draft	Write application design for the run history.			
2.7.1.10.4.2.2.2	Review online run history application design document	Review design document for the online run history application.			
2.7.1.10.4.2.2.3	Finalize online run history application design document	Complete and update online run history design document based on review comments.			
2.7.1.10.4.2.3	Prototype online run history application and database access	Generate DDL, SQL scripts. Separate server functionality from client.			
2.7.1.10.4.2.4	Implement & test online run history application in the development environment	Does ER diagram match DDL. Write code modules, write and run test suites, create test data, revise schemas, design application monitoring and diagnostic tools.			
2.7.1.10.4.2.5	Implement online run history application in the integration environment	Integrate application with other database applications and make available for user tests in integration environment.			
2.7.1.10.4.2.6	Update online run history application	Tune application and document changes based on user feedback from integration tests.			
2.7.1.10.4.2.7	Deploy online run history application in production environment	Milestone: Third release contribution of online run history application in the production environment.			
2.7.1.10.4.3	**Online Monitoring Database Application**	**Database application and schema for online DAQ monitoring.**			
2.7.1.10.4.3.1	**Online Monitoring Application Specification**	**Online monitoring application specification.**			
2.7.1.10.4.3.1.1	Develop online monitoring application specification	Draw ER diagram (iterative process), document and review overall design strategy, generate data dictionary, identify database sub-schema interactions, write data flow diagram.			
2.7.1.10.4.3.1.2	Review online monitoring application specification	Review ER diagram, overall design strategy, data dictionary, database sub-schema interactions, data flow diagram.			
2.7.1.10.4.3.1.3	Finalize online monitoring application specification	Complete and update online monitoring specification based on review comments.			
2.7.1.10.4.3.2	**Online Monitoring Application Design Document**	**Online monitoring applicaton design document.**			
2.7.1.10.4.3.2.1	Online monitoring application design document draft	Write application design for online monitoring.			
2.7.1.10.4.3.2.2	Review online monitoring application design document	Review design document for the online monitoring application.			
2.7.1.10.4.3.2.3	Finalize online monitoring application design document	Complete and update online monitoring design document based on review comments.			

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.7.1.10.4.3.3	Prototype online monitoring application and database access	Generate DDL, SQL scripts. Separate server functionality from client.			
2.7.1.10.4.3.4	Implement & test online monitoring application in the development environment	Does ER diagram match DDL. Write code modules, write and run test suites, create test data, revise schemas, design application monitoring and diagnostic tools.			
2.7.1.10.4.3.5	Implement online monitoring application in the integration environment	Integrate application with other database applications and make available for user tests in integration environment.			
2.7.1.10.4.3.6	Update online monitoring application	Tune application and document changes based on user feedback from integration tests.			
2.7.1.10.4.3.7	Deploy online monitoring application in production environment	Milestone: Second release contribution of online monitoring application in the production environment.			
2.7.2	**DAQ Hardware**	**Hardware for receiving signals from FEB, buffering and archival, delivery of clock/timing signals.**			
2.7.2.1	**Data Concentrator**	**Hardware for receiving signals from FEBs, delivery of timing and control signals to FEBs, buffering and delivery of data to network.**			
2.7.2.1.1	**Design**	**Design phase for production Data Concentrators.**			
2.7.2.1.1.1	Firmware design	Update Data Concentrator firmware and embedded software.			
2.7.2.1.1.2	Embedded software	Update buffer management software for embedded processor.			
2.7.2.1.2	**Production**	**Manufacturing phase for production Data Concentrators.**			
2.7.2.1.2.1	Manufacturing requirements document	Update manufacturing requirements.			
2.7.2.1.2.2	Manufacturing assembly and test specifications document	Write manufacturing assembly and test specifications.			
2.7.2.1.2.3	Manufacturing review	Review manufacturing requirements and specifications.			
2.7.2.1.2.4	**Order Production Manufacture**	**Place order for production Data Concentrators.**			
2.7.2.1.2.4.1	Write RFQ	Compile bid package and request for quotes.			
2.7.2.1.2.4.2	Request bids	Request manufacturer bids.			
2.7.2.1.2.4.3	Evaluate bids	Compare and evaluate bid responses.			
2.7.2.1.2.4.4	Write purchase request	Printed circuit boards and components for vendor assembly and packaging.			
2.7.2.1.2.4.5	Obtain project approvals	Project level purchase request approvals.			
2.7.2.1.2.4.6	Obtain DOE approvals	Additional approvals for higher cost items.			
2.7.2.1.2.4.7	Write purchase orders	Write production purchase order.			
2.7.2.1.2.4.8	Place purchase orders	Place production purchase order.		375 DCM units * $0.880k per unit + $33.180k for power supplies = $363.180k	
2.7.2.1.2.5	Receive first article data concentrators	Manufacturer delivery of first production Data Concentrators.			
2.7.2.1.2.6	**First Article Test**	**Acceptance testing of Data Concentrators.**			
2.7.2.1.2.6.1	Standalone board tests	Self-test and internal operation verification.			
2.7.2.1.2.6.2	Interface tests	Communication and external operation verification.			
2.7.2.1.2.6.3	Evaluate test results				
2.7.2.1.2.7	Release production hold	First article production meets requirements.			
2.7.2.1.2.8	Production data concentrators received	Manufacturer delivery of production Data Concentrators.			
2.7.2.1.2.9	**Production Test**	**Acceptance testing of Data Concentrators.**			

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.7.2.1.2.9.1	Standalone board tests	Self-test and internal operation verification.			
2.7.2.1.2.9.2	Interface tests	Communication and external operation verification.			
2.7.2.1.3	**Failure Modes and Effects Analysis**	**Failure Mode Effects Analysis for Data Concentrator.**			
2.7.2.1.3.1	Perform FMEA tests and analysis	Test/analysis of likely failure scenarios and system effect.			
2.7.2.1.3.2	Write failure modes and effects analysis document	Document to assist system operators in locating and repairing failures.			
2.7.2.2	**Control and Timing System**	**Hardware for delivery of timing and control signals to Data Concentrators, readout of status.**			
2.7.2.2.1	**Pre-production Design Modifications**	**Design modifications based on prototype testing.**			
2.7.2.2.1.1	**Specifications**	**Revise specifcations as necessary.**			
2.7.2.2.1.1.1	Prepare specifications document	Update Specifications document.			
2.7.2.2.1.2	**Circuit Design**	**Update Control and Timing circuit design.**			
2.7.2.2.1.2.1	Schematic entry	Revise Control and Timing circuit design as necessary.			
2.7.2.2.1.3	Board design	Update Control and Timing board layouts.			
2.7.2.2.1.4	Simulation	Resimulate circuit and firmware design.			
2.7.2.2.2	**Pre-production Manufacture**	**Manufacturing phase for pre-production Control and Timing.**			
2.7.2.2.2.1	**Order Pre-production Manufacture**	**Place order for pre-production Control and Timing.**			
2.7.2.2.2.1.1	Write purchase requests	Pre-production printed circuit boards and components for local assembly.			
2.7.2.2.2.1.2	Obtain project approvals	Project level purchase request approvals.			
2.7.2.2.2.1.3	Write purchase orders	Write PCB and components purchase orders.			
2.7.2.2.2.1.4	Place purchase orders	Place PCB and components purchase orders.		4 timing + fanout boards @ $4k ea = $16k	
2.7.2.2.2.2	Pre-production PCBs and components received for control and timing system	Manufacturer delivery of pre-production Control and Timing components.			
2.7.2.2.2.3	Assemble pre-production version	In-house assembly of pre-production Control and Timing system.			
2.7.2.2.3	**Test**	**Acceptance testing of pre-production Control and Timing system.**			
2.7.2.2.3.1	Perform standalone board tests	Self-test and internal operation verification.			
2.7.2.2.3.2	Perform interface tests	Communication and external operation verification.			
2.7.2.2.3.3	Review test results				
2.7.2.2.4	Production approved	Control and Timing system design approved for production.			
2.7.2.2.5	**Design**	**Design phase for production Control and Timing.**			
2.7.2.2.5.1	Firmware design	Update Control and Timing firmware.			
2.7.2.2.6	**Production**	**Manufacturing phase for production Control and Timing.**			
2.7.2.2.6.1	Manufacturing requirements document	Update manufacturing requirements for PCBs.			
2.7.2.2.6.2	**Order Production PCB Manufacture**	**Place order for production Control and Timing PCBs and components.**			
2.7.2.2.6.2.1	Write RFQ	Compile bid package and request for quotes.			
2.7.2.2.6.2.2	Request bids	Request manufacturer bids.			

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.7.2.2.6.2.3	Evaluate bids	Compare and evaluate bid responses.			
2.7.2.2.6.2.4	Write purchase requests	Printed circuit boards and components for local assembly and packaging.			
2.7.2.2.6.2.5	Obtain project approvals	Project level purchase request approvals.			
2.7.2.2.6.2.6	Write purchase orders	Write production purchase order.			
2.7.2.2.6.2.7	Place purchase orders	Place production purchase order.		boards + GPS + special cable	
2.7.2.2.6.3	Receive production control and timing	Manufacturer delivery of production Control and Timing PCBs and components.			
2.7.2.2.6.4	Production assembly	In-house assembly of Control and Timing system.			
2.7.2.2.6.5	**Production Test**	**Acceptance testing of Control and Timing system.**			
2.7.2.2.6.5.1	Standalone board tests	Self-test and internal operation verification.			
2.7.2.2.6.5.2	Interface tests	Communication and external operation verification.			
2.7.2.2.7	**Failure Modes and Effects Analysis**	**Failure Mode Effects Analysis for Control and Timing.**			
2.7.2.2.7.1	Perform FMEA tests and analysis	Test/analysis of likely failure scenarios and system effect.			
2.7.2.2.7.2	Write failure modes and affects analysis document	Document to assist system operators in locating and repairing failures.			
2.7.2.3	**Network**	**Networking equipment to connect Data Concentrators to Processors, Data Storage and external routers.**			
2.7.2.3.1	Order production components	Place order for production equipment.			
2.7.2.3.2	Write RFQ	Compile bid package and request for quotes.			
2.7.2.3.3	Request bids	Request manufacturer bids.			
2.7.2.3.4	Evaluate bids	Compare and evaluate bid responses.			
2.7.2.3.5	Write purchase requests	Write purchase requests for production equipment.			
2.7.2.3.6	Obtain project approvals	Project level purchase request approvals.			
2.7.2.3.7	Write purchase orders	Write production purchase order.			
2.7.2.3.8	Place purchase orders	Place production purchase order.		31 switches + storage system controller	
2.7.2.3.9	Receive production components	Vendor delivery of production equipment.			
2.7.2.3.10	Test	Acceptance testing of production equipment.			
2.7.2.3.11	**Failure Modes and Effects Analysis**	**Failure Mode Effects Analysis for Network.**			
2.7.2.3.11.1	Perform FMEA tests and analysis	Test/analysis of likely failure scenarios and system effect			
2.7.2.3.11.2	Write failure modes and effects analysis document	Document to assist system operators in locating and repairing failures.			
2.7.2.4	**Control Room Equipment and Infrastucture**	**Computers and Displays for Control Room, Run Control, Database server applications. Control Room furnishings and infrastructure.**			
2.7.2.4.1	Order production components	Place order for production equipment.			
2.7.2.4.2	Write RFQ	Compile bid package and request for quotes.			
2.7.2.4.3	Request bids	Request manufacturer bids.			
2.7.2.4.4	Evaluate bids	Compare and evaluate bid responses.			
2.7.2.4.5	Write purchase requests	Write purchase requests for production equipment.			
2.7.2.4.6	Obtain project approvals	Project level purchase request approvals.			
2.7.2.4.7	Write purchase orders	Write production purchase order.			

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.7.2.4.8	Place purchase orders	Place production purchase order.		several $3k interactive workstation/cotrol nodes + monitors + console stations + accelerator intereface	
2.7.2.4.9	Receive production components	Vendor delivery of production equipment.			
2.7.2.4.10	Assemble equipment and infrastructure	Assembly and interconnect of Control Room equipment.			
2.7.2.4.11	Test	Acceptance testing of production equipment.			
2.7.2.4.12	**Failure Modes and Effects Analysis**	**Failure Mode Effects Analysis for Control Room equipment.**			
2.7.2.4.12.1	Perform FMEA tests and analysis	Test/analysis of likely failure scenarios and system effect.			
2.7.2.4.12.2	Write failure modes and effects analysis document	Document to assist system operators in locating and repairing failures.			
2.7.2.5	**Buffer Farm**	**Processor Farm for Trigger.**			
2.7.2.5.1	Order production components	Place order for production equipment.			
2.7.2.5.2	Write RFQ	Compile bid package and request for quotes.			
2.7.2.5.3	Request bids	Request manufacturer bids.			
2.7.2.5.4	Evaluate bids	Compare and evaluate bid responses.			
2.7.2.5.5	Write purchase requests	Write purchase requests for production equipment.			
2.7.2.5.6	Obtain project approvals	Project level purchase request approvals.			
2.7.2.5.7	Obtain DOE approvals	Additional approvals for higher cost items.			
2.7.2.5.8	Write purchase orders	Write production purchase order.			
2.7.2.5.9	Place purchase orders	Place production purchase order.		256 nodes + spares(10%) (all headless)	
2.7.2.5.10	Receive production components	Vendor delivery of production equipment.			
2.7.2.5.11	Test	Acceptance testing of production equipment.			
2.7.2.5.12	**Failure Modes and Effects Analysis**	**Failure Mode Effects Analysis for Processors.**			
2.7.2.5.12.1	Perform FMEA tests and analysis	Test/analysis of likely failure scenarios and system effect.			
2.7.2.5.12.2	Write failure modes and effects analysis document	Document to assist system operators in locating and repairing failures.			
2.7.2.6	**Data Storage**	**Network attached storage system.**			
2.7.2.6.1	Order production components	Place order for production equipment.			
2.7.2.6.2	Write RFQ	Compile bid package and request for quotes.			
2.7.2.6.3	Request bids	Request manufacturer bids.			
2.7.2.6.4	Evaluate bids	Compare and evaluate bid responses.			
2.7.2.6.5	Write purchase requests	Write purchase requests for production equipment.			
2.7.2.6.6	Obtain project approvals	Project level purchase request approvals.			
2.7.2.6.7	Write purchase orders	Write production purchase order.			
2.7.2.6.8	Place purchase orders	Place production purchase order.			
2.7.2.6.9	Receive production components	Vendor delivery of production equipment.			
2.7.2.6.10	Test	Acceptance testing of production equipment.			
2.7.2.6.11	**Failure Modes and Effects Analysis**	**Failure Mode Effects Analysis for Data Storage.**			
2.7.2.6.11.1	Perform FMEA tests and analysis	Test/analysis of likely failure scenarios and system effect.			

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.7.2.6.11.2	Write failure modes and effects analysis document	Document to assist system operators in locating and repairing failures.			
2.7.2.7	**Cabling**	**All data acquisition and network cabling.**			
2.7.2.7.1	Order production components	Place order for production cabling.			
2.7.2.7.2	Write RFQ	Compile bid package and request for quotes.			
2.7.2.7.3	Request bids	Request manufacturer bids.			
2.7.2.7.4	Evaluate bids	Compare and evaluate bid responses.			
2.7.2.7.5	Write purchase requests	Write purchase requests for production cabling.			
2.7.2.7.6	Obtain project approvals	Project level purchase request approvals.			
2.7.2.7.7	Write purchase orders	Write production purchase order.			
2.7.2.7.8	Place purchase orders	Place production purchase order.	assumes first pass ant IPND and ND		
2.7.2.7.9	Receive production components	Vendor delivery of production cabling.			
2.7.2.7.10	Test	Acceptance testing of production cabling.			
2.7.2.7.11	**Failure Modes and Effects Analysis**	**Failure Mode Effects Analysis for cabling.**			
2.7.2.7.11.1	Perform FMEA tests and analysis	Test/analysis of likely failure scenarios and system effect.			
2.7.2.7.11.2	Write failure modes and effects a nalysis document	Document to assist system operators in locating and repairing failures.			
2.7.2.8	**Databases**				
2.7.2.8.1	Procure database computers			3 computers at $2.5k each = $7.5k	
2.7.3	**Integration**	**Integration testing of DAQ and trigger electronics hardware and software. It assumes a single, central test facility and all test equipment, computers, and displays have been purchased in 1.7.1.**			
2.7.3.1	**Readout Electronics Integration Testing**				
2.7.3.1.1	Upgrade integration test stand				
2.7.3.1.2	Integrate data concentrators	Integration testing of production Data Concentrator interfaces to control and timing networks.			
2.7.3.1.3	Integrate timing system	Integration testing of production timing system to front end electronics			
2.7.3.2	**Software Integration Testing**	**I've made up releases and functionality pending releases listed in 1.7.1**			
2.7.3.2.1	Integrate RCS multinode	Includes graphics and database capability, hardware event builder, data quality monitoring.			
2.7.3.2.2	Integrate data storage system	Includes data storage.			
2.7.3.2.3	Integrate RCS partitioning	Includes graphics and database capability, hardware event builder, data quality monitoring.			
2.7.3.3	**Consultation**	**General support of the installation and integration of the trigger/daq system at the near and far detectors.**			
2.7.3.3.1	Consultation - FY08				
2.7.3.3.2	Consultation - FY09				
2.7.3.3.3	Consultation - FY10				
2.7.3.3.4	Consultation - FY11				
2.7.3.3.5	Consultation - FY12				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.7.4	**Detector Control System**	**Receives and archives monitoring data as needed.**			
2.7.4.1	**Detector Control System Procurement and Fabrication (Far Detector)**				
2.7.4.1.1	**Detector Controls Computing Hardware and Infrastructure Procurement (Far Detector)**				
2.7.4.1.1.1	Procure DCS Master control servers w/ video display interfaces				
2.7.4.1.1.2	Procure DCS readout IOC nodes				
2.7.4.1.1.3	Procure DCS far site local logger station w/ 3TB raid				
2.7.4.1.1.4	Procure DCS display consoles for far site and FNAL controls				
2.7.4.1.1.5	Procure DCS far site server cabinets (42U 19inch rack)				
2.7.4.1.1.6	Procure DCS KVM switch for readout node cluster				
2.7.4.1.1.7	Procure network cabling for DCS readout farm				
2.7.4.1.1.8	Procure power protection circuits				
2.7.4.1.1.9	Procure power backup device (10kVA UPS)				
2.7.4.1.1.10	Procure DCS mobil stations				
2.7.4.1.1.11	Procure DCS master buffered gigabit ethernet switch				
2.7.4.1.1.12	Procure DCS second level 24 port gigabit switches				
2.7.4.1.1.13	Procure DCS wireless access points (far hall)				
2.7.4.1.1.14	Procure network cabling for DCS readouts (far hall)				
2.7.4.1.1.15	Procure fiber interconnect (second level switch to master)				
2.7.4.1.2	**Detector Controls Readout Hardware Procurement (Far Detector)**				
2.7.4.1.2.1	Procure water pumping/cooling and environmental readout stations (Fieldpoints)				
2.7.4.1.2.2	Procure RS485 readout interface cards				
2.7.4.1.2.3	Procure sensor packs for water systems, env, rack mon.				
2.7.4.2	**Computer Systems Installation (Far Detector)**				
2.7.4.2.1	Configure and test master control server				
2.7.4.2.2	Configure and test readout IOC nodes				
2.7.4.2.3	Configure and test data logging server				
2.7.4.2.4	Install servers and switches in far site eletronics room				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.7.4.2.5	Install control room displays and monitoring facilities				
2.7.4.2.6	Install DCSNet network infrastructure and switches				
2.7.4.2.7	Verify network and cluster stablity at far site				
2.7.4.2.8	Perform security audit of far detector computer systems				
2.7.4.3	**Readout Systems Installation in Far Detector Hall (Block 1)**				
2.7.4.3.1	Install field point stations for block 1				
2.7.4.3.2	Install sensor packs for block 1				
2.7.4.3.3	Install readout connections to misc. devices for block 1				
2.7.4.4	**Detector Control System Commissioning**				
2.7.4.4.1	Test DCS subsystem readout				
2.7.4.4.2	Test DCS subsystem alarm notification				
2.7.4.4.3	Test DCS subsystem controls				
2.7.4.4.4	Test DCS remote operations				
2.7.4.4.5	Test DCS full-scale integration				
2.7.4.5	DCS production operations certification - stage 1				
2.7.4.6	Install full-scale far site readout systems (blocks 2-20)				
2.7.4.7	Conduct DCS load scaling and performance review				
2.7.4.8	Install full-scale far site readout systems (Blocks 21-40)				
2.7.4.9	Conduct DCS full production system review				
2.7.5	**Management - Construction Phase**				
2.7.5.2	**FY08**				
2.7.5.2.1	Labor				
2.7.5.2.2	Travel			1 domestic trip @$1.5k = $1.5k	
2.7.5.2.3	Equipment				
2.7.5.2.4	Materials and supplies				
2.7.5.3	**FY09**				
2.7.5.3.1	Labor				
2.7.5.3.2	Travel			1 domestic trip @$1.5k = $1.5k	
2.7.5.3.3	Equipment				
2.7.5.3.4	Materials and supplies				
2.7.5.4	**FY10**				
2.7.5.4.1	Labor				
2.7.5.4.2	Travel			1 domestic trip @$1.5k = $1.5k	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.7.5.4.3	Equipment				
2.7.5.4.4	Materials and supplies				
2.7.5.5	**FY11**				
2.7.5.5.1	Labor				
2.7.5.5.2	Travel			1 domestic trip @$1.5k = $1.5k	
2.7.5.5.3	Equipment				
2.7.5.5.4	Materials and supplies				
2.7.5.6	**FY12**				
2.7.5.6.1	Labor				
2.7.5.6.2	Travel				
2.7.5.6.3	Equipment				
2.7.5.6.4	Materials and supplies				
2.8	**Near Detector Assembly**	**This level 2 summary element provides for the engineering design of the mechanical devices and tooling needed to install the NOvA Near Detector. Fabrication of the necessary tooling, installation and commissioning of the near Detector in its underground location at Fermilab is also included. The close similarity of many Near and Far Detector assembly systems requires close coordination with WBS 2.9.**	**The start of the near detector site preparation is delayed so that the ND will be installed and ready to take data about the same time as the first 5000 tons of the far detector begins taking data.**		
2.8.1	**Near Detector Site Preparation**				
2.8.1.1	**Cave Excavation Design and Engineering**				
2.8.1.1.1	Finalize location of cave to be excavated				
2.8.1.1.2	Finalize size of cave to be excavated				
2.8.1.1.3	Contract with engineering firm to specify excavation methodology and details				
2.8.1.1.4	Review and certify excavation design and plans				
2.8.1.1.5	Administrative and safety signoffs on excavation design				
2.8.1.2	**Tunnel and Cave Infrastructure Design and Engineering**				
2.8.1.2.1	Determine new route for MINOS cables				
2.8.1.2.2	Design/specify lighting for new cavern				
2.8.1.2.3	Specify HVAC for new cavern				
2.8.1.2.4	**Near Detector Electrical Power Needs**				
2.8.1.2.4.1	Specify power requirements				
2.8.1.2.4.2	Engineer power sourcing and distribution				
2.8.1.2.5	Design/engineer fire protection for Near Detector				
2.8.1.3	**Tunnel Infrastructure Contract**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.8.1.3.1	Prepare bid documents				
2.8.1.3.2	Solicit bids				
2.8.1.3.3	Select contractor				
2.8.1.3.4	Notice to Proceed on phase 1				
2.8.1.3.5	Reposition MINOS infrastructure				
2.8.1.3.6	Notice to Proceed on phase 2				
2.8.1.3.7	Lighting portion of contract				
2.8.1.3.8	HVAC portion of contract				
2.8.1.3.9	Electrical Power portion of contract				
2.8.1.3.10	Fire Protection Systems portion of contract				
2.8.1.3.11	Infrastructure contract completed				
2.8.1.4	**Excavation Contract**				
2.8.1.4.1	Prepare bid documents				
2.8.1.4.2	Solicit bids				
2.8.1.4.3	Select contractor				
2.8.1.4.4	Notice to Proceed - excavation				
2.8.1.4.5	Perform excavation				
2.8.1.4.6	Excavation contract completed				
2.8.1.5	Connect and certify FIRUS				
2.8.1.6	Specify safety and training requirements for this region				
2.8.1.7	Beneficial occupancy of new cavern				
2.8.1.8	Survey location for detector				
2.8.2	**Mechanical Construction and Installation**				
2.8.2.1	**Containment of ND Full Volume**				
2.8.2.1.1	Review and certify containment scheme for ND full volume				
2.8.2.1.2	Issue P.O. for containment of full ND volume				
2.8.2.1.3	Install containment for full ND volume - initial phase				
2.8.2.1.4	Install remainder of containment for full ND volume				
2.8.2.2	**Muon Catcher**				
2.8.2.2.1	**Muon Catcher Support Structure**				
2.8.2.2.1.1	Review and certify muon catcher support design				
2.8.2.2.1.2	Procure materials for support structure				
2.8.2.2.1.3	Weld structure pieces				
2.8.2.2.1.4	Move support structure underground				
2.8.2.2.1.5	Preceisely position support structure				
2.8.2.2.2	**Muon Catcher Planes**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.8.2.2.2.1	**Muon Catcher Steel**				
2.8.2.2.2.1.1	Design steel pieces				
2.8.2.2.2.1.2	Review and certify size and shape of muon steel pieces				
2.8.2.2.2.1.3	Purchase raw steel and ship to cutting shop				
2.8.2.2.2.1.4	Cut steel pieces to appropriate shape				
2.8.2.2.2.1.5	Accept steel pieces				
2.8.2.2.2.2	Make muon catcher planes				
2.8.2.2.2.3	Attach detector planes to steel				
2.8.2.2.2.4	Move planes underground				
2.8.2.2.2.5	Mount planes on support structure				
2.8.2.2.3	Muon catcher mechanical construction completed				
2.8.2.3	**Active Detector**				
2.8.2.3.1	**Three Blocks From IPND**				
2.8.2.3.1.1	Review and certify suitability of cradles for descending in shaft				
2.8.2.3.1.2	Release of three blocks from IPND to ND				
2.8.2.3.1.3	Prepare three blocks to be moved				
2.8.2.3.1.4	Modify cooling connections for at least one block				
2.8.2.3.1.5	Move three blocks underground				
2.8.2.3.1.6	Position blocks in ND				
2.8.2.3.2	**Final Three Blocks**				
2.8.2.3.2.1	**Cradles for Final Three Blocks**				
2.8.2.3.2.1.1	Procure parts for three cradles				
2.8.2.3.2.1.2	Weld cradles				
2.8.2.3.2.1.3	Test cradles				
2.8.2.3.2.2	**Active Blocks**				
2.8.2.3.2.2.1	Modules for final three blocks available				
2.8.2.3.2.2.2	Modify block construction tooling for final three blocks				
2.8.2.3.2.2.3	Construct three blocks at ANL				
2.8.2.3.2.2.4	Fiducialize three blocks				
2.8.2.3.2.2.5	Update block view of database				
2.8.2.3.2.2.6	Attach blocks to cradles				
2.8.2.3.2.2.7	Transport three blocks to FNAL				
2.8.2.3.2.2.8	Move blocks underground				
2.8.2.3.2.2.9	Place blocks in detector				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.8.2.4	**South Bookend**				
2.8.2.4.1	Move bookend major pieces underground				
2.8.2.4.2	Complete assembly of bookend in place				
2.8.2.5	Survey and align muon catcher and six blocks				
2.8.2.6	Muon catcher, all blocks and bookend in place				
2.8.3	**Liquid Scintillator Filling Equipment**				
2.8.3.1	Design ND-specific scintillator filling equipment				
2.8.3.2	Review and certify design of ND-specific scintillator filling equipment				
2.8.3.3	**Shaft Fill and Vent Pipes**				
2.8.3.3.1	Issue P.O. for shaft pipes				
2.8.3.3.2	Install shaft pipes				
2.8.3.3.3	Pressure test shaft fill pipes				
2.8.3.4	Transfer scintillator fill machine from IPND to ND				
2.8.3.6	**Containment at Base of Shaft**				
2.8.3.6.1	Review and certify containment scheme at base of shaft				
2.8.3.6.2	Issue P.O. for containment at base of shaft				
2.8.3.6.3	Install containment at base of shaft				
2.8.3.7	Both containment systems ready to accept scintillator				
2.8.4	**Installation Coordination**				
2.8.4.1	Review near detector outfitting procedures				
2.8.4.2	Collect detector readout outfitting electronics and DAQ components				
2.8.4.3	**Scintillator Module Filling**				
2.8.4.3.1	Review and certify scintillator module filling procedure				
2.8.4.3.2	Install scintillator supply plumbing and attach to shaft piping				
2.8.4.3.3	Fill scintillator modules				
2.8.4.3.4	Maintain scintillator view of database				
2.8.4.4	**Photodetector, High Voltage and Readout Electronics Systems**				
2.8.4.4.1	Move photodetector and electronics systems underground				
2.8.4.4.2	Install photodetector and electronics systems				
2.8.4.4.3	Maintain photodetector and electronics view of database				
2.8.4.5	**DAQ System**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.8.4.5.1	Move DAQ system underground				
2.8.4.5.2	Install DAQ system				
2.8.4.6	**Detector Turn-on and Commissioning**				
2.8.4.6.1	**Operational Readiness Approval**				
2.8.4.6.1.1	Operational Readiness Review				
2.8.4.6.1.2	Operational readiness approved				
2.8.4.6.2	Photodetector, Readout, and DAQ Systems Commissioning				
2.8.4.6.3	First cosmic ray tracks observed in near detector				
2.8.4.6.4	First NuMI beam events observed in near detector				
2.8.4.6.5	Near detector completed and ready to operate				
2.8.5	**Management - Construction Phase**	**This WBS element includes the tasks required to support and manage WBS 2.8 activities including quality assurance, value management, risk management, schedule monitoring, preparation of reports and other related activities.**			
2.8.5.1	**FY08**				
2.8.5.1.1	Labor				Physicist - a couple of weeks per year for minimal admin since this project doesn't really get going until Q4FY09
2.8.5.1.2	Travel			no travel - local to FNAL/ANL	
2.8.5.1.3	Equipment				
2.8.5.1.4	Materials and supplies				
2.8.5.2	**FY09**				
2.8.5.2.1	Labor				Physicist - a couple of weeks per year for minimal admin since this project doesn't really get going until Q4 of this fiscal year
2.8.5.2.2	Travel			no travel - local to FNAL/ANL	
2.8.5.2.3	Equipment				
2.8.5.2.4	Materials and supplies				
2.8.5.3	**FY10**				
2.8.5.3.1	Labor				Physicist - est of 6 weeks per year spent on subproject-related management and oversight activites (project reporting, informatin gathering, personnel matters, reviews, etc.) not covered elsewhere in the project plan/schedule. split between FNAL and ANL
2.8.5.3.2	Travel			no travel - local to FNAL/ANL	
2.8.5.3.3	Equipment				
2.8.5.3.4	Materials and supplies				
2.8.5.4	**FY11**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.8.5.4.1	Labor				Physicist - a couple of weeks per year for minimal admin since this sub project is mainly concluded in FY10
2.8.5.4.2	Travel			no travel - local to FNAL/ANL	
2.8.5.4.3	Equipment				
2.8.5.4.4	Materials and supplies				
2.8.5.5	**FY12**				
2.8.5.5.1	Labor				Physicist - a couple of days per year for minimal admin since this sub project is mainly concluded in FY10
2.8.5.5.2	Travel				
2.8.5.5.3	Equipment				
2.8.5.5.4	Materials and supplies				
2.8.5.6	**Milestones**	**These are temporary place-holder milestones that will be replaced by actual milestones in other Level 2 WBS tasks when WBS 2.8 is integrated into the overall Project WBS. The dates shown are just guesses.**			
2.8.5.6.1	Near detector assembly subproject start				
2.9	**Far Detector Assembly**	**This task provides for the engineering design of the mechanical systems and tooling needed to install the NOvA Far Detector. Fabrication of the necessary tooling, installation and commissioning of the detector in the detector building in northern Minnesota is also included. This task requires close coordination with the WBS 2.1 (far site and buildings), WBS 2.2 (scintillator), WBS 2.5 (PVC modules), and WBS 2.6/2.7 (electronics and DAQ).**			
2.9.1	**Mechanical Systems**	**Complete the engineering design, procurement and fabrication of the Far Detector mechanical support structures and other block assembly equipment, including the block pivoter, block safety contraint beam, module lifting fixtures, adhesive dispenser, and survey equipment. This task includes final optimization, review and approval of associated equipment and assembly procedures.**			
2.9.1.1	**Module Lifting Fixtures**				
2.9.1.1.1	Complete final design				
2.9.1.1.2	Review final design				
2.9.1.1.3	Final design approved - module lifting fixture				
2.9.1.1.4	Procure components				
2.9.1.1.5	Fabricate components				
2.9.1.1.6	Test fixture on prototype modules				
2.9.1.1.7	Document operating procedures				
2.9.1.1.8	Conduct operational readiness review				
2.9.1.1.9	Module lifting fixtures completed				
2.9.1.1.10	Disassemble and pack for shipping				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.9.1.1.11	Module lifting fixtures ready for shipping				
2.9.1.2	**Adhesive Dispenser and Staging Stand**	**The adhesive dispenser applies adhesive to the surfaces of modules before they are placed in position during block assembly. It also applies adhesive to the surface of block spacer on the block raiser before the block is raised into position on the detector. The final design builds on the designs and prototype testing during the R&D phase of the NOvA Project.**		**see BOE binder for details**	
2.9.1.2.1	Complete final design				
2.9.1.2.2	Procure components				
2.9.1.2.3	Assemble dispenser				
2.9.1.2.4	Test dispenser on prototype modules				
2.9.1.2.5	Document operating procedures				
2.9.1.2.6	Conduct operational readiness review				
2.9.1.2.7	Adhesive dispenser completed				
2.9.1.2.8	Disassemble and pack for shipping				
2.9.1.2.9	Adhesive dispenser ready for shipping				
2.9.1.3	**Block Safety Constraint Beam**				
2.9.1.3.1	Final design of safety constraint beam				
2.9.1.3.2	Review constraint design				
2.9.1.3.3	Procure components				
2.9.1.3.4	Fabricate components				
2.9.1.3.5	Test safety constraint				
2.9.1.3.6	Document installation procedures and analysis				
2.9.1.3.7	Conduct operational readiness review				
2.9.1.3.8	Block safety constraint completed				
2.9.1.3.9	Disassemble and pack for shipping				
2.9.1.3.10	Constraint beam ready for shipping				
2.9.1.4	**Block Pivoter Construction and Pallet Final Design**	**These tasks include the integrated design of the block pivoter and block support pallets, as well as the construction of the block pivoter.**			
2.9.1.4.1	Finalize block pivoter design				
2.9.1.4.2	Review final design				
2.9.1.4.3	Final design approved - block pivoter and pallet				
2.9.1.4.4	Fabricate demonstration pallet				
2.9.1.4.5	Procure pivoter components				
2.9.1.4.6	Fabricate components				
2.9.1.4.7	Assemble components				
2.9.1.4.8	Prepare test site				
2.9.1.4.9	Design and construct test load				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.9.1.4.10	Document and review test procedures				
2.9.1.4.11	Assemble and test block pivoter				
2.9.1.4.12	Document operating procedures				
2.9.1.4.13	Conduct operational readiness review				
2.9.1.4.14	Block pivoter completed				
2.9.1.4.15	Disassemble and pack for shipping				
2.9.1.4.16	Block pivoter ready for shipping				
2.9.1.5	**Survey Equipment**	**Survey and alignment equipment is used to determine the correct locations of modules as they are attached to blocks and of entire blocks as they are mounted on the detector by the block pivoter. The survey and alignment system also measures and records the as-built locations of detector components as they are assembled. It consists of both commercially-available and custom-designed equipment. The final design builds on the designs and prototype testing during the R&D phase of the NOvA Project.**			
2.9.1.5.1	Specify survey requirements				
2.9.1.5.2	Procure equipment			cost of a v-star system based on info from FNAL alignment group.	
2.9.1.5.3	Document survey procedures				
2.9.1.5.4	Survey equipment ready for assembly				
2.9.2	**Detector Infrastructure**				
2.9.2.1	**Electrical Infrastructure**				
2.9.2.1.1	Install circuits from panels to glue machine area				
2.9.2.1.2	Install circuits from panels to block pivoter area				
2.9.2.1.3	Install circuits from panels to scintillator equipment				
2.9.2.1.4	Install circuits from panels to electronics racks/refrigerators				
2.9.2.1.5	Install machine shop and control room circuits				
2.9.2.2	Machine Shop				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.9.2.3	**Bookends**	**This task includes the final design, review, fabrication and shipment to the far site of components needed to complete assembly of the north and south detector bookends. The final design builds on the conceptual designs produced by the R&D phase of the NOvA Project. For the south bookend, WBS 2.1 provides the basic structure. This task provides equipment and material needed to prepare the bookend surface for attaching the first block to the south bookend. For the north bookend, this task provides material and equipment needed to convert the Block Pivoter into a permanent bookend structure. It does not include the 10 ft thick concrete cosmic-ray shield wall, whichwill be installedon the north side of the north bookend.**			
2.9.2.3.21	**South Bookend**				
2.9.2.3.21.1	Finalize design of south bookend				engineer estimate
2.9.2.3.21.2	Review design of south bookend				
2.9.2.3.21.3	Final design approved-south bookend				
2.9.2.3.21.4	Procure south bookend components				
2.9.2.3.21.5	Fabricate components				
2.9.2.3.21.6	South bookend components ready for shipment				
2.9.2.3.22	**North Bookend**				**refer to BOE notebook**
2.9.2.3.22.1	Finalize design of north bookend				engineer estimate
2.9.2.3.22.2	Review design of north bookend				
2.9.2.3.22.3	Final design approved- north bookend				
2.9.2.3.22.4	Procure north bookend components				
2.9.2.3.22.5	Fabricate components				
2.9.2.3.22.6	Prepare components for shipment to far site				
2.9.2.3.22.7	Ship components to far site				
2.9.2.3.22.8	Convert block pivoter to north bookend				
2.9.2.4	**Shield Wall**	**This is the design, procurement and installation of the precast shield wall that seperates the Detector Enclosure from the Assembly Space.**		**Architectural/Engineering (A/E) activities are part of the ED&I activities. A/E activities are services that are an integral part of the production and delivery of the design plans,specifications, and drawings.**	
2.9.2.4.1	**Design Precast**			**Design costs are assumed to be 10% of installed precast. Assume 75% of Design Costs will be accomplished by consultants**	**Design costs are assumed to be 10% of installed precast. Assume 25% of Design Costs will be accomplished by in-house forces**
2.9.2.4.1.1	Prepare drawings				
2.9.2.4.1.2	Prepare specifications				
2.9.2.4.1.3	Prepare cost estimate				
2.9.2.4.1.4	Assemble, print, and distribute documents				
2.9.2.4.1.5	Comment and compliance review				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.9.2.4.1.6	Finalize drawings				
2.9.2.4.1.7	Finalize specifications				
2.9.2.4.1.8	Finalize cost estimate				
2.9.2.4.1.9	Assemble and print documents				
2.9.2.4.2	**Procure Precast**				
2.9.2.4.2.1	Write requisition				
2.9.2.4.2.2	Circulate requisition				
2.9.2.4.2.3	Prepare request for proposal				
2.9.2.4.2.4	Issue request for proposal				
2.9.2.4.2.5	Review received proposals				
2.9.2.4.2.6	Prepare purchase order				
2.9.2.4.2.7	Shield wall precast purchase order released				
2.9.2.4.2.8	Submit and approve precast shop drawings				
2.9.2.4.2.9	Fabricate precast elements				
2.9.2.4.2.10	Deliver precast elements				
2.9.2.4.3	**Install Precast**				
2.9.2.4.3.1	Crane rental	This is the rental of a portable crane and operator for the installation of the precast shield blocks.		Assume 10 day rental at $4,000 per day. Includes set up charges	
2.9.2.4.3.2	Place precast	This is the rigging crew for installing the precast elements.		Assumes 4 man crew for 10 days including misc materails	
2.9.2.5	Control Room				
2.9.2.6	Office Area				
2.9.2.7	Safety Equipment				
2.9.3	**Scintillator Filling Equipment**	**Complete the engineering design, the procurement and fabrication of the Far Detector liquid scintillator transfer and filling equipment, the associated distribution controls, the distribution plumbing that connects the transfer equipment to the filling machines and detector modules and the vapor recovery system.**			
2.9.3.1	**Scintillator Transfer Facility**				
2.9.3.1.1	Finalize design of transfer facility				
2.9.3.1.2	Scintillator transfer facility final design approved				
2.9.3.1.3	Procure parts				
2.9.3.1.4	**Commission Distribution Controls (Indiana)**				
2.9.3.1.4.1	Assemble parts, control system				
2.9.3.1.4.2	Develop control scheme, monitoring software				
2.9.3.1.4.3	Test control scheme				
2.9.3.1.4.4	Document scintillator transfer control system				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.9.3.1.4.5	Disassemble parts and prepare for shipping				
2.9.3.1.5	**Commission Distribution Controls (Ash River)**				
2.9.3.1.5.1	Ship distribution control system to far detector site				
2.9.3.1.5.2	Assemble parts, control system				
2.9.3.1.5.3	Test control scheme				
2.9.3.1.5.4	Document scintillator transfer control system				
2.9.3.1.5.5	Conduct operational readiness review				
2.9.3.2	**Scintillator Distribution Plumbing**				
2.9.3.2.1	Finalize design of distribution plumbing				
2.9.3.2.2	Procure parts				
2.9.3.2.3	Install main distribution lines				
2.9.3.3	**Scintillator Filling Machines**				
2.9.3.3.1	Finalize design of filling machines				
2.9.3.3.2	Procure parts				
2.9.3.3.3	Assemble and test filling machines				
2.9.3.3.4	Document fillling machine operation				
2.9.3.4	**Vapor Recovery System**				
2.9.3.4.1	Finalize vent design				
2.9.3.4.2	Document vapor vent system				
2.9.3.4.3	Procure parts				
2.9.3.4.4	Install main (building level) vent lines				
2.9.3.5	**Scintillator Filling System Commissioning**				
2.9.3.5.1	Connect and fill prototype modules				
2.9.3.5.2	Document complete operating procedures				
2.9.3.5.3	Conduct operational readiness review for scintillator filling system				
2.9.3.6	Scintillator filling system completed				
2.9.4	**Block Assembly and Installation**				
2.9.4.1	**Assembly Infrastructure Setup**				
2.9.4.1.1	Install work platforms				
2.9.4.1.2	Procure and setup material handling equipment				
2.9.4.1.3	Ship module handling fixtures				
2.9.4.1.4	Ship block safety constraint beam				
2.9.4.1.5	Ship south bookend components				
2.9.4.1.6	Install south bookend				
2.9.4.1.40	**Adhesive Dispenser and Staging Stand**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.9.4.1.40.1	Ship adhesive dispenser and staging stand				
2.9.4.1.40.2	Assemble and test adhesive ventilation				
2.9.4.1.40.3	Assemble adhesive dispenser and staging stand				
2.9.4.1.40.4	Test and document adhesive dispenser				
2.9.4.1.40.5	Conduct operational readiness review				
2.9.4.1.40.6	Adhesive dispenser ready for operation				
2.9.4.1.50	**Block Pivoter**				
2.9.4.1.50.1	Ship block pivoter parts				
2.9.4.1.50.2	Assemble block pivoter				
2.9.4.1.50.3	Test and document block pivoter procedures				
2.9.4.1.50.4	Conduct operational readiness review				
2.9.4.1.50.5	Block pivoter ready for operation				
2.9.4.1.60	**Alignment and Survey Setup**				
2.9.4.1.60.1	Survey detector hall, establish local procedures				
2.9.4.1.60.2	Install needed monuments and other equipment				
2.9.4.1.60.3	Document survey procedures				
2.9.4.2	**Block Assembly Components**				
2.9.4.2.1	**Block Pallets**	**This task includes vendor fabrication and shipment to the far site of the 38 support pallets that form the bases of the detector blocks. The pallet design is integrated with that of the block pivoter Each support pallet is installed on the pivoter as part of the block assembly procedure**			
2.9.4.2.1.1	Establish pallet contract				
2.9.4.2.1.2	Receive 5 block pallets				
2.9.4.2.1.3	Receive 5 block pallets				
2.9.4.2.1.4	Receive 5 block pallets				
2.9.4.2.1.5	Receive 5 block pallets				
2.9.4.2.1.6	Receive 5 block pallets				
2.9.4.2.1.7	Receive 5 block pallets				
2.9.4.2.1.8	Receive 5 block pallets				
2.9.4.2.1.9	Receive 3 block pallets				
2.9.4.2.2	**Adhesive**				
2.9.4.2.2.1	Establish adhesive contract				
2.9.4.2.2.2	Receive 5 shipments - adhesive				
2.9.4.2.2.3	Receive 5 shipments - adhesive				
2.9.4.2.2.4	Receive 5 shipments - adhesive				
2.9.4.2.2.5	Receive 5 shipments - adhesive				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.9.4.2.2.6	Receive 5 shipments - adhesive				
2.9.4.2.2.7	Receive 5 shipments - adhesive				
2.9.4.2.2.8	Receive 5 shipments - adhesive				
2.9.4.2.2.9	Receive 3 shipments - adhesive				
2.9.4.2.3	**Expansion Tanks**				
2.9.4.2.3.1	Establish expansion tank contract				
2.9.4.2.3.2	Fabricate and deliver 5 shipments - expansion tanks				
2.9.4.2.3.3	Fabricate and deliver 5 shipments - expansion tanks				
2.9.4.2.3.4	Fabricate and deliver 5 shipments - expansion tanks				
2.9.4.2.3.5	Fabricate and deliver 5 shipments - expansion tanks				
2.9.4.2.3.6	Fabricate and deliver 5 shipments - expansion tanks				
2.9.4.2.3.7	Fabricate and deliver 5 shipments - expansion tanks				
2.9.4.2.3.8	Fabricate and deliver shipments - expansion tanks				
2.9.4.2.3.9	Fabricate and deliver 3 shipments - expansion tanks				
2.9.4.2.4	**Filler Grout**				
2.9.4.2.4.1	Establish grout filler contract				
2.9.4.2.4.2	Receive 5 batches - grout filler				
2.9.4.2.4.3	Receive 5 batches - grout filler				
2.9.4.2.4.4	Receive 5 batches - grout filler				
2.9.4.2.4.5	Receive 5 batches - grout filler				
2.9.4.2.4.6	Receive 5 batches - grout filler				
2.9.4.2.4.7	Receive 5 batches - grout filler				
2.9.4.2.4.8	Receive 5 batches - grout filler				
2.9.4.2.4.9	Receive 3 batches - grout filler				
2.9.4.3	**Block Assembly and Alignment**				
2.9.4.3.1	Review and approve far detector plane assembly procedures				
2.9.4.3.2	Far detector plane assembly begins				
2.9.4.3.3	Assemble and mount block 1				
2.9.4.3.4	Assemble and mount block 2				
2.9.4.3.5	Assemble and mount block 3				
2.9.4.3.6	Assemble and mount block 4				
2.9.4.3.7	Assemble and mount block 5				
2.9.4.3.8	Super-block 1 assembled				
2.9.4.3.9	Assemble and mount block 6				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.9.4.3.10	Assemble and mount block 7				
2.9.4.3.11	Assemble and mount block 8				
2.9.4.3.12	Assemble and mount block 9				
2.9.4.3.13	Assemble and mount block 10				
2.9.4.3.14	Super-block 2 assembled				
2.9.4.3.15	Assemble and mount block 11				
2.9.4.3.16	Assemble and mount block 12				
2.9.4.3.17	Assemble and mount block 13				
2.9.4.3.18	Assemble and mount block 14				
2.9.4.3.19	Assemble and mount block 15				
2.9.4.3.20	Super-block 3 assembled				
2.9.4.3.21	Assemble and mount block 16				
2.9.4.3.22	Assemble and mount block 17				
2.9.4.3.23	Assemble and mount block 18				
2.9.4.3.24	Assemble and mount block 19				
2.9.4.3.25	Assemble and mount block 20				
2.9.4.3.26	Super-block 4 assembled				
2.9.4.3.27	Assemble and mount block 21				
2.9.4.3.28	Assemble and mount block 22				
2.9.4.3.29	Assemble and mount block 23				
2.9.4.3.30	Assemble and mount block 24				
2.9.4.3.31	Assemble and mount block 25				
2.9.4.3.32	Super-block 5 assembled				
2.9.4.3.33	Assemble and mount block 26				
2.9.4.3.34	Assemble and mount block 27				
2.9.4.3.35	Assemble and mount block 28				
2.9.4.3.36	Assemble and mount block 29				
2.9.4.3.37	Assemble and mount block 30				
2.9.4.3.38	Super-block 6 assembled				
2.9.4.3.39	Assemble and mount block 31				
2.9.4.3.40	Assemble and mount block 32				
2.9.4.3.41	Assemble and mount block 33				
2.9.4.3.42	Assemble and mount block 34				
2.9.4.3.43	Assemble and mount block 35				
2.9.4.3.44	Super-block 7 assembled				
2.9.4.3.45	Assemble and mount block 36				
2.9.4.3.46	Assemble and mount block 37				
2.9.4.3.47	Assemble and mount block 38				
2.9.4.3.48	Survey super-block 1				
2.9.4.3.49	Survey super-block 2				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.9.4.3.50	Survey super-block 3				
2.9.4.3.51	Survey super-block 4				
2.9.4.3.52	Survey super-block 5				
2.9.4.3.53	Survey super-block 6				
2.9.4.3.54	Survey super-block 7				
2.9.4.3.55	Survey super-block 8				
2.9.4.3.480	Block assembly and allignment completed				
2.9.4.4	**Detector Block Filling**				
2.9.4.4.1	Crew Training and Setup				
2.9.4.4.2	Fill block 1				
2.9.4.4.3	Fill block 2				
2.9.4.4.4	Fill block 3				
2.9.4.4.5	Fill block 4				
2.9.4.4.6	Fill block 5				
2.9.4.4.7	Super-block 1 filled				
2.9.4.4.8	Fill block 6				
2.9.4.4.9	Fill block 7				
2.9.4.4.10	Fill block 8				
2.9.4.4.11	Fill block 9				
2.9.4.4.12	Fill block 10				
2.9.4.4.13	Super-block 2 filled				
2.9.4.4.14	Fill block 11				
2.9.4.4.15	Fill block 12				
2.9.4.4.16	Fill block 13				
2.9.4.4.17	Fill block 14				
2.9.4.4.18	Fill block 15				
2.9.4.4.19	Super-block 3 filled				
2.9.4.4.20	Fill block 16				
2.9.4.4.21	Fill block 17				
2.9.4.4.22	Fill block 18				
2.9.4.4.23	Fill block 19				
2.9.4.4.24	Fill block 20				
2.9.4.4.25	Super-block 4 filled				
2.9.4.4.26	Fill block 21				
2.9.4.4.27	Fill block 22				
2.9.4.4.28	Fill block 23				
2.9.4.4.29	Fill block 24				
2.9.4.4.30	Fill block 25				
2.9.4.4.31	Super-block 5 filled				
2.9.4.4.32	Fill block 26				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.9.4.4.33	Fill block 27				
2.9.4.4.34	Fill block 28				
2.9.4.4.35	Fill block 29				
2.9.4.4.36	Fill block 30				
2.9.4.4.37	Super-block 6 filled				
2.9.4.4.38	Fill block 31				
2.9.4.4.39	Fill block 32				
2.9.4.4.40	Fill block 33				
2.9.4.4.41	Fill block 34				
2.9.4.4.42	Fill block 35				
2.9.4.4.43	Super-block 7 filled				
2.9.4.4.44	Fill block 36				
2.9.4.4.45	Fill block 37				
2.9.4.4.46	Fill block 38				
2.9.4.4.47	Block filling completed				
2.9.4.4.55	Final detector survey				
2.9.4.5	**Detector Block Outfitting**				
2.9.4.5.1	Outfit blocks 1-2				
2.9.4.5.2	Outfit blocks 3-4				
2.9.4.5.3	Outfit blocks 5-6				
2.9.4.5.4	Outfit blocks 7-8				
2.9.4.5.5	Outfit blocks 9-10				
2.9.4.5.6	Outfit blocks 11-12				
2.9.4.5.7	Outfit blocks 13-14				
2.9.4.5.8	Outfit blocks 15-16				
2.9.4.5.9	Outfit blocks 17-18				
2.9.4.5.10	Outfit blocks 19-20				
2.9.4.5.11	Outfit blocks 21-22				
2.9.4.5.12	Outfit blocks 23-24				
2.9.4.5.13	Outfit blocks 25-26				
2.9.4.5.14	Outfit blocks 27-28				
2.9.4.5.15	Outfit blocks 29-30				
2.9.4.5.16	Outfit blocks 31-32				
2.9.4.5.17	Outfit blocks 33-34				
2.9.4.5.18	Outfit blocks 35-36				
2.9.4.5.19	Outfit blocks 37-38				
2.9.4.5.22	Superblock 1 oufitting completed				
2.9.4.5.25	Superblock 2 outfitting completed				
2.9.4.5.28	Superblock 3 oufitting completed				
2.9.4.5.31	Superblock 4 oufitting completed				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.9.4.5.34	Superblock 5 oufitting completed				
2.9.4.5.37	Superblock 6 outfitting completed				
2.9.4.5.40	Superblock 7 oufitting completed				
2.9.4.5.43	Superblock 8 oufitting completed				
2.9.4.5.46	All block oufitting completed				
2.9.4.6	**Detector Turn-on and Checkout**	**This task covers the Minnesota crewmember effort required for the initial turn-on and commissioning for the first block and its associated APD, readout and DAQ systems. This task is broken out separately from the turn-on and commissioning of subsequent blocks (which is covered in WBS 2.9.4.6) because it leads to the observation of the first cosmic ray and neutrino events in the detector. These important milestones are also included in this task.**			
2.9.4.6.1	Review readout system for operational readiness				
2.9.4.6.2	Checkout block 1 photodetector and readout system				
2.9.4.6.3	First cosmic ray tracks observed in Far Detector				
2.9.4.6.4	First NuMI neutrino events observed in Far Detector				
2.9.4.6.5	Far Detector installation completed				
2.9.4.7	**Assembly Crew Management - Minnesota**	**This task covers the oversight and coordination effort provided by the Lab Supervisor, the Assistant Lab Supervisor and the Lab Administrative Assistant during the detector assembly phase of WBS 2.9, which begins when the building outfitting is completed.**			
2.9.4.7.1	Assembly crew management - outfitting and setup phase				
2.9.4.7.2	Assembly crew management - detector assembly startup phase				
2.9.4.7.3	Assembly crew management - detector assembly full rate phase				
2.9.5	**Management - Construction Phase**	**This WBS element includes the tasks required to support and manage WBS 2.9 activities including quality assurance, value management, risk management, schedule monitoring, preparation of reports and other related activities.**			
2.9.5.1	**FY08**				
2.9.5.1.1	Labor				Physicist - est of 6 weeks per year spent on subproject-related management and oversight activites (project reporting, informatin gathering, personnel matters, reviews, etc.) not covered elsewhere in the project plan/schedule.
2.9.5.1.2	Travel			No travel as installation has not started.	
2.9.5.1.3	Equipment				
2.9.5.1.4	Materials and supplies				
2.9.5.2	**FY09**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.9.5.2.1	Labor				Physicist - est of 6 weeks per year spent on subproject-related management and oversight activites (project reporting, informatin gathering, personnel matters, reviews, etc.) not covered elsewhere in the project plan/schedule.
2.9.5.2.2	Travel			6 domestic trips @ $1.5k per trip = $9k	
2.9.5.2.3	Equipment				
2.9.5.2.4	Materials and supplies				
2.9.5.3	**FY10**				
2.9.5.3.1	Labor				Physicist - est of 6 weeks per year spent on subproject-related management and oversight activites (project reporting, informatin gathering, personnel matters, reviews, etc.) not covered elsewhere in the project plan/schedule.
2.9.5.3.2	Travel			6 domestic trips @ $1.5k per trip = $9k	
2.9.5.3.3	Equipment				
2.9.5.3.4	Materials and supplies				
2.9.5.4	**FY11**				
2.9.5.4.1	Labor				Physicist - est of 6 weeks per year spent on subproject-related management and oversight activites (project reporting, informatin gathering, personnel matters, reviews, etc.) not covered elsewhere in the project plan/schedule.
2.9.5.4.2	Travel			6 domestic trips @ $1.5k per trip = $9k	
2.9.5.4.3	Equipment				
2.9.5.4.4	Materials and supplies				
2.9.5.5	**FY12**				
2.9.5.5.1	Labor				Physicist - est of 2.5 weeks per year spent on subproject-related management and oversight activites (project reporting, informatin gathering, personnel matters, reviews, etc.) not covered elsewhere in the project plan/schedule. Q1 of FY12 only
2.9.5.5.2	Travel			2 domestic trips @ $1.5k per trip= $3k	
2.9.5.5.3	Equipment				
2.9.5.5.4	Materials and supplies				
2.10	**Project Management - Construction**	**This Level 2 summary element consists of reviews, reports, site visits, local supervision, running technical board meetings, standards preparation, tracking and analysis, schedule preparation tracking and analysis, change control. It also includes procurement of relevant software and computers, the cost of running the project office and the salaries of non-scientists working in the project office.**	**The resource hours assigned represent level-of-effort assignments for the project office staff**		
2.10.2	**FY08**				
2.10.2.1	**FNAL Management 08**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.10.2.1.1	Labor	FNAL project office labor effort for fiscal year.			Fulltime project manager, deputy PM, budget officer, project mechancial engineer, project chemist, and administrative support; half-time ESH person, halftime AD document specialist and quarter time AD PM (phy); and 150% schedulers (ppd) + 35% sched (AD);
2.10.2.1.2	Travel	Travel support from project office for fiscal year.	Covers travel by project office personnel and others	7 domestic trips per year @ $1.5k = $10.5k; 5 foreign trips per year @ $5K = $25k; Total = $35.5k	
2.10.2.1.3	Equipment	FNAL project office equipment procurements for fiscal year.	Covers office equipment and software needs for the project office during the fiscal year	Computer = $5k; Prnter = $2k; Welcom licenses = $10k; Total = $17k	
2.10.2.1.4	Materials and supplies	FNAL project office M&S procurements for fiscal year.		Traning = $10k; Supplies/software/misc = $12k; Total = $22k	
2.10.2.2	**Harvard Management 08**				
2.10.2.2.1	Labor				
2.10.2.2.2	Travel				
2.10.3	**FY09**				
2.10.3.1	**FNAL Management 09**				
2.10.3.1.1	Labor	FNAL project office labor effort for fiscal year.			Fulltime project manager, deputy PM, budget officer, project mechancial engineer, project chemist, and administrative support; 75% ESH person;halftime AD document specialist and quarter time AD PM (phy); and 125% schedulers (ppd) + 35% sched (AD);.
2.10.3.1.2	Travel	Travel support from project office for fiscal year.	Covers travel by project office personnel and others	7 domestic trips per year @ $1.5k = $10.5k; 5 foreign trips per year @ $5k = $25k; Total = $35.5k	
2.10.3.1.3	Equipment	FNAL project office M&S procurements for fiscal year.	Covers office equipment and related software needs for the project office during the fiscal year	Computer = $5k; Prnter = $2k; Welcom licenses = $10k; Total = $17k	
2.10.3.1.4	Materials and supplies	FNAL project office M&S procurements for fiscal year.	Covers office materials and supplies; covers training costs for office personnel	Traning = $10k; Supplies/software/misc = $12k; Total = $22k	
2.10.3.2	**Harvard Management 09**				
2.10.3.2.1	Labor				PROJ ELEC ENG = .75 FTE
2.10.3.2.2	Travel				
2.10.4	**FY10**				
2.10.4.1	**FNAL Management 10**				
2.10.4.1.1	Labor	FNAL project office labor effort for fiscal year.			fulltime project manager, deputy PM, budget officer, project mechancial engineer, project chemist, administrative support; ESH person; halftime AD document specialist and quarter time AD PM (phy); and scheduler(ppd) + 35% sched (AD);.
2.10.4.1.2	Travel	Travel support from project office for fiscal year.	Covers travel by project office personnel and others	7 domestic trips per year @ $1.5k = $10.5k; 5 foreign trips per year @ $5k = $25k; Total = $35.5k	

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.10.4.1.3	Equipment	FNAL project office M&S procurements for fiscal year.	Covers office equipment and related software needs for the project office during the fiscal year	Computer = $5k; Prnter = $2k; Welcom licenses = $10k; Total= $17k	
2.10.4.1.4	Materials and supplies	FNAL project office M&S procurements for fiscal year.	Covers office materials and supplies; covers training costs for office personnel	Traning = $10k; Supplies/software/misc = $12k; Total = $22k	
2.10.4.2	**Harvard Management 10**				
2.10.4.2.1	Labor				PROJ ELEC ENG = .75 FTE
2.10.4.2.2	Travel				
2.10.5	**FY11**				
2.10.5.1	**FNAL Management 11**				
2.10.5.1.1	Labor	FNAL project office labor effort for fiscal year.			Fulltime project manager, deputy PM, budget officer, project mechancial engineer, project chemist, administrative support; ESH person; halftime AD document specialist and quarter time AD PM (phy); and scheduler (PPD) + 35% sched (AD);.
2.10.5.1.2	Travel	Travel support from project office for fiscal year.	Covers travel by project office personnel and others	7 domestic trips per year @ $1.5k = $10.5k; 5 foreign trips per year @ $5k = $25k; Total = $35.5k	
2.10.5.1.3	Equipment	FNAL project office equipment procurements for fiscal year.	Covers office equipment and related software needs for the project office during the fiscal year	Computer =$5k; Prnter = $2k; Welcom licenses = $10k; Total= $17k	
2.10.5.1.4	Materials and supplies	FNAL project office M&S procurements for fiscal year.	Covers office materials and supplies; covers training costs for office personnel	Traning = $10k; Supplies/software/misc = $12k; Total = $22k	
2.10.5.2	**Harvard Management 11**				
2.10.5.2.1	Labor				PROJ ELEC ENG = .75 FTE
2.10.5.2.2	Travel				
2.10.6	**FY12**				
2.10.6.1	**FNAL Management 12**				
2.10.6.1.1	Labor	FNAL project office labor effort for fiscal year.	Project engineer, project chemist, and ESH effort only occurs in first quarter of FY12 since the plan shows detector completed by end of Q1FY12; other project office labor is assumed to be necessary for at least an additional quarter due to project closeout activities; Task duration kept at full FY 250d duration to accomodate possible slippage in detector completion during FY12.		PC, PE, and ESH assumed to work fulltime, but only for Q1, hence 442 hrs for each; other project office resources work fulltime for first two quarters of FY12 (884 hrs)
2.10.6.1.2	Travel	Travel support from project office for fiscal year.	Covers travel by project office personnel and others	7 domestic trips per year @ $1.5k = $10.5k; 5 foreign trips per year @ $5k = $25k; Total = $35.5k	
2.10.6.1.3	Equipment	FNAL project office M&S procurements for fiscal year.	Covers office equipment and related software needs for the project office during the fiscal year	Computer = $5k; Prnter = $2k; Welcom licenses = $10k; Total = $17k	
2.10.6.1.4	Materials and supplies	FNAL project office M&S procurements for fiscal year.	Covers office materials and supplies; covers training costs for office personnel	Traning = $10k; Supplies/software/misc = $12k; Total = $22k	
2.10.6.2	**Harvard Management 12**				

WBS	Activity Description	WBS Definition	BoE: Ground Rules & Assumptions	BoE: M&S (Materials)	BoE: Labor
2.10.6.2.1	Labor				
2.10.6.2.2	Travel				
2.10.7	**FY13**				
2.10.7.1	**FNAL Management 13**				
2.10.7.1.1	Labor	FNAL project office labor effort for fiscal year.	Project engineer, project chemist, and ESH effort only occurs in first quarter of FY12 since the plan shows detector completed by end of Q1FY12; other project office labor is assumed to be necessary for at least an additional quarter due to project closeout activities; Task duration kept at full FY 250d duration to accomodate possible slippage in detector completion during FY12.		PC, PE, and ESH assumed to work fulltime, but only for Q1, hence 442 hrs for each; other project office resources work fulltime for first two quarters of FY12 (884 hrs)
2.10.7.1.2	Travel	Travel support from project office for fiscal year.	Covers travel by project office personnel and others	7 domestic trips per year @ $1.5k = $10.5k; 5 foreign trips per year @ $5k = $25k; Total = $35.5k	
2.10.7.1.3	Equipment	FNAL project office M&S procurements for fiscal year.	Covers office equipment and related software needs for the project office during the fiscal year	Computer = $5k; Prnter = $2k; Welcom licenses = $10k; Total = $17k	
2.10.7.1.4	Materials and supplies	FNAL project office M&S procurements for fiscal year.	Covers office materials and supplies; covers training costs for office personnel	Traning = $10k; Supplies/software/misc = $12k; Total = $22k	
2.10.7.2	**Harvard Management 13**				
2.10.7.2.1	Labor				
2.10.7.2.2	Travel				
2.10.8	**Critical Decision Milestones**				
2.10.8.1	CD-3a				
2.10.8.2	CD-3b				
2.10.8.3	CD-4				
2.10.8.4	FY08 Funds Available				
2.10.9	**Other Management Milestones**				
2.10.9.1	Project office milestone for end-date float monitoring				