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E907 Cost and Schedule Plan

Version 1.0

Abstract

This document contains the cost and schedule plan for Fermilab experiment E907. The plan covers: cleanup of MC5, MC6, and MC7, including removal of the Hyper-CP experiment; design, fabrication, and installation of the E907 beam line components and beam detectors in MC5 and MC6; design, fabrication, and installation of the E907 detectors, trigger and data acquisition system in the MC7 worm; operation of the experiment (but not the accelerator complex); development of the core analysis suite; and project management. The first section discusses the changes made in this plan compared to the November 2000 draft. Subsequent sections discuss: the project scope, general estimating method, and basis; the WBS Dictionary and cost basis; and the schedule, including resource and funding limitations, generally assuming a 2 January 2002 start date.

E907 will cost $1.55M; $0.31M has already been spent. The funding and resource limited schedule shows that E907 will be ready for beam in February 2003.

Contents

Introduction

We have drafted a complete cost, manpower, and schedule estimate for E907.[1] By "complete," we mean we have covered all systems and sub-systems of the experiment, including the upstream beam line. We have also included removal of existing equipment from Meson Center to make way for this experiment. The work breakdown structure (WBS) is shown with our estimate basis in Appendix A.

On the manpower side, we have included physicist and engineering to complete the physics design, to plan and manage the installation, and to commission the detector. We have also made preliminary estimates of the number of physicists that will be required to operate the experiment during data running and to perform the basic analysis.

Since this report was first issued, in November 2000,[2] there have been a number of significant changes, in scope of work, work accomplished in FY01, and cost estimates for the remaining work. In the first section of this report we discuss these changes. In the remainder of this report we discuss the scope of our estimate; our estimating method, baseline treatment, and cost contingency; the scope and method used to estimate the manpower requirements; funding; and the schedule and schedule contingency. We present the WBS Dictionary and Estimate Basis, the Manpower Estimate, and the Schedule in Appendices.

Major Changes to the November 2000 Plan

With the encouragement of the Fermilab management, we undertook a number of major tasks in FY01, funded by a $230K Integrated Contractor Order from Lawrence Livermore National Laboratory to Fermilab. We have worked to refine our understanding of the project as a whole. We have secured significant funding commitments. These activities have resulted in major changes to the November 2000 plan. Here we discuss the work undertaken and accomplished in FY01, changes in scope, and the significant cost estimate changes,.

Changes to the WBS structure have been extensive. Items that are no longer part of the plan have been removed; new items have been added. The experiment section, WBS 5, has been restructured to reflect the gross sequence of installations required. As a consequence of these changes, the WBS numbers for many tasks have changed.

Work Undertaken in FY01

With the encouragement of Fermilab management, we undertook four major tasks in FY01:

- (WBS 4.1–3) Remove the HyperCP experiment from the MC7 worm, to make room for E907.
- (WBS 5.3.2) Repair the short in one of the Jolly Green Giant (JGG)

magnet coils.

- (WBS 5.3–4) Install the two analyzing magnets, the Jolly Green Giant and Rosie.
- (WBS 5.9.3) Install the TPC, in the MTest area of the Meson Detector Building, and read out cosmic rays. This represents a scope increase from the November 2000 plan.
- (parts of WBS 5.11.2) Assess the condition of the RICH PMTs and electronics. Prepare the RICH for removal from PC4.

Based on the November 2000 plan, we placed an Integrated Contractor Order from Livermore to Fermilab in the amount of $230K, to fund these activities.

The HyperCP experiment was removed from MCenter. These items had been budgeted at $59K; the work was accomplished for $72K, an overrun of 22%.

The JGG coil repair was budgeted for $60K; the vendor quote was $48K (all costs are fully loaded). They had planned to burn off the insulation, spread the turns apart, then rewrap the turns by hand before potting. It turned out to be too difficult to wrap the turns this way, so the vendor fell back to the more conventional approach of straightening the conductor and machine wrapping and winding the coil. This change in approach, as well as some more minor issues, led the vendor to submit a $21K change order, and led us to spend $22K on engineering oversight and travel. This totaled $31K more than we had budgeted.

As discussed below, we had to solve a major engineering issue before we could install the magnets, so that activity has been deferred to FY02.

The TPC is completely installed in MTest.[2] All support systems are fully operational, with the exception of the gating grid drivers, which are not needed for cosmic ray tests. As of this writing, we expect to obtain permission to flow P10 gas on 29 October 2001. The data acquisition development is well underway. We expect to read out our first cosmics the same week.

We successfully powered the PMTs and front end electronics of the Rich. Only 58 of the 2484 PMTs produce unacceptable signals. This is more than sufficient to detect the Cherenkov rings. The Russian hybrid chips at the front end have continued to die at the rate of 1-2% per month, as during the SELEX experiment. Plans for recovering from this are discussed below.

Major Changes to Scope

There have been four significant changes in scope of work: substitution of Rosie for TPL M2 as our second analyzing magnet; identification of the HyperCP calorimeter as our neutral calorimater (NCAL); longer beam Cherenkov counters, which has had a major cost impact; replacement of primary magnet power to MCenter; changes to the RICH plan; and installation and test of the TPC in MTest.

Substitute Rosie for TPL-M2

The November 2000 plan called out the TPL M2 (TPL-B) magnet as the second analyzing magnet. We had been informed that that magnet was still available, but had not yet located it. Since that time we have learned definitively that the magnet has become unusable because of weather exposure at the railhead. We also learned that the Rosie magnet from the DONUT experiment is now available. We have adopted Rosie as the second analyzing magnet. It has been removed from PW8 and staged near MC7. Based on that work, the estimate to assemble Rosie is $8K less than we had for the TPL M2 magnet.

Identification of the Neutral Calorimeter.

We have identified the HyperCP calorimeter as a suitable device for our neutral calorimeter.[3] This has a negligible impact on cost, since we had already included an allowance for installation.

Locate Magnets Over MBottom

The largest cost impact has come from a change to the beam tag Cherenkov counters. A physics study by Michael Heffner[4] of the light output, tagging efficiency, and misidentification probability showed that these Cherenkovs counters should be more than double the length we had originally assumed. The original length for the two counters combined was assumed to be 12 m; the new length is 30 m. This change had a particularly bad interaction with the MCenter worm. We had originally positioned the experiment to avoid placing the analyzing magnets over the MBottom enclosure, in order to avoid the potential structural issues. The longer beam Cherenkov counters have pushed the magnets to the middle of that enclosure. We performed a structural analysis and learned that the presence of the MBottom enclosure, the sub par construction of the MCenter floor, and the poor soil quality in that area of the lab, all contribute to a major structural problem.

Since we had to solve this problem before we could install the magnets, we redirected the effort and funds to this issue. In the end, we have had to take three steps:

- (WBS 4.4 except 4.4.4, $87K) Design, fabricate, and install a substantial steel structure in MBottom to support the ceiling and walls against the soil pressure that will be generated by the magnets.
- (WBS 4.4.4, $13K) Design and install a 12” thick reinforced concrete slab in MCenter under both magnets to spread the load across sufficient soil area.
- (WBS 4.5, $88K) Raise the roof in the downstream third of the MC7 worm to accommodate the height of the magnets.

The raised position of the magnets has forced us to raise the nominal beam height through the experiment. Our upstream beam line contains the primary beam target, dispersion bend, momentum selection aperture, and focusing of secondaries onto the experimental target. Our original design used strictly horizontal bends for targeting and dispersion. The change to the beam elevation can be accomplished by rotating our upstream beam elements so the dispersion bend is vertical. This, in itself, has negligible cost impact. However, we will have to remove the bottom portion of the welded steel “T” blocks in the MC Target Pile. This adds approximately $4K to the cost of the beam line.

In total, the change in magnet position accounts for $192K of increased scope and cost.

Replace Primary Magnet Power to MCenter.

When we were directed to consider MCenter for E907, the existing MC7 magnets for HyperCP were powered from supplies in the MS5 area on the east side of the Meson Detector Building (MDB) These supplies were powered from two substations on the pad on the east side of MDB. Water-cooled copper bus delivered the DC current to the magnets in MC7. It is now anticipated that the NLC activity in MP will use the MS5 area, and will need one of the existing substations. Leon Beverly has identified a range of solutions,[5] none of them ideal, and ranging in cost from $54–100K. Until the issues are resolved, we have budgeted $70 K for one of the moderate cost solutions.

Changes to the RICH Plan

We have made a number of changes to the RICH plan to take advantage of the PC4 cleanout effort. This effort plans to remove the SELEX components, including the RICH, in the next two months. We have already prepared the RICH for removal, as part the effort to assess its condition this summer. The net effect of these changes is cost neutral.

In our November 2000 plan we had tentatively rejected reusing the RICH tank, since retrieving it from PC4 appeared to be more expensive than purchasing a new tank. Removal of the RICH tank by the PC4 project makes it possible for us to reuse the tank, saving $42K. At the same time, we are beginning to address the continued failure of the front end hybrid chips.[6] We need to replace approximately 2000. SELEX contracted with a US manufacturer for replacements at a price (1995) of $26 each. Unfortunately, that manufacturer has gone out of business. An alternative is to replace all channels with circuits being developed for CKM by Sten Hansen. He anticipates a cost of $20 per channel. We have budgeted $60K to replace the 2500 front ends and provide 500 spares.

TPC Installation and Cosmic Ray Tests in MTest

The scope of work and status are discussed above. This activity has not resulted in captured costs to E907; we have benefited from approximately 2 technician weeks for installation of AC power.

Major Changes to Estimate

In addition to the cost impacts resulting from work accomplished in FY01 and changes in scope, there have been changes to two detector estimates that have significant cost impact. All changes in the experiment estimate (WBS 5) bring the total from $742K to $914K, an increase of $172K. Removing the changes in magnet costs, $23K, the detectors have increased $151K. This is almost entirely ($130K) due to a thorough analysis of the time of flight (TOF) system.

The TOF analysis, by Tim Bergfeld,[7] demonstrated that the TOF can be separated into two parts, a “window frame,” located before Rosie, with 200 ps resolution, and a central TOF, downstream of Rosie and covering its aperture, with 150 ps resolution. The low resolution window frame can be built from existing scintillator and PMTs. Most of the increase in cost is due to the need for the high resolution section, which will be built from new scintillator and PMTs.

Cost Estimate

We have developed a bottom up cost estimate for designing, installing, and operating E907. The WBS, Dictionary, and Estimate Basis are given in Appendix A. In this section we discuss the scope of the estimate, our estimating method and basis, how we manage the baseline estimate, and cost contingency.

Scope of Estimate

Almost all experiment systems are based on existing equipment. By using existing systems with proven performance we eliminate the detector research and development phase, drastically shortening the design cycle and reducing the experiment cost. The engineering and design process for these systems is largely limited to "infrastructure" issues: mounting, installing, connecting electrical and other services, and data cabling.

The trigger and DAQ designs, of necessity, must be specific to the experiment, however, they will be based on existing components and infrastructure, as discussed in [1]. This will reduce to a minimum the design effort. Procurement costs will be largely limited to cables. The use of local (Nevis, FNAL DART) or commercial (VMEbus) systems will facilitate the adoption and reuse of existing communications and control software.

Since we propose to run with both 120 GeV/c primary beam from the Main Injector (MI), as well as 5--105 GeV/c secondary beams, the upstream beamline is not trivial. We have included in this estimate the costs associated with designing and constructing this beamline, based on the design discussed in [1], including the secondary beam production target, detectors to enable accurate targeting of Main Iinjector primary beam on the production target, a dispersive bend with adjustable aperture to make the momentum selection, beam species tagging using threshold Cernkov counters, and tracking detectors to enable accurate targeting of the beam onto the experimental target.

Meson Center was most recently used by E871 (Hyper-CP). A certain amount of disassembly and cleanout is required before this experiment can be installed. We have included a preliminary estimate for this work.

Estimate Method and Basis

Since most detector systems are based on existing hardware, most of the WBS items require a fairly detailed understanding of the component designs and infrastructure requirements to produce detailed designs for costing. Therefore, at this stage cost estimating has been limited to known costs of similar recent tasks, detailed below, and engineer or physicist estimates, generally at WBS level three.

For each task, we separately estimate the level of effort required from physicists, engineers, and technicians, and the materials and supplies. We use nominal Fermilab rates, including fringe benefits, for engineers and technicians, as provided by John Cooper. (Engineer II, $352/day; Tech Specialist, $284/day; Senior Tech, $206/day; Tech II, $174/day) We assume that physicist effort is not charged directly to the experiment, however the level of physicist effort required *is* part of the estimate (see the discussion of manpower, below). Engineers (and physicists) are counted as EDIA (engineering, design, inspection, and administration), technicians as labor. (Since physicists are assumed to be zero cost for the project, however, their efforts don't increase the totaled costs.)

Technician effort has been further broken out into ``FNAL & E907'', work that is most naturally staffed by Fermilab and/or the collaboration; and ``FNAL | T&M'', work that could be accomplished by T&M contracts, at approximately 2.5 times the cost. Despite the increased cost ($37.4k increasing to $93.5k), contracting this work through T&M might be desirable to reduce the workload on Fermilab staff by 36 man weeks.

Materials and supplies, M&S, is also broken down into T&M contracts for heavy rigging, and all other M&S, which are largely parts procurements.

Where possible, the estimates have been based on known effort and costs for similar tasks accomplished in the recent past. Tasks and costs for rigging and magnet connections/disconnections were developed with the generous assistance of Leon Beverly and Mike Mascione in PPD, based on recent work in MC6, MC8, and Lab G.

Before the last run of the Hyper-CP experiment, an access was made to the MC6SWP magnet in the upstream section of the MC6 Target Pile. Opening just this section of the pile took a T&M rigging crew of five people one week, at an approximate cost of $10k. This effort of five man weeks forms the basis for the estimates in WBS~2 and 3 for opening and closing the MC6 Pretarget Enclosure and Target Pile.

The rate for T&M rigging ($500/man day) is based on the contract work completed in the last few months to remove the Jolly Green Giant and a second large magnet from Lab G, which required 3.5 crew weeks at a cost of $42k. The effort in Lab G forms the basis for the estimate to reassemble the Jolly Green Giant and TPL-B magnets in the MC7 worm.

The costs of opening and closing the MC7 worm roof to enable crane access for the magnet assembly are based on the actual costs incurred in opening and closing the MC8 worm roof to extract steel shielding blocks, as provided by Leon Beverly and Mike Mascione.

Baseline Treatment

We use the baseline cost estimate to benchmark our actual costs against our expectations when we embarked on a task. For tasks that have not yet commenced, we have updated the baseline cost to reflect our current estimate. In effect, we have rebaselined all future tasks.

Cost Contingency

As a sanity check, we can look at the partial dismantlement of the Meson Polarized target piles (MP6) in the Meson Hall. This work resulted in $60k of captured costs, and approximately $10–20k of uncaptured labor effort, according to Paul Czarpata and Harlan Dick. A direct comparison is difficult since the scope of work was different. The MP6 work involved partial (semi-destructive) dismantlement of the pile, including special procedures and handling to address contamination issues, and installation of the recovered steel as shielding in the Booster area. (The scope of work in MC6 is unlikely to disturb lower sections of the piles containing most of the contamination.) Approximately half of the material in the MP6 pile was removed, over a length approximately half of the MC pile length. Roughly speaking, then, opening the MC pile should cost double the MP6 cost. The rollup for WBS~2, Meson hall (MC6) Preparation, is $125k, roughly double the MP6 dismantlement cost, as expected. Similarly, relacing the shielding in MC6 after configuring our beamline is approximately equal to the estimate for removing the shielding.

The comparison to the work done in MP6 provides some confidence that our estimates for the beamline work (WBS~2 and 3) are not off by a large factor. Similarly, the very recent work to remove magnets from Lab G provides a sound basis for estimating the magnet assembly costs in MP7 (WBS~5.4 and 5.7). These items only account for 35% of the cost, however, leaving a substantial fraction of the total cost that is somewhat uncertain.

We wrote in November 2000:

> Because of the very limited level of detail available at this early stage in the design, the confidence interval on the cost estimate must be somewhat broad. Certainly any contingency estimate less than 35–50% is unjustified at this stage. Since most of the tasks are fairly narrow in scope, however, completion of the design tasks should result in fairly good cost and effort estimates for the actual work.

Comparing the total cost estimates then and now, we see that the estimate has increased by 50%, in line with our contingency estimate. For work that we have done, such as the MC7 cleanout, (WBS 4.1–3), the actual costs have been 22% higher than budgeted. Likewise, the increase in all detector components, including the higher than expected costs for the JGG coil, amounts to a 23% increase. These comparisons suggest that a contingency closer to 20–30% is more appropriate at this stage.

Manpower Estimate

As a necessary part of developing the cost estimate, we have estimated the level of physicist, engineer, and technician effort required to design, install, commission, operate, and analyze the experiment. First, we have estimated the engineering effort by discipline, mechanical or civil. Second, we have separated engineering and technician effort.

Third, we have included physicist effort, in order to understand the size of collaboration required. We have done a physicist estimate of the level of physicist effort required for each task. We have assigned two physicists half time for six months to finalize the experiment design. Generally we have included a physicist at one-quarter time for the duration of each system design task. For the trigger and DAQ we have assigned a full time physicist.

During the operation of the experiment, we assume a total of 16 physicists will be required to cover 24 hour per day running with beam.

The manpower estimate is shown in Appendix B. In man years, the totals amount to 17 physicist years, 2¼ engineer years, and 7 technician years (all assume a 92% effort factor).

Physicist Effort for Core Analysis

Finally, we have estimated the physicist effort required to produce a bare minimum analysis, comprising acceptance determination, quantification of systematic errors, and determination of particle type and relativistic four-vectors for all observed particles. These outputs are the common core that all further physics analyses will be based on, yet involve no specializations for any particular topic.

As a zero'th order estimate, we have assumed that two man-months of effort will be required to develop the analysis for each detector system (upstream beamline, Jolly Green Giant field, differential Cerenkov, time-of-flight, TPL-B field, RICH, drift chamber tracking, neutral calorimeter, trigger and DAQ), four man-months to develop the TPC analysis, and two man-months for the core analysis production pass on all data. This effort is included in the total above.

Funding

There have been three developments on the funding. First, with the rejection of KaMI, Fermilab Beams Division has redirected FY02 Accelerator Improvement Project (AIP) funds, that had been designated for the KaMI beamline, to the construction of the E907 beamline. This represents a commitment of $266K in FY02.

Second, Lawrence Livermore National Laboratory has demonstrated their ability to budget for and transfer significant funds to Fermilab to support E907. Third, they have indicated that they continue to have the support of their management, and have budgeted $500K in each of FY02 and FY03 to support E907. They have requested that Fermilab negotiate and sign a Memorandum of Understanding with Livermore before releasing FY02 funds.

As a baseline funding profile, then, we have assumed $765K in FY02, and $500K in FY03. As discussed below, the current schedule is funding limited in FY02.

In addition, E907 collaborators are pursuing three additional funding lines.

- South Carolina EPSCORE and South Carolina Commissioner of Higher Education (University of South Carolina)
- NSF (University of Houston)
- DoE National Nuclear Security Administration Stockpile Stewardship Academic Alliance Program

If these funds are realized, they can be used to accelerate the schedule, as discussed below.

Schedule

We have constructed a schedule using our best estimate of the level of effort required to accomplish each task. We have assumed that FY02 work will not commence before 2 January 2002 (to allow time to complete the MOU and begin releasing funds). We have imposed two resource limits, on funding profile and peak number of technicians. The detailed schedule is shown in Appendix C.

Under this schedule, E907 will be ready for beam in mid February 2003.

This date is largely driven by funding profile. As discussed above, at this time we have identified $765K available in FY02. To meet this profile, we have constrained various items to begin no earlier than 10/1/02 (start of FY03).

With no other constraints, the tasks fall into two clusters on the schedule: those that start in January 2002, and those that start in October 2002. The scheduling of work in FY03 determines the milestone date when E907 will be ready for beam.

Many of the tasks require technician support. To avoid placing inordinate peak loads on the Fermilab technician pool, we have limited our peak use of technicians. Restricting ourselves to approximately five technicians in the first quarter of FY03 puts the date E907 is ready for beam at mid February 2003.

There are a number of variations on this schedule that one can consider. These are summarized in Table 1.

Table 1. Impact of various constraints on the schedule and technician usage. The last line reflects our proposed schedule.

Imposed Constraints	**Profile**		**E907 Ready for Beam**	**Technician Peak Usage**	
	FY02	**FY03**		**FY02**	**FY03**
No Contraints	$ 1,239,336	$ 0	4/29/02	23	0
Technicians	$ 1,236,864	$ 2,472	10/9/02	9	1
Funding	$ 734,316	$ 505,020	1/21/03	12	10
Funding & Technicians	$ 734,316	$ 505,020	2/18/02	9	5

The impact of the technician constraint in FY03 is approximately four weeks. The impact of imposing the funding constraint instead of the technician constraint is three and a half months. In effect, this is the schedule float in FY02. This gives us the opportunity to spread the work out during the year and reduce the technician bump, which occurs in March 2002. Conversely, if more funding were available in FY02, we could accelerate the schedule by as much as two and a half months, before becoming limited by technician availability.

References

1. Y. Fisyak, et al., P-907: Proposal to Measure Particle Production in the Meson Area Using Main Injector Primary and Secondary Beams, May 2000 (Fermilab, 2000)

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3. M. Longo, Calorimeter Status, in proceedings of E907 Collaboration Meeting, Fermilab, September 29, 2001 (http://ppd.fnal.gov/experiments/e907/Meetings/collab2/longo.pdf).

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6. E. Swallow, RICH Status, in proceedings of E907 Collaboration Meeting, Fermilab, September 29, 2001 (http://ppd.fnal.gov/experiments/e907/Meetings/collab2/swallow.pdf).

7. T. Bergfeld, TOF Studies, in proceedings of E907 Collaboration Meeting, Fermilab, September 29, 2001 (http://ppd.fnal.gov/experiments/e907/Meetings/collab2/bergfeld.pdf).

Appendix A. WBS Dictionary and Cost Basis

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
	E907	**$209,356**	**$342,050**	**$952,800**	**$1,548,250**	**$1,256,898**	**$308,915**	**$1,239,336**
1	Experiment Design	$0	$0	$0	$0	$0	$0	$0

Develop experiment Monte Carlo code. Optimize detector geometry and placement. Evaluate implementation trade-offs.

Estimate Source: Physicist

Estimate Basis:
4 physicists @ 0.25% during the installation year.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
2	**Meson Detector Building (MDB**	**$1,760**	**$28,464**	**$100,000**	**$130,224**	**$130,224**	**$0**	**$130,224**

Plan and execute in MC5 and MC6 (Meson Center) of the Meson Hall
(a) the removal of existing equipment, shielding, etc.;
(b) any necessary refurbishments of these areas; and
(c) the installation of necessary infrastructure (electrical power, cooling water, controls, safety systems, etc.)
for the subsequent installation and operation of E907.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
2.1	MDB Preparation Planning	$1,760	$0	$0	$1,760	$1,760	$0	$1,760

Plan all work required to prepare MC5 and MC6 for installation of E907 upstream beam line components. This item includes
(a) work plans and ES&H preparation for opening the Pretarget Enclosure and Target Pile in MC6;
(b) work plans for removing interfering beam line technical components from MC5 and MC6;
(b) work plans for any necessary refurbishments of these areas; and
(c) any engineering pre-design and work plans required for the installation of necessary infrastructure (electrical power, cooling water, controls, safety systems, etc.) for the subsequent installation and operation of Upstream Beam Line technical components.

Estimate Source: Physicist

Estimate Basis:
1 Mechanical Engineer @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
2.2	MC6 Clear Storage from Top of P	$0	$15,180	$0	$15,180	$15,180	$0	$15,180

Remove all stored material from the top of the MC6 Pretarget Enclosure and Target Pile, in preparation for opening same.

Estimate Source: Tech. Supervisor

Estimate Basis:
Eyeball estimate of duration required to remove all the material stored as of April 2000.

5 person rigging crew @ 100%
1 Tech Specialist FNAL - TM
1 Senior Tech FNAL - TM
3 Technician FNAL - TM

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
2.3	**Open and Clear Pretarget Encl**	**$0**	**$11,576**	**$50,000**	**$61,576**	**$61,576**	**$0**	**$61,576**

Open the Pretarget Enclosure (PTE) in MC6 and remove interfering beam line technical components, including items in the MC5 enclosure. This item includes:
(a) removal of the concrete and steel lid sections of the Pretarget Enclosure;
(b) removal of the steel sidewall shielding inside the enclosure, to allow the E907 horizontal offset in that area;
(c) removal of all interfering beam line technical components from the MC5 enclosure and the exposed section of the MC6 enclosure.
(It is possible that some components or shielding may remain without interfering with the subsequent installation of E907 beamline technical components; this will be determined by the "MC6 Cleanout Planning" element.)

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
2.3.1	PTE Remove Concrete Lid Blocks	$0	$0	$37,500	$37,500	$37,500	$0	$37,500

Removal of the concrete lid sections of the PTE in MC6.

Estimate Source: Scaling, Tech. Supervisor, Physicist

Estimate Basis:
Scaled from the 1998 access to the Hyper-CP MC6SWP magnet in the upstream section of the MC6 Target Pile, which required a five person T&M rigging crew one week to remove and replace. This item involves removing approximately five times as much shielding, hence the 3 week duration. This work can be performed by contract riggers.

5 T&M Riggers @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
2.3.2	PTE Remove Steel Lid	$0	$0	$12,500	$12,500	$12,500	$0	$12,500

Removal of the steel lid sections of the PTE in MC6.

Estimate Source: Scaling, Tech. Supervisor, Physicist

Estimate Basis:
Scaled from the 1998 access to the Hyper-CP MC6SWP magnet in the upstream section of the MC6 Target Pile, which required a five person T&M rigging crew one week to remove and replace. This item involves removing approximately twice as much shielding so we use the same duration. This work can be performed by contract riggers.

5 T&M Riggers @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
2.3.3	PTE Remove Steel Side Walls	$0	$5,060	$0	$5,060	$5,060	$0	$5,060

Removal of the steel side wall sections of the PTE in MC6. It is likely that only the eastern wall will be removed to accomadate the displacement of the E907 beam to the east in this region.

Estimate Source: Scaling, Tech. Supervisor, Physicist

Estimate Basis:
Scaled from the 1998 access to the Hyper-CP MC6SWP magnet in the upstream section of the MC6 Target Pile, which required a five person T&M rigging crew one week to remove and replace. This item involves removing approximately twice as much shielding so we use the same duration.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining

"PTE Remove Steel Side Walls" continued

5 person rigging crew @ 100%
1 Tech Specialist FNAL - TM
1 Senior Tech FNAL - TM
3 Technician FNAL - TM

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
2.3.4	PTE Disconnect Magnets	$0	$3,480	$0	$3,480	$3,480	$0	$3,480

Disconnect water and power from all magnets in the PTE region of MC6 and all interfering devices in MC5.

Estimate Source: Tech Supervisor, Physicist

Estimate Basis:
MC6 presently contains four 10' dipoles and one 20' dipole that must be removed, as well as numerous other small components. We assume that the seven quadrupoles and two trim dipoles in MC5 can remain. For this estimate we assume two technicians can disconnect one magnet per day, and allow an equal amount of time for other components.

2 Technician - FNAL @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
2.3.5	PTE Remove Magnets	$0	$3,036	$0	$3,036	$3,036	$0	$3,036

Remove interfering beam line technical components from MC5 and the PTE section of MC6.

Estimate Source: Tech Supervisor, Physicist

Estimate Basis:
We assume that a five person rigging crew can move two magnets per day, and allow half a day of startup/cleanup.

5 person rigging crew @ 100%
1 Tech Specialist FNAL - TM
1 Senior Tech FNAL - TM
3 Technician FNAL - TM

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
2.4	**Open and Clear Target Pile (TP**	**$0**	**$1,708**	**$50,000**	**$51,708**	**$51,708**	**$0**	**$51,708**

Open the Target Pile (TP) in MC6 and remove the MC6SWP magnet and decay pipe. This item is restricted to removing the lids without disturbing the sidewalls, in order to minimize the disturbance of dispersable radioactive material.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
2.4.1	TP Remove Concrete Lid Blocks	$0	$0	$25,000	$25,000	$25,000	$0	$25,000

Removal of the concrete lid sections of the TP in MC6.

Estimate Source: Scaling, Tech. Supervisor, Physicist

Estimate Basis:
Scaled from the 1998 access to the Hyper-CP MC6SWP magnet in the upstream section of the MC6 Target Pile, which required a five person T&M rigging crew one week to remove and replace This item involves removing approximately twice as much shielding, hence the 2 week duration. This work can be performed by contract riggers.

5 T&M Riggers @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
2.4.2	TP Remove Steel Plugs	$0	$0	$12,500	$12,500	$12,500	$0	$12,500

Removal of the steel lid sections of the TP in MC6.

Estimate Source: Scaling, Tech. Supervisor, Physicist

Estimate Basis:
Scaled from the 1998 access to the Hyper-CP MC6SWP magnet in the upstream section of the MC6 Target Pile, which required a five person T&M rigging crew one week to remove and replace. This item involves removing approximately twice the amount of shielding so we use the same duration. This work can be performed by contract riggers.

5 T&M Riggers @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
2.4.3	TP Remove Downstream Concret	$0	$0	$12,500	$12,500	$12,500	$0	$12,500

Removal of the downstream TP concrete shielding blocks in MC6.

Estimate Source: Scaling, Tech. Supervisor, Physicist

Estimate Basis:
Scaled from the 1998 access to the Hyper-CP MC6SWP magnet in the upstream section of the MC6 Target Pile, which required a five person T&M rigging crew one week to remove and replace. This item involves removing approximately twice the amount of shielding so we use the same duration. This work can be performed by contract riggers.

5 T&M Riggers @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
2.4.4	TP Disconnect Magnet	$0	$696	$0	$696	$696	$0	$696

Disconnect water and power from MC6SWP magnet in the MC6 TP.

Estimate Source: Tech Supervisor, Physicist

Estimate Basis:
We assume two technicians need one day for this task.

2 Technician - FNAL @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
2.4.5	TP Remove Magnet	$0	$1,012	$0	$1,012	$1,012	$0	$1,012

Remove MC6SWP magnet from MC6 TP.

Estimate Source: Tech Supervisor, Physicist

Estimate Basis:
We assume that a five person rigging crew needs one day for this item, including startup/cleanup.

5 person rigging crew @ 100%
1 Tech Specialist FNAL - TM
1 Senior Tech FNAL - TM
3 Technician FNAL - TM

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
3	**E907 Beamline (BEAM) in MC6**	**$14,080**	**$21,450**	**$100,000**	**$135,530**	**$135,530**	**$0**	**$135,530**

Design and install in MC5 and MC6 (Meson Center) of the Meson Hall beam line technical components for the E907 secondary beam, excluding beam detectors. This item includes
(a) focussing and steering magnets to target the beam on the secondary beam production target;
(b) the E907 momentum selection bend;
(c) the E907 secondary beam production target; and
(c) focussing and steering magnets to target the secondary beam on the experimental target.
This item does not include beam line instrumentation.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
3.1	BEAM Optics and Mechanical De	$14,080	$0	$0	$14,080	$14,080	$0	$14,080

Design the optics and installation of the Meson Hall beam line technical components for the E907 secondary beam, excluding beam detectors.

Estimate Source: Physicist

Estimate Basis:
We assume a physicist will need two weeks at 100% to refine the optics design, and will support the engineers at 0.25%. We assum a mechanical and electrical engineer will need four weeks at 100% to design the installation.

1 Physicist @ 50%
1 Engineer - Mechanical @ 50%
1 Engineer - Electrical @ 50%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
3.2	**BEAM Magnet Installation**	**$0**	**$12,200**	**$0**	**$12,200**	**$12,200**	**$0**	**$12,200**

Install in MC5 and MC6 beam line technical components for the E907 secondary beam, excluding beam detectors. This item includes
(a) focussing and steering magnets to target the beam on the secondary beam production target;
(b) the E907 momentum selection bend;
(c) the E907 secondary beam production target; and
(c) focussing and steering magnets to target the secondary beam on the experimental target.
We assume that the seven quadrupoles and two trim dipoles in MC5 will be adequate in their current locations. This item does not include beam line instrumentation.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
3.2.1	BEAM Install 3 Dipoles	$0	$6,180	$0	$6,180	$6,180	$0	$6,180

Install in MC5 and MC6 three large dipoles to provide the momentum selection bump. This item provides mounting of the dipoles, as well as power, cooling water, and interlock connections.

Estimate Source: Tech Supervisor, Physicist

Estimate Basis:
We assume two Senior Techs need one week per magnet to make all connections. We assume that power cables will be run from the power supply room at the west side of the Meson Hall, and that the water supply to MC6 will be increased by installing new headers from the building LCW system. The water system will also provide LCW to the quadrupoles.

2 Senior Techs @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
3.2.2	BEAM Install 4 Quadrupoles	$0	$4,120	$0	$4,120	$4,120	$0	$4,120

Install in MC5 and MC6 seven quadrupoles to provide the momentum selection and experimental target focussing. This item provides mounting of the quadrupoles, as well as power, cooling water, and interlock connections.

Estimate Source: Tech Supervisor, Physicist

Estimate Basis:
We assume two Senior Techs need one day per magnet to make all connections. We assume that power cables will be run from the power supply room at the west side of the Meson Hall, and that the dipole LCW water installation will provide the necessary cooling water.

2 Senior Techs @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
3.2.3	BEAM Survey	$0	$1,900	$0	$1,900	$1,900	$0	$1,900

Survey all beam line technical components for the E907 secondary beam, including beam detectors.

Estimate Source: Physicist

Estimate Basis:
We assume a team consisting of one physicist, one Senior Tech, and one Technician need one week to survey all components in MC5 and MC6.

1 Physicst @ 100%
1 Senior Tech @ 100%
1 Technician @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
3.3	**Close Pretarget Enclosure**	**$0**	**$9,250**	**$50,000**	**$59,250**	**$59,250**	**$0**	**$59,250**

Replace steel and concrete shielding in the MC6 Pretarget Enclosure.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
3.3.1	PTE Replace Steel Side Walls	$0	$5,060	$0	$5,060	$5,060	$0	$5,060

Replacement of the steel side wall sections of the PTE in MC6.

Estimate Source: Scaling, Tech. Supervisor, Physicisist

Estimate Basis:
Scaled from the 1998 access to the Hyper-CP MC6SWP magnet in the upstream section of the MC6 Target Pile, which required a five person T&M rigging crew one week to remove and replace. This item involves replacing approximately twice as much shielding so we use the same duration.

5 person rigging crew @ 100%
1 Tech Specialist FNAL - TM
1 Senior Tech FNAL - TM
3 Technician FNAL - TM

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
3.3.2	PTE Remove T-Block Lower Stee	$0	$4,190	$0	$4,190	$4,190	$0	$4,190

Unweld the lower pieces of steel on the so-called "T-block" assemblies to accommodate the secondary beam elevation.

This is a scope change from the November 2000 baseline plan, caused by raising the beam elevation to accommodate the MC7 slab over MBottom.

Estimate Source:

Estimate Source: Scaling, Physicisist

Estimate Basis:
We estimate one week of rigging and two weeks of technicians (welders).

5 person rigging crew @ 100%
1 Tech Specialist FNAL - TM
1 Senior Tech FNAL - TM
3 Technician FNAL - TM

2 Technician FNAL - TM @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
3.3.3	PTE Replace Steel Lid	$0	$0	$12,500	$12,500	$12,500	$0	$12,500

Replacement of the steel lid sections of the PTE in MC6.

Estimate Source: Scaling, Tech. Supervisor, Physicist

Estimate Basis:
Scaled from the 1998 access to the Hyper-CP MC6SWP magnet in the upstream section of the MC6 Target Pile, which required a five person T&M rigging crew one week to remove and replace. This item involves replacing approximately twice as much shielding so we use the same duration. This work can be performed by contract riggers.

5 T&M Riggers @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
3.3.4	PTE Replace Concrete Lid Blocks	$0	$0	$37,500	$37,500	$37,500	$0	$37,500

Replacement of the concrete lid sections of the PTE in MC6.

Estimate Source: Scaling, Tech. Supervisor, Physicist

Estimate Basis:
Scaled from the 1998 access to the Hyper-CP MC6SWP magnet in the upstream section of the MC6 Target Pile, which required a five person T&M rigging crew one week to remove and replace. This item involves replacing approximately five times as much shielding, hence the 3 week duration. This work can be performed by contract riggers.

5 T&M Riggers @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
3.4	**Close Target Pile**	**$0**	**$0**	**$50,000**	**$50,000**	**$50,000**	**$0**	**$50,000**

Replace steel and concrete shielding in the MC6 Target Pile.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
3.4.1	TP Replace Downstream Concret	$0	$0	$12,500	$12,500	$12,500	$0	$12,500

Replacement of the downstream TP concrete shielding blocks in MC6.

Estimate Source: Scaling, Tech. Supervisor, Physicist

Estimate Basis:
Scaled from the 1998 access to the Hyper-CP MC6SWP magnet in the upstream section of the MC6 Target Pile, which required a five person T&M rigging crew one week to remove and replace. This item involves replacing approximately twice the amount of shielding so we use the same duration. This work can be performed by contract riggers.

5 T&M Riggers @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
3.4.2	TP Replace Steel Plugs	$0	$0	$12,500	$12,500	$12,500	$0	$12,500

Replacement of the steel lid sections of the TP in MC6.

Estimate Source: Scaling, Tech. Supervisor, Physicist

Estimate Basis:
Scaled from the 1998 access to the Hyper-CP MC6SWP magnet in the upstream section of the MC6 Target Pile, which required a five person T&M rigging crew one week to remove and replace. This item involves replacing approximately twice the amount of shielding so we use the same duration. This work can be performed by contract riggers.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining

"TP Replace Steel Plugs" continued

5 T&M Riggers @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
3.4.3	TP Replace Concrete Lid Blocks	$0	$0	$25,000	$25,000	$25,000	$0	$25,000

Replacement of the concrete lid sections of the TP in MC6.

Estimate Source: Scaling, Tech. Supervisor, Physicist

Estimate Basis:
Scaled from the 1998 access to the Hyper-CP MC6SWP magnet in the upstream section of the MC6 Target Pile, which required a five person T&M rigging crew one week to remove and replace This item involves replacing approximately twice as much shielding, hence the 2 week duration. This work can be performed by contract riggers.

5 T&M Riggers @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
4	**Meson Worm (MC7) Preparatio**	**$27,660**	**$48,654**	**$235,500**	**$355,858**	**$267,746**	**$172,310**	**$183,548**

Removal of the HyperCP detectors and magnets from the MC7 Worm. This item includes opening and closing the MC7 roof at the location of the BM109 magnets to permit crane access.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
4.1	**Remove or Stage HyperCP Det**	**$0**	**$6,460**	**$12,500**	**$31,150**	**$18,960**	**$31,150**	**$0**

Removal of the Hyper-CP detectors from the MC7 worm.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
4.1.1	MC7 Remove 9 PWC	$0	$3,800	$0	$13,750	$3,800	$13,750	$0

Removal of the 9 wire chambers from the MC7 worm. This item includes disconnecting all services, dismounting the chambers, and removing them from the worm for storage.

Estimate Source: Physicist

Estimate Basis:
We assume two technicians need one day per chamber to disconnect, dismount, remove, and store it.

1 Senior Tech @ 100%
1 Technician @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
4.1.2	MC7 Remove Muon Arms	$0	$1,900	$12,500	$17,400	$14,400	$17,400	$0

Removal of the two muon/calorimeter arms from the MC7 worm. This item includes disconnecting all services, dismounting the detectors and removing them from the worm for storage, and removal of sampling steel and support blocks.

Estimate Source: Physicist

Estimate Basis:
We assume two technicians need one week to disconnect, dismount, remove, and store the detectors. We a five person rigging crew will need one week to remove the heavy components through the downstream door, which was their entry route.

1 Senior Tech @ 50%
1 Technician @ 50%
5 T&M Riggers @ 50%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
4.1.3	MC7 Remove 2 HODO	$0	$760	$0	$0	$760	$0	$0

Removal of two hodoscopes from the MC7 worm.
Estimate Source: Physicist

Estimate Basis:
We assume two technicians need two days to disconnect, dismount, remove, and store it.

1 Senior Tech @ 100%
1 Technician @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
4.2	**Remove BM109 Magnets**	**$0**	**$5,526**	**$22,500**	**$34,600**	**$28,026**	**$34,600**	**$0**

Remove the BM109 magnets from the upstream bump out of the MC7 worm. This item includes disconnecting the magnets from services, moving utilities to enable opening the roof, prepping the exterior area for use by a mobile crane, and rigging out the magnet pieces.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
4.2.1	MC7 Disconnect BM109 Magnets	$0	$1,030	$0	$2,620	$1,030	$2,620	$0

Disconnect electrical and water services for the BM109 magnets in MC7.

Estimate Source: Physicist

Estimate Basis:
We assume a technician needs a week to disconnect the services.

1 Senior Tech @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
4.2.2	MC7 Prep Outside Area for Crane	$0	$2,770	$0	$5,630	$2,770	$5,630	$0

Prepare exterior area on east side of MC7 worm for mobile crane access. This item removes a fence and other light equipment in the alley between the MC7 and MP7 worms.

Estimate Source: Tech Supervisor

Estimate Basis:
We assume a technician crew of three needs one week to prepare the area.

1 Senior Tech @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
"MC7 Prep Outside Area for Crane" continued								

2 Technicians @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
4.2.3	MC7 Remove Utilities	$0	$1,030	$0	$11,620	$1,030	$11,620	$0

Remove utilities from the east wall of the MC7 worm in the area of the upstream bumpout. This is necessary to enable gantry crane access from the east alley.

Estimate Source: Senior Tech, Physicist

Estimate Basis:
We assume a technician needs one week.

1 Senior Tech @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
4.2.4	MC7 Open Worm US	$0	$696	$0	$0	$696	$0	$0

Remove MC7 worm roof and east wall at the upstream bumpout.

Estimate Source: Scaling, Senior Tech

Estimate Basis:
Scaled from the access to the MC9 worm to extract shielding steel. We assume two technicians need two days.

2 Technician @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
4.2.5	MC7 Rig Out BM109 Magnets	$0	$0	$22,500	$14,730	$22,500	$14,730	$0

Erect gantry crane and rig out two BM109 magnets to east alley. Rent mobile crane to move pieces from gantry to truck.

Estimate Source: Scaling, Senior Tech

Estimate Basis:
Scaled from 1999 removal of Jolly Green Giant magnet from Lab G, which took a T&M rigging crew four weeks at a cost of $40,000. This item is approximately one fourth in size, and we have escalated the rate. We also include rental of a mobile truck crane, since the highest capacity FNAL truck crane is likely to be inadequate.

5 T&M Rigger @ 100%
1 Crane Rental @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
4.3	**Close MC7 Worm US**	**$0**	**$7,120**	**$9,000**	**$11,770**	**$12,640**	**$6,550**	**$5,220**

Close the MC7 upstream worm roof and east wall at the upstream bump out.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
4.3.1	MC7 US Replace Panels and Insu	$0	$1,900	$9,000	$6,550	$10,900	$6,550	$0

Replace roof and east wall of MC7 at the upstream bump out.

Estimate Source: Scaling, Senior Tech

Estimate Basis:
Scaled from the vendor cost to replace the MC8 roof after removing steel blocks. Scaling by the number and type of panels, we estimate one week for two technicians and $9,000 in M&S.

1 Senior Tech @ 100%
1 Technician @ 100%
$9,000 M&S

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
4.3.2	MC7 US Restore Utilities	$0	$5,220	$0	$5,220	$5,220	$0	$5,220

Restore utilities to the east wall of the MC7 worm in the area of the upstream bumpout.

Estimate Source: Senior Tech, Physicist

Estimate Basis:
We assume two technicians need one week.

2 Technicians @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
4.4	**MBottom Shoring**	**$27,660**	**$24,720**	**$18,000**	**$100,010**	**$53,280**	**$100,010**	**$0**

Design, fabricate, and install shoring in MBottom to support the analysis magnets, JGG and Rosie.

This is a scope increase over the November 2000 baseline plan, caused by moving the experiment downstream to accommodate longer beam Cherenkov counters.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
4.4.1	MB Shoring Engineering & Desigr	$27,660	$0	$0	$27,660	$10,560	$27,660	$0

Design thel shoring required in MBottom to support the analysis magnets, JGG and Rosie. This task includes obtaining FESS approval for the design.

Estimate Source: physicist, engineer

Estimate Basis: We assume this task requires an engineer for 6 weeks.

1 Mechanical Engineer @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
4.4.2	MB Shoring Fabrication	$0	$9,270	$4,000	$20,350	$13,270	$20,350	$0

Fabricate the shoring beams and footings for MBottom.

Estimate Source: Tech. Supervisor

Estimate Basis: We assume this task requires three technicians three weeks.

3 Technicians @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
"MB Shoring Fabrication" continued								

$4K M&S

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
4.4.3	MB Shoring Installation	$0	$15,450	$1,000	$38,900	$16,450	$38,900	$0

Install the MBottom shoring.

Estimate Source: Tech. Supervisor

Estimate Basis: We assume this task requires 5 technicians 3 weeks, and $1K in supplies.

5 Technicians @ 100%
$1K M&S

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
4.4.4	MC Slab	$0	$0	$13,000	$13,100	$13,000	$13,100	$0

Install MC7 slab to spread floor load of the analyzing magnets, JGG and Rosie.

Estimate Source: Tech. Supervisor

Estimate Basis: Vendor Quote

$13K M&S

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
4.5	**MC7 DS Roof**	**$0**	**$4,828**	**$83,500**	**$88,328**	**$88,328**	**$0**	**$88,328**
4.5.1	MC7 Temporary Wall	$0	$0	$1,500	$1,500	$1,500	$0	$1,500

Remove the MC7 roof downstream of the middle bumpout.

This is a scope increase over the November 2000 baseline plan, caused by moving the experiment downstream to accommodate longer beam Cherenkov counters, which required us to add a slab to spread the floor load of the magnets, which raises the beam height.

Estimate Source: Tech. Supervisor

Estimate Basis: Tech Supervisor

$1500 M&S

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
4.5.2	MC7 Remove DS Roof	$0	$1,988	$0	$1,988	$1,988	$0	$1,988

Replace the MC7 roof downstream of the middle bumpout.

This is a scope increase over the November 2000 baseline plan, caused by moving the experiment downstream to accommodate longer beam Cherenkov counters, which required us to add a slab to spread the floor load of the magnets, which raises the beam height.

Estimate Source: Tech. Supervisor

Estimate Basis: We estimate one Tech Specialiest for 7 days.

1 Technician @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
4.5.3	MC7 Replace DS Roof	$0	$2,840	$82,000	$84,840	$84,840	$0	$84,840

Replace the MC7 roof downstream of the middle bumpout.

This is a scope increase over the November 2000 baseline plan, caused by moving the experiment downstream to accommodate longer beam Cherenkov counters, which required us to add a slab to spread the floor load of the magnets, which raises the beam height.

Estimate Source: Tech. Supervisor

Estimate Basis: Vendor Quote, Tech Supervisor
The vendor quotes: $40K materials, $30K installation, $12K insulation. In addition, we estimate that a technician needs to support the vendor for two weeks.

1 Technician @ 100%
$82K M&S

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
4.6	MC7 Magnet Primary Power	$0	$0	$90,000	$90,000	$90,000	$0	$90,000

Install primary power for analyzing magnet power supplies. There are four options that have been developed for sourcing the AC power and sitnig the DC supplies. See the note by Leon Beverly for details. We assume the middle cost options which locate the supplies in MC7.

Estimate Source: Tech. Supervisor

Estimate Basis: We assume that the supplies will be located in MC8. The estimate is $90K of trades labor (largely electrician).

$70K M&S

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5	**E907 Experiment (in MC7)**	**$165,856**	**$243,482**	**$517,300**	**$926,638**	**$718,170**	**$136,605**	**$790,034**

Design, fabricate, install, and make operational all beam line and detector components of E907.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.1	MC7 Design	$13,536	$0	$0	$13,536	$18,060	$1,856	$11,680

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.2	**Upstream Beamline Detectors (**	**$7,040**	**$26,780**	**$0**	**$33,820**	**$33,820**	**$0**	**$33,820**

Design, refurbish or fabricate, install, and make operational all beam line detectors upstream of the Experimental Target station (ETGT). These components include:
(a) wire chambers, beam definition scintillators, flags, and current monitors; and
(b) Cerenkov detectors to tag the secondary beam particles.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.2.1	UBL Design	$7,040	$0	$0	$7,040	$7,040	$0	$7,040

Design and installation plan for all beam line detectors upstream of the Experimental Target station (ETGT).

Estimate Source: Physicist

Estimate Basis:
We assume one physicist for a week to design the instrumentation layout. We assume two engineers, one electrical and one mechanical, for two weeks to design the detector mounting and services, supervised by additional week of the physicist.

1 Physicist @ 50%
1 Engineer - Electrical @ 50%
1 Engineer - Mechanical @ 50%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.2.2	UBL Secondary Production Targe	$0	$8,240	$0	$8,240	$8,240	$0	$8,240

Build the E907 secondary beam production target and insertion device.

Estimate Source: Physicist

Estimate Basis:
We assume two technicians need four weeks to build the target.

2 Technician @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.2.3	UBL Tracking Chamber Refurbish	$0	$4,120	$0	$4,120	$4,120	$0	$4,120

Refurbish beam wire chambers.

Estimate Source: Physicist

Estimate Basis:
We assume one technician needs four weeks.

1 Technician @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.2.4	UBL Cerenkov (BCKV) Fabricatio	$0	$8,240	$0	$8,240	$8,240	$0	$8,240

Build two beam tagging Cerenkov chambers.

Estimate Source: Physicist

Estimate Basis:
We assume two technicians need four weeks.

2 Technicians @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.2.5	**UBL Installation**	**$0**	**$6,180**	**$0**	**$6,180**	**$6,180**	**$0**	**$6,180**

Install beam line detectors in the MC5 and MC6 enclosures.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.2.5.1	UBL Pretarget Enclosure Detecto	$0	$4,120	$0	$4,120	$4,120	$0	$4,120

Install upstream beam detectors in the MC5 and MC6 enclosures.

Estimate Source: Physicist

Estimate Basis:
We assume one physicist and two technicians need four weeks.

1 Physicist @ 100%
2 Technician @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.2.5.2	UBL Target Pile Detectors Installa	$0	$2,060	$0	$2,060	$2,060	$0	$2,060

Install upstream beam detectors in the MC6 target pile.

Estimate Source: Physicist

Estimate Basis:
We assume one physicist and one technician need two weeks.

1 Physicist @ 100%
2 Technician @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.3	**Jolly Green Giant (JGG)**	**$15,200**	**$5,655**	**$111,000**	**$131,855**	**$96,275**	**$93,600**	**$38,255**

Move from its present location, assess the condition of, refurbish as required, install, and make operational all components of the FNAL E690 Jolly Green Giant magnet (JGG). These include
(a) disassembly and removal from its current location,
(b) construction or repair of a coil to replace one that is shorted,
(c) design, fabrication, and installation of a support structure in MC,
(d) assembly in MC,
(e) field mapping to the extent deemed necessary (bearing in mind that FNAL E690 has already developed high precision maps),
(e) necessary support systems, including power supplies, cooling water, and protection system.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.3.1	JGG Move & Installation Design	$9,920	$0	$0	$9,920	$7,040	$2,320	$7,600

Design of the installation of the JGG.

Estimate Source: Physicist

Estimate Basis:
We assume one physicist week, two electrical engineer weeks, and two mechanical engineer weeks.

1 Physicist @ 25%
1 Engineer - Electrical @ 50%
1 Engineer - Mechanical @ 50%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.3.2	JGG Replacement Coil	$5,280	$0	$86,000	$91,280	$60,000	$91,280	$0

Repair of the JGG shorted coil, or purchase of a replacement.

Estimate Source: Budgetary Quote, Physicist

Estimate Basis:
Pacific Electric Motor provided a budgetary quote in 1991 of $55,000 to build a replacement coil. Escalation due to inflation since that time is ~30%, while the price of copper has decreased by ~30%. We assume $60,000 M&S for a new coil.

$60,000 M&S

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.3.3	JGG Assembly	$0	$1,420	$25,000	$26,420	$26,420	$0	$26,420

Assembly of the JGG in the MC7 worm.

Estimate Source: Scaling, Senior Tech, Physicist

Estimate Basis:
Scaled from 1999 removal of Jolly Green Giant and TPL M2 magnets from Lab G, which took a T&M rigging crew four weeks at a cost of $40,000. We estimate a three person T&M rigging crew for one week, one week rental for a 90T crane, and one week of a FNAL Senior Tech.

5 T&M Riggers @ 100%
1 Senior Tech - FNAL @ 100%
1 Rental 120T Crane @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.3.4	JGG Connections	$0	$4,235	$0	$4,235	$4,235	$0	$4,235

Power, LCW, and interlock connections to the JGG

Estimate Source: Senior Tech, Physicist

Estimate Basis:
We estimate three technicians a week for the power and LCW, and a technician for half a week for interlocks.

1 Senior Tech @ 100%
2.5 Technicians @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.4	**Rosie Magnet (Rosie)**	**$9,920**	**$5,371**	**$14,000**	**$29,291**	**$36,275**	**$2,320**	**$26,971**

Move from its present location, assess the condition of, refurbish as required, install, and make operational all components of the Rosie magnet. These include
(a) disassembly and removal from its current location,
(b) construction or repair of a coil to replace one that is shorted,
(c) design, fabrication, and installation of a support structure in MC,
(d) assembly in MC,
(e) field mapping to the extent deemed necessary (bearing in mind that FNAL E690 has already developed high precision maps),
(e) necessary support systems, including power supplies, cooling water, and protection system.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.4.1	Rosie Move & Installation Design	$9,920	$0	$0	$9,920	$7,040	$2,320	$7,600

Design of the installation of the Rosie magnet, or equivalent.

Estimate Source: Physicist

Estimate Basis:
We assume one physicist week, two electrical engineer weeks, and two mechanical engineer weeks.

1 Physicist @ 25%
1 Engineer - Electrical @ 50%
1 Engineer - Mechanical @ 50%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.4.2	Rosie Assembly	$0	$1,136	$14,000	$15,136	$15,136	$0	$15,136

Assembly of the Rosie magnet in the MC7 worm.

Estimate Source: Scaling, Senior Tech, Physicist

Estimate Basis:
Scaled from 1999 removal of Jolly Green Giant and TPL M2 magnets from Lab G, which took a T&M rigging crew four weeks at a cost of $40,000. We estimate a three person T&M rigging crew for five days, a 90T crane rental, and one week of a FNAL Senior Tech

5 T&M Riggers @ 100%
1 Senior Tech - FNAL @ 100%
1 Rental 90T Crane @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.4.3	Rosie Connections	$0	$4,235	$0	$4,235	$4,235	$0	$4,235

Power, LCW, and interlock connections to the Rosie magnet....

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.5	**Differential Cerenkov (CKOV)**	**$14,080**	**$29,400**	**$25,000**	**$68,480**	**$70,780**	**$7,692**	**$60,788**

Move from its present location, assess the condition of, refurbish as required, install, and make operational all components of the FNAL E766/FNAL E690/BNL E910 differential Cernkov counter (CKOV).

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.5.1	CKOV Move	$0	$7,692	$0	$7,692	$9,992	$7,692	$0

Dismantle, package for shipping, and ship the CKOV from BNL to FNAL.

Estimate Source: Senior Tech, Physicist

Estimate Basis:
We assume two technicians for one week, plus their travel expenses from LLNL to BNL, plus material.

2 Technicians @ 100%
$2,300 M&S

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.5.2	CKOV Chamber Move & Installati	$1,760	$0	$0	$1,760	$1,760	$0	$1,760

Design the installation of the CKOV.

Estimate Source: Physicist

Estimate Basis:
We assume one physicist week, two electrical engineer weeks, and two mechanical engineer weeks.

1 Physicist @ 25%
1 Engineer - Electrical @ 50%
1 Engineer - Mechanical @ 50%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.5.3	CKOV Equipment Installation Des	$5,280	$0	$0	$5,280	$5,280	$0	$5,280

Design the installation of the CKOV.

Estimate Source: Physicist

Estimate Basis:
We assume one physicist week, two electrical engineer weeks, and two mechanical engineer weeks.

1 Physicist @ 25%
1 Engineer - Electrical @ 50%
1 Engineer - Mechanical @ 50%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.5.4	CKOV Undercarriage Fabrication	$3,520	$8,240	$10,000	$21,760	$21,760	$0	$21,760

Fabrication of the CKOV support hardware.

Estimate Source: Physicist

Estimate Basis:
We assume two technicians for four weeks, a mechanical engineer for two weeks, and $10,000 M&S.

2 Technician @ 100%
1 Engineer - Mechanical @ 50%
$10,000 M&S

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.5.5	CKOV Freon Recovery Fabricatio	$3,520	$8,240	$10,000	$21,760	$21,760	$0	$21,760

Fabrication of the CKOV freon circulation and recovery system.

Estimate Source: Physicist

Estimate Basis:
We assume two technicians for four weeks, a mechanical engineer for two weeks, and $10,000 M&S.

2 Technician @ 100%
1 Engineer - Mechanical @ 50%
$10,000 M&S

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.5.6	CKOV Locate in Position	$0	$1,108	$0	$1,108	$1,108	$0	$1,108

Installation of the CKOV in the MC7 worm.

Estimate Source: Experience, Physicist

Estimate Basis:
Three physicists completely disassembled and packed the CKOV components in two days in August 2000. We assume four technicians and a physicist need two days to install and reassemble the CKOV.

1 Physicist @ 100%
1 Senior Tech @ 100%
3 Technician @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.5.7	CKOV Align Mirrors	$0	$0	$0	$0	$0	$0	$0

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.5.8	CKOV Connections	$0	$4,120	$5,000	$9,120	$9,120	$0	$9,120

Install gas, high voltage, and signal cabling to the CKOV.

Estimate Source: Physicist

Estimate Basis:
We assume two technicians need two weeks, and $5,000 M&S.

2 Technicians @ 100%
$5,000 M&S

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.6	Magnets & CKOV in MC7	$0	$0	$0	$0	$0	$0	$0
5.7	**Experimental Targets (ETGT)**	**$12,320**	**$20,600**	**$0**	**$32,920**	**$32,920**	**$0**	**$32,920**

Design, refurbish or fabricate, install, and make operational all components for the experimental target station (ETGT) just upstream of the TPC in MC7, including
(a) (possibly multiple) target wheels (TGTW) for thin homogeneous targets,
(b) thick homogeneous targets and mounting,
(c) cryogenic targets and mounting, and
(d) NuMI Target samples (nTGT).

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.7.1	**Target Wheel (TGTW)**	**$1,760**	**$3,090**	**$0**	**$4,850**	**$4,850**	**$0**	**$4,850**

Design, refurbish or fabricate, install, and make operational (possibly multiple) target wheels (TGTW) for thin homogeneous targets.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.7.1.1	TGTW Design	$1,760	$0	$0	$1,760	$1,760	$0	$1,760

Design of the (possibly multiple) target wheels (TGTW) for thin homogeneous targets.

Estimate Source: Physicist

Estimate Basis:
We assume one physicist week to design the targets, and half of two engineers, one mechanical and one electrical, to design the mounting, installation, control, and interlocks.

1 Physicist @ 100%
1 Engineer - Electrical @ 50%
1 Engineer - Mechanical @ 50%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.7.1.2	TGTW Fabrication	$0	$2,060	$0	$2,060	$2,060	$0	$2,060

Fabrication of (possibly multiple) target wheels.

Estimate Source: Physicist

Estimate Basis:
We assume one technician needs two weeks to fabricate the target wheel system and targets.

1 Technician @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.7.1.3	TGTW Installation	$0	$1,030	$0	$1,030	$1,030	$0	$1,030

Installation of the target wheel system.

Estimate Source: Physicist

Estimate Basis:
We assume one technician needs one week to install the target wheel system and targets.

1 Technician @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.7.2	**Cryogenic Target (CTGT)**	**$7,040**	**$12,360**	**$0**	**$19,400**	**$19,400**	**$0**	**$19,400**

Design, refurbish or fabricate, install, and make operational the cryogenic hydrogen and nitrogen target systems.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.7.2.1	CTGT Design	$7,040	$0	$0	$7,040	$7,040	$0	$7,040

Design of the cryogenic hydrogen and nitrogen target systems.

Estimate Source: Physicist

Estimate Basis:
We assume tw0 physicist week to design the targets, and four mechanical engineer weeks.

1 Physicist @ 50%
1 Engineer - Mechanical @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.7.2.2	CTGT Fabrication	$0	$8,240	$0	$8,240	$8,240	$0	$8,240

Fabrication of the cryogenic hydrogen and nitrogen target systems.

Estimate Source: Physicist

Estimate Basis:
We assume two technicians need fourweeks to fabricate the cryogenic hydrogen and nitrogen target systems.

2 Technician @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.7.2.3	CTGT Installation	$0	$4,120	$0	$4,120	$4,120	$0	$4,120

Installation of the cryogenic hydrogen and nitrogen target systems.

Estimate Source: Physicist

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining

"CTGT Installation" continued

Estimate Basis:
We assume two technicians need two weeks to install the cryogenic hydrogen and nitrogen target systems.

2 Technician @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.7.3	**NuMI Target Sample (NTGT)**	**$3,520**	**$5,150**	**$0**	**$8,670**	**$8,670**	**$0**	**$8,670**

Design, fabrication, and installation of the NuMI target assembly and mounting.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.7.3.1	NTGT Design	$3,520	$0	$0	$3,520	$3,520	$0	$3,520

Design of the NuMI target assembly and mounting.

Estimate Source: Physicist

Estimate Basis:
We assume one physicist week and two mechanical engineer weeks.

1 Physicist @ 50%
1 Engineer - Mechanical @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.7.3.2	NTGT Fabrication	$0	$4,120	$0	$4,120	$4,120	$0	$4,120

Fabrication of the NuMI target assembly and mounting.

Estimate Source: Physicist

Estimate Basis:
We assume that the target itself can be obtained from NuMI as a prototype. Since our beam current is low, this will not be a destructive test of the target, and leave it only mildly radioactive. We assume that one technician will need four weeks to fabricate the mounting fixtures.

1 Technician @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.7.3.3	NTGT Installation	$0	$1,030	$0	$1,030	$1,030	$0	$1,030

Installation of the NuMI target assembly and mounting.

Estimate Source: Physicist

Estimate Basis:
We assume one technician will need one week to install the NuMI target assembly.

1 Technician @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.8	**Target Recoil Detector (TRD)**	**$28,160**	**$24,720**	**$0**	**$52,880**	**$52,880**	**$0**	**$52,880**

Design, refurbish or fabricate, install, and make operational all components for the Target Recoil Detector (TRD).

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.8.1	TRD Design	$28,160	$0	$0	$28,160	$28,160	$0	$28,160

Design of the TRD.

Estimate Source: Physicist

Estimate Basis:
We assume one physicist and two engineers, one mechanical and one electrical, for two months.

1 Physicist @ 100%
1 Engineer - Electrical @ 100%
1 Engineer - Mechanical @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.8.2	TRD Fabrication	$0	$12,360	$0	$12,360	$12,360	$0	$12,360

Fabrication of the TRD.

Estimate Source: Physicist

Estimate Basis:
We assume one physicist and three technicians for fourweeks.

1 Physicist @ 100%
3 Technician @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.8.3	TRD Installation	$0	$12,360	$0	$12,360	$12,360	$0	$12,360

Installation of the TRD.

Estimate Source: Physicist

Estimate Basis:
We assume one physicist and three technicians for fourweeks.

1 Physicist @ 100%
3 Technician @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.9	**Time Projection Chamber (TPC**	**$10,560**	**$15,932**	**$22,300**	**$48,792**	**$53,942**	**$19,992**	**$28,800**

Assess the condition of, refurbish as required, install, and make operational all components of the LBNL EOS/BNL E895/BNL E910 time projection chamber (TPC). This includes
(a) assessing the condition of the chamber and refurbishing as necessary,

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining

"Time Projection Chamber (TPC)" continued

(b) physical mounting and support,
(c) high voltage system,
(d) gas handling system, and
(e) chamber readout up to the data acquisition (DAQ) interface.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.9.1	**TPC Move to FNAL**	**$0**	**$7,692**	**$12,300**	**$19,992**	**$19,992**	**$19,992**	**$0**

Prepare for shipment, package, and ship the TPC from BNL to FNAL.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.9.1.1	TPC Move Shipping Container	$0	$7,692	$2,300	$9,992	$9,992	$9,992	$0

Design and fabricate the TPC shipping container.

Estimate Source: Senior Tech, Physicist

Estimate Basis:
We assume two technicians for one week, plus their travel expenses from LLNL to BNL, plus material.

2 Technicians @ 100%
$2,300 M&S

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.9.1.2	TPC Move Transportation	$0	$0	$10,000	$10,000	$10,000	$10,000	$0

Package and ship the TPC from BNL to FNAL.

Estimate Source: Vendor Quote, Physicist

Estimate Basis:
Vendor quote for shipping the TPC crate, seven double wide electronic racks, and two crates of cables.

$10,000 M&S

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.9.2	TPC Assess Condition	$0	$0	$0	$0	$1,030	$0	$0

Assess the condition of the TPC at FNAL after shipping. This item includes:
(a) installation of the cathode plane;
(b) measurement of the field cage current at 10 kV nominal operating voltage;
(c) measurement of the anode currents at 1300 V nominal operating voltage.

Estimate Source: Physicist

Estimate Basis:
Based Gulshan Rai's estimate, we assume four physicists and one technician for one week.

4 Physicist @ 100%
1 Technician @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.9.3	**TPC Test in Mtest**	**$0**	**$0**	**$0**	**$0**	**$4,120**	**$0**	**$0**

Install and test the TPC in MTest

This is a scope increase since the November 2000 baseline.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.9.3.1	TPC MTest Installation	$0	$0	$0	$0	$4,120	$0	$0

Install the TPC and all support systems in MTest for testing with cosmic rays.

Estimate Source: Physicist

Estimate Basis: We estimate this will take a physicist 4 days per month, and a technician 1 week per month.

16 days Physicist
4 weeks Technician

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.9.3.2	TPC Mtest Testing	$0	$0	$0	$0	$0	$0	$0
5.9.4	TPC Installation Design	$10,560	$0	$0	$10,560	$10,560	$0	$10,560

Design of the TPC installation, including mechanical, gas system, and high voltage, low voltage, slow control, and fiber optic cabling.

Estimate Source: Physicist

Estimate Basis:
We assume one physicist week, two electrical engineer weeks, and four mechanical engineer weeks.

1 Physicist @ 25%
1 Engineer - Electrical @ 50%
1 Engineer - Mechanical @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.9.5	TPC Installation	$0	$8,240	$10,000	$18,240	$18,240	$0	$18,240

Installation of the TPC chamber, gas rack, power supplies, and cabling.

Estimate Source: Physicist

Estimate Basis:
We assume one physicist and two technicians for four weeks, plus $10,000 in material.

1 Physicist @ 100%
2 Technicians @ 100%
$10,000 M&S

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.10	**Time-of-Flight (TOF)**	**$10,560**	**$24,720**	**$125,000**	**$160,280**	**$160,280**	**$0**	**$160,280**

Locate a suitable existing parts, move them from their present location, assess the condition of, refurbish or replace as required, install, and make operational all components of the time-of-flight (TOF). This item includes
(a) the scintillator pieces,
(b) the photo-multiplier tubes (PMTs) and bases,
(c) the assembly of scintillator and PMTs into working detector modules,
(e) the mechanical support system,
(d) the high voltage system, and
(e) the electronics up to the interface with the data acquisition system (DAQ).

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.10.1	TOF Design	$10,560	$4,120	$0	$14,680	$14,680	$0	$14,680

Design of the TOF system installation, test existing scintillator and phototubes for use in system. Design electrical readout and high voltage as well as mechanical support structure of the TOF wall.

Estimate Source: Physicist

Estimate Basis:
We assume twelve physicist weeks, two electrical engineer weeks, and four mechanical engineer weeks, and four technician weeks.

3 Physicist @ 100%
1 Engineer - Electrical @ 50%
1 Engineer - Mechanical @ 100%
1 Technician @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.10.2	TOF Fabrication	$0	$8,240	$100,000	$108,240	$108,240	$0	$108,240

Fabrication of the TOF installation components, purchase of new components not available at Fermilab as needed. Wrapping of scintillator, attaching. PMTs, light leak testing

Estimate Source: Physicist

Estimate Basis:
We assume two physicisst and two technicians for fourweeks.

2 Physicist @ 100%
2 Technician @ 100%
$100K M&S

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.10.3	TOF Installation	$0	$12,360	$25,000	$37,360	$37,360	$0	$37,360

Installation of the TOF components and construction of mounting structure. Install and verify cabling to phototubes and readout electronics.

Estimate Source: Physicist

Estimate Basis:
We assume two technicians for six weeks and one physicist for six weeks.

1 Physicist @ 100%
2 Technician @ 100%
$25K M&S

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.11	**Ring Imaging Cerenkov (RICH)**	**$16,320**	**$23,354**	**$120,000**	**$159,674**	**$154,514**	**$11,144**	**$148,530**

Move from its present location, assess the condition of, refurbish as required, install, and make operational all components of the FNAL SELEX (E781) ring imaging Cerenkov counter (RICH). These include
(a) disassembly and removal from its current location,
(b) design, fabrication, and installation of a support structure in MC,
(c) assembly in MC,
(d) modifications to the gas handling system to accomadate the E907 gas selection,
(e) replacement of photo-multiplier tubes, as necessary,
(f) the high voltage system, and
(g) the electronics up to the interface to the data acquisition system (DAQ).

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.11.1	RICH Installation Design	$16,320	$0	$0	$16,320	$7,040	$5,568	$10,752

Design the installation of the RICH.

Estimate Source: Physicist

Estimate Basis:
We assume one physicist week, two electrical engineer weeks, and two mechanical engineer weeks.

1 Physicist @ 25%
1 Engineer - Electrical @ 50%
1 Engineer - Mechanical @ 50%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.11.2	**RICH Extraction from PC4**	**$0**	**$5,576**	**$0**	**$5,576**	**$9,696**	**$5,576**	**$0**

Move the RICH from PC4 to MC7. We assume that fabricating a new tank will be cheaper than extracting the existing tank from PC4.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.11.2.1	RICH Remove PMTs	$0	$0	$0	$0	$4,120	$0	$0

Remove and package the RICH phototubes and bases.

Estimate Source: Physicist

Estimate Basis:
We assume two technicians for two weeks, supervised by a physicist for 2 days total.

1 Physicist @ 25%
2 Technicians @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.11.2.2	RICH Open End Flanges	$0	$1,456	$0	$1,456	$1,456	$1,456	$0

Remove upstream and downstream window flanges from the RICH.

Estimate Source: Physicist

Estimate Basis:
We assume four technicians need one per flange.

1 Senior Tech @ 100%
3 Technicians @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.11.2.3	RICH Remove Mirrors	$0	$2,060	$0	$2,060	$2,060	$2,060	$0

Remove the mirrors from the RICH.

Estimate Source: Physicist

Estimate Basis:
We assume two technicians need one week to remove the mirrors, supervised by a physicist for one day.

1 Physicist @ 25%
2 Technicians @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.11.2.4	RICH Disconnect Support Equipn	$0	$2,060	$0	$2,060	$2,060	$2,060	$0

Disconnect power supplies and gas system from the RICH.

Estimate Source: Physicist

Estimate Basis:
We assume two technicians need one week, supervised by a physicist for one day.

1 Physicist @ 25%
2 Technicians @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.11.3	RICH Position Tank in MC7	$0	$728	$0	$728	$728	$0	$728

Position RICH tank in MC7.

Estimate Source: Senior Tech, Physicist

Estimate Basis:
We assume four technicians can locate the tank in MC7 in one day.

1 Senior Tech @ 100%
3 Technicians @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.11.4	RICH Install Mirrors	$0	$1,998	$0	$1,998	$1,998	$0	$1,998

Install the RICH mirrors into the RICH in MC7.

Estimate Source: Physicist

Estimate Basis:
We assume that two technicians need one week to install the mirrors, supervised by a physicist and a Senior Tech.

1 Physicist @ 50%
1 Senior Tech @ 25%
2 Technicians @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.11.5	RICH Close End Flanges	$0	$1,662	$0	$1,662	$1,662	$0	$1,662

Install the window flanges at each end of the RICH tank.

Estimate Source: Senior Tech, Physicist

Estimate Basis:
We assume a crew of four technicians need one day for each flange.

1 Senior Tech @ 100%
3 Technicians @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.11.6	RICH Install Support Equipment	$0	$4,120	$0	$4,120	$4,120	$0	$4,120

Install RICH support equipment.

Estimate Source: Physicist

Estimate Basis:
We assume two technicians need two weeks, supervised by a physicist.

1 Physicist @ 25%
2 Technicians @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.11.7	RICH Gas Clean & FIll	$0	$1,030	$0	$1,030	$1,030	$0	$1,030

Purge the RICH and fill with gas.

Estimate Source: Experience, Physicist

Estimate Basis:
We assume two technicians need one week, supervised by a physicist.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
"RICH Gas Clean & FIll" continued								
	1 Physicist @ 25% 2 Technicians @ 100%							
5.11.8	RICH Purchase PMTs	$0	$0	$60,000	$60,000	$60,000	$0	$60,000
	Purchase the RICH PMTs from the Russian owners. Estimate Source: Vendor Quote Estimate Basis: The Russian group has agreed to sell the PMTs for $60,000. $60,000 M&S							
5.11.9	RICH Install PMTs	$0	$4,120	$0	$4,120	$4,120	$0	$4,120
	Install the RICH phototubes and bases. Estimate Source: Physicist Estimate Basis: We assume two technicians for two weeks, and a physicist for one week. 1 Physicist @ 50% 2 Technicians @ 100%							
5.11.10	RICH Front End Electronics	$0	$0	$60,000	$60,000	$60,000	$0	$60,000
5.11.11	RICH Install Electronics	$0	$4,120	$0	$4,120	$4,120	$0	$4,120
	Install the RICH electronics. Estimate Source: Physicist Estimate Basis: We assume two technicians and a physicist for two weeks. 1 Physicist @ 100% 2 Technicians @ 100%							
5.12	**Drift Chambers (DC)**	**$5,280**	**$31,930**	**$100,000**	**$137,210**	**$137,210**	**$0**	**$137,210**
	Install, and make operational all components of the drift chamber system (DC). These may be refurbished as-yet unidentified existing chambers, new chambers of the FNAL E690 design but somewhat larger, or refurbished E690 chambers. This item includes (a) the chambers, (b) their support structures, (c) the gas handling system, (d) the high voltage system, and (e) the electronics up to the interface with the data acquisition system (DAQ).							
5.12.1	DC Move & Installation Design	$5,280	$3,090	$0	$8,370	$8,370	$0	$8,370
	Design of the DC installation. Estimate Source: Physicist Estimate Basis: We assume a physicist at quarter time, three electrical engineer weeks, and three mechanical engineer weeks. 1 Physicist @ 25% 1 Engineer - Electrical @ 50% 1 Engineer - Mechanical @ 50%							
5.12.2	DC Move	$0	$8,240	$0	$8,240	$8,240	$0	$8,240
	Move the DCs to MC7. Estimate Source: Physicist Estimate Basis: We assume two technicians for a month. 2 Technicians @ 100%							
5.12.3	DC Parts Fabrication	$0	$12,360	$100,000	$112,360	$112,360	$0	$112,360
	Fabrication of the DC installation parts. Estimate Source: Physicist Estimate Basis: We assume two technicians for six weeks, plus $100,000 M&S 2 Technician @ 100% $100,000 M&S							

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.12.4	DC Installation	$0	$8,240	$0	$8,240	$8,240	$0	$8,240

Installation of the DCs.

Estimate Source: Physicist

Estimate Basis:
We assume two technicians for four weeks.

2 Technician @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.13	**Neutral Calorimeter (NCAL)**	**$8,800**	**$16,480**	**$0**	**$25,280**	**$25,280**	**$0**	**$25,280**

Design, refurbish or fabricate, install, and make operational all components for the Neutral Calorimeter (NCAL).

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.13.1	NCAL Design	$8,800	$0	$0	$8,800	$8,800	$0	$8,800

Design of the NCAL installation.

Estimate Source: Physicist

Estimate Basis:
We assume a physicist and mechanical engineer for a month, and one electrical engineer week.

1 Physicist @ 100%
1 Engineer - Mechanical @ 100%
1 Engineer - Electrical @ 25%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.13.2	NCAL Fabrication	$0	$8,240	$0	$8,240	$8,240	$0	$8,240

Fabrication of the NCAL installation hardware.

Estimate Source: Physicist

Estimate Basis:
We assume two technicians for four weeks.

2 Technician @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.13.3	NCAL Installation	$0	$8,240	$0	$8,240	$8,240	$0	$8,240

Installation of the NCAL.

Estimate Source: Physicist

Estimate Basis:
We assume two technicians for four weeks.

2 Technician @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.14	**Trigger (TRG)**	**$7,040**	**$6,180**	**$0**	**$13,220**	**$13,220**	**$0**	**$13,220**

Design, construct, and install the trigger system (TRG). This item includes
(a) specialized trigger detectors, their electronics, and support systems,
(b) collection of all trigger signals from the various sources,
(c) computation of a variety of trigger conditions,
(d) prescaling of those conditions,
(e) selection of appropriate triggers, and
(f) the distribution of trigger signals to the data acquisition and all detector systems.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.14.1	TRG Design	$7,040	$0	$0	$7,040	$7,040	$0	$7,040

Design of the trigger (TRG).

Estimate Source: Physicist

Estimate Basis:
We assume a physicist and electrical engineer for a month.

1 Physicist @ 100%
1 Engineer - Electrical @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.14.2	TRG Fabrication	$0	$4,120	$0	$4,120	$4,120	$0	$4,120

Fabrication of the trigger (TRG).

Estimate Source: Physicist

Estimate Basis:
We assume a physicist and technician for a month.

1 Physicist @ 100%
1 Technician @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
5.14.3	TRG Installation	$0	$2,060	$0	$2,060	$2,060	$0	$2,060

Installation of the trigger (TRG).

Estimate Source: Physicist

Estimate Basis:
We assume a physicist and technician for two weeks.

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
"TRG Installation" continued								
	1 Physicist @ 100% 1 Technician @ 100%							
5.15	**Data Acquisition (DAQ)**	**$7,040**	**$12,360**	**$0**	**$19,400**	**$19,400**	**$0**	**$19,400**
	Design, construct, and install the data acquisition system (DAQ). This item includes (a) all electronics from a defined interface with each detector system up to the digitizers, (b) collection of all digitized signals, (c) on-line processing, (d) performance monitoring, and (d) permanent storage of all data.							
5.15.1	DAQ Design	$7,040	$0	$0	$7,040	$7,040	$0	$7,040
	Design of the Data Acquisition (DAQ). Estimate Source: Physicist Estimate Basis: We assume a physicist and electrical engineer for a month. 1 Physicist @ 100% 1 Engineer - Electrical @ 100%							
5.15.2	DAQ Fabrication	$0	$8,240	$0	$8,240	$8,240	$0	$8,240
	Fabrication of the DAQ. Estimate Source: Physicist Estimate Basis: We assume two physicists and a technician for two months. 2 Physicist @ 100% 1 Technician @ 100%							
5.15.3	DAQ Installation	$0	$4,120	$0	$4,120	$4,120	$0	$4,120
	Installation of the DAQ. Estimate Source: Physicist Estimate Basis: We assume a physicist and technician for a month. 1 Physicist @ 100% 1 Technician @ 100%							
6	**Data Taking (DATA)**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
	Plan and execute the run plan for acquiring engineering, calibration, and beam data.							
6.1	DATA Engineering Run	$0	$0	$0	$0	$0	$0	$0
	Operation of the experiment for a two week engineering run. Estimate Source: Physicist Estimate Basis: We assume operations are manned 24/7 in three shifts, with four people per shift. We also assume four crews with one day off every four. 16 Physicist @ 100%							
6.2	DATA 1% Targets	$0	$0	$0	$0	$0	$0	$0
	Operation of the experiment for a four month run using the target wheel and cryogenic targets. Estimate Source: Physicist Estimate Basis: We assume operations are manned 24/7 in three shifts, with four people per shift. We also assume four crews with one day off every four. 16 Physicist @ 100%							
6.3	DATA Cryo Target	$0	$0	$0	$0	$0	$0	$0
6.4	DATA NuMI Target Running	$0	$0	$0	$0	$0	$0	$0
	Operation of the experiment for a two week run with the NuMI target. Estimate Source: Physicist Estimate Basis: We assume operations are manned 24/7 in three shifts, with four people per shift. We also assume four crews with one day off every four. 16 Physicist @ 100%							
6.5	Data Collection Complete	$0	$0	$0	$0	$0	$0	$0

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
7	**Core Analysis**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
	Process all data to (a) assess and correct for the effects of detector and system calibrations, (b) compute 4-vectors for all tracks, (c) determine resolution functions, and (d) quantify systematic errors.							
7.1	**Analysis Development**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
	Development of subsystem analysis packages.							
7.1.1	UBL Analysis Development	$0	$0	$0	$0	$0	$0	$0
	Development of UBL analysis package. Estimate Source: Physicist Estimate Basis: We assume one physicist needs two months to develop the code. 1 Physicist @ 100%							
7.1.2	TRD Analysis Development	$0	$0	$0	$0	$0	$0	$0
	Development of TRD analysis package. Estimate Source: Physicist Estimate Basis: We assume one physicist needs two months to develop the code. 1 Physicist @ 100%							
7.1.3	TPC Analysis Development	$0	$0	$0	$0	$0	$0	$0
	Development of TPC analysis package. Estimate Source: Physicist Estimate Basis: We assume one physicist needs four months to develop the code. 1 Physicist @ 100%							
7.1.4	JGG Analysis Development	$0	$0	$0	$0	$0	$0	$0
	Development of JGG analysis package. Estimate Source: Physicist Estimate Basis: We assume one physicist needs two months to develop the code. 1 Physicist @ 100%							
7.1.5	CKOV Analysis Development	$0	$0	$0	$0	$0	$0	$0
	Development of CKOV analysis package. Estimate Source: Physicist Estimate Basis: We assume one physicist needs two months to develop the code. 1 Physicist @ 100%							
7.1.6	TOF Analysis Development	$0	$0	$0	$0	$0	$0	$0
	Development of TOF analysis package. Estimate Source: Physicist Estimate Basis: We assume one physicist needs two months to develop the code. 1 Physicist @ 100%							
7.1.7	TPL-B Analysis Development	$0	$0	$0	$0	$0	$0	$0
	Development of TPL-B analysis package. Estimate Source: Physicist Estimate Basis: We assume one physicist needs two months to develop the code. 1 Physicist @ 100%							
7.1.8	RICH Analysis Development	$0	$0	$0	$0	$0	$0	$0
	Development of RICH analysis package. Estimate Source: Physicist							

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
"RICH Analysis Development" continued								
	Estimate Basis: We assume one physicist needs two months to develop the code. 1 Physicist @ 100%							
7.1.9	DC Analysis Development	$0	$0	$0	$0	$0	$0	$0
	Development of DC analysis package. Estimate Source: Physicist Estimate Basis: We assume one physicist needs two months to develop the code. 1 Physicist @ 100%							
7.1.10	NCAL Analysis Development	$0	$0	$0	$0	$0	$0	$0
	Development of NCAL analysis package. Estimate Source: Physicist Estimate Basis: We assume one physicist needs two months to develop the code. 1 Physicist @ 100%							
7.1.11	TRG/DAQ Analysis Development	$0	$0	$0	$0	$0	$0	$0
	Development of TRG/DAQ analysis package. Estimate Source: Physicist Estimate Basis: We assume one physicist needs two months to develop the code. 1 Physicist @ 100%							
7.2	**Tracking & PID Integration**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
	Integration of subsystem analysis packages to enable track matching, global fitting, and particle ID.							
7.2.1	UBL-TGT-TRD-TPC Tracking	$0	$0	$0	$0	$0	$0	$0
	Development of UBL-TGT-TRD-TPC integrated analysis. Estimate Source: Physicist Estimate Basis: We assume two physicists need one month to develop the code. 2 Physicist @ 100%							
7.2.2	TPC-CKOV Tracking & PID	$0	$0	$0	$0	$0	$0	$0
	Development of TPC-CKOV integrated analysis. Estimate Source: Physicist Estimate Basis: We assume two physicists need one month to develop the code. 2 Physicist @ 100%							
7.2.3	CKOV-TOF Tracking & PID	$0	$0	$0	$0	$0	$0	$0
	Development of CKOV-TOF integrated analysis. Estimate Source: Physicist Estimate Basis: We assume two physicists need one month to develop the code. 2 Physicist @ 100%							
7.2.4	TOF-RICH Tracking & PID	$0	$0	$0	$0	$0	$0	$0
	Development of TOF-RICH integrated analysis. Estimate Source: Physicist Estimate Basis: We assume two physicists need one month to develop the code. 2 Physicist @ 100%							
7.2.5	RICH-NCAL Tracking	$0	$0	$0	$0	$0	$0	$0
	Development of RICH-NCAL integrated analysis. Estimate Source: Physicist							

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
"RICH-NCAL Tracking" continued								

Estimate Basis:
We assume two physicists need one month to develop the code.

2 Physicist @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
7.3	Core Analysis Production	$0	$0	$0	$0	$0	$0	$0

Production analysis pass through all data, producing four vector momenta and particle ID for all tracks.

Estimate Source: Physicist

Estimate Basis:
We assume one physicist will need two months to pass all data through the core analysis.

1 Physicist @ 100%

WBS	Task Name	EDIA	Labor	M&S	Total Cost	Baseline	To Date	Remaining
8	Project Management	$0	$0	$0	$0	$0	$0	$0

Project management for the construction of E907.

Estimate Source: Physicist

Estimate Basis:
We assume one physicist will need one week per month to track the project development during the construction year.

1 Physicist @ 25%

Appendix B. Effort Estimate

WBS effort, broken down into Physicists, Engineers, and Technicians. Durations in weeks; effort in manweeks.

WBS	Task Name	Duration	Physicist	Engineer	Technician
	E907	**239 wks**	**811.89**	**107.8**	**331.25**
1	Experiment Design	50 wks	50	0	0
2	**Meson Detector Building (MDB) I**	**20.6 wks**	**0**	**1**	**28.8**
2.1	MDB Preparation Planning	1 wk	0	1	0
2.2	MC6 Clear Storage from Top of Pil	3 wks	0	0	15
2.3	**Open and Clear Pretarget Enclos**	**7.6 wks**	**0**	**0**	**12**
2.3.1	PTE Remove Concrete Lid Blocks	3 wks	0	0	0
2.3.2	PTE Remove Steel Lid	1 wk	0	0	0
2.3.3	PTE Remove Steel Side Walls	1 wk	0	0	5
2.3.4	PTE Disconnect Magnets	2 wks	0	0	4
2.3.5	PTE Remove Magnets	3 days	0	0	3
2.4	**Open and Clear Target Pile (TP)**	**4.6 wks**	**0**	**0**	**1.8**
2.4.1	TP Remove Concrete Lid Blocks	2 wks	0	0	0
2.4.2	TP Remove Steel Plugs	1 wk	0	0	0
2.4.3	TP Remove Downstream Concrete	1 wk	0	0	0
2.4.4	TP Disconnect Magnet	2 days	0	0	0.8
2.4.5	TP Remove Magnet	1 day	0	0	1
3	**E907 Beamline (BEAM) in MC6**	**31.6 wks**	**5**	**8**	**21**
3.1	BEAM Optics and Mechanical Desi	8 wks	4	8	0
3.2	**BEAM Magnet Installation**	**6 wks**	**1**	**0**	**12**
3.2.1	BEAM Install 3 Dipoles	3 wks	0	0	6
3.2.2	BEAM Install 4 Quadrupoles	2 wks	0	0	4
3.2.3	BEAM Survey	1 wk	1	0	2
3.3	**Close Pretarget Enclosure**	**6 wks**	**0**	**0**	**9**
3.3.1	PTE Replace Steel Side Walls	1 wk	0	0	5
3.3.2	PTE Remove T-Block Lower Steel	1 wk	0	0	4
3.3.3	PTE Replace Steel Lid	1 wk	0	0	0
3.3.4	PTE Replace Concrete Lid Blocks	3 wks	0	0	0
3.4	**Close Target Pile**	**8 wks**	**0**	**0**	**0**
3.4.1	TP Replace Downstream Concrete	1 wk	0	0	0
3.4.2	TP Replace Steel Plugs	1 wk	0	0	0
3.4.3	TP Replace Concrete Lid Blocks	2 wks	0	0	0
4	**Meson Worm (MC7) Preparation**	**61.8 wks**	**0**	**9**	**48**
4.1	**Remove or Stage HyperCP Detec**	**4.4 wks**	**0**	**0**	**6.8**
4.1.1	MC7 Remove 9 PWC	2 wks	0	0	4
4.1.2	MC7 Remove Muon Arms	2 wks	0	0	2
4.1.3	MC7 Remove 2 HODO	2 days	0	0	0.8
4.2	**Remove BM109 Magnets**	**3.4 wks**	**0**	**0**	**5.8**
4.2.1	MC7 Disconnect BM109 Magnets	1 wk	0	0	1
4.2.2	MC7 Prep Outside Area for Crane	1 wk	0	0	3
4.2.3	MC7 Remove Utilities	1 wk	0	0	1
4.2.4	MC7 Open Worm US	2 days	0	0	0.8
4.2.5	MC7 Rig Out BM109 Magnets	1 wk	0	0	0
4.3	**Close MC7 Worm US**	**3 wks**	**0**	**0**	**8**
4.3.1	MC7 US Replace Panels and Insul	1 wk	0	0	2
4.3.2	MC7 US Restore Utilities	2 wks	0	0	6
4.4	**MBottom Shoring**	**10 wks**	**0**	**9**	**24**
4.4.1	MB Shoring Engineering & Design	6 wks	0	9	0
4.4.2	MB Shoring Fabrication	3 wks	0	0	9
4.4.3	MB Shoring Installation	3 wks	0	0	15
4.4.4	MC Slab	1 wk	0	0	0
4.5	**MC7 DS Roof**	**9.6 wks**	**0**	**0**	**3.4**
4.5.1	MC7 Temporary Wall	5 days	0	0	0
4.5.2	MC7 Remove DS Roof	7 days	0	0	1.4
4.5.3	MC7 Replace DS Roof	2 wks	0	0	2
4.6	MC7 Magnet Primary Power	4 wks	0	0	0

WBS	Task Name	Duration	Physicist	Engineer	Technician
5	**E907 Experiment (in MC7)**	**193 wks**	**106.89**	**89.8**	**233.45**
5.1	MC7 Design	4 wks	0	6.8	0
5.2	**Upstream Beamline Detectors (U**	**23.8 wks**	**5**	**4**	**26**
5.2.1	UBL Design	4 wks	1	4	0
5.2.2	UBL Secondary Production Target	4 wks	0	0	8
5.2.3	UBL Tracking Chamber Refurbishn	4 wks	0	0	4
5.2.4	UBL Cerenkov (BCKV) Fabrication	4 wks	0	0	8
5.2.5	**UBL Installation**	**2 wks**	**4**	**0**	**6**
5.2.5.1	UBL Pretarget Enclosure Detectors	2 wks	2	0	4
5.2.5.2	UBL Target Pile Detectors Installati	2 wks	2	0	2
5.3	**Jolly Green Giant (JGG)**	**75 wks**	**1**	**7**	**5.5**
5.3.1	JGG Move & Installation Design	4 wks	1	5	0
5.3.2	JGG Replacement Coil	20 wks	0	2	0
5.3.3	JGG Assembly	5 days	0	0	1
5.3.4	JGG Connections	1 wk	0	0	4.5
5.4	**Rosie Magnet (Rosie)**	**40.8 wks**	**1**	**5**	**5.3**
5.4.1	Rosie Move & Installation Design	4 wks	1	5	0
5.4.2	Rosie Assembly	4 days	0	0	0.8
5.4.3	Rosie Connections	1 wk	0	0	4.5
5.5	**Differential Cerenkov (CKOV)**	**90.4 wks**	**2.4**	**8**	**23.2**
5.5.1	CKOV Move	1 wk	0	0	2
5.5.2	CKOV Chamber Move & Installatio	2 wks	0.5	1	0
5.5.3	CKOV Equipment Installation Desi	2 wks	0.5	3	0
5.5.4	CKOV Undercarriage Fabrication	4 wks	0	2	8
5.5.5	CKOV Freon Recovery Fabrication	4 wks	0	2	8
5.5.6	CKOV Locate in Position	2 days	0.4	0	1.2
5.5.7	CKOV Align Mirrors	1 wk	1	0	0
5.5.8	CKOV Connections	2 wks	0	0	4
5.6	Magnets & CKOV in MC7	0.2 wks	0	0	0
5.7	**Experimental Targets (ETGT)**	**46.8 wks**	**4**	**7**	**20**
5.7.1	**Target Wheel (TGTW)**	**10 wks**	**1**	**1**	**3**
5.7.1.1	TGTW Design	5 days	1	1	0
5.7.1.2	TGTW Fabrication	2 wks	0	0	2
5.7.1.3	TGTW Installation	1 wk	0	0	1
5.7.2	**Cryogenic Target (CTGT)**	**12 wks**	**2**	**4**	**12**
5.7.2.1	CTGT Design	4 wks	2	4	0
5.7.2.2	CTGT Fabrication	4 wks	0	0	8
5.7.2.3	CTGT Installation	2 wks	0	0	4
5.7.3	**NuMI Target Sample (NTGT)**	**7 wks**	**1**	**2**	**5**
5.7.3.1	NTGT Design	2 wks	1	2	0
5.7.3.2	NTGT Fabrication	4 wks	0	0	4
5.7.3.3	NTGT Installation	1 wk	0	0	1
5.8	**Target Recoil Detector (TRD)**	**16 wks**	**16**	**16**	**24**
5.8.1	TRD Design	8 wks	8	16	0
5.8.2	TRD Fabrication	4 wks	4	0	12
5.8.3	TRD Installation	4 wks	4	0	12
5.9	**Time Projection Chamber (TPC)**	**152.2 wks**	**12.24**	**6**	**15**
5.9.1	**TPC Move to FNAL**	**5.4 wks**	**0**	**0**	**2**
5.9.1.1	TPC Move Shipping Container	1 wk	0	0	2
5.9.1.2	TPC Move Transportation	1 wk	0	0	0
5.9.2	TPC Assess Condition	1 wk	4	0	1
5.9.3	**TPC Test in Mtest**	**20 wks**	**3.24**	**0**	**4**
5.9.3.1	TPC MTest Installation	4 mons	3.2	0	4
5.9.3.2	TPC Mtest Testing	4 wks	0.04	0	0
5.9.4	TPC Installation Design	4 wks	1	6	0
5.9.5	TPC Installation	4 wks	4	0	8

WBS	Task Name	Duration	Physicist	Engineer	Technician
5.10	**Time-of-Flight (TOF)**	**36.8 wks**	**14**	**6**	**24**
5.10.1	TOF Design	4 wks	4	6	4
5.10.2	TOF Fabrication	4 wks	4	0	8
5.10.3	TOF Installation	6 wks	6	0	12
5.11	**Ring Imaging Cerenkov (RICH)**	**87.4 wks**	**11.75**	**8**	**25.45**
5.11.1	RICH Installation Design	4 wks	1	8	0
5.11.2	**RICH Extraction from PC4**	**3.4 wks**	**0.5**	**0**	**7.6**
5.11.2.1	RICH Remove PMTs	2 wks	0	0	2
5.11.2.2	RICH Open End Flanges	2 days	0	0	1.6
5.11.2.3	RICH Remove Mirrors	1 wk	0.25	0	2
5.11.2.4	RICH Disconnect Support Equipme	1 wk	0.25	0	2
5.11.3	RICH Position Tank in MC7	1 day	0	0	0.8
5.11.4	RICH Install Mirrors	1 wk	0.5	0	2.25
5.11.5	RICH Close End Flanges	3 days	0	0	1.8
5.11.6	RICH Install Support Equipment	2 wks	0.5	0	4
5.11.7	RICH Gas Clean & FIll	1 wk	0.25	0	1
5.11.8	RICH Purchase PMTs	0.2 wks	0	0	0
5.11.9	RICH Install PMTs	2 wks	1	0	4
5.11.10	RICH Front End Electronics	6 wks	6	0	0
5.11.11	RICH Install Electronics	2 wks	2	0	4
5.12	**Drift Chambers (DC)**	**48.8 wks**	**1.5**	**3**	**31**
5.12.1	DC Move & Installation Design	6 wks	1.5	3	3
5.12.2	DC Move	4 wks	0	0	8
5.12.3	DC Parts Fabrication	6 wks	0	0	12
5.12.4	DC Installation	4 wks	0	0	8
5.13	**Neutral Calorimeter (NCAL)**	**19 wks**	**4**	**5**	**16**
5.13.1	NCAL Design	4 wks	4	5	0
5.13.2	NCAL Fabrication	4 wks	0	0	8
5.13.3	NCAL Installation	4 wks	0	0	8
5.14	**Trigger (TRG)**	**10 wks**	**10**	**4**	**6**
5.14.1	TRG Design	4 wks	4	4	0
5.14.2	TRG Fabrication	4 wks	4	0	4
5.14.3	TRG Installation	2 wks	2	0	2
5.15	**Data Acquisition (DAQ)**	**16 wks**	**24**	**4**	**12**
5.15.1	DAQ Design	4 wks	4	4	0
5.15.2	DAQ Fabrication	8 wks	16	0	8
5.15.3	DAQ Installation	4 wks	4	0	4
6	**Data Taking (DATA)**	**38 wks**	**480**	**0**	**0**
6.1	DATA Engineering Run	2 wks	32	0	0
6.2	DATA 1% Targets	14 wks	224	0	0
6.3	DATA Cryo Target	12 wks	192	0	0
6.4	DATA NuMI Target Running	2 wks	32	0	0
6.5	Data Collection Complete	0 wks	0	0	0
7	**Core Analysis**	**36 wks**	**144**	**0**	**0**
7.1	**Analysis Development**	**16 wks**	**96**	**0**	**0**
7.1.1	UBL Analysis Development	8 wks	8	0	0
7.1.2	TRD Analysis Development	8 wks	8	0	0
7.1.3	TPC Analysis Development	16 wks	16	0	0
7.1.4	JGG Analysis Development	8 wks	8	0	0
7.1.5	CKOV Analysis Development	8 wks	8	0	0
7.1.6	TOF Analysis Development	8 wks	8	0	0
7.1.7	TPL-B Analysis Development	8 wks	8	0	0
7.1.8	RICH Analysis Development	8 wks	8	0	0
7.1.9	DC Analysis Development	8 wks	8	0	0
7.1.10	NCAL Analysis Development	8 wks	8	0	0
7.1.11	TRG/DAQ Analysis Development	8 wks	8	0	0

WBS	Task Name	Duration	Physicist	Engineer	Technician
7.2	**Tracking & PID Integration**	**12 wks**	**40**	**0**	**0**
7.2.1	UBL-TGT-TRD-TPC Tracking	4 wks	8	0	0
7.2.2	TPC-CKOV Tracking & PID	4 wks	8	0	0
7.2.3	CKOV-TOF Tracking & PID	4 wks	8	0	0
7.2.4	TOF-RICH Tracking & PID	4 wks	8	0	0
7.2.5	RICH-NCAL Tracking	4 wks	8	0	0
7.3	Core Analysis Production	8 wks	8	0	0
8	Project Management	104 wks	26	0	0

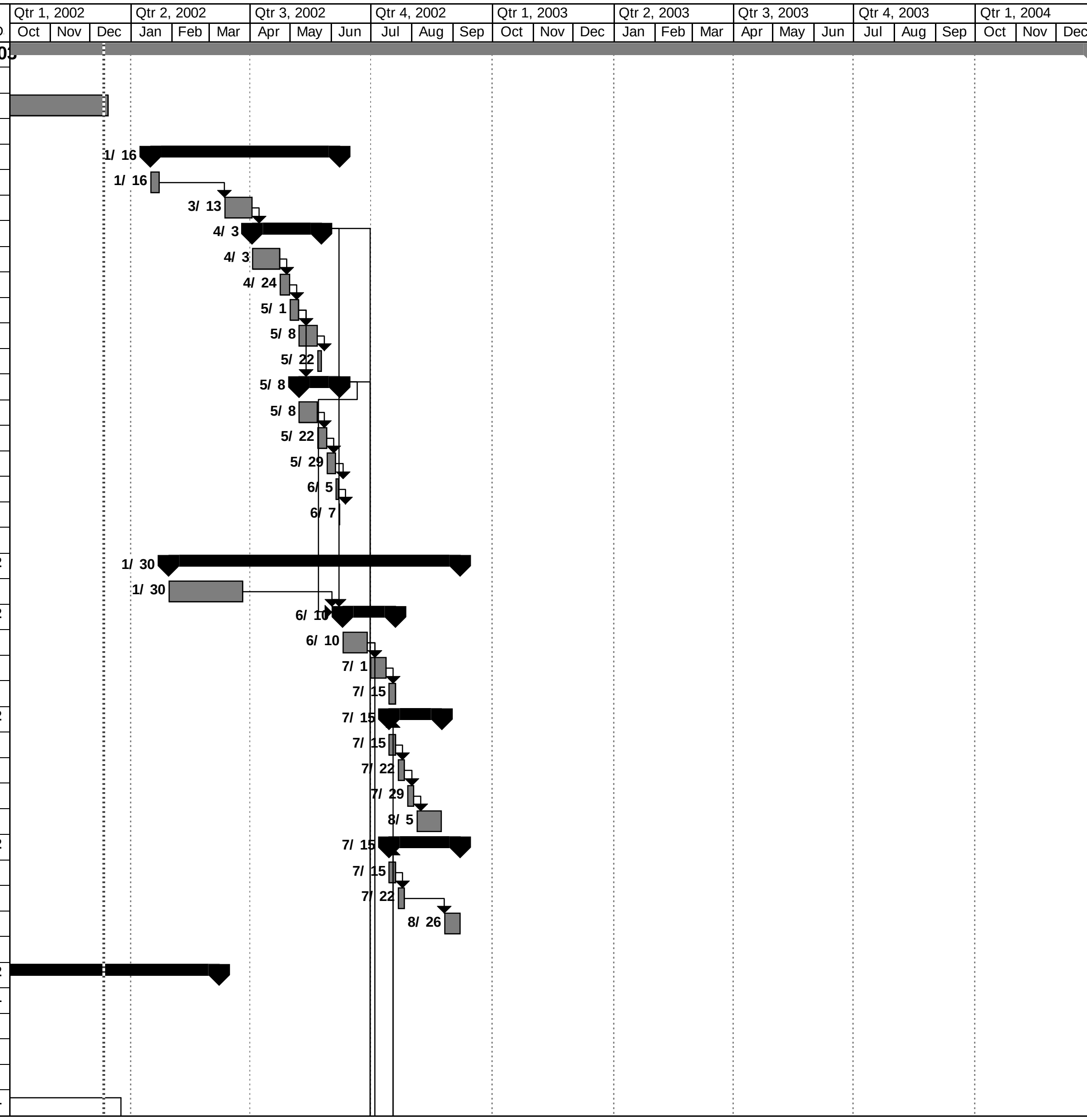
Appendix C. Schedule

WBS Schedule, limited to FY01–FY03.

Fermilab E907
Schedule

Version 1.0
12/11/01

WBS	Task Name	Start	Duration	Finish	Milestone D
	E907	**6/ 1/ 99**	**239 wks**	**12/ 29/ 03**	**12/ 29/ 03**
1	Experiment Design	1/1/01	50 wks	12/14/01	12/29/03
2	**Meson Detector Building (MDB) I**	**1/ 16/ 02**	**20.6 wks**	**6/ 7/ 02**	**7/ 1/ 02**
2.1	MDB Preparation Planning	1/16/02	1 wk	1/22/02	1/22/02
2.2	MC6 Clear Storage from Top (	3/13/02	3 wks	4/2/02	4/2/02
2.3	**Open and Clear Pretarget Er**	**4/ 3/ 02**	**7.6 wks**	**5/ 24/ 02**	**6/ 7/ 02**
2.3.1	PTE Remove Concrete Li	4/3/02	3 wks	4/23/02	4/23/02
2.3.2	PTE Remove Steel Lid	4/24/02	1 wk	4/30/02	4/30/02
2.3.3	PTE Remove Steel Side '	5/1/02	1 wk	5/7/02	5/7/02
2.3.4	PTE Disconnect Magnets	5/8/02	2 wks	5/21/02	5/21/02
2.3.5	PTE Remove Magnets	5/22/02	3 days	5/24/02	7/1/02
2.4	**Open and Clear Target Pile (**	**5/ 8/ 02**	**4.6 wks**	**6/ 7/ 02**	**6/ 7/ 02**
2.4.1	TP Remove Concrete Lid	5/8/02	2 wks	5/21/02	5/21/02
2.4.2	TP Remove Steel Plugs	5/22/02	1 wk	5/28/02	5/28/02
2.4.3	TP Remove Downstream	5/29/02	1 wk	6/4/02	6/4/02
2.4.4	TP Disconnect Magnet	6/5/02	2 days	6/6/02	6/6/02
2.4.5	TP Remove Magnet	6/7/02	1 day	6/7/02	7/1/02
3	**E907 Beamline (BEAM) in MC6**	**1/ 30/ 02**	**31.6 wks**	**9/ 6/ 02**	**9/ 30/ 02**
3.1	BEAM Optics and Mechanical	1/30/02	8 wks	3/26/02	6/7/02
3.2	**BEAM Magnet Installation**	**6/ 10/ 02**	**6 wks**	**7/ 19/ 02**	**8/ 12/ 02**
3.2.1	BEAM Install 3 Dipoles	6/10/02	3 wks	6/28/02	6/28/02
3.2.2	BEAM Install 4 Quadrupo	7/1/02	2 wks	7/12/02	7/12/02
3.2.3	BEAM Survey	7/15/02	1 wk	7/19/02	9/30/02
3.3	**Close Pretarget Enclosure**	**7/ 15/ 02**	**6 wks**	**8/ 23/ 02**	**9/ 30/ 02**
3.3.1	PTE Replace Steel Side '	7/15/02	1 wk	7/19/02	7/19/02
3.3.2	PTE Remove T-Block Lov	7/22/02	1 wk	7/26/02	7/26/02
3.3.3	PTE Replace Steel Lid	7/29/02	1 wk	8/2/02	8/2/02
3.3.4	PTE Replace Concrete Li	8/5/02	3 wks	8/23/02	9/30/02
3.4	**Close Target Pile**	**7/ 15/ 02**	**8 wks**	**9/ 6/ 02**	**9/ 30/ 02**
3.4.1	TP Replace Downstream	7/15/02	1 wk	7/19/02	7/19/02
3.4.2	TP Replace Steel Plugs	7/22/02	1 wk	7/26/02	7/26/02
3.4.3	TP Replace Concrete Lid	8/26/02	2 wks	9/6/02	9/30/02
4	**Meson Worm (MC7) Preparation**	**1/ 2/ 01**	**61.8 wks**	**3/ 8/ 02**	**9/ 30/ 02**
4.1	**Remove or Stage HyperCP D**	**1/ 2/ 01**	**4.4 wks**	**1/ 31/ 01**	**1/ 31/ 01**
4.1.1	MC7 Remove 9 PWC	1/2/01	2 wks	1/15/01	1/15/01
4.1.2	MC7 Remove Muon Arms	1/16/01	2 wks	1/29/01	1/29/01
4.1.3	MC7 Remove 2 HODO	1/30/01	2 days	1/31/01	1/31/01
4.2	**Remove BM109 Magnets**	**2/ 1/ 01**	**3.4 wks**	**2/ 23/ 01**	**2/ 23/ 01**

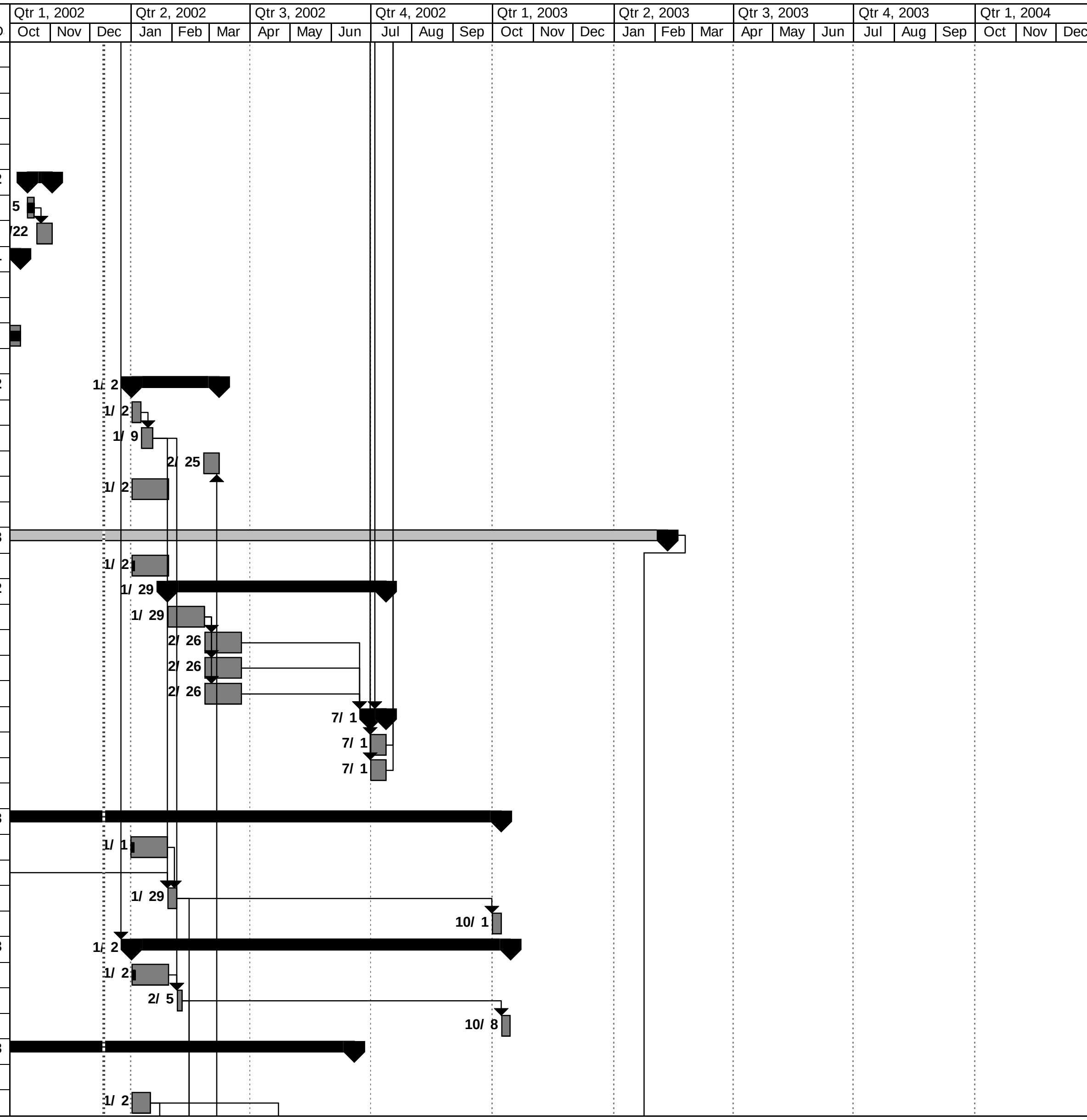


Task		Milestone		Rolled Up Task		Rolled Up Progress		Project Summary	
Critical Task		Summary		Rolled Up Critical Task		Split		Group By Summary	
Progress		Critical Summary		Rolled Up Milestone		External Tasks			

Fermilab E907
Schedule

Version 1.0
12/11/01

WBS	Task Name	Start	Duration	Finish	Milestone D
4.2.1	MC7 Disconnect BM109 I	2/1/01	1 wk	2/7/01	2/7/01
4.2.2	MC7 Prep Outside Area f	2/1/01	1 wk	2/7/01	2/7/01
4.2.3	MC7 Remove Utilities	2/8/01	1 wk	2/14/01	2/14/01
4.2.4	MC7 Open Worm US	2/15/01	2 days	2/16/01	2/16/01
4.2.5	MC7 Rig Out BM109 Mag	2/19/01	1 wk	2/23/01	2/23/01
4.3	**Close MC7 Worm US**	**10/ 15/ 01**	**3 wks**	**11/ 2/ 01**	**9/ 30/ 02**
4.3.1	MC7 US Replace Panels	10/15/01	1 wk	10/19/01	10/19/01
4.3.2	MC7 US Restore Utilities	10/22/01	2 wks	11/2/01	9/30/02
4.4	**MBottom Shoring**	**8/ 1/ 01**	**10 wks**	**10/ 9/ 01**	**10/ 9/ 01**
4.4.1	MB Shoring Engineering	8/1/01	6 wks	9/11/01	9/11/01
4.4.2	MB Shoring Fabrication	9/5/01	3 wks	9/25/01	9/25/01
4.4.3	MB Shoring Installation	9/19/01	3 wks	10/9/01	10/9/01
4.4.4	MC Slab	9/17/01	1 wk	9/21/01	9/21/01
4.5	**MC7 DS Roof**	**1/ 2/ 02**	**9.6 wks**	**3/ 8/ 02**	**8/ 29/ 02**
4.5.1	MC7 Temporary Wall	1/2/02	5 days	1/8/02	1/8/02
4.5.2	MC7 Remove DS Roof	1/9/02	7 days	1/17/02	1/28/02
4.5.3	MC7 Replace DS Roof	2/25/02	2 wks	3/8/02	9/30/02
4.6	MC7 Magnet Primary Power	1/2/02	4 wks	1/29/02	9/30/02
5	**E907 Experiment (in MC7)**	**6/ 1/ 99**	**193 wks**	**2/ 10/ 03**	**2/ 10/ 03**
5.1	MC7 Design	1/2/02	4 wks	1/29/02	2/10/03
5.2	**Upstream Beamline Detector**	**1/ 29/ 02**	**23.8 wks**	**7/ 12/ 02**	**8/ 19/ 02**
5.2.1	UBL Design	1/29/02	4 wks	2/25/02	2/25/02
5.2.2	UBL Secondary Producti	2/26/02	4 wks	3/25/02	6/28/02
5.2.3	UBL Tracking Chamber F	2/26/02	4 wks	3/25/02	6/28/02
5.2.4	UBL Cerenkov (BCKV) Fa	2/26/02	4 wks	3/25/02	6/28/02
5.2.5	**UBL Installation**	**7/ 1/ 02**	**2 wks**	**7/ 12/ 02**	**8/ 5/ 02**
5.2.5.1	UBL Pretarget Enclo	7/1/02	2 wks	7/12/02	7/12/02
5.2.5.2	UBL Target Pile Det	7/1/02	2 wks	7/12/02	7/12/02
5.3	**Jolly Green Giant (JGG)**	**5/ 1/ 01**	**75 wks**	**10/ 7/ 02**	**2/ 10/ 03**
5.3.1	JGG Move & Installation	1/1/02	4 wks	1/28/02	1/28/02
5.3.2	JGG Replacement Coil	5/1/01	20 wks	9/17/01	9/17/01
5.3.3	JGG Assembly	1/29/02	5 days	2/4/02	2/21/02
5.3.4	JGG Connections	10/1/02	1 wk	10/7/02	2/10/03
5.4	**Rosie Magnet (Rosie)**	**1/ 2/ 02**	**40.8 wks**	**10/ 14/ 02**	**2/ 10/ 03**
5.4.1	Rosie Move & Installation	1/2/02	4 wks	1/29/02	1/29/02
5.4.2	Rosie Assembly	2/5/02	4 days	2/8/02	2/21/02
5.4.3	Rosie Connections	10/8/02	1 wk	10/14/02	2/10/03
5.5	**Differential Cerenkov (CKOV**	**9/ 25/ 00**	**90.4 wks**	**6/ 18/ 02**	**2/ 10/ 03**
5.5.1	CKOV Move	9/25/00	1 wk	9/29/00	9/29/00
5.5.2	CKOV Chamber Move &	1/2/02	2 wks	1/15/02	1/15/02



Task | Milestone | Rolled Up Task | Rolled Up Progress | Project Summary
Critical Task | Summary | Rolled Up Critical Task | Split | Group By Summary
Progress | Critical Summary | Rolled Up Milestone | External Tasks

Fermilab E907
Schedule

Version 1.0
12/11/01

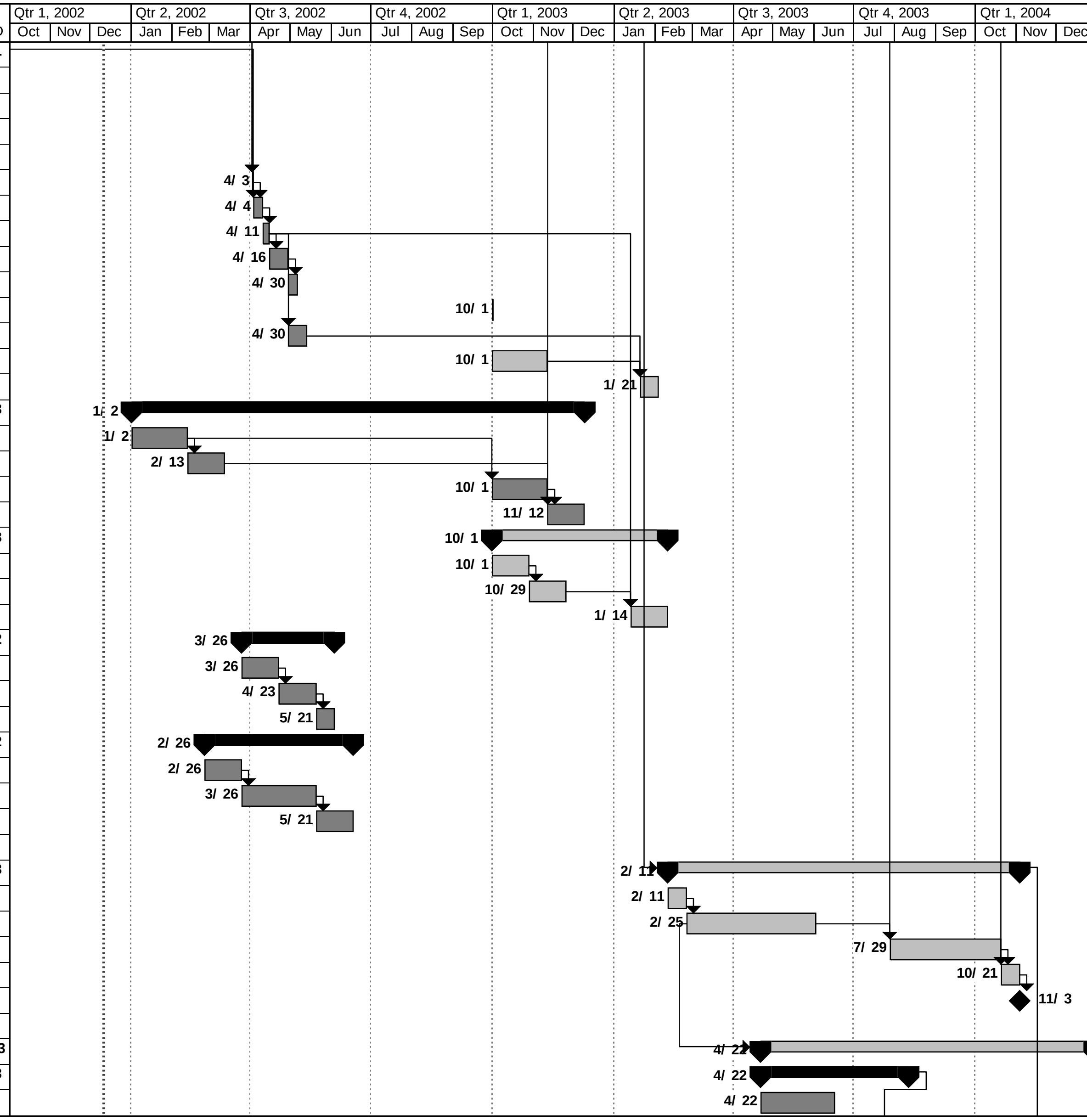
WBS	Task Name	Start	Duration	Finish	Milestone D
5.5.3	CKOV Equipment Installa	4/23/02	2 wks	5/6/02	5/6/02
5.5.4	CKOV Undercarriage Fal	1/23/02	4 wks	2/19/02	2/19/02
5.5.5	CKOV Freon Recovery F	5/8/02	4 wks	6/4/02	6/4/02
5.5.6	CKOV Locate in Position	2/20/02	2 days	2/21/02	2/21/02
5.5.7	CKOV Align Mirrors	2/22/02	1 wk	2/28/02	6/4/02
5.5.8	CKOV Connections	6/5/02	2 wks	6/18/02	2/10/03
5.6	Magnets & CKOV in MC7	2/22/02	0.2 wks	2/22/02	2/22/02
5.7	**Experimental Targets (ETGT**	**2/ 27/ 02**	**46.8 wks**	**1/ 20/ 03**	**2/ 10/ 03**
5.7.1	**Target Wheel (TGTW)**	**2/ 27/ 02**	**10 wks**	**5/ 7/ 02**	**9/ 30/ 02**
5.7.1.1	TGTW Design	2/27/02	5 days	3/5/02	3/5/02
5.7.1.2	TGTW Fabrication	3/14/02	2 wks	3/27/02	4/30/02
5.7.1.3	TGTW Installation	5/1/02	1 wk	5/7/02	9/30/02
5.7.2	**Cryogenic Target (CTG**	**10/ 29/ 02**	**12 wks**	**1/ 20/ 03**	**2/ 10/ 03**
5.7.2.1	CTGT Design	10/29/02	4 wks	11/25/02	11/25/02
5.7.2.2	CTGT Fabrication	12/10/02	4 wks	1/6/03	1/6/03
5.7.2.3	CTGT Installation	1/7/03	2 wks	1/20/03	2/10/03
5.7.3	**NuMI Target Sample (N**	**11/ 26/ 02**	**7 wks**	**1/ 13/ 03**	**2/ 10/ 03**
5.7.3.1	NTGT Design	11/26/02	2 wks	12/9/02	12/9/02
5.7.3.2	NTGT Fabrication	12/10/02	4 wks	1/6/03	1/6/03
5.7.3.3	NTGT Installation	1/7/03	1 wk	1/13/03	2/10/03
5.8	**Target Recoil Detector (TRD**	**10/ 1/ 02**	**16 wks**	**1/ 20/ 03**	**2/ 10/ 03**
5.8.1	TRD Design	10/1/02	8 wks	11/25/02	11/25/02
5.8.2	TRD Fabrication	11/26/02	4 wks	12/23/02	12/23/02
5.8.3	TRD Installation	12/24/02	4 wks	1/20/03	2/10/03
5.9	**Time Projection Chamber (T**	**6/ 1/ 99**	**152.2 wks**	**4/ 30/ 02**	**9/ 23/ 02**
5.9.1	**TPC Move to FNAL**	**6/ 1/ 99**	**5.4 wks**	**7/ 7/ 99**	**7/ 7/ 99**
5.9.1.1	TPC Move Shipping	6/1/99	1 wk	6/7/99	6/7/99
5.9.1.2	TPC Move Transpor	7/1/99	1 wk	7/7/99	7/7/99
5.9.2	TPC Assess Condition	7/25/00	1 wk	7/31/00	7/31/00
5.9.3	**TPC Test in Mtest**	**6/ 1/ 01**	**20 wks**	**10/ 18/ 01**	**1/ 1/ 02**
5.9.3.1	TPC MTest Installati	6/1/01	4 mons	9/20/01	9/20/01
5.9.3.2	TPC Mtest Testing	9/21/01	4 wks	10/18/01	4/2/02
5.9.4	TPC Installation Design	3/6/02	4 wks	4/2/02	4/2/02
5.9.5	TPC Installation	4/3/02	4 wks	4/30/02	4/30/02
5.10	**Time-of-Flight (TOF)**	**3/ 27/ 02**	**36.8 wks**	**12/ 9/ 02**	**2/ 10/ 03**
5.10.1	TOF Design	3/27/02	4 wks	4/23/02	9/30/02
5.10.2	TOF Fabrication	10/1/02	4 wks	10/28/02	10/28/02
5.10.3	TOF Installation	10/29/02	6 wks	12/9/02	2/10/03
5.11	**Ring Imaging Cerenkov (RIC**	**6/ 1/ 01**	**87.4 wks**	**2/ 3/ 03**	**2/ 10/ 03**
5.11.1	RICH Installation Design	1/30/02	4 wks	2/26/02	2/26/02

Task		Milestone		Rolled Up Task		Rolled Up Progress		Project Summary	
Critical Task		Summary		Rolled Up Critical Task		Split		Group By Summary	
Progress		Critical Summary		Rolled Up Milestone		External Tasks			

Fermilab E907
Schedule

Version 1.0
12/11/01

WBS	Task Name	Start	Duration	Finish	Milestone D
5.11.2	**RICH Extraction from P**	**6/ 1/ 01**	**3.4 wks**	**6/ 25/ 01**	**6/ 25/ 01**
5.11.2.1	RICH Remove PMTs	6/1/01	2 wks	6/14/01	6/14/01
5.11.2.2	RICH Open End Fla	6/15/01	2 days	6/18/01	6/18/01
5.11.2.3	RICH Remove Mirro	6/19/01	1 wk	6/25/01	6/25/01
5.11.2.4	RICH Disconnect Su	6/1/01	1 wk	6/7/01	6/7/01
5.11.3	RICH Position Tank in M(	4/3/02	1 day	4/3/02	4/3/02
5.11.4	RICH Install Mirrors	4/4/02	1 wk	4/10/02	4/10/02
5.11.5	RICH Close End Flanges	4/11/02	3 days	4/15/02	4/15/02
5.11.6	RICH Install Support Equ	4/16/02	2 wks	4/29/02	4/29/02
5.11.7	RICH Gas Clean & FIll	4/30/02	1 wk	5/6/02	9/30/02
5.11.8	RICH Purchase PMTs	10/1/02	0.2 wks	10/1/02	2/10/03
5.11.9	RICH Install PMTs	4/30/02	2 wks	5/13/02	11/11/02
5.11.10	RICH Front End Electron	10/1/02	6 wks	11/11/02	11/11/02
5.11.11	RICH Install Electronics	1/21/03	2 wks	2/3/03	2/10/03
5.12	**Drift Chambers (DC)**	**1/ 2/ 02**	**48.8 wks**	**12/ 9/ 02**	**2/ 10/ 03**
5.12.1	DC Move & Installation D	1/2/02	6 wks	2/12/02	2/12/02
5.12.2	DC Move	2/13/02	4 wks	3/12/02	9/30/02
5.12.3	DC Parts Fabrication	10/1/02	6 wks	11/11/02	11/11/02
5.12.4	DC Installation	11/12/02	4 wks	12/9/02	2/10/03
5.13	**Neutral Calorimeter (NCAL)**	**10/ 1/ 02**	**19 wks**	**2/ 10/ 03**	**2/ 10/ 03**
5.13.1	NCAL Design	10/1/02	4 wks	10/28/02	10/28/02
5.13.2	NCAL Fabrication	10/29/02	4 wks	11/25/02	11/25/02
5.13.3	NCAL Installation	1/14/03	4 wks	2/10/03	2/10/03
5.14	**Trigger (TRG)**	**3/ 26/ 02**	**10 wks**	**6/ 3/ 02**	**9/ 30/ 02**
5.14.1	TRG Design	3/26/02	4 wks	4/22/02	4/22/02
5.14.2	TRG Fabrication	4/23/02	4 wks	5/20/02	5/20/02
5.14.3	TRG Installation	5/21/02	2 wks	6/3/02	9/30/02
5.15	**Data Acquisition (DAQ)**	**2/ 26/ 02**	**16 wks**	**6/ 17/ 02**	**9/ 30/ 02**
5.15.1	DAQ Design	2/26/02	4 wks	3/25/02	3/25/02
5.15.2	DAQ Fabrication	3/26/02	8 wks	5/20/02	5/20/02
5.15.3	DAQ Installation	5/21/02	4 wks	6/17/02	9/30/02
6	**Data Taking (DATA)**	**2/ 11/ 03**	**38 wks**	**11/ 3/ 03**	**11/ 3/ 03**
6.1	DATA Engineering Run	2/11/03	2 wks	2/24/03	2/24/03
6.2	DATA 1% Targets	2/25/03	14 wks	6/2/03	6/2/03
6.3	DATA Cryo Target	7/29/03	12 wks	10/20/03	10/20/03
6.4	DATA NuMI Target Running	10/21/03	2 wks	11/3/03	11/3/03
6.5	Data Collection Complete	11/3/03	0 wks	11/3/03	11/3/03
7	**Core Analysis**	**4/ 22/ 03**	**36 wks**	**12/ 29/ 03**	**12/ 29/ 03**
7.1	**Analysis Development**	**4/ 22/ 03**	**16 wks**	**8/ 11/ 03**	**8/ 11/ 03**
7.1.1	UBL Analysis Developme	4/22/03	8 wks	6/16/03	10/6/03

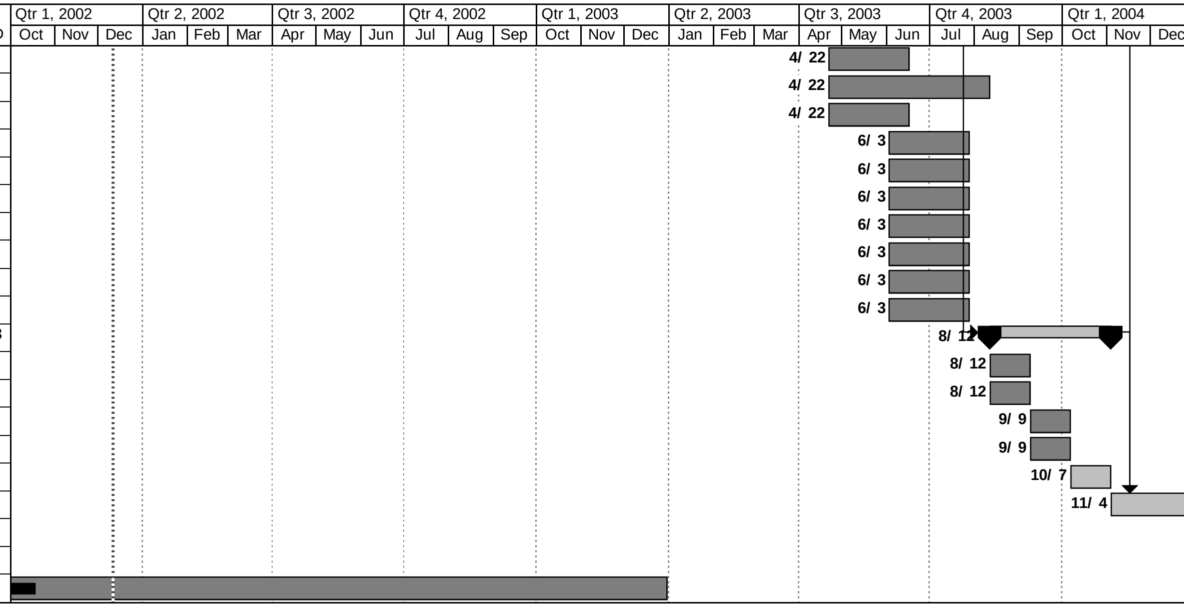


Task | Milestone | Rolled Up Task | Rolled Up Progress | Project Summary
Critical Task | Summary | Rolled Up Critical Task | Split | Group By Summary
Progress | Critical Summary | Rolled Up Milestone | External Tasks

Fermilab E907
Schedule

Version 1.0
12/11/01

WBS	Task Name	Start	Duration	Finish	Milestone D
7.1.2	TRD Analysis Developme	4/22/03	8 wks	6/16/03	10/6/03
7.1.3	TPC Analysis Developme	4/22/03	16 wks	8/11/03	10/6/03
7.1.4	JGG Analysis Developme	4/22/03	8 wks	6/16/03	10/6/03
7.1.5	CKOV Analysis Developn	6/3/03	8 wks	7/28/03	10/6/03
7.1.6	TOF Analysis Developme	6/3/03	8 wks	7/28/03	10/6/03
7.1.7	TPL-B Analysis Developn	6/3/03	8 wks	7/28/03	10/6/03
7.1.8	RICH Analysis Developm	6/3/03	8 wks	7/28/03	10/6/03
7.1.9	DC Analysis Developmen	6/3/03	8 wks	7/28/03	10/6/03
7.1.10	NCAL Analysis Developm	6/3/03	8 wks	7/28/03	10/6/03
7.1.11	TRG/DAQ Analysis Devel	6/3/03	8 wks	7/28/03	10/6/03
7.2	**Tracking & PID Integration**	**8/ 12/ 03**	**12 wks**	**11/ 3/ 03**	**11/ 3/ 03**
7.2.1	UBL-TGT-TRD-TPC Trac	8/12/03	4 wks	9/8/03	11/3/03
7.2.2	TPC-CKOV Tracking & P	8/12/03	4 wks	9/8/03	11/3/03
7.2.3	CKOV-TOF Tracking & P	9/9/03	4 wks	10/6/03	11/3/03
7.2.4	TOF-RICH Tracking & PI	9/9/03	4 wks	10/6/03	11/3/03
7.2.5	RICH-NCAL Tracking	10/7/03	4 wks	11/3/03	11/3/03
7.3	Core Analysis Production	11/4/03	8 wks	12/29/03	12/29/03
8	Project Management	1/2/01	104 wks	12/30/02	12/29/03



Task | Milestone | Rolled Up Task | Rolled Up Progress | Project Summary
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