

WBS	Name	Cost
1.2	Calorimeter Upgrades	\$956,607.00
1.2.1	Central Preshower	\$701,736.00

Notes

Summary task for the Central Preradiator detector

1.2.1.1	Research and Development	\$101,234.00
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ID	Resource Name	Units	Work	Delay	Start	Finish
2	FNALR&D	0%	0 hrs	0 days	Wed 5/1/02	Wed 5/1/02
4	Italy - In Kind	0%	0 hrs	0 mons	Wed 5/1/02	Wed 5/1/02
5	Japan - In Kind	0%	0 hrs	0 mons	Wed 5/1/02	Wed 5/1/02

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
2	FNALR&D	0%	\$55,672.00	\$0.00	\$0.00	\$55,672.00
4	Italy - In Kind	0%	\$18,000.00	\$0.00	\$0.00	\$18,000.00
5	Japan - In Kind	0%	\$27,562.00	\$0.00	\$0.00	\$27,562.00

Notes

WBS Definition-

Estimated costs of building prototype detectors and system tests.

Labor BOE-
N/A

M&S BOE-

U.S. \$55,672 combined R+D proposals from ANL and MSU to design and build prototype detectors.

Japan \$27,562 purchase of 20 multichannel phototubes for testing.

Italy \$18,000 purchase of scintillator and fibers for prototype detector tests

1.2.1.2	Procure parts	\$465,426.00
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Notes

Summary task for the procurement of all the parts needed for the detector

1.2.1.2.1	Phototubes and bases	\$264,250.00
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ID	Resource Name	Units	Work	Delay	Start	Finish
5	Japan - In Kind	0%	0 hrs	0 days	Sat 2/1/03	Sat 2/1/03

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
5	Japan - In Kind	0%	\$264,250.00	\$0.00	\$0.00	\$264,250.00

Notes

WBS Definition-

Procurement of 220 multichannel phototubes and bases from Hamamatsu.

Labor BOE-
N/A

M&S BOE-

WBS	Name	Cost
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"Phototubes and bases" continued

Notes

Hamamatsu quote to Fumi Ukegawa (Univ of Tsukuba) on 2-28-2002, reinforced by an initial purchase for R+D of 20 tubes. Price is for 220 tubes and bases (includes 15% spares) of

H8711A-10mod 16-channel type. Exchange rate assumed was 120 yen/dollar.

Price depends on discount rate, before discounts or tax the tube price is 180000 yen for the standard base, *1.7% for an outside vendor to add the SHV cable = 183060 yen.

Assumed purchase sequence is:

JY2002 40 tubes - 15% discount = 6.22 Myen

JY2003 130 tubes - 30% discount = 16.66 Myen

JY2004 50 tubes - 20% discount = 7.32 Myen

Total = 30.20 Myen

Total + 5% tax = 31.71 Myen = \$264250

True price is 149041 yen per tube, including all discounts which change year by year. This gives an estimate of \$273243.

1.2.1.2.2

Electronics Transition Card

\$24,312.00

ID	Resource Name	Units	Work	Delay	Start	Finish
1	FNALEQ	0%	0 hrs	0 days	Fri 5/16/03	Fri 5/16/03

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
1	FNALEQ	0%	\$24,312.00	\$0.00	\$0.00	\$24,312.00

Notes

WBS Definition-

Transition card and cables that go from phototubes to the back of the Shower Maximum Detector VME crate.

Labor BOE-

N/A

M&S BOE-

Detailed estimate from Gary Drake (ANL) based on Minos design.

Transition card itself is \$75/card * 2/wedge * 48 wedges * 10% spare = \$7920, including all parts and assembly labor.

Engineering for the card is \$8K, a one-time cost.

Total cost of transition card is \$15920.

Cables to transition card: \$35/card * 4/wedge * 48 wedges * 10% spare = \$7392, including all parts and assembly labor.

Engineering for this cable is \$1K, a one-time cost.

Total cost of cables is \$8392.

Total cost is \$24312.

WBS	Name	Cost
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"Wavelength-shifting fiber holder parts" continued

Notes
N/A

M&S BOE-
Detailed estimate from MSU engineer Ron Richards. \$7800

1.2.1.2.6 Phototube box parts \$36,000.00

ID	Resource Name	Units	Work	Delay	Start	Finish
1	FNALEQ	0%	0 hrs	0 days	Fri 5/16/03	Fri 5/16/03

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
1	FNALEQ	0%	\$36,000.00	\$0.00	\$0.00	\$36,000.00

Notes
WBS Definition-
Clear fiber bundles that go from the counters to the phototube box.

Labor BOE-
N/A

M&S BOE-
Detailed estimate from MSU engineer Ron Richards. \$36000

1.2.1.2.7 CPR Detector parts \$57,017.00

Notes
Summary task for the parts included in the detector modules.

1.2.1.2.7.1 Scintillator \$36,288.00

ID	Resource Name	Units	Work	Delay	Start	Finish
1	FNALEQ	0%	0 hrs	0 mons	Wed 2/5/03	Wed 2/5/03
4	Italy - In Kind	0%	0 hrs	0 days	Wed 2/5/03	Wed 2/5/03

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
1	FNALEQ	0%	\$0.00	\$0.00	\$0.00	\$0.00
4	Italy - In Kind	0%	\$36,288.00	\$0.00	\$0.00	\$36,288.00

Notes
WBS Definition:
Amount INFN has agreed to pay JINR (Dubna) for their 2 cm scintillator, and provide in-kind to this project.

Labor BOE:
n/a

M&S BOE:
Costs are based on quote from INFN's Giorgio Belletini of \$28/liter.
How many liters are needed?

WBS	Name	Cost
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"Scintillator" continued

Notes

1 sheet is 180 cm x 45 cm x 2cm = 16.2 liter = \$453.6
Assume 15 cm x 15 cm tiles including cutting space, this is
36 tiles per sheet. Need 54 tiles/wedge * 48 wedges = 2592 tiles.
Add 10% spares, this gives 80 sheets * \$453.6 = \$36288

1.2.1.2.7.2 Optical Fibers \$8,265.00

ID	Resource Name	Units	Work	Delay	Start	Finish
1	FNALEQ	0%	0 hrs	0 mons	Wed 3/5/03	Wed 3/5/03
4	Italy - In Kind	0%	0 hrs	0 days	Wed 3/5/03	Wed 3/5/03

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
1	FNALEQ	0%	\$0.00	\$0.00	\$0.00	\$0.00
4	Italy - In Kind	0%	\$8,265.00	\$0.00	\$0.00	\$8,265.00

Notes

WBS Definition:
Wavelength shifting and clear fibers purchased by INFN and provided in-kind to this project.

Labor BOE:
n/a

M&S BOE:
Total length of WLS fibers =
54 channels * 1 fiber/channel * 1.5m average length* 48 wedges *20% spare = 4500 m
Total length of clear fiber =
54 channels * 1 fiber/channel * 5m average length * 48 wedges *20% spare = 15000 m
For this quantity of fibers the quote from Dr. Massimo Meoni of Polhitech Co. is
\$0.47/m for WLS and \$0.41/m for clear.
Total cost is then:
\$0.47 * 4500 = \$2115 WLS
\$0.41 * 15000 = \$6150 clear
\$2115 + \$6150 = \$8265 total

1.2.1.2.7.3 Sheet metal and misc. supplies \$12,464.00

ID	Resource Name	Units	Work	Delay	Start	Finish
1	FNALEQ	0%	0 hrs	0 mons	Tue 4/29/03	Tue 4/29/03

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
1	FNALEQ	0%	\$12,464.00	\$0.00	\$0.00	\$12,464.00

Notes

WBS Definition:
Sheet metal and other supplies to make the counter shell.

WBS	Name	Cost
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"Sheet metal and misc. supplies " continued

Notes

Labor BOE:
n/a

M&S BOE:

Sheet metal estimate from Jim Grudzinski (Argonne) comes from purchase and shop time for full-size prototype: \$188 per module * 53 = \$9964 for sheet metal, \$2500 for epoxies and other misc. Total: \$12464

1.2.1.2.8	CCR Detector parts	\$13,947.00
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Notes

Summary task for the parts needed in the Crack Chamber modules.

1.2.1.2.8.1	Scintillator	\$10,000.00
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ID	Resource Name	Units	Work	Delay	Start	Finish
1	FNALEQ	0%	0 hrs	0 mons	Tue 4/29/03	Tue 4/29/03
4	Italy - In Kind	0%	0 hrs	0 mons	Tue 4/29/03	Tue 4/29/03

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
1	FNALEQ	0%	\$0.00	\$0.00	\$0.00	\$0.00
4	Italy - In Kind	0%	\$10,000.00	\$0.00	\$0.00	\$10,000.00

Notes

WBS Definition:
Scintillator for CCR purchased from Bicron by INFN.

Labor BOE:
n/a

M&S BOE:
Physicist estimate based on previous Bicron purchases.

1.2.1.2.8.2	Optical Fibers	\$1,454.00
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ID	Resource Name	Units	Work	Delay	Start	Finish
1	FNALEQ	0%	0 hrs	11.5 mons	Tue 3/30/04	Tue 3/30/04
4	Italy - In Kind	0%	0 hrs	11.5 mons	Tue 3/30/04	Tue 3/30/04

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
1	FNALEQ	0%	\$0.00	\$0.00	\$0.00	\$0.00
4	Italy - In Kind	0%	\$1,454.00	\$0.00	\$0.00	\$1,454.00

Notes

WBS Definition:
Wavelength shifting and clear fibers purchased by INFN and provided in-kind to this project for the CCR.

Labor BOE:

WBS	Name	Cost
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"Optical Fibers" continued

Notes
n/a

M&S BOE:
See the quote for the CPR fibers, these are the same fibers.
WLS: 10 channels * 1 fiber/channel * 1.5m average * 48 wedges * 10% spares * \$0.47/m = \$372 Clear: 10 channels * 1 fiber/channel * 5m average * 48 wedges * 10% spares * \$0.41/m = \$1082
Total: \$1454

1.2.1.2.8.3	Sheet metal and misc. supplies	\$2,493.00
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ID	Resource Name	Units	Work	Delay	Start	Finish
1	FNALEQ	0%	0 hrs	0 mons	Tue 4/29/03	Tue 4/29/03

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
1	FNALEQ	0%	\$2,493.00	\$0.00	\$0.00	\$2,493.00

Notes
WBS Definition:
Sheet metal and other supplies for the shell for the CCR.

Labor BOE:
n/a

M&S BOE:
See the estimate for CPR. This is 20% of the surface area so we use 20% of that estimate of \$12464 = \$2493.

1.2.1.3	CPR Detector Assembly	\$90,648.00
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Notes
Summary task for the assembly of the CPR modules.

1.2.1.3.1	Prepare scintillator tiles	\$46,710.00
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ID	Resource Name	Units	Work	Delay	Start	Finish
1	FNALEQ	0%	0 hrs	0 days	Tue 4/1/03	Tue 4/1/03
6	MechTechF	100%	1,384 hrs	0 mons	Wed 4/2/03	Fri 12/5/03
7	SeniorMechTechF	25%	346 hrs	0 mons	Wed 4/2/03	Fri 12/5/03

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
1	FNALEQ	0%	\$0.00	\$0.00	\$0.00	\$0.00
6	MechTechF	100%	\$33,216.00	\$0.00	\$0.00	\$33,216.00
7	SeniorMechTechF	25%	\$13,494.00	\$0.00	\$0.00	\$13,494.00

Notes
WBS Definition:
Cutting scintillator tiles to correct size and cutting grooves in them.

WBS	Name	Cost
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"Prepare scintillator tiles" continued

Notes

Labor BOE:

This has been done for the prototype, it took 22.5 minutes per tile according to FNAL Lab 8 Director Phyllis Dearing. The final tiles may need slightly more work due to keyed grooves, we'll use an estimate of 1 tile every 30 minutes, 2 per hour, 16 per day. We need 54*48*10% spare for CPR= 2851. 2851/16 = 178 days of labor.

M&S BOE:

n/a

1.2.1.3.2 Prepare optical fibers \$7,830.00

ID	Resource Name	Units	Work	Delay	Start	Finish
1	FNAL EQ	0%	0 hrs	0 days	Tue 4/29/03	Tue 4/29/03
6	MechTechF	100%	232 hrs	0 mons	Wed 4/30/03	Tue 6/10/03
7	SeniorMechTechF	25%	58 hrs	0 mons	Wed 4/30/03	Tue 6/10/03

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
1	FNAL EQ	0%	\$0.00	\$0.00	\$0.00	\$0.00
6	MechTechF	100%	\$5,568.00	\$0.00	\$0.00	\$5,568.00
7	SeniorMechTechF	25%	\$2,262.00	\$0.00	\$0.00	\$2,262.00

Notes

WBS Definition:

Splicing, polishing and mirroring fibers.

Labor BOE:

Estimate from Ewa Skup. Range for splicing alone was 120-160 fibers per day using CMS procedure. Will assume 100 fibers per day including polishing and mirroring. We need 54*48*10% spare for CPR= 2851. 2851/100 = 29 days of labor.

M&S BOE:

n/a

1.2.1.3.3 Assemble bottom of module \$4,738.00

ID	Resource Name	Units	Work	Delay	Start	Finish
1	FNAL EQ	0%	0 hrs	0 days	Tue 4/29/03	Tue 4/29/03

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
1	FNAL EQ	0%	\$4,738.00	\$0.00	\$0.00	\$4,738.00

Notes

WBS Definition:

Assembly of shell of CPR modules at Argonne.

Labor BOE:

WBS	Name	Cost
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"Assemble bottom of module" continued

Notes
n/a

M&S BOE:
Estimate from Jim Grudzinski (Argonne) based on assembly of prototype
modules: 1.5 hr * 48 * 10% spare * \$59.82/hr = \$4738

1.2.1.3.4 Installing fibers into tiles \$15,793.00

ID	Resource Name	Units	Work	Delay	Start	Finish
1	FNALEQ	0%	0 hrs	0 days	Thu 6/12/03	Thu 6/12/03

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
1	FNALEQ	0%	\$15,793.00	\$0.00	\$0.00	\$15,793.00

Notes
WBS Definition:
Installing fibers into modules at Argonne.

Labor BOE:
n/a

M&S BOE:
Estimate from Jim Grudzinski (Argonne) based on assembly of prototype
modules: 5 hrs/module * 48 modules * 10% spare * \$59.82/hr = \$15793

1.2.1.3.5 Assemble module top \$6,317.00

ID	Resource Name	Units	Work	Delay	Start	Finish
1	FNALEQ	0%	0 hrs	0 days	Thu 6/19/03	Thu 6/19/03

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
1	FNALEQ	0%	\$6,317.00	\$0.00	\$0.00	\$6,317.00

Notes
WBS Definition:
Assembly of top of CPR modules at Argonne.

Labor BOE:
n/a

M&S BOE:
Estimate from Jim Grudzinski (Argonne) based on assembly of prototype
modules: 2 hr * 48 * 10% spare * \$59.82/hr = \$6317

WBS	Name	Cost
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"Assemble phototube fixtures" continued

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
1	FNALEQ	0%	\$10,100.00	\$0.00	\$0.00	\$10,100.00

Notes

WBS Definition-
Assemble phototube boxes at MSU.

Labor BOE-
N/A

M&S BOE-
Detailed estimate from MSU engineer Ron Richards. 480 hours at \$21.1/hour = \$10100

1.2.1.5.3	Assemble clear fiber bundles	\$10,100.00
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ID	Resource Name	Units	Work	Delay	Start	Finish
1	FNALEQ	0%	0 hrs	0 mons	Mon 2/16/04	Mon 2/16/04

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
1	FNALEQ	0%	\$10,100.00	\$0.00	\$0.00	\$10,100.00

Notes

WBS Definition-
Assemble clear fiber bundles that go from the counters to the phototube box, assembly performed at MSU.

Labor BOE-
N/A

M&S BOE-
Detailed estimate from MSU engineer Ron Richards. 477 hours at \$21.1/hour = \$10100

1.2.1.6	Physicist or Student Labor	\$0.00
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1.2.1.6.1	Phototube Testing Year 1	\$0.00
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ID	Resource Name	Units	Work	Delay	Start	Finish
8	PhysicistU	10%	93.6 hrs	0 mons	Thu 5/1/03	Wed 10/15/03

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
8	PhysicistU	10%	\$0.00	\$0.00	\$0.00	\$0.00

1.2.1.6.2	Phototube Testing Year 2	\$0.00
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ID	Resource Name	Units	Work	Delay	Start	Finish
8	PhysicistU	10%	92 hrs	0 mons	Mon 12/1/03	Fri 5/14/04

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
8	PhysicistU	10%	\$0.00	\$0.00	\$0.00	\$0.00

WBS	Name						Cost
"Phototube Testing Year 2" continued							
1.2.1.6.3	Phototube Testing Year 3					\$0.00	
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	
8	PhysicistU	10%	62.4 hrs	0 mons	Mon 5/3/04	Fri 8/20/04	
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>	
8	PhysicistU	10%	\$0.00	\$0.00	\$0.00	\$0.00	
1.2.1.6.4	Detector Testing					\$0.00	
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	
8	PhysicistU	10%	215.2 hrs	0 mons	Thu 6/19/03	Wed 7/14/04	
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>	
8	PhysicistU	10%	\$0.00	\$0.00	\$0.00	\$0.00	
1.2.1.7	Milestones					\$0.00	
1.2.1.7.1	First phototube order placed					\$0.00	
1.2.1.7.2	1st WLS fiber holder finished					\$0.00	
1.2.1.7.3	1st CPR module assembled					\$0.00	
1.2.1.7.4	1st CPR module finished and tested					\$0.00	
1.2.1.7.5	1st CCR module finished and tested					\$0.00	
1.2.1.7.6	First set of phototubes tested					\$0.00	
1.2.1.7.7	50% CPR Detectors Tested					\$0.00	
1.2.1.7.8	50% CCR Detectors Tested					\$0.00	
1.2.1.7.9	Second set of phototubes tested					\$0.00	
1.2.1.7.10	Final CPR Detector Tested					\$0.00	
1.2.1.7.11	Final CCR Detector Tested					\$0.00	
1.2.1.7.12	Final set of phototubes tested					\$0.00	
1.2.2	Electromagnetic timing					\$254,871.00	
1.2.2.1	Research and Development					\$12,192.00	
1.2.2.1.1	Procure parts for splitters & cable prototypes, misc test stand equip					\$2,000.00	
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	
9	U.S. Univ. Grants	0%	0 hrs	0 days	Sat 6/15/02	Sat 6/15/02	

WBS	Name	Cost
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"Procure parts for splitters & cable prototypes, misc test stand equip" continued

<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
9	U.S. Univ. Grants	0%	\$2,000.00	\$0.00	\$0.00	\$2,000.00

Notes

These are the prototypes of the splitter, PEM harness, ASD->TDC cable and miscellaneous Test stand equipment. We will use the existing 2nd floor test stands which have ADMEM's and TDC's in working crates.

Splitter: This is 2 harnesses (20 cables) of splitters. The cost per splitter is \$25 for a cost of \$500. The parts for his have already been purchased, and the splitters built.

PEM harness: This is 1 harness (8 cables). It is the LEMO connectors, the RG174 and the AMP connectors. The LEMO's are \$48 total, the cable is \$25 total and the AMP connectors are \$50 for a total of \$123. We are recycling all the parts for this assembly and the parts are all in hand.

We have purchased 2 ASD->TDC cables is purchased directly from 3M at a small-order cost of \$700. These parts are all in hand.

Other miscellaneous parts include extra LEMO connectors, terminators, BNC->LEMO connectors, short RG174 cables etc. Estimated cost \$300.

1.2.2.1.2	Assemble Splitter and PEM harness prototypes	\$192.00
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<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>
10	ElecTechF	50%	8 hrs	0 days	Tue 7/30/02	Wed 7/31/02
11	ElecTechU	100%	16 hrs	0 days	Tue 7/30/02	Wed 7/31/02

<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
10	ElecTechF	50%	\$192.00	\$0.00	\$0.00	\$192.00
11	ElecTechU	100%	\$0.00	\$0.00	\$0.00	\$0.00

Notes

This is assembling the splitter harness and the PEM harness.

The individual splitters are about 20 minutes and bundling them up in to a harness takes another 20 minutes. The estimate is rounded to 2 days. This was already done at UC.

The PEM harness is about 1 hour to put the cables into the single AMP connector. We assume a day to be conservative. This will be done by a FNAL tech.

To be conservative we assume that this doesn't begin until all the prototype parts are ready.

1.2.2.1.3	Tests to finalize CEM Splitter	\$0.00
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<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>
12	PostDocU	50%	320 hrs	0 days	Thu 8/1/02	Mon 11/25/02

<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
12	PostDocU	50%	\$0.00	\$0.00	\$0.00	\$0.00

Notes

The final splitter must be shown to be mechanically compatible with the system, as well as perform as expected without introducing noise or a disruption to the existing CEM system. This is work done by TAMU post-doc. This includes building a test setup.

Prototypes of the CEM splitter exist and have been extensively tested with no known problems. A prototype of the mechanical harness exists and is being tested.

WBS	Name	Cost
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"Tests to finalize CEM Splitter" continued

Notes

The parts costs here are not included as they are included in the production costs.

1.2.2.1.4 Tests to finalize PEM Harness \$0.00

ID	Resource Name	Units	Work	Delay	Start	Finish
12	PostDocU	10%	72 hrs	0 days	Thu 8/1/02	Mon 12/9/02

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
12	PostDocU	10%	\$0.00	\$0.00	\$0.00	\$0.00

Notes

This is the mechanical testing of a PEM harness between the PEM PMT box and the ASD/TB crates. This includes building a production test setup. This is work done by TAMU post-docs.

The parts costs are not included here as they are included in the production costs.

1.2.2.1.5 Finalize ASD->TDC cable tests \$0.00

ID	Resource Name	Units	Work	Delay	Start	Finish
12	PostDocU	10%	72 hrs	0 days	Mon 6/17/02	Tue 10/22/02

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
12	PostDocU	10%	\$0.00	\$0.00	\$0.00	\$0.00

Notes

The current ASD->TDC cable must be shown to pass the mechanical requirements as well as have timing resolution consistent with being small relative to the current TDC resolution (1nsec). These tests will be done by TAMU post-doc.

A cable already exists and has undergone preliminary tests.

Its cost has already been included in the production costs.

This includes building a tester for the cables.

1.2.2.1.6 Build ASD/TB Prototypes and test \$10,000.00

ID	Resource Name	Units	Work	Delay	Start	Finish
4	Italy - In Kind	0%	0 hrs	0 days	Sat 6/15/02	Sat 6/15/02

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
4	Italy - In Kind	0%	\$10,000.00	\$10,000.00	\$0.00	\$10,000.00

Notes

The Italian group will make a new batch of ASD's which are functionally identical to the existing ASD's but with a new output connector such that there is only one cable out.

WBS	Name	Cost
1.2.2.2.1	CEM Splitter	\$37,726.00

Notes

The CEM splitter is used to pull off a small copy of the CEM anode signal for use into a ASD/TB. It is a completely passive device.

EMTiming Splitter parts list: (Estimate based on completion of 10 prototype splitters)

960+96 spares- Lemo right angle receptacle EPL.00.250 NTN. \$6.10/part. These parts are in stock.

960+96 long Rg174 cables with lemo connectors on one end. Average of 26 ft/cable=25,344 ft.
The connector we use is LEMO FFS.00.25.CTCE31 (equivalent to the Kings K-LOC 1075-1). Part \$6.36/part.
All the cable is in hand and is being recycled (\$0.14/foot). The connectors are in stock.

960+96 short Rg174 cables with lemo connectors on one end (LEMO-ettes).
These are all in hand and are recycled. Value: \$6/connectors, \$0.10 cable, \$2.75 to connect => \$9/LEMO-ette.

1200- Phillips TX/13/7.1/4.8-3E27 ferrite toroids @ \$0.208ea
In hand.

2400 cable clamps (cable-ties) Panduit PLT.6SM-M 1000/pkg approx \$40, and
40 PKgs--Heat shrink tubing SPC FPS-048-6012-CLR 3/4in X 6in long
1 pkg can do 36 boards. Total cost \$450. These are in hand.

30 Printed circuit boards [40 channels/ board after cutting on scored perforations] which are part UC dwg A-2508. Price \$1K. These are in hand.

Prototyping has shown assembly to be 20 minutes/splitter for an experienced technician (ElecTechF).
960+96 splitters needed => 44 technican days. 1 day of overall setup. 2 days of setup fixing/technician. 3 Technicans working in parallel for a total of 51 days.
The FNAL rate for ElecTechF is \$24/hour.

Even though the parts are in stock, we assume a 6 week lead-time to be conservative.

Parts = 27,934 Labor = 9,792 Parts&Labor= 37,726 Recycling= 13,052

WBS	Name	Cost
1.2.2.2.1.1	Procure Splitter parts	\$27,934.00

ID	Resource Name	Units	Work	Delay	Start	Finish
9	U.S. Univ. Grants	0%	0 hrs	0 days	Sun 12/15/02	Sun 12/15/02

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
9	U.S. Univ. Grants	0%	\$27,934.00	\$0.00	\$0.00	\$27,934.00

Notes

These are the parts for the CEM splitter. They are enumerated in the sub-heading.

WBS **Name** **Cost**
1.2.2.2.1.2 Build Splitters \$9,792.00

ID	Resource Name	Units	Work	Delay	Start	Finish
10	ElecTechF	100%	408 hrs	0 days	Tue 11/26/02	Tue 2/11/03

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	ElecTechF	100%	\$9,792.00	\$0.00	\$0.00	\$9,792.00

Notes

The labor costs for building the splitters is enumerated in the sub-heading.

While production can begin well before we have all the parts, for conservativeness we assume that it cannot until after all the parts are assembled.

1.2.2.2.1.3 Test CEM Splitter Cables \$0.00

ID	Resource Name	Units	Work	Delay	Start	Finish
13	StudentU	100%	40 hrs	0 days	Wed 2/12/03	Tue 2/18/03

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
13	StudentU	100%	\$0.00	\$0.00	\$0.00	\$0.00

Notes

Each splitter needs to be tested individually. Use the test setup from above. Should take about 20 minutes per harness (20 cables). This is about 4 days of testing and will go in parallel with the production. This work will be done by TAMU. To be conservative, we assume 5 days of a 1/2 time student after the end of production.

1.2.2.2.2 PEM Cable Harness \$20,287.00

Notes

The PEM harness is the set of 16 RG174 cables which go from the PEM dynode directly to the ASD Transition boards. There are 4 lines terminated in 50 ohms. There are 48 harnesses (24 wedges per side, East and West). The harness connects to the Plug light box using two AMP connector packages (parts list below), which are connected to the 16 RG174 cables which are terminated with male LEMO's on the end ASD/TB end.

Part's list and costs:

768+76 spares Male LEMO connectors: (FFS.00.250.CTCE, \$6.36). We assume a 6 week lead time. Total cost \$6.36*844=\$5,367.84

The cable from the PMT connectors to the ASD/TB is 19,440 ft (768+76 spares *23 ft) of RG174 which is \$0.14/foot; The total value is \$2,720. We are recycling all of it and the cable is already in hand.

The AMP connector packages bundle the RG174 cables so they can be connected to the plug light boxes. We note that the 400 50-ohm terminators are not explicitly costed as the parts should be under \$1 and the labor to install them is part of the overall assembly. Similarly, the 20 ft of tubing to protect the cables from the harness casing (2 inches/AMP connector) is also under \$3 and is not listed explicitly. The parts for a single harness are:

AMP 1-332056-0 Ferrule 1000*\$0.20 (Need 768+78 spares. Come in packages of 1000)
 AMP 51565-1 Socket 1100*\$2.53 (Need 960+96 spares. Come in packages of 100)
 AMP 201356-1 Connector 106*\$4.02 (Need 96+10 spares. We are recycling 50 that we have in hand)
 AMP 204087-1 Housing 106*\$23.98 (Need 96+10 spares. Come in packages of 100. We are recycling 6 of the 36 that we have in hand.)
 AMP 200867-1 Female Jackscrew Kit 106*\$1.72 (Need 96+10 spares. Come in packages of 100. We are recycling 6 of the 14 that we have in hand.)
 AMP 200868-1 Male Jackscrew Kit 106*\$2.20 (Need 96+10 spares. Come in packages of 100. We are recycling 6 of the 14 that we have in hand.)

WBS	Name	Cost
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"PEM Cable Harness" continued

Notes

Based on previous construction of similar harnesses we estimate this is 4 hrs/harness and 48 harnesses -> 24 days. We assume an additional 2 days/tecnician to setup and fix. With 3 ElecTechF this can take 10 days. The FNAL rate for ElecTechF is \$24/hour.

Parts = 14,527 Labor = 5,760 Parts & Labor = 20,287 Recycling = 3,188

The longest lead time is 40 days which is on the 51565-1.

1.2.2.2.2.1 Procure PEM Harness Parts \$14,527.00

ID	Resource Name	Units	Work	Delay	Start	Finish
9	U.S. Univ. Grants	0%	0 hrs	0 days	Sun 12/15/02	Sun 12/15/02

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
9	U.S. Univ. Grants	0%	\$14,527.00	\$0.00	\$0.00	\$14,527.00

Notes

The PEM harness is the set of 16 RG174 cables which go from the PEM dynode directly to the ASD Transition boards. There are 4 lines terminated in 50 ohms. There are 48 harnesses (24 wedges per side, East and West). The harness connects to the Plug light box using two AMP connector packages (parts list below), which are connected to the 16 RG174 cables which are terminated with male LEMO's on the end ASD/TB end.

Part's list and costs:

768+76 spares Male LEMO connectors: (FFS.00.250.CTCE, \$6.36). We assume a 6 week lead time. Total cost \$6.36*844=\$5,367.84

The cable from the PMT connectors to the ASD/TB is 19,440 ft (768+76 spares *23 ft) of RG174 which is \$0.14/foot; The total value is \$2,720. We are recycling all of it and the cable is already in hand.

The AMP connector packages bundle the RG174 cables so they can be connected to the plug light boxes. We note that the 400 50-ohm terminators are not explicitly costed as the parts should be under \$1 and the labor to install them is part of the overall assembly. The parts for a single harness are:

- AMP 1-332056-0 Ferrule 1000*\$0.20 (Need 768+78 spares. Come in packages of 1000)
- AMP 51565-1 Socket 1100*\$2.53 (Need 960+96 spares. Come in packages of 100)
- AMP 201356-1 Connector 106*\$4.02 (Need 96+10 spares. We are recycling 50 that we have in hand)
- AMP 204087-1 Housing 106*\$23.98 (Need 96+10 spares. Come in packages of 100. We are recycling 6 of the 36 that we have in hand.)
- AMP 200867-1 Female Jackscrew Kit 106*\$1.72 (Need 96+10 spares. Come in packages of 100. We are recycling 6 of the 14 that we have in hand.)
- AMP 200868-1 Male Jackscrew Kit 106*\$2.20 (Need 96+10 spares. Come in packages of 100. We are recycling 6 of the 14 that we have in hand.)

Based on previous construction of similar harnesses we estimate this is 4 hrs/harness and 48 harnesses -> 24 days. We assume an additional 2 days/tecnician to setup and fix. With 3 ElecTechF this can take 10 days. The FNAL rate for ElecTechF is \$24/hour.

Parts = 14,527 Labor = 5,760 Parts & Labor = 20,287 Recycling = 3,188

The longest lead time is 40 days which is on the 51565-1.

WBS	Name	Cost
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"ASD and Transition Boards" continued

Notes

(4) Transformers	36 \$	
		490 \$
TOTAL		

ASD Costs:

(1) Components	500\$	
(2) Printed circuits	350-400\$ (*)	
(3) Assembly of (1)+(2)	350-400\$ (*)	
(4) Connectors + front panels	50-150 (**)	
(5) Assembly of (4)	50\$	
		1300\$-1500\$

Notes:

- (*) this depends "on" the produced quantity.
- (**) Estimate. Last time materials came from FNAL

Total cost = 45*(1500+490) = \$89,590

1.2.2.2.3.1	Produce ASD and Transition boards	\$89,550.00
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ID	Resource Name	Units	Work	Delay	Start	Finish
4	Italy - In Kind	0%	0 hrs	0 days	Fri 1/17/03	Fri 1/17/03

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
4	Italy - In Kind	0%	\$89,550.00	\$0.00	\$0.00	\$89,550.00

Notes

The estimates for these boards is in the sub-heading.

1.2.2.2.3.2	Test ASDs and Transition boards	\$0.00
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ID	Resource Name	Units	Work	Delay	Start	Finish
12	PostDocU	100%	40 hrs	0 days	Thu 10/30/03	Wed 11/5/03

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
12	PostDocU	100%	\$0.00	\$0.00	\$0.00	\$0.00

WBS	Name	Cost
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"Test ASDs and Transition boards" continued

Notes

We assume here that each ASD and Transition Board has been checked out at INFN, and this is the final checkout at FNAL by TAMU people using the test stand. 3 ASD/TB board pairs/day => 2 weeks for the CEM, 2 week for the PEM => 4 weeks.

1.2.2.2.4	ASD->TDC Cables	\$22,516.00
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Notes

These are the ASD->TDC Cables which go up stairs. This is the 220 foot 3M 3756/68 and 3M 10168-8100-EE cable and connector assembly. There are 24 (+8 spares) for the CEM and 16 (+4 spares) for the PEM. These are \$433/part.

1.2.2.2.4.1	Purchase ASD to TDC cables	\$22,516.00
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ID	Resource Name	Units	Work	Delay	Start	Finish
4	Italy - In Kind	0%	0 hrs	0 days	Fri 1/17/03	Fri 1/17/03

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
4	Italy - In Kind	0%	\$22,516.00	\$0.00	\$0.00	\$22,516.00

Notes

These are the ASD->TDC Cables which go upstairs. This is the 220 foot 3M 3756/68 and 3M 10168-8100-EE cable and connector assembly. There are 24 (+8 spares) for the CEM and 16 (+4 spares) for the PEM. These are \$433/cable for a total of \$13,586 for the CEM, and \$8,660 for the PEM for a total of \$22,516. We assume 10 week lead time on these cables.

1.2.2.2.4.2	Test ASD->TDC Cables	\$0.00
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ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
13	StudentU	10%	4 hrs	0 days	Mon 3/31/03	Fri 4/4/03	\$0.00	\$0.00	\$0.00	\$0.00

Notes

This is the testing of the ASD->TDC cables. We will use the test stand described above. Based on previous experience testing these cables, we estimate it will take a full week of a TAMU students time to test 40.

1.2.2.2.5	VME Crate for TDCs	\$15,000.00
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Notes

This is the crate on the first floor which will contain all the TDC's for both the CEM and the PEM. As noted elsewhere, this crate will contain a Tracer, power supplies, and processor. There are 6 TDCs for the CEM and 4 TDCs for the PEM.

1.2.2.2.5.1	Procure VME Crate for TDCs	\$5,000.00
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ID	Resource Name	Units	Work	Delay	Start	Finish
9	U.S. Univ. Grants	0%	0 hrs	0 days	Mon 2/10/03	Mon 2/10/03

ID	Resource Name	Units	Cost	Baseline Cost	Act. Cost	Rem. Cost
9	U.S. Univ. Grants	0%	\$5,000.00	\$0.00	\$0.00	\$5,000.00

Notes

This is the crate for the upstairs TDC crate. This is being recycled and has a value of \$5,000.

WBS	Name	Cost
1.2.2.3.2	DOE Critical Decision 3	\$0.00
	<u>Notes</u> This is the DOE critical decision. It is used, among other things, to finalize the final Italian funding.	
1.2.2.3.3	Italian R&D Funding Approval	\$0.00
	<u>Notes</u> This is the preliminary approval needed for funding of the ASD prototypes to be built by the INFN group.	
1.2.2.3.4	Full Italian Government Approval	\$0.00
	<u>Notes</u> Project has to be approved by Italian Government	