

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1	Run 2b Silicon Project	\$12,374,885	\$8,177,995	\$4,205,812	0	0	0

Notes

WBS Definition -
This is the upgrade Silicon Detector for CDF RunIIb.
These tables summarize the number of major components for the project.

Layer	Type	φ-seg.	Z-seg.	Length	Width	Pitch	Total
5	A	30	6	96.4	40.5	75/37.5	360
5	A	30	6	96.4	40.5	75/37.5	360
4	A	24	6	96.4	40.5	75/37.5	288
4	1.2°	24	6	96.4	43.1	80/40	288
3	A	18	6	96.4	40.5	75/37.5	216
3	1.2°	18	6	96.4	43.1	80/40	216
2	A	12	6	96.4	40.5	75/37.5	144
2	1.2°	12	6	96.4	43.1	80/40	144
1	A	6	6	96.4	40.5	75/37.5	72
1	A	6	6	96.4	40.5	75/37.5	72
0	A	12	6	96.4	14.8	50/25	144

	Sensors	Modules	Staves	4-chips hybrids	2-chips hybrids	MPC	JPC
Outer Axials	1512	756	180	1080	0	180	40
Outer Stereo	648	324					
L0	144	72	0	0	72	0	16
TOTAL	2304	1152	180	1080	72	180	56

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.1	Administration	\$315,716	\$5,000	\$349,076	0	0	0

Notes

WBS Definition -
Administration costs for the project

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.1.1	Level 2 Project managers	\$0	\$0	\$0	0	0.1	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	200%	64 hrs	0 days	Mar 3 '03	Mar 6 '03	\$0	\$0	\$0	\$0

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
-----	------	------	-----	-------	-----------	-------------	-------

"Level 2 Project managers" continued

Notes

WBS Definition -
This is the labor associated with the L2 Project Managers

M&S BOE -

Labor BOE -
This accounts for the time of the Silicon Project managers.

1.1.1.2 Level 3 Project managers \$219,996 \$0 \$247,156 0 0.1 0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	100%	6,480 hrs	0 days	Mar 3 '03	May 19 '06	\$0	\$0	\$0	\$0
17	ElecEngF	20%	1,296 hrs	0 days	Mar 3 '03	May 19 '06	\$71,280	\$71,280	\$0	\$71,280
20	MechEngSF	45%	2,916 hrs	0 days	Mar 3 '03	May 19 '06	\$148,716	\$148,716	\$0	\$148,716

Notes

WBS Definition -
This accounts for the time of the Level 3 project managers.

M&S BOE -

Labor BOE -
We anticipate that they will need to spend 20% each of an FTE on managerial tasks over the duration of the project.
There are 5 level 3 managers and each one will include a physicist. Total 100%
We have an electrical engineer to oversee the DAQ half of the project and 3 mechanical engineers to oversee the mechanical part of the project - one is dedicated to the production of modules and staves, the 2nd is dedicated to the barrel assembly and installation.
Each of these will take 20% on managerial tasks.
We have an additional mech engineer for the cooling system cooling. This is a small task and will only require 5% of an engineer for managerial duties.

1.1.1.3 Integration meetings \$90,720 \$0 \$101,920 0 0.1 0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	50%	3,240 hrs	0 days	Mar 3 '03	May 19 '06	\$0	\$0	\$0	\$0
11	Postdoc	100%	6,480 hrs	0 days	Mar 3 '03	May 19 '06	\$0	\$0	\$0	\$0
17	ElecEngF	10%	648 hrs	0 days	Mar 3 '03	May 19 '06	\$35,640	\$35,640	\$0	\$35,640
20	MechEngSF	10%	648 hrs	0 days	Mar 3 '03	May 19 '06	\$33,048	\$33,048	\$0	\$33,048
22	MechTechSF	10%	648 hrs	0 days	Mar 3 '03	May 19 '06	\$22,032	\$22,032	\$0	\$22,032

1.1.1.4 Software support for parts database \$5,000 \$5,000 \$0 1 0.1 0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	5,000	5,000	0 days	Aug 13 '03	Mar 31 '06	\$5,000	\$5,000	\$0	\$5,000
11	Postdoc	50%	2,640 hrs	0 days	Aug 13 '03	Mar 31 '06	\$0	\$0	\$0	\$0

Notes

WBS Definition -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Software support for parts database" continued

Notes

This item covers the development of the software to track all the production parts in Run IIa.
It requires some time to setup before the production parts arrive, and then will require attention for the entering of data as the parts come in.

M&S BOE -
Physicist estimate based on Run IIa experience.
Cost is for software packages.

Labor BOE -
Based on Run IIa experience

1.1.2	DAQ	\$5,770,275	\$4,876,460	\$856,233	0	0	0
-------	-----	-------------	-------------	-----------	---	---	---

Notes

WBS Definition -
This is all the electrical part of the schedule.
It covers:

Item	Number of Parts
Svx4 chip	4464
Transceiver chip (TRX25)	792
Hybrid 4-chips (Outer)	1080
Hybrids 2-chips (L0)	72
Mini-Port Cards (MPC)	180
Bus Cables	360
Junction Port Cards (JPC)	52
L0 Analogue Signal Cables	144
Fiber Transition Modules (FTM)	26
Power Supplies	440HV,572LV
Cables (JPC-crates)	52 sets
Cables (MPC-JPC)	180 sets
DAQ Test&Readiness	

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.2.1	SVX4 Chips	\$886,538	\$758,390	\$110,548	0	0	0

Notes

WBS Definition -

This is the readout chip for the silicon sensors.

Runs:

1. Prototype (Hybrid #1)
2. Contingency (Hybrid #2)
3. Production (Preproduction and Production hybrids)

Need **4,464** chips for the project

M&S BOE -

Labor BOE -

1.1.2.1.1	SVX4 chip: 1st Prototype	\$228,552	\$189,812	\$38,740	0	0	0
-----------	--------------------------	-----------	-----------	----------	---	---	---

Notes

WBS Definition -

First full svx4 chip prototype. It has all functionality of the final chip.

M&S BOE -

Labor BOE -

Schedule Risk:

The schedule already assumes the need for a second submission.

No risk for this task.

1.1.2.1.1.1	1st chip: layout	\$130,448	\$105,500	\$24,948	0	0	0
-------------	------------------	-----------	-----------	----------	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	105,500	105,500	0 days	Jul 2 '01	Apr 4 '02	\$105,500	\$105,500	\$105,500	\$0
11	Postdoc	100%	1,512 hrs	0 days	Jul 2 '01	Apr 4 '02	\$0	\$0	\$0	\$0
17	ElecEngF	30%	453.6 hrs	0 days	Jul 2 '01	Apr 4 '02	\$24,948	\$24,948	\$24,948	\$0

Notes

WBS Definition -

Layout of the 1st full prototype of the svx4 chip

M&S BOE -

Actual Cost.

This is half the amount charged to FNAL from LBL on Run 2b budget codes (split with D0) = 80.5k\$. It covers the labor cost at LBL up to the submission of the 1 prototype chip.

INFN contributed with \$25,000 (Buy Backs).

Labor BOE -

LBL provided an equivalent of ~1.6 FTE to the project (Costed as R&D)

FNAL provided an equivalent of 0.3 FTE on the project (Costed as Labor)

INFN-Padova provided ~1 FTE on the project (Not Costed)

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.2.1.1.2	1st Chip submission (eng. Run)	\$0	\$0	\$0	0	0	4

Notes

WBS Definition -

This is the first submission of the new svx4 chip on 0.25um technology.

The minimum order is for ~10wafers and is a joint CDF,D0 and BTeV submission (not equally divided).

M&S BOE -

Labor BOE -

1.1.2.1.1.3	1st chip: documentation	\$7,500	\$7,500	\$0	0	0	0
-------------	-------------------------	---------	---------	-----	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	7,500	7,500	0 days	Apr 5 '02	Oct 22 '02	\$7,500	\$7,500	\$7,500	\$0

Notes

WBS Definition -

This is engineering labor at LBL associated with producing the necessary documentation for the chip.

M&S BOE -

Labor BOE -

1.1.2.1.1.4	1st Chip: manufacturing	\$58,000	\$58,000	\$0	0	0	4
-------------	-------------------------	----------	----------	-----	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	58,000	58,000	0 days	Apr 5 '02	Jun 14 '02	\$58,000	\$58,000	\$58,000	\$0

Notes

WBS Definition -

Fabrication of the svx4 chip.

M&S BOE -

MOSIS/TSMC quote.

Total cost is 200K\$ for 10 wafers minimum order. This order is split between CDF, D0 and BTeV

Cost for CDF is 50K\$ for masks + 8K\$ for chips.

Labor BOE -

Schedule:

8 weeks for fabrication at TSMC

1.1.2.1.1.5	1st Chip: post processing	\$5,000	\$5,000	\$0	0	0	4
-------------	---------------------------	---------	---------	-----	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	5,000	5,000	0 days	Jun 17 '02	Jun 28 '02	\$5,000	\$5,000	\$5,000	\$0

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"1st Chip: post processing" continued

Notes

WBS Definition -
back grounding, backplating and dicing SVX4 chip wafers.

M&S BOE -
Engineering Estimate (R.Yarema, W.Wester)
Total is 15K\$. CDF part is 5K\$

Labor BOE -

Schedule BOE -
2 weeks for backgrounding, backplating and dicing

1.1.2.1.1.6	1st Chip: engineering evaluation at FNAL	\$8,800	\$0	\$8,800	0	0	0
-------------	--	---------	-----	---------	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
17	ElecEngF	100%	160 hrs	0 days	Jul 16 '02	Aug 12 '02	\$8,800	\$8,800	\$8,800	\$0

Notes

WBS Definition -
Engineering evaluation of the 1st prototype svx4 chip at FNAL.

M&S BOE -

Labor BOE -
Eng. Evaluation (R.Yarema)
This is FNAL labor only. It included engineering type tests.

Schedule BOE -
The start date lags behind the LBL testing start date due to shipping and setup at FNAL.

1.1.2.1.1.7	1st Chip: engineering evaluation at LBL	\$13,812	\$13,812	\$0	0	0	0
-------------	---	----------	----------	-----	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	13,812	13,812	0 days	Jun 17 '02	Sep 10 '02	\$13,812	\$13,812	\$13,812	\$0

Notes

WBS Definition -
Engineering evaluation of the svx4 chip at LBL.
Tests performed at LBL include radiation damage assessment.

M&S BOE -

Labor BOE -
Engineering Estiamte.
This is labor cost at LBL as from Henrik Van Der Lippe and Ray Yarema (3/19/02)
project file svx4_0202.mpp of March 20 2002.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"1st Chip: engineering evaluation at LBL" continued

Notes

1.1.2.1.1.8 1st Chip: evaluation and radiation tests \$4,992 \$0 \$4,992 0 0.4 0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	50%	320 hrs	0 days	Jul 1 '02	Oct 22 '02	\$0	\$0	\$0	\$0
11	Postdoc	150%	960 hrs	0 days	Jul 1 '02	Oct 22 '02	\$0	\$0	\$0	\$0
18	ElecTechF	20%	128 hrs	0 days	Jul 1 '02	Oct 22 '02	\$4,992	\$4,992	\$4,992	\$0

Notes

WBS Definition -

This is the evaluation of the chip with CDF Data Acquisition System. Also we will evaluate the performance of the chip with real sensors.

M&S BOE -

Labor BOE -

- 1) Postdocs (150%) for testing the chip with the real DAQ, modify programs etc.
- 2) electrical technician (20%) needed for support with electrical board stuffing and testing.
- 3) Scientist (50%) to coordinate the effort

1.1.2.1.1.9 1st Chip ready for hybrids \$0 \$0 \$0 0 0 3

Notes

WBS Definition -

SVX4 chips are ready to be mounted on hybrids.

M&S BOE -

Labor BOE -

Schedule BOE -

This is 1 month after receiving the Engineering Run parts back from manufacturing.
This is aggressive and assumes the chip works without major problems.

1.1.2.1.2 **SVX4 chips: 2nd prototype** **\$243,432** **\$192,536** **\$33,296** **0** **0** **0**

Notes

WBS Definition -

It could be either the preproduction quantity (if the first prototype is successful) or the 2nd prototype chip run (if the first prototype is not successful). Order quantity may vary depending on the level of success of the first chip prototype. Here we assume 10 wafers for CDF.

M&S BOE -

Labor BOE -

Schedule BOE and Risk -

The schedule assumes that this is the 2nd prototype but we costed it as a preproduction.
50% chance that we need 2 submissions (this is the 2nd submission)

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"SVX4 chips: 2nd prototype" continued

Notes

10% prob. for design or manufacturing failure
Total = 5% risk
Effect is one more submission round:
Cost 100%
Schedule 100%
No change in scope, or Technical.

1.1.2.1.2.1	2nd Chip: layout	\$98,036	\$54,036	\$26,400	0.4	1	0
-------------	------------------	----------	----------	----------	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	54,036	54,036	0 days	Oct 23 '02	Mar 20 '03	\$54,036	\$54,036	\$51,334	\$2,702
17	ElecEngF	100%	800 hrs	0 days	Oct 23 '02	Mar 20 '03	\$44,000	\$26,400	\$41,800	\$2,200

Notes

WBS Definition -
Layout of the 2nd SVX4 chip.

M&S BOE -
This is labor cost at LBL as from Henrik Van Der Lippe and Ray Yarema (3/19/02)
project file svx4_0202.mpp of March 20 2002.

Labor BOE -
LBL labor is costed as M&S.
FNAL will provide 1 engineer for 20 days during this period

Schedule:
this task duration is the FNAL layout part of the entire layout.
This task is scheduled to start after the chip evaluation has been completed but
it could begin earlier if necessary.

The estimated date for the submission is based on a Meeting with Chip designers and engineers Oct. 16th, 2002. this has 40 more days for the layout.

1.1.2.1.2.2	2nd Chip: submission (eng. Run)	\$0	\$0	\$0	0	0	3
-------------	---------------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -
This is the 2nd engineering run submission with only svx4 devices.

M&S BOE -

Labor BOE -

Schedule:
If changes are minor wrt 1st chip, all production wafers might be ordered at this time. For the purpose of this schedule we will order here 5 wafers worth of svx4 chips for CDF

1.1.2.1.2.3	Contingency on 2nd chip submission	\$0	\$0	\$0	0	0	5
-------------	------------------------------------	-----	-----	-----	---	---	---

1.1.2.1.2.4	L2MS 2nd chip submission	\$0	\$0	\$0	0	0	2
-------------	--------------------------	-----	-----	-----	---	---	---

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"L2MS 2nd chip submission" continued

1.1.2.1.2.5 2nd Chip: manufacturing \$125,000 \$125,000 \$0 0.3 0 0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	125,000	125,000	0 days	Mar 21 '03	May 30 '03	\$125,000	\$125,000	\$0	\$125,000

Notes

WBS Definition -
Fabrication of the 2nd svx4 chip

M&S BOE -
MOSIS/TSMC quotation.
The minimum order cost is 200K\$ which yields 10 wafers worth of chips.
100K\$ is the CDF part. We also may want to order extra wafers to get us through the preproduction phase. The extra cost is 25K\$ (10 wafers).
Total is 5+5=10 wafers (~3,500 chips) for CDF.

Labor BOE -

1.1.2.1.2.6 2nd Chip: postprocessing \$7,500 \$7,500 \$0 0.4 0 0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	7,500	7,500	0 days	Jun 2 '03	Jun 13 '03	\$7,500	\$7,500	\$0	\$7,500

Notes

WBS Definition -
back grounding, backplating and dicing SVX4 chip wafers.

M&S BOE -
Engineering Estimate (R.Yarema, W.Wester)
Total is 15K\$. CDF part is 5K\$

Labor BOE -

Schedule BOE -
2 weeks for backgrounding, backplating and dicing

1.1.2.1.2.7 2nd Chip: engineering evaluation at FNAL \$4,400 \$0 \$4,400 0 0.4 0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
17	ElecEngF	50%	80 hrs	0 days	Jun 16 '03	Jul 14 '03	\$4,400	\$4,400	\$0	\$4,400

Notes

WBS Definition -
Engineering evaluation of the 1st prototype svx4 chip at FNAL.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"2nd Chip: engineering evaluation at FNAL" continued

Notes

Eng. Evaluation (R.Yarema)
This is FNAL labor only. It included engineering type tests.

1.1.2.1.2.8	2nd Chip: engineering evaluation at LBL	\$6,000	\$6,000	\$0	0.4	0	0
-------------	---	---------	---------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	6,000	6,000	0 days	Jun 16 '03	Aug 4 '03	\$6,000	\$6,000	\$0	\$6,000

Notes

WBS Definition -
Engineering evaluation of the svx4 chip at LBL.
Tests performed at LBL include radiation damage assessment.

M&S BOE -

Labor BOE -
Engineering Estiamte.
This is labor cost at LBL as from Henrik Van Der Lippe and Ray Yarema (3/19/02)
project file svx4_0202.mpp of March 20 2002.

1.1.2.1.2.9	2nd Chip: evaluation and radiation test	\$2,496	\$0	\$2,496	0	0.4	0
-------------	---	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	50%	160 hrs	0 days	Jun 16 '03	Aug 11 '03	\$0	\$0	\$0	\$0
11	Postdoc	150%	480 hrs	0 days	Jun 16 '03	Aug 11 '03	\$0	\$0	\$0	\$0
18	ElecTechF	20%	64 hrs	0 days	Jun 16 '03	Aug 11 '03	\$2,496	\$2,496	\$0	\$2,496

Notes

WBS Definition -
This is the evaluation of the chip with CDF Data Acquisition System. Also we will evaluate the performance of the chip with real sensor using both a laser and a radioactive source.

M&S BOE -

Labor BOE -
1) Postdocs (100%) for testing the chip with the real DAQ, modify programs etc.
2) electrical technician (20%) needed for support with electrical board stuffing/testing.
3) Scientist (50%) to coordinate the effort

1.1.2.1.2.10	2nd Chip ready for hybrids	\$0	\$0	\$0	0	0	4
--------------	----------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -
SVX4 chips are ready to be mounted on hybrids.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"2nd Chip ready for hybrids" continued

Notes

Schedule BOE -
This is 4 weeks after receiving the Engineering Run parts.
This allows 2 weeks for post processing and 2 more weeks for testing and dicing. It assumes the chip works without major problems.

1.1.2.1.3	SVX4 chip: production	\$414,554	\$376,042	\$38,512	0	0	0
-----------	-----------------------	-----------	-----------	----------	---	---	---

Notes

WBS Definition -
Order production quantity of the svx4 chip. It assumes that either the first or the second prototype chip has been successful.

M&S BOE -

Labor BOE -

1.1.2.1.3.1	Setup for production chip testing	\$9,070	\$3,750	\$5,320	0.5	0.4	0
-------------	-----------------------------------	---------	---------	---------	-----	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	3,750	3,750	0 days	Jul 15 '03	Aug 11 '03	\$3,750	\$3,750	\$0	\$3,750
10	Physicist	50%	80 hrs	0 days	Jul 15 '03	Aug 11 '03	\$0	\$0	\$0	\$0
17	ElecEngF	25%	40 hrs	0 days	Jul 15 '03	Aug 11 '03	\$2,200	\$2,200	\$0	\$2,200
18	ElecTechF	50%	80 hrs	0 days	Jul 15 '03	Aug 11 '03	\$3,120	\$3,120	\$0	\$3,120

Notes

WBS Definition -
This is the work and equipment needed to setup the probestation and DAQ for the SVX4 chip mass production test at FNAL.

M&S BOE -

Engineering Estimate (W.Wester)

Cost is for probe cards, equipment and material. Total is \$7,500 plus \$2,500 for contingency. CDF share is 50% as follows: \$3,750 EQ and \$1,250 CONT.

Labor BOE -

Engineering Estimate (W.Wester)

Same crew as for the final production testing.

We assume that 1 scientist, 1 technician and 1 research associate will work full time on this task which is both for CDF and D0.

Below is the CDF share:

1. Scientist (50%)
2. Elect. Technician (50%)
3. postdoc (25%) support to CDF
4. Research Associate (50%)
5. Elect. Engineer (5%) chip designer expert

Schedule BOE -

This is time for getting programs setup and procedures worked

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Setup for production chip testing" continued

Notes

out for testing chips on wafers.

1.1.2.1.3.2	Production Chip: layout	\$37,192	\$32,792	\$4,400	0.4	0.4	0
-------------	-------------------------	----------	----------	---------	-----	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
8	MANDSPASS	32,792	32,792	0 days	Aug 12 '03	Sep 9 '03	\$32,792	\$32,792	\$0	\$32,792
17	ElecEngF	50%	80 hrs	0 days	Aug 12 '03	Sep 9 '03	\$4,400	\$4,400	\$0	\$4,400

Notes

WBS Definition -

Layout of the final production SVX4 chip.

M&S BOE -

This is labor cost at LBL as from Henrik Van Der Lippe and Ray Yarema (3/19/02) project file svx4_0202.mpp of March 20 2002.

Labor BOE -

LBL labor is costed as M&S.

FNAL will provide 1 engineer for 15 days during this period

1.1.2.1.3.3	Production chip Submission	\$0	\$0	\$0	0	0	3
-------------	----------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

This is the final SVX4 chip submission.

M&S BOE -

Labor BOE -

1.1.2.1.3.4	Contingency on production chip submission	\$0	\$0	\$0	0	0	5
-------------	---	-----	-----	-----	---	---	---

1.1.2.1.3.5	L2MS Production chip submission	\$0	\$0	\$0	0	0	2
-------------	---------------------------------	-----	-----	-----	---	---	---

1.1.2.1.3.6	Production Chip: manufacturing	\$325,000	\$325,000	\$0	0.4	0	0
-------------	--------------------------------	-----------	-----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
8	MANDSPASS	325,000	325,000	0 days	Oct 8 '03	Dec 18 '03	\$325,000	\$325,000	\$0	\$325,000

Notes

WBS Definition -

Fabrication of production SVX4 chips.

M&S BOE -

MOSIS/TSMC quotation.

We need about 5000 chips in the detector + 2,000 spares

We order 14,000 chips to include yield. This is a conservative yield of 50%.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Production Chip: manufacturing" continued

Notes

Masks cost is 150K\$ (to be split with D0) and 50K\$/lot (1lot = 10 wafers). Need to order 5 lots.
Total = 75K\$ + 250 K\$ = 325K\$
INFN contributes for 112 Keuro = 100 K\$ (Buy Backs)
Contingency is 50% This is to cover any change in wafer cost and the risk of a lower yield.

Labor BOE -

1.1.2.1.3.7	Production Chip: post processing	\$10,000	\$10,000	\$0	0.4	0	0
-------------	----------------------------------	----------	----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
8	MANDSPASS	10,000	10,000	0 days	Dec 19 '03	Jan 7 '04	\$10,000	\$10,000	\$0	\$10,000

Notes

WBS Definition -
back grounding, backplating and dicing SVX4 chip wafers.

M&S BOE -
Engineering Estimate (R.Yarema, W.Wester)
Total cost is \$200 per wafer. For 50 wafers = 10K\$

Labor BOE -

Schedule BOE -
2 weeks for backgrounding, backplating and dicing.

1.1.2.1.3.8	Production Chip: engineering evaluation at LBL	\$4,500	\$4,500	\$0	0.4	0	0
-------------	--	---------	---------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
8	MANDSPASS	4,500	4,500	0 days	Jan 8 '04	Feb 12 '04	\$4,500	\$4,500	\$0	\$4,500

Notes

WBS Definition -
Engineering evaluation of the svx4 chip at LBL.
Tests performed at LBL include radiation damage assessment.

M&S BOE -

Labor BOE -
Engineering Estiamte.
This is labor cost at LBL as from Henrik Van Der Lippe and Ray Yarema (3/19/02)
project file svx4_0202.mpp of March 20 2002.

1.1.2.1.3.9	CDF chips: Test	\$28,792	\$0	\$28,792	0	0.4	0
-------------	-----------------	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	50%	472 hrs	0 days	Jan 15 '04	Jun 30 '04	\$0	\$0	\$0	\$0
11	Postdoc	150%	1,416 hrs	0 days	Jan 15 '04	Jun 30 '04	\$0	\$0	\$0	\$0

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"CDF chips: Test" continued

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
17	ElecEngF	20%	188.8 hrs	0 days	Jan 15 '04	Jun 30 '04	\$10,384	\$10,384	\$0	\$10,384
18	ElecTechF	50%	472 hrs	0 days	Jan 15 '04	Jun 30 '04	\$18,408	\$18,408	\$0	\$18,408

Notes

WBS Definition -

This covers the mass production tests of the SVX4 chips at FNAL.

M&S BOE -

Labor BOE -

Engineering Evaluation (W.Wester)

1 scientist 50% time for supervision, 1 technician and 1 research associate (or grad students) 75% time each on this for CDF.

Below is the CDF share:

1. Scientist (50%)
2. Elect. Technician (50%)
3. Research Associate (150%)
4. Elect. Engineer (20%) chip designer expert

Schedule BOE -

We are assuming 44 wafers, 320 chips/wafer, and testing rate of 0.5 wafer per day. This includes classifying and sorting chips. It will take 88 days. 1 week has been at the beginning for setup time and 2 weeks have been added at the end for dicing.

1.1.2.1.3.10	Production Chips ready for hybrids	\$0	\$0	\$0	0	0	4
--------------	------------------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

Production SVX4 chips are ready to be mounted on Hybrids.

M&S BOE -

Labor BOE -

Schedule BOE -

1st chips are available 2 weeks after start of testing to take into account the required testing, dicing and logging. This follows the Run IIa experience.

1.1.2.1.3.11	Chip testing Complete	\$0	\$0	\$0	0	0	4
--------------	-----------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

Mass production testing of the SVX4 chips is complete.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.2.2	Transceiver Chips	\$171,670	\$128,000	\$43,670	0	0	0

Notes

WBS Definition -

A new transceiver chip in 0.25um technology (same as the SVX4) is needed in order to minimize the power consumption at the mini-portcard level and the number of independent power supply lines needed for the project (we completely drop the 5V supply line for the mini-PC). The new transceiver chip is only 2.52x2.88 mm^2.

The backup solution is to re-use the old Honeywell 0.85um rad-hard transceiver chip. These old chips are available in quantity sufficient to cover the needs of this project. The mini-portcard prototype#1 uses the old chip. The new chip should be available for the 2nd mini-portcard round and for all the L0 hybrids.

The mini-portcard needs 4 new transceiver chip (or 5 old ones). The L0 hybrid needs 1 transceiver chip (either old or new).

M&S BOE -

Total number of transceiver chips needed (new) is $180 \times 4 + 72 = 792$.

Labor BOE -

1.1.2.2.1	Transceiver chip Prototype	\$41,010	\$16,000	\$25,010	0	0	0
-----------	----------------------------	----------	----------	----------	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.2.1.1	Transceiver: specifications	\$1,650	\$0	\$1,650	0	0	0
-------------	-----------------------------	---------	-----	---------	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
17	ElecEngF	75%	30 hrs	0 days	May 22 '02	May 29 '02	\$1,650	\$1,650	\$1,650	\$0

Notes

WBS Definition -

Specification, internal components and pad layout for the chip.

M&S BOE -

Labor BOE -

1.1.2.2.1.2	Transceiver: layout	\$11,000	\$0	\$11,000	0	0	0
-------------	---------------------	----------	-----	----------	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
17	ElecEngF	100%	200 hrs	0 days	May 30 '02	Jul 3 '02	\$11,000	\$11,000	\$11,000	\$0

Notes

WBS Definition -

Chip layout (including simulation/verification).

M&S BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level			
"Transceiver: layout" continued										
<u>Notes</u>										
Labor BOE -										
1.1.2.2.1.3	Match chip submission: transceiver layout	\$0	\$0	\$0	0	0	0			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										
1.1.2.2.1.4	Transceiver: MPR submission	\$0	\$0	\$0	0	0	4			
<u>Notes</u>										
WBS Definition - This is a MUST date to submit the transceiver chip to a multiproject submission via MOSIS.										
M&S BOE -										
Labor BOE -										
1.1.2.2.1.5	Transceiver: fabrication	\$21,320	\$16,000	\$5,320	0.1	0.4	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
7	MANDS	16,000	16,000	0 days	Jul 15 '02	Sep 23 '02	\$16,000	\$16,000	\$16,000	\$0
17	ElecEngF	10%	40 hrs	0 days	Jul 15 '02	Sep 23 '02	\$2,200	\$2,200	\$2,200	\$0
18	ElecTechF	20%	80 hrs	0 days	Jul 15 '02	Sep 23 '02	\$3,120	\$3,120	\$3,120	\$0
<u>Notes</u>										
WBS Definition - A simple test card will also be developed to test the chip. Schedule and cost includes dicing.										
M&S BOE - \$14,000 for the minimum wafer space on a multiproject run. We will get ~40 chips. \$2,000 (Printed Circuit Board and parts) based on Engineering estimate.										
Labor BOE - 1. Electrical Eng. (10%) 1 week 2. Electrical Tech (20%) 2 weeks										
Schedule BOE - Required time for fabrication is 8 weeks + 4 weeks contingency.										

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.2.2.1.6	Transceiver: evaluation	\$7,040	\$0	\$7,040	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	10%	16 hrs	0 days	Sep 24 '02	Oct 21 '02	\$0	\$0	\$0	\$0
17	ElecEngF	50%	80 hrs	0 days	Sep 24 '02	Oct 21 '02	\$4,400	\$4,400	\$4,400	\$0
21	ElecTechSF	50%	80 hrs	0 days	Sep 24 '02	Oct 21 '02	\$2,640	\$2,640	\$2,640	\$0

Notes
WBS Definition -
This is an engineering evaluation of the chip.
M&S BOE -

1.1.2.2.2	Transceiver chip 2nd prototype	\$64,940	\$56,000	\$8,940	0	0	0
-----------	--------------------------------	----------	----------	---------	---	---	---

Notes
WBS Definition -
M&S BOE -
Labor BOE -

1.1.2.2.2.1	Transceiver: layout modification	\$4,400	\$0	\$4,400	0	0.4	0
-------------	----------------------------------	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
17	ElecEngF	100%	80 hrs	0 days	Oct 8 '02	Oct 21 '02	\$4,400	\$4,400	\$4,400	\$0

Notes
WBS Definition -
M&S BOE -
Labor BOE -

1.1.2.2.2.2	Match Chip Submission: transceiver layout modification	\$0	\$0	\$0	0	0	0
-------------	--	-----	-----	-----	---	---	---

Notes
WBS Definition -
The transceiver chip submission will be combined with the BTeV Fpix submission which is scheduled for Oct. 31.
M&S BOE -
Cost of the submission is 50k\$ for the extra lot of wafers added to the BTeV order.
Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.2.2.2.3	Transceiver: submission	\$0	\$0	\$0	0	0	4

Notes

WBS Definition -

The transceiver chip submission will be combined with the BTeV Fpix submission which is scheduled for Oct. 31.

M&S BOE -

Cost of the submission is 50k\$ for the extra lot of wafers added to the BTeV order.

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.2.2.2.4	Transceiver: fabrication	\$50,000	\$50,000	\$0	0	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	50,000	50,000	0 days	Nov 1 '02	Jan 17 '03	\$50,000	\$50,000	\$50,000	\$0

Notes

WBS Definition -

The transceiver chip submission will be combined with the BTeV Fpix submission which is scheduled for Oct. 31.

M&S BOE -

Cost of the submission is 50k\$ for the extra lot of wafers added to the BTeV order.

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.2.2.2.5	Transceiver: post processing	\$2,000	\$2,000	\$0	0.5	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	2,000	2,000	0 days	Jan 21 '03	Feb 3 '03	\$2,000	\$2,000	\$2,000	\$0

Notes

WBS Definition -

This is the estimated added cost for the dicing of the transceiver chips.

M&S BOE -

Basic dicing and grinding costs are 400\$/wafer for 5 wafers = \$2000

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.2.2.2.6	Transceiver: evaluation	\$2,200	\$0	\$2,200	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	40 hrs	0 days	Feb 4 '03	Feb 17 '03	\$0	\$0	\$0	\$0
17	ElecEngF	50%	40 hrs	0 days	Feb 4 '03	Feb 17 '03	\$2,200	\$2,200	\$2,200	\$0

Notes

WBS Definition -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
-----	------	------	-----	-------	-----------	-------------	-------

"Transceiver: evaluation" continued

Notes
M&S BOE -
Labor BOE -

1.1.2.2.2.7	Transceiver: testing	\$6,340	\$4,000	\$2,340	0.5	0.4	0
-------------	----------------------	---------	---------	---------	-----	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	4,000	4,000	0 days	Feb 18 '03	Mar 10 '03	\$4,000	\$4,000	\$2,000	\$2,000
10	Physicist	25%	30 hrs	0 days	Feb 18 '03	Mar 10 '03	\$0	\$0	\$0	\$0
18	ElecTechF	50%	60 hrs	0 days	Feb 18 '03	Mar 10 '03	\$2,340	\$2,340	\$1,170	\$1,170

Notes
WBS Definition -
M&S BOE -
For probecards, equipment and material. Estimated cost is \$4,000. Contingency is 50%
Labor BOE -
Schedule BOE -
Testing setup for the transceiver chip is estimated to be 2 weeks. We expect the testing to go at a rate of 1 wafer/ day = 5days.

1.1.2.2.2.8	Transceiver Chips available	\$0	\$0	\$0	0	0	4
-------------	-----------------------------	-----	-----	-----	---	---	---

Notes
WBS Definition -
M&S BOE -
Labor BOE -

1.1.2.2.2.9	Transceiver Chips Complete	\$0	\$0	\$0	0	0	4
-------------	----------------------------	-----	-----	-----	---	---	---

Notes
WBS Definition -
M&S BOE -
Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.2.2.3	Transceiver chip production	\$65,720	\$56,000	\$9,720	0	0	0

Notes

WBS Definition -
This assume the transciever chip is submitted with the SVX4chip

M&S BOE -

Labor BOE -

1.1.2.2.3.1	Transceiver: layout modification	\$4,400	\$0	\$4,400	0	0.4	0
-------------	----------------------------------	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
17	ElecEngF	100%	80 hrs	0 days	Sep 24 '03	Oct 7 '03	\$4,400	\$4,400	\$0	\$4,400

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.2.3.2	Transceiver: submission	\$0	\$0	\$0	0	0	4
-------------	-------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -
The transceiver chip submission will be combined with the SVX4 submission
M&S BOE -

Labor BOE -

1.1.2.2.3.3	Transceiver: fabrication	\$50,000	\$50,000	\$0	0	0	0
-------------	--------------------------	----------	----------	-----	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	50,000	50,000	0 days	Oct 8 '03	Dec 18 '03	\$50,000	\$50,000	\$0	\$50,000

Notes

WBS Definition -
The transceiver chip submission will be combined with the SVX4 submission
M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.2.2.3.4	Transceiver: post processing	\$2,000	\$2,000	\$0	0.5	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	2,000	2,000	0 days	Dec 19 '03	Jan 7 '04	\$2,000	\$2,000	\$0	\$2,000

Notes

WBS Definition -
This is the estimated added cost for the dicing of the transceiver chips.

M&S BOE -
Basic dicing and grinding costs costs are 400\$/wafer for 5 wafers = \$2000

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.2.2.3.5	Transceiver: evaluation	\$2,200	\$0	\$2,200	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	40 hrs	0 days	Jan 8 '04	Jan 22 '04	\$0	\$0	\$0	\$0
17	ElecEngF	50%	40 hrs	0 days	Jan 8 '04	Jan 22 '04	\$2,200	\$2,200	\$0	\$2,200

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.2.2.3.6	Transceiver: testing	\$7,120	\$4,000	\$3,120	0.5	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	4,000	4,000	0 days	Jan 23 '04	Feb 19 '04	\$4,000	\$4,000	\$0	\$4,000
10	Physicist	25%	40 hrs	0 days	Jan 23 '04	Feb 19 '04	\$0	\$0	\$0	\$0
18	ElecTechF	50%	80 hrs	0 days	Jan 23 '04	Feb 19 '04	\$3,120	\$3,120	\$0	\$3,120

Notes

WBS Definition -

M&S BOE -
For probecards, equipment and material. Estimated cost is \$4,000. Contingency is 50%

Labor BOE -

Schedule BOE -

Testing setup for the transceiver chip is estimated to be 2 weeks. Testing should proceed at least at the same rate as the svx4 chip (1 wafer/day). Total number of wafers is 20 (for both CDF and D0). With 150 transceiver chips per wafer, this should be enough to ensure transceiver chip for the entire project (3,000 chip vs 800 needed)

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.2.2.3.7	Transceiver Chips available	\$0	\$0	\$0	0	0	4
	<u>Notes</u>						
	WBS Definition -						
	M&S BOE -						
	Labor BOE -						
1.1.2.2.3.8	Transceiver Chips Complete	\$0	\$0	\$0	0	0	4
	<u>Notes</u>						
	WBS Definition -						
	M&S BOE -						
	Labor BOE -						
1.1.2.3	Hybrids	\$1,685,841	\$1,590,841	\$95,000	0	0	0
	<u>Notes</u>						
	WBS Definition -						
	BeO hybrid for Silicon Readout. There are 2 kinds of hybrids: Outer Detector Hybrids (4-chips) and L0 hybrids (2-chips).						
	M&S BOE -						
	The Outer Detector Hybrid is a BeO substrate (2cmx3.9cm). Included in the hybrids are:						
	1. 4 SVX4 chips.						
	2. miscellaneous components (capacitors, resistors, thermistor).						
	3. pitch adapters						
	4. testing boards						
	Runs (4 chips hybrids):						
	1. Prototype#1 (milestone #1 "electrical stave test")						
	2. Protoype#2-Contingency (milestone #2 "contingency electrical stave test")						
	3. Preproduction (milestone #3 "preproduction electrical stave test")						
	4. Production (milestone #4 "Production electrical stave test")						
	Need 1,080 4-chips hybrids						
	The L0 Hybrid is a BeO substrate (2cmx3.9cm). Included in the L0 hybrids are:						
	1. 2 SVX4 chips.						
	2. miscellaneous components (capacitors, resistors, thermistor).						
	3. 1 Transceiver chip						
	4. 2 Kapton pig tails						
	Runs (L0 hybrids):						
	1. Prototype#1						

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level																																		
"Hybrids" continued																																									
	<u>Notes</u>																																								
	2. Production																																								
	Need 72 2-chips hybrid for the project																																								
	Labor BOE -																																								
1.1.2.3.1	Outer layers	\$1,472,968	\$1,381,488	\$91,480	0	0	0																																		
	<u>Notes</u>																																								
	WBS Definition - Outer Detector hybrids (4-chips)																																								
	M&S BOE - Runs (4 chips hybrids):																																								
	1. Prototype (milestone #1 "prototype electrical stave test"), Proto#1 chip																																								
	2. Contingency (milestone #2 "contingency electrical stave test"), Proto#2 chip																																								
	3. Preproduction (milestone #3 "preproduction electrical stave test"), Production chips																																								
	4. Production (milestone #4 "Production electrical stave test"), Production chips																																								
	Need 1,080 hybrids																																								
	Labor BOE -																																								
1.1.2.3.1.1	Outer Hybrid prototypes	\$92,743	\$87,463	\$5,280	0	0	0																																		
	<u>Notes</u>																																								
	WBS Definition - Prototype Hybrids for Outer Detector (4-chip hybrids). We estimate the need for 2 prototype runs to mitigate the risk of this item. The first prototype run will install the first round of svx4 chips. The second prototype will install the second round. The second prototype hybrid submission is contingent upon the completion of the Prototype DAQ test.																																								
	M&S BOE -																																								
	Labor BOE -																																								
1.1.2.3.1.1.1	Hybrid #1: Layout	\$0	\$0	\$0	0	0	0																																		
	<table border="1"> <thead> <tr> <th>ID</th> <th>Resource Name</th> <th>Units</th> <th>Work</th> <th>Delay</th> <th>Start</th> <th>Finish</th> <th>Cost</th> <th>Baseline Cost</th> <th>Act. Cost</th> <th>Rem. Cost</th> </tr> </thead> <tbody> <tr> <td>10</td> <td>Physicist</td> <td>25%</td> <td>158 hrs</td> <td>0 days</td> <td>Jan 11 '02</td> <td>May 2 '02</td> <td>\$0</td> <td>\$0</td> <td>\$0</td> <td>\$0</td> </tr> <tr> <td>16</td> <td>DesignerU</td> <td>45%</td> <td>284.4 hrs</td> <td>0 days</td> <td>Jan 11 '02</td> <td>May 2 '02</td> <td>\$0</td> <td>\$0</td> <td>\$0</td> <td>\$0</td> </tr> </tbody> </table>	ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost	10	Physicist	25%	158 hrs	0 days	Jan 11 '02	May 2 '02	\$0	\$0	\$0	\$0	16	DesignerU	45%	284.4 hrs	0 days	Jan 11 '02	May 2 '02	\$0	\$0	\$0	\$0							
ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost																															
10	Physicist	25%	158 hrs	0 days	Jan 11 '02	May 2 '02	\$0	\$0	\$0	\$0																															
16	DesignerU	45%	284.4 hrs	0 days	Jan 11 '02	May 2 '02	\$0	\$0	\$0	\$0																															
	<u>Notes</u>																																								
	WBS Definition - Layout of the 1st 4-chip hybrid prototype.																																								

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Hybrid #1: Layout" continued

Notes

M&S BOE -
Cost of the CAD designer is in the manufacturing cost.

Labor BOE -
1. Physicist (25%)
2. Designer at LBL (48%)

1.1.2.3.1.1.2	Hybrid#1: Submission	\$0	\$0	\$0	0	0	4
---------------	----------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -
Submission of the 1st prototype hybrid for manufacturing.

M&S BOE -

Labor BOE -

1.1.2.3.1.1.3	Hybrid #1: manufacturing	\$87,463	\$87,463	\$0	0	0	4
---------------	--------------------------	----------	----------	-----	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	87,463	87,463	0 days	May 3 '02	Jul 15 '02	\$87,463	\$87,463	\$87,463	\$0

Notes

WBS Definition -
Hybrid n1. manufacturing at CPT (Xenitronix). We are planning to order 40 hybrids (outer layers=4chips) to have enough for building 5 staves plus spares.

M&S BOE -
Based on "FY2002 development cost for CDF Run2b Hybrids & stave bus" V6.0 Mar-24-2002 (C.Haber, LBL)

Parts:

1. Hybrids
2. pitch adapter
3. hybrid test card
5. components
4. assembly

Total cost (including Labor, overhead and test costs) = \$87,463

Labor BOE -

1.1.2.3.1.1.4	Hybrid #1 ready for chips	\$0	\$0	\$0	0	0	4
---------------	---------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -
Hybrid has been produced and substrate tested. Waiting for chips and other components to be mounted.

M&S BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
-----	------	------	-----	-------	-----------	-------------	-------

"Hybrid #1 ready for chips" continued

Notes

Labor BOE -

Schedule BOE -

This is a week after receiving hybrids to allow for some minimal test.

1.1.2.3.1.1.5 Hybrid #1 assembly and evaluation \$0 \$0 \$0 0 0 0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	25%	80 hrs	0 days	Jul 23 '02	Sep 17 '02	\$0	\$0	\$0	\$0
11	Postdoc	75%	240 hrs	0 days	Jul 23 '02	Sep 17 '02	\$0	\$0	\$0	\$0

Notes

WBS Definition -

Assembly of hybrid n.1 (loading chips, components and bonding) and testing

M&S BOE -

Assembly cost is in "hybrid #1: manufacturing"

Labor BOE -

1. Postdoc (75%)

2. physicist (25%)

1.1.2.3.1.1.6 Hybrid #1 available \$0 \$0 \$0 0 0 4

Notes

WBS Definition -

Available means hybrids are already loaded, bonded, and tested at LBL.

M&S BOE -

Labor BOE -

Schedule BOE -

We are assuming this will be 2 weeks after assembly begun.

1.1.2.3.1.1.7 Hybrid #1: Evaluation at FNAL \$5,280 \$0 \$5,280 0 0.75 0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	150%	720 hrs	0 days	Aug 6 '02	Oct 29 '02	\$0	\$0	\$0	\$0
17	ElecEngF	20%	96 hrs	0 days	Aug 6 '02	Oct 29 '02	\$5,280	\$5,280	\$5,280	\$0

Notes

WBS Definition -

Evaluation of the 1st hybrid at FNAL using the final DAQ system. Tests are continuing at LBL.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Hybrid #1: Evaluation at FNAL" continued

Notes

FNAL labor is:

1. Postdoc (150%) to verify Hybrids operate before module construction begins.
2. Electrical Engineer (20%) as support

1.1.2.3.1.2	2nd round of hybrid	\$90,983	\$87,463	\$3,520	0	0	0
-------------	---------------------	----------	----------	---------	---	---	---

1.1.2.3.1.2.1	Hybrid #2: Layout	\$0	\$0	\$0	0	0	0
---------------	-------------------	-----	-----	-----	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	33%	63.37 hrs	0 days	Mar 3 '03	Apr 3 '03	\$0	\$0	\$0	\$0
16	DesignerU	100%	192 hrs	0 days	Mar 3 '03	Apr 3 '03	\$0	\$0	\$0	\$0

Notes

WBS Definition -

Layout of the 2nd 4-chip hybrid. This is a 2nd run of hybrids. We may wave this option if the first round of chips+hybrids is working reasonably well.

M&S BOE -

Cost of the CAD designer is in the manufacturing cost.

Labor BOE -

1. Physicist at LBL (33%)
2. Designer at LBL (100%)

1.1.2.3.1.2.2	Hybrid #2: Submission	\$0	\$0	\$0	0	0	4
---------------	-----------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

Submission of the 2nd hybrid for manufacturing. Awaits the final go-ahead from the prototype DAQ chain test.

M&S BOE -

Labor BOE -

1.1.2.3.1.2.3	Hybrid #2: manufacturing	\$87,463	\$87,463	\$0	0.2	0	0
---------------	--------------------------	----------	----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	87,463	87,463	0 days	Apr 4 '03	Jun 13 '03	\$87,463	\$87,463	\$0	\$87,463

Notes

WBS Definition -

Hybrid n1. manufacturing at CPT (Xentronix). This is a run in case the first hybrid run has major flaws or modifications occurred to the chip from first to second engineering run which requires hybrid modifications.

M&S BOE -

Based on "FY2002 development cost for CDF Run2b Hybrids & stave bus" V6.0 Mar-24-2002 (C.Haber, LBL)

Parts:

1. Hybrids
2. pitch adapter

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Hybrid #2: manufacturing" continued

Notes

- 3. hybrid test card
- 5. components
- 4. assembly

Total cost (including Labor, overhead and test costs) = \$87,463

Labor BOE -

Schedule BOE -

We are planning to order 40 hybrids (outer layers=4chips) to have enough for building 5 staves plus spares.

1.1.2.3.1.2.4	Hybrid #2 ready for chips	\$0	\$0	\$0	0	0	4
---------------	---------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

Hybrid has been produced and substrate tested. Awaiting for chips and other components to be mounted.

M&S BOE -

Labor BOE -

Schedule BOE -

This is a week after receiving hybrids to allow for some minimal test.

1.1.2.3.1.2.5	Hybrid #2 assembly and evaluation	\$0	\$0	\$0	0	0	0
---------------	-----------------------------------	-----	-----	-----	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	25%	80 hrs	0 days	Jul 15 '03	Sep 9 '03	\$0	\$0	\$0	\$0
11	Postdoc	75%	240 hrs	0 days	Jul 15 '03	Sep 9 '03	\$0	\$0	\$0	\$0

Notes

WBS Definition -

Assembly of hybrid n21 (loading chips, components and bonding) and testing

M&S BOE -

Assembly cost is in "hybrid #2: manufacturing"

Labor BOE -

- 1. Postdoc (75%)
- 2. physicist (25%)

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Hybrid #2 assembly and evaluation" continued

Notes

1.1.2.3.1.2.6	Hybrid #2 available	\$0	\$0	\$0	0	0	4
---------------	---------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -
Available means hybrids are already loaded, bonded, and tested at LBL.

M&S BOE -

Labor BOE -

Schedule BOE -
We are assuming this will be 2 weeks after assembly begun.

1.1.2.3.1.2.7	Hybrid #2: Evaluation at FNAL	\$3,520	\$0	\$3,520	0	0.2	0
---------------	-------------------------------	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	150%	480 hrs	0 days	Jul 29 '03	Sep 23 '03	\$0	\$0	\$0	\$0
17	ElecEngF	20%	64 hrs	0 days	Jul 29 '03	Sep 23 '03	\$3,520	\$3,520	\$0	\$3,520

Notes

WBS Definition -
Evaluation of the 1st hybrid at FNAL using the final DAQ system. Tests are continuing at LBL.
Also the new simplified PC based DAQ system will be used for testing hybrids at this point.

M&S BOE -

Labor BOE -
FNAL labor is:
1. Postdoc (150%) to verify Hybrids operate before module construction begins.
2. Electrical Engineer (20%) as support

1.1.2.3.1.3	Hybrid Preproduction	\$381,344	\$353,264	\$28,080	0	0	0
-------------	----------------------	-----------	-----------	----------	---	---	---

Notes

WBS Definition -
Pre-Production Hybrids for Outer Detector (4-chips hybrids).

M&S BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Hybrid Preproduction" continued

Notes

Labor BOE -

Schedule BOE -

Preproduction is estimated to be 144 working Hybrids. Rate is estimated to be approximately 10 hybrids per week.

1.1.2.3.1.3.1	Setup Hybrid test stands	\$201,462	\$201,462	\$0	0.4	0	0
---------------	--------------------------	-----------	-----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
8	MANDSPASS	201,462	201,462	0 days	Jul 8 '03	Oct 28 '03	\$201,462	\$201,462	\$0	\$201,462

Notes

WBS Definition -

Setting up the equipment at LBL and UC Davis for hybrid production testing and burn-in. It is mostly an update of the existing equipment and software.

M&S BOE -

LBL upgrade costs are handled by LBL with local funds.

UC Davis costs are based on D.Pellet cost estimate of July 2 2002.

Total is 161,462 and includes labor(90,700) , material and services (60,762).

A replica burn-in system will also be installed at FNAL in order to be able to shift the Hybrid testing and burn-in emphasis from LBL/UC-Davis to FNAL if needed. The extra cost for a burn-in system at FNAL is estimated to be \$40,000

Labor BOE -

Schedule BOE -

Needs to be completed and in place by the time preproduction hybrids are ready to be tested.

1.1.2.3.1.3.2	Preproduction Hybrid: Testing training	\$0	\$0	\$0	0	0	0
---------------	--	-----	-----	-----	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	400%	2,560 hrs	0 days	Oct 29 '03	Feb 26 '04	\$0	\$0	\$0	\$0

Notes

WBS Definition -

Training task for Hybrid testing and burn-in.

M&S BOE -

Labor BOE -

This is handled at LBL and UC Davis with contributions from other institutions participating in the project. Preproduction will require 6 FTE of university personnel. Here we assume 2/3 of that.

Schedule BOE -

Schedule get setup for preproduction testing by training people on prototype parts.

1.1.2.3.1.3.3	Preproduction hybrid: Layout	\$0	\$0	\$0	0	0	0
---------------	------------------------------	-----	-----	-----	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	33%	79.2 hrs	0 days	Oct 22 '03	Dec 4 '03	\$0	\$0	\$0	\$0

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
-----	------	------	-----	-------	-----------	-------------	-------

"Preproduction hybrid: Layout" continued

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
16	DesignerU	52%	124.8 hrs	0 days	Oct 22 '03	Dec 4 '03	\$0	\$0	\$0	\$0

Notes

WBS Definition -
Layout of the Preproduction 4-chip hybrid prototype.

M&S BOE -
Cost of the CAD designer is in the manufacturing cost.

Labor BOE -
1. Physicist (33%)
2. Designer at LBL (52%)

1.1.2.3.1.3.4	Preproduction Hybrids: procurement	\$0	\$0	\$0	0	0	0
---------------	------------------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -
Procurement paperwork for Preproduction Hybrid submission.

M&S BOE -

Labor BOE -
Administrative labor is handled outside the silicon schedule.

1.1.2.3.1.3.5	Preproduction Hybrid: Submission	\$0	\$0	\$0	0	0	4
---------------	----------------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -
Submission of the 1st prototype hybrid for manufacturing. Awaits the end of the "testing of prototype#2 DAQ chain"

M&S BOE -

Labor BOE -

1.1.2.3.1.3.6	Preproduction hybrid: manufacturing	\$151,802	\$151,802	\$0	0.4	0	0
---------------	-------------------------------------	-----------	-----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
8	MANDSPASS	151,802	151,802	0 days	Dec 5 '03	Feb 19 '04	\$151,802	\$151,802	\$0	\$151,802

Notes

WBS Definition -
Prototype Outer Detector Hybrid manufacturing.

M&S BOE -
Based on "FY2002 development cost for CDF Run2b Hybrids & stave bus" V6.0 Mar-24-2002 (C.Haber, LBL). Preproduction parts should be enough for building ~24 staves = 144 hybrids.

Parts:
1. Hybrids
2. pitch adapter

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
"Preproduction hybrid: manufacturing" continued							
<u>Notes</u>							
3. hybrid test card							
5. components							
4. assembly							
Total cost (including Labor, overhead and test costs) = \$151,802							
Labor BOE -							
Schedule BOE -							
Submission awaits end of layout and "go-ahead for preproduction" milestone.							

1.1.2.3.1.3.7	Preproduction Hybrid ready for chips	\$0	\$0	\$0	0	0	4
<u>Notes</u>							
WBS Definition -							
Hybrid has been produced and substrate tested. Awaiting for chips and other components to be mounted.							
M&S BOE -							
Labor BOE -							
Schedule BOE -							
This is a week after receiving hybrids to allow for some minimal test.							

1.1.2.3.1.3.8	Preproduction Hybrid assembly and testing	\$14,040	\$0	\$14,040	0	0.4	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
10	Physicist	150%	1,068 hrs	0 days	Feb 27 '04	Jul 1 '04	\$0	\$0	\$0	\$0
11	Postdoc	250%	1,780 hrs	0 days	Feb 27 '04	Jul 1 '04	\$0	\$0	\$0	\$0
18	ElecTechF	50%	360 hrs	0 days	Feb 27 '04	Jul 2 '04	\$14,040	\$14,040	\$0	\$14,040

Notes

WBS Definition -
Assembly of preproduction hybrid (loading chips, components and bonding) and testing

M&S BOE -
Assembly cost is in "Preproduction Hybrid: manufacturing"

Labor BOE -

1. Postdoc (250%)
2. physicist (150%)

Personnel are at LBL and UC Davis. Contributions come from a pool of institutions participating in the project.

Also FNAL participates in the testing (the amount of participation depends on the status of the project at this time). The plan allows for a shift of emphasis from LBL/UC-Davis based tests to FNAL based tests. Total personnel remains invariant.

Contingency is 100%

Schedule BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level			
1.1.2.3.1.3.9	Preproduction Hybrid burn-in	\$14,040	\$0	\$14,040	0	0.4	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
10	Physicist	100%	720 hrs	0 days	Mar 5 '04	Jul 12 '04	\$0	\$0	\$0	\$0
11	Postdoc	200%	1,440 hrs	0 days	Mar 5 '04	Jul 12 '04	\$0	\$0	\$0	\$0
18	ElecTechF	50%	360 hrs	0 days	Mar 5 '04	Jul 12 '04	\$14,040	\$14,040	\$0	\$14,040

Notes

WBS Definition -
Burn-in test of preproduction hybrid.

M&S BOE -
Burn-in cost are in "Setup Hybrids test stands"

Labor BOE -
1. Postdoc (200%)
2. physicist (100%)
Personnel are at UC Davis and contributions come from a pool of institutions participating in the project.
Also FNAL will have a burn-in system for hybrid and the possibility of shifting the burn-in tests at FNAL. Labor is invariant
Contingency is 100%

Schedule BOE -
Considered rate is (170 assembled to yield ~144) about 10/week. Hybrids are available for burn-in 1 week after they are tested at LBL.

1.1.2.3.1.3.10	Preproduction Hybrid Available	\$0	\$0	\$0	0	0	3
----------------	--------------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -
Available means hybrids are already loaded, bonded, tested and burnt-in.

M&S BOE -

Labor BOE -

Schedule BOE -
We are assuming this will be 2 weeks after burn-in started.

1.1.2.3.1.3.11	Contingency on preproduction hybrid availability	\$0	\$0	\$0	0	0	5
1.1.2.3.1.3.12	L2MS preProduction hybrid available	\$0	\$0	\$0	0	0	2
1.1.2.3.1.3.13	Preproduction Hybrid complete	\$0	\$0	\$0	0	0	4

Notes

WBS Definition -
Preproduction Hybrids are assembled and fully tested. All at FNAL.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.2.3.1.4	Hybrid Production	\$907,898	\$853,298	\$54,600	0	0	0

Notes

WBS Definition -
Production Hybrids for Outer Detector (4-chips hybrids).

M&S BOE -

Labor BOE -

Schedule BOE -

Production is estimated to be 1,300 working Hybrids (including ~220 spares). The rate is estimated to be approximately 40 hybrids per week.

1.1.2.3.1.4.1	Production Hybrid: layout	\$0	\$0	\$0	0	0	0
---------------	---------------------------	-----	-----	-----	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	33%	105.6 hrs	0 days	Jun 14 '04	Aug 9 '04	\$0	\$0	\$0	\$0
16	DesignerU	17%	54.4 hrs	0 days	Jun 14 '04	Aug 9 '04	\$0	\$0	\$0	\$0

Notes

WBS Definition -
Layout of the Production 4-chip hybrid prototype.

M&S BOE -

Cost of the CAD designer is in the manufacturing cost.

Labor BOE -

1. Physicist (33%)
2. Designer at LBL (17%)

Schedule BOE -

Layout begins ~2 months after preproduction hybrids have been available for evaluation.

1.1.2.3.1.4.2	Production Hybrids: procurement	\$0	\$0	\$0	0	0	0
---------------	---------------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -
Procurement paperwork for Production Hybrid submission

M&S BOE -

Labor BOE -

Administrative labor is handled outside the silicon schedule.

1.1.2.3.1.4.3	Production Hybrid Submission	\$0	\$0	\$0	0	0	4
---------------	------------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -
Submission of production hybrid for manufacturing. Awaits "DAQ production go-ahead"

M&S BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
-----	------	------	-----	-------	-----------	-------------	-------

"Production Hybrid Submission" continued

Notes

Labor BOE -

1.1.2.3.1.4.4	Production Hybrid: manufacturing	\$853,298	\$853,298	\$0	0.5	0	0
---------------	----------------------------------	-----------	-----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
8	MANDSPASS	853,298	853,298	0 days	Aug 10 '04	Jan 5 '05	\$853,298	\$853,298	\$0	\$853,298

Notes

WBS Definition -

Production Outer Detector Hybrid manufacturing (4-chips hybrids).

M&S BOE -

Based on "Production cost for CDF Run2b Hybrids & stave bus" V3.0 Mar-24-2002 (C.Haber, LBL)

Total cost is \$966,408. Includes yield, labor, overhead, test cards, and tests

Labor BOE -

Schedule BOE -

Submission awaits end of layout and "go-ahead for Production" milestone.

1.1.2.3.1.4.5	Production Hybrid: assembly and testing	\$27,300	\$0	\$27,300	0	0.4	0
---------------	---	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	200%	2,800 hrs	0 days	Oct 20 '04	Jul 1 '05	\$0	\$0	\$0	\$0
11	Postdoc	300%	4,200 hrs	0 days	Oct 20 '04	Jul 1 '05	\$0	\$0	\$0	\$0
18	ElecTechF	50%	700 hrs	0 days	Oct 20 '04	Jul 1 '05	\$27,300	\$27,300	\$0	\$27,300

Notes

WBS Definition -

Assembly of Production hybrid (loading chips, components and bonding) and testing

M&S BOE -

Assembly cost is in "Production Hybrid: manufacturing"

Labor BOE -

1. Postdoc (300%)

2. physicist (200%)

Personnel is at LBL. Contributions come from a pool of institutions participating in the project.

Also FNAL participates in the testing (the amount of participation depends on the status of the project at this time). The plan allows for a shift of emphasis from LBL/UC-Davis based tests to FNAL based tests. Total personnel remains invariant.

Contingency is 100%

Schedule BOE -

Rate is 40/week. Total for 1,400 hybrid to test is 175 days. The experiment needs 1,080 hybrids. Remaining are spares and yield. We assume we will receive the first batch from manufacturing 50d after order is placed.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level			
1.1.2.3.1.4.6	Production Hybrid burn-in	\$27,300	\$0	\$27,300	0	0.4	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
10	Physicist	100%	1,400 hrs	0 days	Oct 27 '04	Jul 11 '05	\$0	\$0	\$0	\$0
11	Postdoc	200%	2,800 hrs	0 days	Oct 27 '04	Jul 11 '05	\$0	\$0	\$0	\$0
18	ElecTechF	50%	700 hrs	0 days	Oct 27 '04	Jul 11 '05	\$27,300	\$27,300	\$0	\$27,300

Notes

WBS Definition -
Burn-in test of production hybrid.

M&S BOE -
Setup Burn-in cost are in "Setup Hybrids test stands".

Labor BOE -
1. Postdoc (200%)
2. physicist (100%)
Personnel is at UC Davis and contributions come from a pool of institutions participating in the project.
Also FNAL will have a burn-in system for hybrid and the possibility of shifting the burn-in tests at FNAL. Labor is invariant
Contingency is 100%

Schedule BOE -
Estimated rate is >40 hybrids/week. Hybrids are available for burn-in 1 week after they are tested at LBL.

1.1.2.3.1.4.7	Production Hybrids Available	\$0	\$0	\$0	0	0	3
---------------	------------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -
Available means hybrids are already loaded, bonded, tested and burnt-in.

M&S BOE -

Labor BOE -

Schedule BOE -
We are assuming this will be 2 weeks after burn-in started.

1.1.2.3.1.4.8	Contingency on Production Hybrid availability	\$0	\$0	\$0	0	0	5
---------------	---	-----	-----	-----	---	---	---

1.1.2.3.1.4.9	L2MS Production hybrid available	\$0	\$0	\$0	0	0	2
---------------	----------------------------------	-----	-----	-----	---	---	---

1.1.2.3.1.4.10	Hybrid Production Complete	\$0	\$0	\$0	0	0	4
----------------	----------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -
Production Hybrids are assembled and fully tested. All at FNAL.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.2.3.2	Layer 0	\$212,873	\$209,353	\$3,520	0	0	0

Notes

WBS Definition -

The L0 Hybrid is a BeO substrate (2cmx3.9cm).

Included in the L0 hybrids are:

1. 2 SVX4 chips.
2. miscellaneous components (capacitors, resistors, thermistor).
3. 1 Transceiver chip
4. 2 Kapton pig tails

Runs (L0 hybrids):

1. Prototype#1
2. Production

Less runs are felt necessary since the technology and the uncertainty on the svx4 chips are covered by the outer detector hybrids.

Need 72 2-chips hybrid for the project.

M&S BOE -

Labor BOE -

1.1.2.3.2.1	Hybrid Layer 0 Prototype	\$65,164	\$61,644	\$3,520	0	0	0
-------------	--------------------------	----------	----------	---------	---	---	---

Notes

WBS Definition -

Prototype Hybrids for Inner Detector (2-chip hybrids). We estimate the need for 1 prototype run since uncertainty on the hybrid technology and svx4 chip quality are already mitigated by the outer hybrid prototype runs. The first prototype run will install the first round of svx4 chips. About 25 hybrids will be built for the 1st prototype.

M&S BOE -

Labor BOE -

1.1.2.3.2.1.1	Prototype#1 L0 hybrid: Layout	\$0	\$0	\$0	0	0	0
---------------	-------------------------------	-----	-----	-----	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	20%	64 hrs	0 days	Aug 26 '02	Oct 21 '02	\$0	\$0	\$0	\$0
16	DesignerU	90%	288 hrs	0 days	Aug 26 '02	Oct 21 '02	\$0	\$0	\$0	\$0

Notes

WBS Definition -

Layout of the Prototype 2-chip hybrid.

M&S BOE -

Cost of the CAD designer is in the manufacturing cost.

Labor BOE -

1. Physicist (20%)
2. Designer at LBL (60%)

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Prototype#1 L0 hybrid: Layout" continued

Notes

Schedule BOE -
Layout can start as soon as the first outer layer hybrid is assembled and tested.

1.1.2.3.2.1.2	Prototype#1 L0 hybrid: Submission	\$0	\$0	\$0	0	0	4
---------------	-----------------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -
Submission of prototype hybrid for manufacturing. Awaits "Prototype#1 L0 hybrid: Layout"

M&S BOE -

Labor BOE -

1.1.2.3.2.1.3	Prototype#1 L0 hybrid: manufacturing	\$61,644	\$61,644	\$0	0.2	0	0
---------------	--------------------------------------	----------	----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	61,644	61,644	0 days	Oct 22 '02	Jan 7 '03	\$61,644	\$61,644	\$61,644	\$0

Notes

WBS Definition -
Production Outer Detector Hybrid manufacturing (4-chips hybrids).

M&S BOE -
Based on "Production cost for CDF Run2b Hybrids & stave bus"
V3.0 Mar-24-2002 (C.Haber, LBL).
72 needed for entire production. Fabricate 25 working L0 hybrids prototypes.
Total cost is \$61,644. Includes yield, labor, overhead, Kapton cables and tests
Contingency is 50%

Labor BOE -

Schedule BOE -
Submission awaits end of layout and "go-ahead for Production" milestone.

1.1.2.3.2.1.4	Prototype #1 L0 Hybrid: assembly and testing	\$0	\$0	\$0	0	0	0
---------------	--	-----	-----	-----	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	25%	60 hrs	0 days	Jan 8 '03	Feb 19 '03	\$0	\$0	\$0	\$0
11	Postdoc	75%	180 hrs	0 days	Jan 8 '03	Feb 19 '03	\$0	\$0	\$0	\$0

Notes

WBS Definition -
Assembly of Prototype #1 L0 hybrid (loading chips, components and bonding) and testing

M&S BOE -
Assembly cost is in "Prototype #1 L0 Hybrid: manufacturing"

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level			
"Prototype #1 L0 Hybrid: assembly and testing" continued										
<u>Notes</u>										
Labor BOE -										
1. Postdoc (75%)										
2. physicist (25%)										
1.1.2.3.2.1.5	Prototype#1 L0 hybrid Available	\$0	\$0	\$0	0	0	4			
<u>Notes</u>										
WBS Definition -										
Available means hybrids are already loaded, bonded and tested at LBL.										
M&S BOE -										
Labor BOE -										
Schedule BOE -										
We are assuming this will be 2 weeks after assembly begun.										
1.1.2.3.2.1.6	Prototype#1 L0 hybrid: evaluation at FNAL	\$3,520	\$0	\$3,520	0	0.4	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
11	Postdoc	75%	240 hrs	0 days	Jan 23 '03	Mar 19 '03	\$0	\$0	\$0	\$0
17	ElecEngF	20%	64 hrs	0 days	Jan 23 '03	Mar 19 '03	\$3,520	\$3,520	\$0	\$3,520
<u>Notes</u>										
WBS Definition -										
Evaluation of the 1st hybrid at FNAL using the final DAQ system. Tests are continuing at LBL.										
M&S BOE -										
Labor BOE -										
FNAL labor is:										
1. Postdoc (75%) to verify Hybrids operate before module construction begins.										
2. Electrical Engineer (20%) as support.										
1.1.2.3.2.2	Hybrid L0 production	\$147,709	\$147,709	\$0	0	0	0			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.2.3.2.2.1	Production L0 Hybrid: final layout	\$0	\$0	\$0	0	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	20%	64 hrs	0 days	May 27 '04	Jul 23 '04	\$0	\$0	\$0	\$0
16	DesignerU	50%	160 hrs	0 days	May 27 '04	Jul 23 '04	\$0	\$0	\$0	\$0

Notes

WBS Definition -
Layout of the Production 2-chip hybrid.

M&S BOE -
Cost of the CAD designer is in the manufacturing cost.

Labor BOE -
1. Physicist (20%)
2. Designer at LBL (50%)

Schedule BOE -
Layout begins at the end of the FNAL evaluation on the prototype.

1.1.2.3.2.2.2	Production L0 Hybrid Submission	\$0	\$0	\$0	0	0	4
---------------	---------------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -
Submission of production hybrid for manufacturing. Awaits results from the first prototype run, the production transceiver submission, and the svx4 chip production submission.

M&S BOE -

Labor BOE -

1.1.2.3.2.2.3	Production L0 hybrid: manufacturing	\$138,349	\$138,349	\$0	0.2	0	0
---------------	-------------------------------------	-----------	-----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
8	MANDSPASS	138,349	138,349	0 days	Jul 26 '04	Oct 4 '04	\$138,349	\$138,349	\$0	\$138,349

Notes

WBS Definition -

M&S BOE -
Estimated from "Hybrid-L0-costs" (06/15/2002)

Total cost is \$138,349. This includes yield, labor, spares, overhead and tests

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.2.3.2.2.4	Production L0 Hybrid: assembly and testing	\$0	\$0	\$0	0	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	25%	60 hrs	0 days	Oct 5 '04	Nov 15 '04	\$0	\$0	\$0	\$0
11	Postdoc	75%	180 hrs	0 days	Oct 5 '04	Nov 15 '04	\$0	\$0	\$0	\$0

Notes

WBS Definition -
Assembly of Production hybrid (loading chips, components and bonding) and testing.

M&S BOE -
Assembly cost is in "Production L0 Hybrid: manufacturing"

Labor BOE -
1. Postdoc (80%)
2. physicist (40%)

Schedule BOE -
Only about 100 hybrids to test. We assume it will be completed in 1.5 months.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.2.3.2.2.5	Production L0 Hybrid burn-in	\$9,360	\$9,360	\$0	0	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	20%	48 hrs	0 days	Oct 12 '04	Nov 22 '04	\$0	\$0	\$0	\$0
11	Postdoc	80%	192 hrs	0 days	Oct 12 '04	Nov 22 '04	\$0	\$0	\$0	\$0
27	MANDSPASSL	9,360	9,360	0 days	Oct 12 '04	Nov 22 '04	\$9,360	\$9,360	\$0	\$9,360

Notes

WBS Definition -
Burn-in test of preproduction hybrid.

M&S BOE -
Burn-in cost are in "Setup Hybrids test stands"

Labor BOE -
1. Postdoc (80%)
2. physicist (20%)
Personnel are at UC Davis and contributions come from a pool of institutions participating in the project.

Schedule BOE -
Hybrids are available for burn-in 1 week after they are tested at LBL.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.2.3.2.2.6	Production L0 hybrid available	\$0	\$0	\$0	0	0	4

Notes

WBS Definition -
Available means hybrids are already loaded, bonded, tested, and burnt-in.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
"Production L0 hybrid available" continued							
	<u>Notes</u>						
	Schedule BOE - We are assuming this will be 2 weeks after burn-in started.						
1.1.2.3.2.2.7	Production L0 hybrid complete	\$0	\$0	\$0	0	0	4
	<u>Notes</u>						
	WBS Definition - Production Hybrids are assembled and fully tested. All at FNAL.						
	M&S BOE -						
	Labor BOE -						
1.1.2.4	L0 analog signal cables	\$391,022	\$325,937	\$58,183	0	0	0
	<u>Notes</u>						
	WBS Definition -						
	M&S BOE -						
	Labor BOE -						
1.1.2.4.1	L0 cables FNAL	\$85,085	\$20,000	\$58,183	0	0	0
	<u>Notes</u>						
	WBS Definition - These are Kapton cables which carry the analog signals from the silicon to the input of the SVX4 chips. We assume we will have 2 long (580mm), 2 medium (400mm) and 2 short (220mm) cables per sector (12*2 sectors in total).						
	Runs: 1. many small test run just to adjust the process 2. preproduction 3. production						
	M&S BOE - Total cables needed = 144						
	Labor BOE -						
1.1.2.4.1.1	L0 cable prototype (FNAL)	\$54,765	\$20,000	\$27,863	0	0	0
	<u>Notes</u>						
	WBS Definition -						

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"L0 cable prototype (FNAL)" continued

Notes
M&S BOE -

Labor BOE -

1.1.2.4.1.1.1	L0 cables technology testing	\$7,403	\$0	\$7,403	0	0	0
---------------	------------------------------	---------	-----	---------	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	10%	159.2 hrs	0 days	Sep 3 '01	Jun 21 '02	\$0	\$0	\$0	\$0
21	ElecTechSF	10%	159.2 hrs	0 days	Sep 3 '01	Jun 21 '02	\$5,254	\$5,254	\$5,254	\$0
23	WirebonderSF	5%	79.6 hrs	0 days	Sep 3 '01	Jun 21 '02	\$2,149	\$2,149	\$2,149	\$0

Notes
WBS Definition -
These are multiple runs with very few cables (L00 style) each just to test the quality of the process. This effort will determine the technology and vendor we will use for final fabrication.

M&S BOE -
We estimated three runs, of a few cables each, at an approximate cost of \$6,000 per run for a total of \$18,000. This is an in-kind contribution from Japan. 50% contingency added.

Labor BOE -
This work will be done in Japan. Estimated in 0.25 FTE (mostly keep contacts with the vendor and FNAL and some testing). No FNAL labor except for minimum testing (wirebonding tests, electrical tests).

1.1.2.4.1.1.2	L0 Test cables Available	\$0	\$0	\$0	0	0	4
---------------	--------------------------	-----	-----	-----	---	---	---

Notes
WBS Definition -
These are the L00 design cables. They can be used for electrical test.

M&S BOE -

Labor BOE -

1.1.2.4.1.1.3	L0 cable prototype design	\$13,320	\$0	\$13,320	0	0	0
---------------	---------------------------	----------	-----	----------	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	25%	60 hrs	0 days	Jun 11 '02	Jul 23 '02	\$0	\$0	\$0	\$0
19	DesignerSF	75%	180 hrs	0 days	Jun 11 '02	Jul 23 '02	\$7,200	\$7,200	\$7,200	\$0
20	MechEngSF	50%	120 hrs	0 days	Jun 11 '02	Jul 23 '02	\$6,120	\$6,120	\$6,120	\$0

Notes
WBS Definition -
This design goes in parallel with the CF support structure design. The preproduction design should be also the final design for L0 cables.

M&S BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level			
"L0 cable prototype design" continued										
<u>Notes</u>										
Labor BOE - The design work will be done at FNAL.										
1.1.2.4.1.1.4	L0 cable prototype fabrication	\$20,000	\$20,000	\$0	0.1	0	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
7	MANDS	20,000	20,000	0 days	Oct 17 '02	Mar 14 '03	\$20,000	\$20,000	\$20,000	\$0
<u>Notes</u>										
This is to investigate and qualify additional vendors										
1.1.2.4.1.1.5	L0 cable prototype available (in US)	\$0	\$0	\$0	0	0	4			
<u>Notes</u>										
WBS Definition - Assume cables are available in US 10 days after they arrive from the vendor in Japan.										
M&S BOE -										
Labor BOE -										
1.1.2.4.1.1.6	L0 cable prototype evaluation (US)	\$14,042	\$0	\$7,140	0	0.4	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
10	Physicist	50%	236 hrs	0 days	Jan 3 '03	Mar 27 '03	\$0	\$0	\$0	\$0
11	Postdoc	50%	236 hrs	0 days	Jan 3 '03	Mar 27 '03	\$0	\$0	\$0	\$0
20	MechEngSF	25%	118 hrs	0 days	Jan 3 '03	Mar 27 '03	\$6,018	\$6,018	\$1,805	\$4,213
22	MechTechSF	50%	236 hrs	0 days	Jan 3 '03	Mar 27 '03	\$8,024	\$8,024	\$2,407	\$5,617
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE - FNAL labor is for testing cables (electrical, mechanical and wirebonding) and establish procedures for cutting and handling them. Some electrical testing will be done in Japan. Japan labor estimated to be 1 FTE.										
1.1.2.4.1.2	L0 cable production (FNAL)	\$30,320	\$0	\$30,320	0	0	0			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.2.4.1.2.1	Explicit Slack: L0 cable production	\$0	\$0	\$0	0	0	5

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.2.4.1.2.2	L0 production cable design	\$25,040	\$0	\$25,040	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	25%	80 hrs	0 days	Oct 22 '03	Dec 18 '03	\$0	\$0	\$0	\$0
19	DesignerSF	100%	320 hrs	0 days	Oct 22 '03	Dec 18 '03	\$12,800	\$12,800	\$0	\$12,800
20	MechEngSF	75%	240 hrs	0 days	Oct 22 '03	Dec 18 '03	\$12,240	\$12,240	\$0	\$12,240

Notes

WBS Definition -

We assume some minor modifications needed to the mechanics of the cable design.

M&S BOE -

Labor BOE -

This is all FNAL labor.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.2.4.1.2.3	L0 Cable Production Test	\$5,280	\$0	\$5,280	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
21	ElecTechSF	20%	160 hrs	0 days	Feb 20 '04	Jul 12 '04	\$5,280	\$5,280	\$0	\$5,280

Notes

WBS Definition -

It is at this point still unclear whether some repair work on the cables will be needed and whether it can be done in Japan. An estimated repair work is added to FNAL.

M&S BOE -

Labor BOE -

FNAL labor to cover repairs.

All tests will be performed in Japan.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.2.4.1.2.4	L0 cables Available (US)	\$0	\$0	\$0	0	0	4

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS Dictionary as of Mar 13 '03
CDF Run2b Silicon Detector Schedule

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level																																		
1.1.2.4.1.2.5	L0 cables Complete	\$0	\$0	\$0	0	0	4																																		
	<u>Notes</u>																																								
	WBS Definition -																																								
	M&S BOE -																																								
	Labor BOE -																																								
1.1.2.4.2	L0 Cable (Japan)	\$305,937	\$305,937	\$0	0	0	0																																		
	<u>Notes</u>																																								
	WBS Definition -																																								
	M&S BOE -																																								
	Labor BOE -																																								
1.1.2.4.2.1	L0 cable Prototype (Japan)	\$49,600	\$49,600	\$0	0	0	0																																		
	<u>Notes</u>																																								
	WBS Definition -																																								
	M&S BOE -																																								
	Labor BOE -																																								
1.1.2.4.2.1.1	L0 cables technology testing	\$20,000	\$20,000	\$0	0	0	0																																		
	<table border="1"> <thead> <tr> <th>ID</th> <th>Resource Name</th> <th>Units</th> <th>Work</th> <th>Delay</th> <th>Start</th> <th>Finish</th> <th>Cost</th> <th>Baseline Cost</th> <th>Act. Cost</th> <th>Rem. Cost</th> </tr> </thead> <tbody> <tr> <td>9</td> <td>INKIND</td> <td>20,000</td> <td>20,000</td> <td>0 days</td> <td>Sep 3 '01</td> <td>Jun 21 '02</td> <td>\$20,000</td> <td>\$20,000</td> <td>\$20,000</td> <td>\$0</td> </tr> <tr> <td>11</td> <td>Postdoc</td> <td>100%</td> <td>1,592 hrs</td> <td>0 days</td> <td>Sep 3 '01</td> <td>Jun 21 '02</td> <td>\$0</td> <td>\$0</td> <td>\$0</td> <td>\$0</td> </tr> </tbody> </table>	ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost	9	INKIND	20,000	20,000	0 days	Sep 3 '01	Jun 21 '02	\$20,000	\$20,000	\$20,000	\$0	11	Postdoc	100%	1,592 hrs	0 days	Sep 3 '01	Jun 21 '02	\$0	\$0	\$0	\$0							
ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost																															
9	INKIND	20,000	20,000	0 days	Sep 3 '01	Jun 21 '02	\$20,000	\$20,000	\$20,000	\$0																															
11	Postdoc	100%	1,592 hrs	0 days	Sep 3 '01	Jun 21 '02	\$0	\$0	\$0	\$0																															
	<u>Notes</u>																																								
	WBS Definition -																																								
	These are multiple runs with very few cables (L00 style) each just to test the quality of the process. This effort will determine the technology and vendor we will use for final fabrication.																																								
	M&S BOE -																																								
	We estimated three runs, of few cables each, at an approximate cost of \$6,000 per run for a total cost of \$18,000. This is an in-kind contribution from Japan. 50% contingency has been added.																																								
	Labor BOE -																																								
	This work will be done in Japan. Estimate to require 1 FTE.																																								

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level			
1.1.2.4.2.1.2	L0 prototype cable fabrication	\$29,600	\$29,600	\$0	0	0	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
9	INKIND	29,600	29,600	0 days	Jul 24 '02	Dec 13 '02	\$29,600	\$29,600	\$29,600	\$0
<u>Notes</u>										
WBS Definition - This task is very long to allow multiple prototype runs. The end of the task is defined by having functional cables for L0 Module construction.										
M&S BOE - Based on quote from KeyCom, Japan. Preproduction quantity is 10 cables for each length. Type A: 1.080 MYen = 8.1K\$ Type B: 1.314 MYen = 9.9K\$ Type C: 1.536 MYen = 11.6K\$ Total = 29.6K\$ Added 50% contingency										
Labor BOE -										
1.1.2.4.2.1.3	L0 cable prototype available (Japan)	\$0	\$0	\$0	0	0	4			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										
1.1.2.4.2.1.4	L0 cable prototype evaluation (Japan)	\$0	\$0	\$0	0	0	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
11	Postdoc	75%	198 hrs	0 days	Dec 16 '02	Feb 5 '03	\$0	\$0	\$0	\$0
<u>Notes</u>										
WBS Definition - All electrical testing and quality assurance is done in Japan. Part of it is done at the company.										
M&S BOE -										
Labor BOE - Japan labor estimated to be 1.5 FTE										
1.1.2.4.2.2	L0 Production Cable Fabrication	\$256,337	\$256,337	\$0	0	0	0			
<u>Notes</u>										
WBS Definition -										

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"L0 Production Cable Fabrication" continued

Notes
M&S BOE -

Labor BOE -

1.1.2.4.2.2.1	L0 production cable fabrication	\$256,337	\$256,337	\$0	0.5	0	0
---------------	---------------------------------	-----------	-----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
9	INKIND	256,337	256,337	0 days	Dec 19 '03	May 13 '04	\$256,337	\$256,337	\$0	\$256,337

Notes
WBS Definition -
L0 production of analogue cables (silicon to hybrids). 6 types of cables, 3 lengths, 48 of each length for the whole detector.

M&S BOE -
Based on quote from KeyCom, Japan. Total is = \$256,337 (in US Dollars)

Labor BOE -

1.1.2.4.2.2.2	L0 production cables available (Japan)	\$0	\$0	\$0	0	0	4
---------------	--	-----	-----	-----	---	---	---

Notes
WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.4.2.2.3	L0 Cable Production Test	\$0	\$0	\$0	0	0	0
---------------	--------------------------	-----	-----	-----	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	150%	1,260 hrs	0 days	Feb 6 '04	Jul 2 '04	\$0	\$0	\$0	\$0

Notes
WBS Definition -
Tests will be performed in Japan. Some tests are part of the production of the cables and have been priced together with the cable.

M&S BOE -

Labor BOE -
Non FNAL labor. Estimated labor in Japan 1.5 FTE.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.2.5	Bus Cables	\$43,386	\$43,386	\$0	0	0	0

Notes

WBS Definition -

Outer layer Bus cable is a Kapton based cable with signal and power traces to electrically connect the mini-PC to the hybrids. It also provides a ground shield plate to minimize noise pick-up from the sensors and the sensor bias connection.

Runs:

1. Prototype (milestone #1 "electrical stave test")
2. Preproduction (milestone #3 "Preproduction electrical stave test")
3. Production (milestone #4 "Production electrical stave test")

M&S BOE -

Need 360 bus cables for the 180 staves installed. We will construct 200 Staves to include 20 spares and thus will need 400 Bus cables.

Labor BOE -

All LBL labor. No FNAL efforts for the Bus Cable.

1.1.2.5.1	Bus Cable Prototype	\$2,385	\$2,385	\$0	0	0	0
-----------	---------------------	---------	---------	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.5.1.1	Prototype#1 Bus Cable: specs, design and Layout	\$0	\$0	\$0	0	0	0
-------------	---	-----	-----	-----	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	100%	792 hrs	0 days	Jan 11 '02	May 31 '02	\$0	\$0	\$0	\$0

Notes

WBS Definition -

M&S BOE -

Labor BOE -

All labor is in LBL by physicists (no FNAL labor).

Schedule BOE -

Submission date coincides with the submission date for the hybrid. Hybrids take longer to fabricate, load, and test.

1.1.2.5.1.2	Prototype#1 Bus Cable Submission	\$0	\$0	\$0	0	0	4
-------------	----------------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Prototype#1 Bus Cable Submission" continued

Notes

Labor BOE -

1.1.2.5.1.3	Prototype#1 Bus Cable: Manufacturing	\$2,385	\$2,385	\$0	0	0	0
-------------	--------------------------------------	---------	---------	-----	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	2,385	2,385	0 days	Jun 3 '02	Sep 10 '02	\$2,385	\$2,385	\$2,385	\$0

Notes

WBS Definition -

We want 2 flavors of these cables (thinner and thicker shield plane) in order to test the noise pick-up on the silicon.

M&S BOE -

Based on "FY2002 development cost for CDF Run2b Hybrids & stave bus" V6.0 Mar-24-2002 (C.Haber, LBL). \$2,385 for 20 parts (10 of each flavor). Includes overhead.

Labor BOE -

1.1.2.5.1.4	Prototype #1 Mechanical Bus cables available	\$0	\$0	\$0	0	0	4
-------------	--	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.5.1.5	Prototype#1 Electrical Bus Cable available	\$0	\$0	\$0	0	0	4
-------------	--	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.5.1.6	Prototype#1 Bus Cable: Evaluation	\$0	\$0	\$0	0	0	0
-------------	-----------------------------------	-----	-----	-----	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	160 hrs	0 days	Sep 10 '02	Nov 4 '02	\$0	\$0	\$0	\$0

Notes

WBS Definition -

M&S BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Prototype#1 Bus Cable: Evaluation" continued

Notes

Labor BOE -
All labor is done at LBL (no FNAL labor).

1.1.2.5.2	Bus Cable #2	\$2,385	\$2,385	\$0	0	0	0
1.1.2.5.2.1	#2 Bus Cable: design and Layout	\$0	\$0	\$0	0	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	100%	160 hrs	0 days	Mar 7 '03	Apr 3 '03	\$0	\$0	\$0	\$0

Notes

WBS Definition -

M&S BOE -

Labor BOE -
All labor is in LBL by physicists (no FNAL labor).

Schedule BOE -
Submission date coincides with the submission date for the hybrid. Hybrids take longer to fabricate, load, and test.

1.1.2.5.2.2	#2 Bus Cable Submission	\$0	\$0	\$0	0	0	4
-------------	-------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.5.2.3	#2 manufacturing	\$2,385	\$2,385	\$0	0	0	0
-------------	------------------	---------	---------	-----	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	2,385	2,385	0 days	Apr 4 '03	Jun 13 '03	\$2,385	\$2,385	\$0	\$2,385

Notes

WBS Definition -

M&S BOE -
Cost is the same as 1st round of prototype cables. Based on "FY2002 development cost for CDF Run2b Hybrids & stave bus" V6.0 Mar-24-2002 (C.Haber, LBL). \$2,385 for 20 parts (10 of each flavor). Includes overhead.

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level																							
1.1.2.5.2.4	#2 Mechanical Bus cables available	\$0	\$0	\$0	0	0	4																							
	<u>Notes</u>																													
	WBS Definition -																													
	M&S BOE -																													
	Labor BOE -																													
1.1.2.5.2.5	#2 Electrical Bus Cable available	\$0	\$0	\$0	0	0	4																							
	<u>Notes</u>																													
	WBS Definition -																													
	M&S BOE -																													
	Labor BOE -																													
1.1.2.5.2.6	#2 Bus Cable: Evaluation	\$0	\$0	\$0	0	0	0																							
	<table border="1"> <thead> <tr> <th>ID</th> <th>Resource Name</th> <th>Units</th> <th>Work</th> <th>Delay</th> <th>Start</th> <th>Finish</th> <th>Cost</th> <th>Baseline Cost</th> <th>Act. Cost</th> <th>Rem. Cost</th> </tr> </thead> <tbody> <tr> <td>11</td> <td>Postdoc</td> <td>50%</td> <td>160 hrs</td> <td>0 days</td> <td>Jun 16 '03</td> <td>Aug 11 '03</td> <td>\$0</td> <td>\$0</td> <td>\$0</td> <td>\$0</td> </tr> </tbody> </table>	ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost	11	Postdoc	50%	160 hrs	0 days	Jun 16 '03	Aug 11 '03	\$0	\$0	\$0	\$0							
ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost																				
11	Postdoc	50%	160 hrs	0 days	Jun 16 '03	Aug 11 '03	\$0	\$0	\$0	\$0																				
	<u>Notes</u>																													
	WBS Definition -																													
	M&S BOE -																													
	Labor BOE -																													
	All labor is done at LBL (no FNAL labor).																													
1.1.2.5.3	Bus Cable Preproduction and Production	\$38,616	\$38,616	\$0	0	0	0																							
	<u>Notes</u>																													
	WBS Definition -																													
	M&S BOE -																													
	Labor BOE -																													
1.1.2.5.3.1	Preproduction Bus Cable: layout	\$0	\$0	\$0	0	0	0																							
	<table border="1"> <thead> <tr> <th>ID</th> <th>Resource Name</th> <th>Units</th> <th>Work</th> <th>Delay</th> <th>Start</th> <th>Finish</th> <th>Cost</th> <th>Baseline Cost</th> <th>Act. Cost</th> <th>Rem. Cost</th> </tr> </thead> <tbody> <tr> <td>11</td> <td>Postdoc</td> <td>50%</td> <td>120 hrs</td> <td>0 days</td> <td>Oct 22 '03</td> <td>Dec 4 '03</td> <td>\$0</td> <td>\$0</td> <td>\$0</td> <td>\$0</td> </tr> </tbody> </table>	ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost	11	Postdoc	50%	120 hrs	0 days	Oct 22 '03	Dec 4 '03	\$0	\$0	\$0	\$0							
ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost																				
11	Postdoc	50%	120 hrs	0 days	Oct 22 '03	Dec 4 '03	\$0	\$0	\$0	\$0																				

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level			
"Preproduction Bus Cable: layout" continued										
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE - All labor is done at LBL (no FNAL labor).										
Schedule BOE - Submission date coincides with the submission date for the preproduction hybrids. Hybrids take longer to fabricate, load, and test.										
1.1.2.5.3.2	Preproduction Bus Cable Submission	\$0	\$0	\$0	0	0	4			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										
1.1.2.5.3.3	Preproduction Bus Cable: manufacturing	\$6,466	\$6,466	\$0	0.4	0	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
8	MANDSPASS	6,466	6,466	0 days	Dec 5 '03	Feb 19 '04	\$6,466	\$6,466	\$0	\$6,466
<u>Notes</u>										
WBS Definition -										
M&S BOE - Based on "FY2002 development cost for CDF Run2b Hybrids & stave bus" V6.0 Mar-24-2002 (C.Haber, LBL). \$6,466 for 60 parts. Includes overhead.										
Labor BOE -										
1.1.2.5.3.4	Preproduction Bus Cables available	\$0	\$0	\$0	0	0	4			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										

WBS Dictionary as of Mar 13 '03
CDF Run2b Silicon Detector Schedule

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level			
1.1.2.5.3.5	Production Bus Cable: final design and layout	\$0	\$0	\$0	0	0	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
11	Postdoc	50%	120 hrs	0 days	Jun 28 '04	Aug 9 '04	\$0	\$0	\$0	\$0
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										
All labor is in LBL by physicists (no FNAL labor).										
Schedule BOE -										
Submission date coincides with the submission date for the preproduction hybrid. Hybrids take longer to fabricate, load, and test. This task is contingency.										
1.1.2.5.3.6	Production Bus Cable Submission	\$0	\$0	\$0	0	0	4			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										
1.1.2.5.3.7	Production Bus Cable: manufacturing	\$32,150	\$32,150	\$0	0.4	0	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
8	MANDSPASS	32,150	32,150	0 days	Aug 10 '04	Oct 19 '04	\$32,150	\$32,150	\$0	\$32,150
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Based on "FY2002 development cost for CDF Run2b Hybrids & stave bus" V6.0 Mar-24-2002 (C.Haber, LBL). \$32,150 for 400 parts. Includes overhead.										
1.1.2.5.3.8	Production Bus cables available	\$0	\$0	\$0	0	0	4			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.2.5.3.9	Production Bus Cables complete	\$0	\$0	\$0	0	0	4

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.6	Mini Port Card	\$585,270	\$362,936	\$205,104	0	0	0
----------------	-----------------------	------------------	------------------	------------------	----------	----------	----------

Notes

WBS Definition -

The MPC is a BeO hybrid (2"x1.55"). Included in the MiniPortcards are:

1. components (including transceiver chips), connectors etc.
2. short Kapton cables (2 cables, one for power and one for data)
3. cable wing (one Kapton cable that connects the top MPC to the bottom stave bus cable)

Runs:

1. Prototype (milestone #1 "electrical stave test")
2. Contingency (milestone #2 "contingency electrical stave test")
3. Preproduction (milestone #3 "preproduction electrical stave test")
4. Production (milestone #4 "Production electrical stave test")

M&S BOE -

Need **180** Mini Port Cards for the project.

Labor BOE -

1.1.2.6.1	Mini Port Card Prototypes	\$132,888	\$45,522	\$61,624	0	0	0
------------------	----------------------------------	------------------	-----------------	-----------------	----------	----------	----------

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.6.1.1	Prototype#1 MPC: specs, design and layout	\$44,744	\$0	\$44,744	0	0	0
-------------	---	----------	-----	----------	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
17	ElecEngF	50%	476 hrs	0 days	Oct 29 '01	Apr 25 '02	\$26,180	\$26,180	\$26,180	\$0
18	ElecTechF	50%	476 hrs	0 days	Oct 29 '01	Apr 25 '02	\$18,564	\$18,564	\$18,564	\$0

Notes

WBS Definition -

Layout should finish together with the Hybrid#1 design.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Prototype#1 MPC: specs, design and layout" continued

Notes

M&S BOE -

Labor BOE -

1.1.2.6.1.2	Prototype#1 MPC submission	\$0	\$0	\$0	0	0	4
-------------	----------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.6.1.3	Prototype#1 MPC: manufacturing	\$45,522	\$45,522	\$0	0	0	0
-------------	--------------------------------	----------	----------	-----	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	45,522	45,522	0 days	Apr 26 '02	Oct 1 '02	\$45,522	\$45,522	\$45,522	\$0

Notes

WBS Definition -

We need 10 mini-PC to sustain the stave prototype effort + test stand needs.

M&S BOE -

- 1/31/2002 estimated cost is (quotation from CPT n. 1-1201-112)

- newer quotation (02/01/2002) :

1. 25 (minimum order) MPC @ 1,168.90 each
2. NRE 4,500.00
3. Pigtail (2) 370.00 (per MPC) 185 each
4. cable wing 210.00 (per MPC)
3. miscellaneous components 600.00 (per MPC)

45,522.50

We priced the "loading" of 10 MPCs as prototypes.

Labor BOE -

1.1.2.6.1.4	Prototype#1 MPC: assembly and evaluation	\$42,622	\$0	\$16,880	0	0.4	0
-------------	--	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	404 hrs	0 days	Oct 2 '02	Feb 28 '03	\$0	\$0	\$0	\$0
17	ElecEngF	25%	202 hrs	0 days	Oct 2 '02	Feb 28 '03	\$11,110	\$4,400	\$11,110	\$0
18	ElecTechF	100%	808 hrs	0 days	Oct 2 '02	Feb 28 '03	\$31,512	\$12,480	\$31,512	\$0

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
-----	------	------	-----	-------	-----------	-------------	-------

"Prototype#1 MPC: assembly and evaluation" continued

Notes
WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.6.1.5	Prototype#1 MPC Available	\$0	\$0	\$0	0	0	4
-------------	---------------------------	-----	-----	-----	---	---	---

Notes
WBS Definition -

M&S BOE -

Labor BOE -

Schedule BOE -
This has 10 days for assembly after receiving parts and 5 days (1week) for testing and debugging.

1.1.2.6.2	2nd Mini Port Card	\$75,170	\$45,522	\$38,160	0	0	0
------------------	---------------------------	-----------------	-----------------	-----------------	----------	----------	----------

1.1.2.6.2.1	#2 MPC: design and layout	\$12,768	\$0	\$21,280	0	0.4	0
-------------	---------------------------	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
17	ElecEngF	50%	96 hrs	0 days	Mar 3 '03	Apr 3 '03	\$5,280	\$5,280	\$4,752	\$528
18	ElecTechF	100%	192 hrs	0 days	Mar 3 '03	Apr 3 '03	\$7,488	\$7,488	\$6,739	\$749

Notes
WBS Definition -
This is a run of MPCs. We would wave this option if the first round of chips+hybrids+MPC is working reasonably well.

M&S BOE -

Labor BOE -

Schedule BOE -
Submission date is linked to the DAQ go ahead for round 2.

1.1.2.6.2.2	#2 MPC Submission	\$0	\$0	\$0	0	0	4
-------------	-------------------	-----	-----	-----	---	---	---

Notes
WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"#2 MPC Submission" continued

Notes

1.1.2.6.2.3 #2 MPC: manufacturing \$45,522 \$45,522 \$0 0.2 0 0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	45,522	45,522	0 days	Apr 4 '03	Jun 13 '03	\$45,522	\$45,522	\$0	\$45,522

Notes

WBS Definition -

M&S BOE -

This cost is the same as for "Prototype#1 MPC: manufacturing".

Labor BOE -

1.1.2.6.2.4 #2 MPC: assembly and evaluation \$16,880 \$0 \$16,880 0 0.4 0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	160 hrs	0 days	Jun 16 '03	Aug 11 '03	\$0	\$0	\$0	\$0
17	ElecEngF	25%	80 hrs	0 days	Jun 16 '03	Aug 11 '03	\$4,400	\$4,400	\$0	\$4,400
18	ElecTechF	100%	320 hrs	0 days	Jun 16 '03	Aug 11 '03	\$12,480	\$12,480	\$0	\$12,480

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.6.2.5 #2 MPC Available \$0 \$0 \$0 0 0 4

Notes

WBS Definition -

M&S BOE -

Labor BOE -

Schedule BOE -

This has 10 days for assembly after receiving parts and 5 days for testing.

1.1.2.6.3 Mini Port Card Preproduction \$102,792 \$63,712 \$39,080 0 0 0

Notes

WBS Definition -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Mini Port Card Preproduction" continued

Notes
M&S BOE -

Labor BOE -

1.1.2.6.3.1	Preproduction MPC: design and layout	\$15,960	\$0	\$15,960	0	0.4	0
-------------	--------------------------------------	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
17	ElecEngF	50%	120 hrs	0 days	Oct 22 '03	Dec 4 '03	\$6,600	\$6,600	\$0	\$6,600
18	ElecTechF	100%	240 hrs	0 days	Oct 22 '03	Dec 4 '03	\$9,360	\$9,360	\$0	\$9,360

Notes
WBS Definition -
Linked to the Preproduction hybrid layout.

M&S BOE -

Labor BOE -

1.1.2.6.3.2	Preproduction MPC Submission	\$0	\$0	\$0	0	0	4
-------------	------------------------------	-----	-----	-----	---	---	---

Notes
WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.6.3.3	Preproduction MPC: manufacturing	\$63,712	\$63,712	\$0	0.5	0	0
-------------	----------------------------------	----------	----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	63,712	63,712	0 days	Dec 5 '03	Feb 19 '04	\$63,712	\$63,712	\$0	\$63,712

Notes
WBS Definition -

M&S BOE -
We order enough to sustain stave preproduction. 24 staves = 30 MPC including some spares and yield.

30 MPC (same price as the prototypes)
1. finished substrate @ 1,169 (per MPC)
2. NRE 4,500
3. Pig Tails 3,895 (for 100 cables, 2 per MPC needed)
4. cable wing 2,250 (for 100 wings, 1 per MPC needed)
3. miscellaneous components 600 (per MPC) includes testing cards

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Preproduction MPC: manufacturing" continued

Notes

\$ 63,712

Labor BOE -

1.1.2.6.3.4	Preproduction MPC assembly and evaluation	\$23,120	\$0	\$23,120	0	0.4	0
-------------	---	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	100%	320 hrs	0 days	Feb 20 '04	Apr 15 '04	\$0	\$0	\$0	\$0
17	ElecEngF	25%	80 hrs	0 days	Feb 20 '04	Apr 15 '04	\$4,400	\$4,400	\$0	\$4,400
18	ElecTechF	150%	480 hrs	0 days	Feb 20 '04	Apr 15 '04	\$18,720	\$18,720	\$0	\$18,720

Notes

WBS Definition -

M&S BOE -

Labor BOE -

Schedule BOE -

This assumes 40 days for producing first substrates plus 20 days for loading and testing. This should also coincide with preproduction hybrids available.

1.1.2.6.3.5	Preproduction MPC Available	\$0	\$0	\$0	0	0	4
-------------	-----------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.6.4	Mini Port Card Production	\$274,420	\$208,180	\$66,240	0	0	0
-----------	---------------------------	-----------	-----------	----------	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.6.4.1	Production MPC: design and layout	\$8,440	\$0	\$8,440	0	0.4	0
-------------	-----------------------------------	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
17	ElecEngF	25%	40 hrs	0 days	Jul 13 '04	Aug 9 '04	\$2,200	\$2,200	\$0	\$2,200
18	ElecTechF	100%	160 hrs	0 days	Jul 13 '04	Aug 9 '04	\$6,240	\$6,240	\$0	\$6,240

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Production MPC: design and layout" continued

Notes

WBS Definition -

M&S BOE -

Labor BOE -

Schedule BOE -

Linked to the production hybrid layout. This task is contingency.

1.1.2.6.4.2	Production MPC go ahead	\$0	\$0	\$0	0	0	4
-------------	-------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.6.4.3	Production MPC: manufacturing	\$208,180	\$208,180	\$0	0.5	0	0
-------------	-------------------------------	-----------	-----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	208,180	208,180	0 days	Aug 10 '04	Dec 2 '04	\$208,180	\$208,180	\$0	\$208,180

Notes

WBS Definition -

M&S BOE -

We need 180 + spares = 200 MPC:

Production price is (quotation from CPT 1-1201-112)

MPC @ 418.00 each

NRE @ 4,500.00

pigtails are 77.90 per MPC

wing is 22.50 per MPC

components is 500 per MPC (includes testing cards)

Total is \$208,180

Labor BOE -

1.1.2.6.4.4	Production MPC available	\$0	\$0	\$0	0	0	4
-------------	--------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
-----	------	------	-----	-------	-----------	-------------	-------

"Production MPC available" continued

Notes

Labor BOE -

Schedule BOE -

40 days for production of first substrates and 20 days for assembly and testing.

1.1.2.6.4.5	Production MPC: assembly and evaluation	\$57,800	\$0	\$57,800	0	0.4	0
-------------	---	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	100%	800 hrs	0 days	Oct 20 '04	Mar 17 '05	\$0	\$0	\$0	\$0
17	ElecEngF	25%	200 hrs	0 days	Oct 20 '04	Mar 17 '05	\$11,000	\$11,000	\$0	\$11,000
18	ElecTechF	150%	1,200 hrs	0 days	Oct 20 '04	Mar 17 '05	\$46,800	\$46,800	\$0	\$46,800

Notes

WBS Definition -

M&S BOE -

Labor BOE -

Schedule BOE -

We need to sustain a rate of 1MPC/day or 5MPC/week. It should be possible to load and test at least 2/day (10/week). For production quantity of 200 MPC this is 100 days.

1.1.2.6.4.6	Production MPC complete	\$0	\$0	\$0	0	0	4
-------------	-------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.7	Junction Port Cards	\$262,558	\$150,000	\$112,558	0	0	0
---------	---------------------	-----------	-----------	-----------	---	---	---

Notes

WBS Definition -

The JPC is an FR4 board for signal and power distribution. JPC includes the components such as capacitors, resistors, power filters, FPGA, connectors etc. and the Runs as follows:

1. Prototype#1 (milestone#1 "prototype electrical stave test")
2. Prototype#2 - contingency
3. Preproduction (milestone#3 "preproduction electrical stave test")
4. Production (milestone#4 "production electrical stave test")

Each port card can serve up to 5 mini-PC.

M&S BOE -

Total number of JPC for the project (including L0) is **54**.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
-----	------	------	-----	-------	-----------	-------------	-------

"Junction Port Cards" continued

Notes

Labor BOE -

1.1.2.7.1	Junction Port Card Prototypes	\$48,318	\$9,000	\$39,318	0	0	0
-----------	-------------------------------	----------	---------	----------	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.7.1.1	JPC for milestone #1	\$4,400	\$0	\$4,400	0	0	0
-------------	----------------------	---------	-----	---------	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	160 hrs	0 days	Jun 17 '02	Aug 12 '02	\$0	\$0	\$0	\$0
17	ElecEngF	25%	80 hrs	0 days	Jun 17 '02	Aug 12 '02	\$4,400	\$4,400	\$4,400	\$0

Notes

WBS Definition -

This card is already done. It was developed for BTeV and can be used for the milestone #1.

Optionally, we would like to have also the prototype #1 JPC ready for milestone #1 but it is not mandatory. This JPC has the same functionality of the final JPC.

M&S BOE -

Labor BOE -

This is to program the card (firmware).

1.1.2.7.1.2	Explicit Slack: start JPC design	\$0	\$0	\$0	0	0	5
-------------	----------------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.7.1.3	Prototype#1 JPC: specs, design and layout	\$16,758	\$0	\$16,758	0	0.4	0
-------------	---	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
17	ElecEngF	25%	126 hrs	0 days	Jan 31 '03	Apr 29 '03	\$6,930	\$6,930	\$3,119	\$3,812
18	ElecTechF	50%	252 hrs	0 days	Jan 31 '03	Apr 29 '03	\$9,828	\$9,828	\$4,423	\$5,405

Notes

WBS Definition -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level			
"Prototype#1 JPC: specs, design and layout" continued										
<u>Notes</u>										
M&S BOE -										
Labor BOE -										
Schedule BOE - linked to the end of the mini-PC evaluation.										
1.1.2.7.1.4	Prototype#1 JPC Submission	\$0	\$0	\$0	0	0	4			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										
1.1.2.7.1.5	Prototype#1 JPC: manufacturing	\$9,000	\$9,000	\$0	0.5	0	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
7	MANDS	9,000	9,000	0 days	Apr 30 '03	May 28 '03	\$9,000	\$9,000	\$0	\$9,000
<u>Notes</u>										
WBS Definition -										
M&S BOE - We need 5 for testing chips/hybrids/mpc/cables and staves at \$800 each for the FR4 manufacturing (Engineering Estimate) and \$1,000 each for miscellaneous components (Engineering Estimate) for a total cost of \$9,000.										
Labor BOE -										
1.1.2.7.1.6	Prototype#1 JPC: loading and testing	\$6,880	\$0	\$6,880	0	0.4	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
17	ElecEngF	25%	40 hrs	0 days	May 29 '03	Jun 25 '03	\$2,200	\$2,200	\$0	\$2,200
18	ElecTechF	75%	120 hrs	0 days	May 29 '03	Jun 25 '03	\$4,680	\$4,680	\$0	\$4,680
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE - Loading and testing done at FNAL.										

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.2.7.1.7	Prototype#1 JPC Available	\$0	\$0	\$0	0	0	4
	<u>Notes</u>						
	WBS Definition - This is the 1st real prototype JPC. It will tested with the 2nd round of the hybrids and staves.						
	M&S BOE -						
	Labor BOE -						
1.1.2.7.1.8	Prototype#1JPC: evaluation	\$11,280	\$0	\$11,280	0	0.4	0
	<u>Notes</u>						
	WBS Definition - Noise and DAQ chain compatibility tests.						
	M&S BOE -						
	Labor BOE -						
1.1.2.7.2	2nd Junction Port Card	\$34,680	\$9,000	\$25,680	0	0	0
1.1.2.7.2.1	#2 JPC: design and layout	\$11,280	\$0	\$11,280	0	0.4	0
	<u>Notes</u>						
	WBS Definition - This is a 2nd run of JPCs. We would wave this option if the first round of chips+hybrids+MPC+JPC is working reasonably well.						
	M&S BOE -						
	Labor BOE - This is the same as for the 1st prototype.						
1.1.2.7.2.2	#2 JPC Submission	\$0	\$0	\$0	0	0	4
	<u>Notes</u>						
	WBS Definition -						
	M&S BOE -						
	Labor BOE -						

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
-----	------	------	-----	-------	-----------	-------------	-------

"#2 JPC Submission" continued

Notes

1.1.2.7.2.3 #2 JPC: manufacturing \$9,000 \$9,000 \$0 0 0 0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	9,000	9,000	0 days	Nov 3 '03	Dec 2 '03	\$9,000	\$9,000	\$0	\$9,000

Notes

WBS Definition -

M&S BOE -

We need 5 for testing chips/hybrids/mpc/cables and staves at \$800 each for the FR4 manufacturing (Engineering Estimate) and \$1,000 each for miscellaneous components (Engineering Estimate) for a total cost of \$9,000.

Labor BOE -

1.1.2.7.2.4 #2 JPC: loading and testing \$6,880 \$0 \$6,880 0 0.4 0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
17	ElecEngF	25%	40 hrs	0 days	Dec 3 '03	Jan 5 '04	\$2,200	\$2,200	\$0	\$2,200
18	ElecTechF	75%	120 hrs	0 days	Dec 3 '03	Jan 5 '04	\$4,680	\$4,680	\$0	\$4,680

Notes

WBS Definition -

M&S BOE -

Labor BOE -

Loading and testing done at FNAL.

1.1.2.7.2.5 #2 JPC Available \$0 \$0 \$0 0 0 4

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.7.2.6 #2: JPC evaluation \$7,520 \$0 \$7,520 0 0.4 0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	25%	80 hrs	0 days	Jan 6 '04	Mar 2 '04	\$0	\$0	\$0	\$0
17	ElecEngF	25%	80 hrs	0 days	Jan 6 '04	Mar 2 '04	\$4,400	\$4,400	\$0	\$4,400
18	ElecTechF	25%	80 hrs	0 days	Jan 6 '04	Mar 2 '04	\$3,120	\$3,120	\$0	\$3,120

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level				
"#2: JPC evaluation" continued											
<u>Notes</u>											
WBS Definition -											
M&S BOE -											
Labor BOE -											
1.1.2.7.3	Junction Portcard Preproduction	\$56,068	\$28,500	\$27,568	0	0	0				
<u>Notes</u>											
WBS Definition -											
M&S BOE -											
Labor BOE -											
1.1.2.7.3.1	Explicit Slack: Preproduction and production JPC design	\$0	\$0	\$0	0	0	5				
1.1.2.7.3.2	Preproduction JPC: design and layout	\$15,040	\$0	\$15,040	0	0.4	0				
	<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
	17	ElecEngF	50%	160 hrs	0 days	Oct 4 '04	Nov 30 '04	\$8,800	\$8,800	\$0	\$8,800
	18	ElecTechF	50%	160 hrs	0 days	Oct 4 '04	Nov 30 '04	\$6,240	\$6,240	\$0	\$6,240
<u>Notes</u>											
WBS Definition -											
M&S BOE -											
Labor BOE -											
Schedule BOE -											
Linked to the MPC preproduction.											
1.1.2.7.3.3	Preproduction JPC Submission	\$0	\$0	\$0	0	0	4				
<u>Notes</u>											
WBS Definition -											
M&S BOE -											
Labor BOE -											

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.2.7.3.4	Preproduction JPC: manufacturing	\$25,500	\$25,500	\$0	0.5	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	25,500	25,500	0 days	Dec 1 '04	Dec 30 '04	\$25,500	\$25,500	\$0	\$25,500

Notes

WBS Definition -

M&S BOE -

We need 10 (preproduction) plus an additional 5 for testing setups including spares.

\$600 each for FR4 boards and \$1,100 each for components, loading, and testing (Engineering Estimate) for a total cost of \$25,500.

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.2.7.3.5	Preproduction JPC: assembly	\$3,000	\$3,000	\$0	0.5	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	3,000	3,000	0 days	Jan 11 '05	Feb 8 '05	\$3,000	\$3,000	\$0	\$3,000

Notes

WBS Definition -

M&S BOE -

This work will be done by an outside company. Estimated cost is \$200 for each JPC.

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.2.7.3.6	Preproduction JPC: testing	\$6,880	\$0	\$6,880	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
17	ElecEngF	25%	40 hrs	0 days	Feb 9 '05	Mar 8 '05	\$2,200	\$2,200	\$0	\$2,200
18	ElecTechF	75%	120 hrs	0 days	Feb 9 '05	Mar 8 '05	\$4,680	\$4,680	\$0	\$4,680

Notes

WBS Definition -

M&S BOE -

Labor BOE -

Testing will be done at FNAL making use of the following personnel resources.

1. Electrical Eng. (25%) support
2. Electrical Tech (75%) testing

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.2.7.3.7	Preproduction JPC available	\$0	\$0	\$0	0	0	4

Notes

WBS Definition -

M&S BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Preproduction JPC available" continued

Notes
Labor BOE -

Schedule BOE -
Lag time of 20days for loading and testing.

1.1.2.7.3.8	Preproduction JPC: evaluation	\$5,648	\$0	\$5,648	0	0.4	0
-------------	-------------------------------	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	75%	240 hrs	0 days	Mar 9 '05	May 3 '05	\$0	\$0	\$0	\$0
17	ElecEngF	25%	80 hrs	0 days	Mar 9 '05	May 3 '05	\$4,400	\$4,400	\$0	\$4,400
18	ElecTechF	10%	32 hrs	0 days	Mar 9 '05	May 3 '05	\$1,248	\$1,248	\$0	\$1,248

Notes
WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.7.4	Junction Portcard Production	\$123,492	\$103,500	\$19,992	0	0	0
-----------	------------------------------	-----------	-----------	----------	---	---	---

Notes
WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.7.4.1	Production JPC: design and layout	\$2,200	\$0	\$2,200	0	0.4	0
-------------	-----------------------------------	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	80 hrs	0 days	May 4 '05	Jun 1 '05	\$0	\$0	\$0	\$0
17	ElecEngF	25%	40 hrs	0 days	May 4 '05	Jun 1 '05	\$2,200	\$2,200	\$0	\$2,200

Notes
WBS Definition -

M&S BOE -

Labor BOE -

Schedule BOE -
Linked to the MPC production layout. This task is contingency.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.2.7.4.2	Production JPC go ahead	\$0	\$0	\$0	0	0	4

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.2.7.4.3	Production JPC: manufacturing	\$102,000	\$102,000	\$0	0.5	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	102,000	102,000	0 days	Jun 2 '05	Jun 29 '05	\$102,000	\$102,000	\$0	\$102,000

Notes

WBS Definition -

M&S BOE -

We need 52 working boards + spares for a total of 60 boards (15 have been made already during pre-production). \$600 each for FR4 substrate (Engineering Estimate) and \$1,100 each for components, loading, and testing (Engineering Estimate) for a cost of \$1,700 per JPC.

Total cost is \$102,000.

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.2.7.4.4	Preproduction JPC: assembly	\$1,500	\$1,500	\$0	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	1,500	1,500	0 days	Jul 8 '05	Aug 18 '05	\$1,500	\$1,500	\$0	\$1,500

Notes

WBS Definition -

M&S BOE -

This work will be done by an outside company. Estimated cost is \$200 for each JPC.

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.2.7.4.5	Production JPC: testing	\$17,792	\$0	\$17,792	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
17	ElecEngF	10%	51.2 hrs	0 days	Jun 9 '05	Sep 8 '05	\$2,816	\$2,816	\$0	\$2,816
18	ElecTechF	75%	384 hrs	0 days	Jun 9 '05	Sep 8 '05	\$14,976	\$14,976	\$0	\$14,976

Notes

WBS Definition -

M&S BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
"Production JPC: testing" continued							
	<u>Notes</u>						
	Labor BOE - Loading and basic testing done on a outside company. This is FNAL labor for more extensive testing of the card.						
	Schedule BOE - We plan to test 1 board per day.						
1.1.2.7.4.6	Production JPC Available	\$0	\$0	\$0	0	0	4
	<u>Notes</u>						
	WBS Definition -						
	M&S BOE -						
	Labor BOE -						
	Schedule BOE - Lag time of 40 days includes 20 days for getting the first boards tested.						
1.1.2.7.4.7	Production JPC Complete	\$0	\$0	\$0	0	0	4
	<u>Notes</u>						
	WBS Definition -						
	M&S BOE -						
	Labor BOE -						
1.1.2.8	Cables	\$488,906	\$435,816	\$53,090	0	0	0
	<u>Notes</u>						
	WBS Definition - We will replace all cables going from the silicon detector to the DAQ and Power Supplies racks. There are 2 sets of these cables:						
	<ul style="list-style-type: none"> from the mini Port Card (end of stave) to the Junction Port Card from the Junction Port Card to the racks (FTM and Power Supplies) 						
	M&S BOE -						
	Labor BOE -						
1.1.2.8.1	Cables from MPC to JPC	\$198,342	\$173,536	\$24,806	0	0	0
	<u>Notes</u>						
	WBS Definition - Cables from Stave (mini port card) to Junction Port Card. These are in reality 2 sets of cables.						

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
-----	------	------	-----	-------	-----------	-------------	-------

"Cables from MPC to JPC" continued

Notes

One set from the end of the MPC pig-tail to the Junction card (signal + power) and a second set from the Junction card to the Junction Portcard (signal + power).
The Junction Card is actually just a place where the cables are split (with a connector) for ease of connection.
First set (miniPC to JC) is about 3 feet long
Second set (JP to JPC) is about 9 feet long.
The Junction Card connects the 2 sets.

M&S BOE -
In production we will need 180 (Outer) + 72 (L0) = **432** sets of cables.

Labor BOE -

1.1.2.8.1.1	Cables from MPC to JPC: Prototypes	\$6,400	\$2,000	\$4,400	0	0	0
-------------	---	----------------	----------------	----------------	----------	----------	----------

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.8.1.1.1	Finalize cables and connectors for milestone#1	\$4,400	\$0	\$4,400	0	0	0
---------------	---	----------------	------------	----------------	----------	----------	----------

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	50%	160 hrs	0 days	Mar 8 '02	May 2 '02	\$0	\$0	\$0	\$0
17	ElecEngF	25%	80 hrs	0 days	Mar 8 '02	May 2 '02	\$4,400	\$4,400	\$4,400	\$0

Notes

WBS Definition -

These are not the same cables we will use in the final version since for milestone #1 we are not using the JPC necessarily.

M&S BOE -

Labor BOE -

1.1.2.8.1.1.2	Procure cables for milestone#1	\$2,000	\$2,000	\$0	0	0	4
---------------	---------------------------------------	----------------	----------------	------------	----------	----------	----------

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	2,000	2,000	0 days	May 3 '02	May 31 '02	\$2,000	\$2,000	\$2,000	\$0
18	ElecTechF	25%	0 hrs	0 days	May 3 '02	May 3 '02	\$0	\$0	\$0	\$0

Notes

WBS Definition -

These are not necessarily the cables from the MPC to the JPC since the JPC may not be part of milestone#1. These are just "functional cables" for milestone #1.
Need 2 sets (4m long) with connectors for testing staves for milestone#1

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level			
"Procure cables for milestone#1" continued										
<u>Notes</u>										
M&S BOE - \$1,000 per set (Engineering Estimate) for a total cost of \$2,000.										
Labor BOE -										
1.1.2.8.1.1.3	MPC-JPC Cables available for milestone#1	\$0	\$0	\$0	0	0	4			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										
1.1.2.8.1.2	Cables from MPC to JPC: Preproduction and Production	\$191,942	\$171,536	\$20,406	0	0	0			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										
1.1.2.8.1.2.1	Finalize preproduction cables and connectors	\$7,520	\$0	\$7,520	0	0.4	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
17	ElecEngF	25%	80 hrs	0 days	Nov 5 '03	Jan 7 '04	\$4,400	\$4,400	\$0	\$4,400
18	ElecTechF	25%	80 hrs	0 days	Nov 5 '03	Jan 7 '04	\$3,120	\$3,120	\$0	\$3,120
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										
Schedule BOE -										
After the first DAQ chain has been tested, we can finalize the cables and connectors. These are now the prototype/preproduction cables.										
1.1.2.8.1.2.2	MPC-JPC Preproduction Cables and Connectors Finalized	\$0	\$0	\$0	0	0	4			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"MPC-JPC Preproduction Cables and Connectors Finalized" continued

Notes

Labor BOE -

1.1.2.8.1.2.3	Preproduction MPC-JPC cables: procure	\$11,882	\$11,882	\$0	0.5	0	0
---------------	---------------------------------------	----------	----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	11,882	11,882	0 days	Dec 12 '03	Feb 12 '04	\$11,882	\$11,882	\$3,565	\$8,317

Notes

WBS Definition -

Preproduction procurement of the mini Port Card to Junction Port Card cables.

M&S BOE -

Production costs is (test will be done at FNAL):

a set consists of all cables serving 1 stave (or 1 L0 module).

quotation New England Wire n. 00128434 (06/04/02) [Signal Cable]

quotation New England Wire n. 00128835 (06/17/02) [High Voltage]

quotation Sub-Sem Inc. n.08142002-1 (08/14/02) [Power Cable]

quotation Omnetics n.Q0417201 (04/17/02) [connectors+termination+labor]

SET:

1. signal cable (MPC to JC) \$ 7.711 per foot (3')
cable terminations \$141.39
2. signal cable (MPC to JC) \$ 7.711 per foot (12')
cable terminations \$141.39
Total \$398.5
3. HV cable (MPC to JC) \$ 2.549 per foot (3')
cable terminations \$42 (extrapolated from poin 1.)
4. HV cable (MPC to JC) \$ 2.549 per foot (12')
cable terminations \$42 (extrapolated from point 1.)
Total \$122.2
5. Power cable (MPC to JC) \$0.89 per foot (3')
cable terminations \$30 (extrapolated from poin 1.)
6. Power cable (JC to JPC) \$0.89 per foot (12')
cable terminations \$30 (extrapolated from poin 1.)
Total \$73.4

Cost per set is **\$594.1**

Preproduction quantity is 20 sets = **\$11,882**

Contingency is 50% pending radiation hardness understanding of some standard cable insulation.

Labor BOE -

1.1.2.8.1.2.4	Preproduction MPC-JPC cable: testing	\$4,780	\$4,000	\$780	0	0.4	0
---------------	--------------------------------------	---------	---------	-------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	4,000	4,000	0 days	Feb 13 '04	Mar 11 '04	\$4,000	\$4,000	\$0	\$4,000

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
-----	------	------	-----	-------	-----------	-------------	-------

"Preproduction MPC-JPC cable: testing" continued

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
18	ElecTechF	13%	20 hrs	0 days	Feb 13 '04	Mar 11 '04	\$780	\$780	\$0	\$780

Notes

WBS Definition -
Testing of the preproduction cables from mini Port Card to Junction Port Card.

M&S BOE -
We will build (or purchase) a test box for testing cables (\$4,000 engineering estimate).

Labor BOE -
Termination and testing will be done at the company. Here is just considered the final check at FNAL. We estimate approximately 1hour per set.

1.1.2.8.1.2.5	MPC-JPC preproduction cables available	\$0	\$0	\$0	0	0	4
---------------	--	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.8.1.2.6	Explicit Slack: Order cables from MPC-JPC	\$0	\$0	\$0	0	0	5
---------------	---	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.8.1.2.7	Production go ahead on MPC -JPC cables	\$0	\$0	\$0	0	0	4
---------------	--	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

Schedule BOE -
This is linked to the test on the preproduction DAQ chain.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level			
1.1.2.8.1.2.8	Production MPC-JPC cables: procure	\$157,526	\$155,654	\$1,872	0.5	0.4	0			
ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	155,654	155,654	0 days	Mar 18 '05	Jun 10 '05	\$155,654	\$155,654	\$0	\$155,654
18	ElecTechF	10%	48 hrs	0 days	Mar 18 '05	Jun 10 '05	\$1,872	\$1,872	\$0	\$1,872

Notes

WBS Definition -

Production procurement of the mini Port Card to Junction Port Card cables.

M&S BOE -

Detailed cost estimate in "Preproduction MPC-JPC cables: procure"

Cost base on quotations.

Cost per set is **\$594.1**

Production quantity is 180 (Outer) + 72 (L0) = 252 sets +10 spares (20 extra spares are in preproduction) = **\$155,654**

Contingency is 50% pending radiation hardness understanding of some standard cable insulation.

Labor BOE -

One Electrical Technician at(10% to keep in contact with the cable manufacturing company.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level			
1.1.2.8.1.2.9	Production MPC-JPC cable: testing	\$10,234	\$0	\$10,234	0	0.4	0			
ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
18	ElecTechF	41%	262.4 hrs	0 days	Jun 13 '05	Oct 4 '05	\$10,234	\$10,234	\$0	\$10,234

Notes

WBS Definition -

Testing of the production cables from mini Port Card to Junction Port Card.

M&S BOE -

Labor BOE -

Estimated 1hr. of work per set. Total 262 sets.

Basic tests will be done by the manufacturer. At FNAL just the final tests prior to installation.

Schedule BOE -

We expect the 1st batch of cables to arrive 40 days after the order is placed.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.2.8.1.2.10	MPC-JPC production cables available	\$0	\$0	\$0	0	0	4

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
-----	------	------	-----	-------	-----------	-------------	-------

"Finalize cables and connectors for milestone #1" continued

Notes

Linked to milestone #1. These are not the final cables, however they do have the same functionality.

1.1.2.8.2.1.2	Procure cables for milestone #1	\$5,000	\$5,000	\$0	0	0	4
---------------	---------------------------------	---------	---------	-----	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	5,000	5,000	0 days	May 3 '02	May 3 '02	\$5,000	\$5,000	\$5,000	\$0

Notes

WBS Definition -

M&S BOE -

Need 5 sets with connectors for milestone #1 priced at \$1,000 per set (Engineering Estimate) for a total cost of \$5,000.

Labor BOE -

1.1.2.8.2.1.3	cable testing for milestone #1	\$1,560	\$0	\$1,560	0	0	0
---------------	--------------------------------	---------	-----	---------	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
18	ElecTechF	50%	40 hrs	0 days	Jul 1 '02	Jul 15 '02	\$1,560	\$1,560	\$1,560	\$0

Notes

WBS Definition -

M&S BOE -

Labor BOE -

This is for terminating cables and testing.

1.1.2.8.2.1.4	JPC-Crates cables available for milestone #1	\$0	\$0	\$0	0	0	4
---------------	--	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.8.2.2	Cables from JPC to crates: PreProduction and Production	\$279,605	\$257,280	\$22,325	0	0	0
-------------	---	-----------	-----------	----------	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.2.8.2.2.1	Finalize preproduction cables and connectors	\$11,280	\$0	\$11,280	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	25%	120 hrs	0 days	Sep 17 '03	Dec 11 '03	\$0	\$0	\$0	\$0
17	ElecEngF	25%	120 hrs	0 days	Sep 17 '03	Dec 11 '03	\$6,600	\$6,600	\$3,300	\$3,300
18	ElecTechF	25%	120 hrs	0 days	Sep 17 '03	Dec 11 '03	\$4,680	\$4,680	\$2,340	\$2,340

Notes

WBS Definition -

M&S BOE -

Labor BOE -

Schedule BOE -

After the first DAQ chain has been tested, we can finalize the cables and connectors. These are now the prototype/preproduction cables.

1.1.2.8.2.2.2	JPC-Crates preProduction Cables Finalized	\$0	\$0	\$0	0	0	4
---------------	---	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.8.2.2.3	Preproduction JPC-crates cables: procure	\$19,791	\$19,791	\$0	0.5	0	0
---------------	--	----------	----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	19,791	19,791	0 days	Dec 12 '03	Feb 12 '04	\$19,791	\$19,791	\$0	\$19,791

Notes

WBS Definition -

Cables from the Junction Port card to FTM and Power Supplies.

M&S BOE -

We need on set of cables per JPC.

Price estimated from the IIa project cost.

Price per JPC:

- a. HV cable at 222.63 each [*5] = 1113.15
- b. Sense cable at 164.48 each [*5] = 822.4
- c. Timing/control at 163.63 each [*5] = 818.15
- d. Low Voltage at 240.89 [*5] = 1204.45

Total cost per set equals **\$3,958.15** and 1 set equals 1JPC. Preproduction is 5 sets for a total cost of (5 X 3958.15 =) **\$19,791**

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level																						
1.1.2.8.2.2.4	Preproduction JPC-crates cable: testing	\$1,560	\$0	\$1,560	0	0.4	0																						
	<table border="1"> <thead> <tr> <th>ID</th> <th>Resource Name</th> <th>Units</th> <th>Work</th> <th>Delay</th> <th>Start</th> <th>Finish</th> <th>Cost</th> <th>Baseline Cost</th> <th>Act. Cost</th> <th>Rem. Cost</th> </tr> </thead> <tbody> <tr> <td>18</td> <td>ElecTechF</td> <td>25%</td> <td>40 hrs</td> <td>0 days</td> <td>Feb 13 '04</td> <td>Mar 11 '04</td> <td>\$1,560</td> <td>\$1,560</td> <td>\$0</td> <td>\$1,560</td> </tr> </tbody> </table>	ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost	18	ElecTechF	25%	40 hrs	0 days	Feb 13 '04	Mar 11 '04	\$1,560	\$1,560	\$0	\$1,560						
ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost																			
18	ElecTechF	25%	40 hrs	0 days	Feb 13 '04	Mar 11 '04	\$1,560	\$1,560	\$0	\$1,560																			
	<u>Notes</u>																												
	WBS Definition - Testing and bundling of the preproduction cables from Junction Port Card to crates (FTM and Power Supplies).																												
	M&S BOE -																												
	Labor BOE - This is for bundling and testing 5 sets of cables. We should be able to complete one set per day.																												
1.1.2.8.2.2.5	Preproduction JPC-Crates cables available	\$0	\$0	\$0	0	0	4																						
	<u>Notes</u>																												
	WBS Definition -																												
	M&S BOE -																												
	Labor BOE -																												
1.1.2.8.2.2.6	Explicit Slack: Order Cables for JPC-Crate	\$0	\$0	\$0	0	0	5																						
	<u>Notes</u>																												
	WBS Definition -																												
	M&S BOE -																												
	Labor BOE -																												
1.1.2.8.2.2.7	Production go ahead on JPC-Crates cables	\$0	\$0	\$0	0	0	4																						
	<u>Notes</u>																												
	WBS Definition -																												
	M&S BOE -																												
	Labor BOE -																												
1.1.2.8.2.2.8	Production JPC-crates cables: procurement	\$237,489	\$237,489	\$0	0.5	0	0																						
	<table border="1"> <thead> <tr> <th>ID</th> <th>Resource Name</th> <th>Units</th> <th>Work</th> <th>Delay</th> <th>Start</th> <th>Finish</th> <th>Cost</th> <th>Baseline Cost</th> <th>Act. Cost</th> <th>Rem. Cost</th> </tr> </thead> <tbody> <tr> <td>7</td> <td>MANDS</td> <td>237,489</td> <td>237,489</td> <td>0 days</td> <td>Mar 18 '05</td> <td>Jun 10 '05</td> <td>\$237,489</td> <td>\$237,489</td> <td>\$0</td> <td>\$237,489</td> </tr> </tbody> </table>	ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost	7	MANDS	237,489	237,489	0 days	Mar 18 '05	Jun 10 '05	\$237,489	\$237,489	\$0	\$237,489						
ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost																			
7	MANDS	237,489	237,489	0 days	Mar 18 '05	Jun 10 '05	\$237,489	\$237,489	\$0	\$237,489																			

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Production JPC-crates cables: procurement" continued

Notes

WBS Definition -
Cables from the Junction Port card to FTM and Power Supplies.

M&S BOE -
We need on set of cables per JPC.
Price estimated from the Ila project cost.
Detail on cost in "Preproduction JPC-crates cables: procurement"
Price per set (= 1JPC) is **\$3,958.15**
Production is 52 + spares = 60 * \$3,958.15 = **\$237,489**

Labor BOE -

1.1.2.8.2.2.9	Production JPC-crates cables: testing	\$9,485	\$0	\$9,485	0	0.4	0
---------------	---------------------------------------	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
18	ElecTechF	38%	243.2 hrs	0 days	Jun 13 '05	Oct 4 '05	\$9,485	\$9,485	\$0	\$9,485

Notes

WBS Definition -
Testing and bundling of the production cables from Junction Port Card to crates (FTM and Power Supplies).

M&S BOE -

Labor BOE -
This is for bundling and testing 60 sets of cables.

Schedule BOE -
We should be able to complete two sets per day based on the Run Ila bundling and testing times.

1.1.2.8.2.2.10	Production JPC cables available	\$0	\$0	\$0	0	0	4
----------------	---------------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.8.2.2.11	Production JPC cables complete	\$0	\$0	\$0	0	0	4
----------------	--------------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Production JPC cables complete" continued

Notes

Labor BOE -

1.1.2.9	Fiber Transition Module Replacements	\$266,868	\$165,500	\$101,368	0	0	0
---------	--------------------------------------	-----------	-----------	-----------	---	---	---

Notes

WBS Definition -

Fiber Transition Modules. These boards are part of the upper DAQ system and are the interface to the JPC. There are 2 JPC per FTM. New boards are needed to replace the Fiber Transition Modules (FTMs) because we are not using optical transmitter/receivers for the data.

M&S BOE -

Here we estimate the price of making a totally new card.

There are 52 JPC's installed the project.

There is one FTM every 2 JPC = 26 FTMs.

We need to have spares and extra boards for test stands: need 36 total FTMs (6 spares + 4 for DAQ test stands)

Runs:

1. Prototype
2. Preproduction
3. Production

Labor BOE -

1.1.2.9.1	FTM Prototype	\$440	\$0	\$440	0	0	0
-----------	---------------	-------	-----	-------	---	---	---

Notes

WBS Definition -

Prototype run of the Fiber Transition module. At the beginning, there will just be a modification of the existing module by replacing the optical TR/TX with an electrical one. Later it will be a new module.

M&S BOE -

Labor BOE -

1.1.2.9.1.1	modify existing FTM for milestone #1	\$440	\$0	\$440	0	0	0
-------------	--------------------------------------	-------	-----	-------	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	25%	40 hrs	0 days	Apr 5 '02	May 2 '02	\$0	\$0	\$0	\$0
17	ElecEngF	5%	8 hrs	0 days	Apr 5 '02	May 2 '02	\$440	\$440	\$440	\$0

Notes

WBS Definition -

This is just a modification of one existing FTM card, replacing the optical tx/rx part with a copper conventional one.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level			
1.1.2.9.1.2	FTM ready for milestone #1	\$0	\$0	\$0	0	0	4			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										
1.1.2.9.2	FTM - 1st Preproduction	\$51,780	\$22,500	\$29,280	0	0	0			
1.1.2.9.2.1	Explicit Slack: FTM design	\$0	\$0	\$0	0	0	5			
1.1.2.9.2.2	FTM: spec, design and layout	\$21,280	\$0	\$21,280	0	0.4	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
17	ElecEngF	25%	160 hrs	0 days	Jul 11 '03	Oct 31 '03	\$8,800	\$8,800	\$4,400	\$4,400
18	ElecTechF	50%	320 hrs	0 days	Jul 11 '03	Oct 31 '03	\$12,480	\$12,480	\$6,240	\$6,240
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										
1. Electrical Eng. (50%) specifications, design and firmware development										
2. Electrical Tech. (50%) layout										
1.1.2.9.2.3	FTM Submission	\$0	\$0	\$0	0	0	4			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										
1.1.2.9.2.4	FTM: procurement and assembly	\$22,500	\$22,500	\$0	0.5	0	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
7	MANDS	22,500	22,500	0 days	Nov 3 '03	Jan 5 '04	\$22,500	\$22,500	\$0	\$22,500
<u>Notes</u>										
WBS Definition -										
Procurement and Assembly of the Prototype of the Fiber Transition Module.										
M&S BOE -										
Cost is based on the price of the Run Ila FTM card.										

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

" FTM: procurement and assembly" continued

Notes

\$1,000 PCB
\$500.00 FPGA
\$500.00 Ball Grid Array assembly of FPGA
\$2,500 for miscellaneous components and assembly.
Total is \$4,500 per FTM.
5 boards as prototype. Total is \$22,500

Labor BOE -

Schedule BOE -

It takes 20 days to manufacture the board + 20 days for installing and assembly FPGA and connectors.

1.1.2.9.2.5	FTM: test and evaluation	\$8,000	\$0	\$8,000	0	0.4	0
-------------	--------------------------	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	160 hrs	0 days	Jan 6 '04	Mar 2 '04	\$0	\$0	\$0	\$0
17	ElecEngF	10%	32 hrs	0 days	Jan 6 '04	Mar 2 '04	\$1,760	\$1,760	\$0	\$1,760
18	ElecTechF	50%	160 hrs	0 days	Jan 6 '04	Mar 2 '04	\$6,240	\$6,240	\$0	\$6,240

Notes

WBS Definition -

M&S BOE -

Labor BOE -

Assembling labor is costed in the manufacturing. The labor called out here is just for testing the card with the DAQ system.

1.1.2.9.2.6	FTM available	\$0	\$0	\$0	0	0	4
-------------	---------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.9.3	FTM preproduction	\$69,560	\$35,000	\$34,560	0	0	0
-----------	-------------------	----------	----------	----------	---	---	---

Notes

WBS Definition -

Preproduction run of the Fiber Transition module. Preproduction quantity is 10.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.2.9.3.1	Explicit Slack: Preproduction and Production FTMs	\$0	\$0	\$0	0	0	5
1.1.2.9.3.2	Preproduction FTM: spec, design and layout	\$22,560	\$0	\$22,560	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
17	ElecEngF	50%	240 hrs	0 days	Jan 4 '05	Mar 29 '05	\$13,200	\$13,200	\$0	\$13,200
18	ElecTechF	50%	240 hrs	0 days	Jan 4 '05	Mar 29 '05	\$9,360	\$9,360	\$0	\$9,360

Notes

WBS Definition -
This is intended to be the final FTM design (i.e. preproduction).

M&S BOE -

Labor BOE -

Schedule BOE -

1.1.2.9.3.3	Preproduction FTM Submission	\$0	\$0	\$0	0	0	4
-------------	------------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.9.3.4	Preproduction FTM: procurement and assembly	\$35,000	\$35,000	\$0	0.5	0	0
-------------	---	----------	----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	35,000	35,000	0 days	Mar 30 '05	May 24 '05	\$35,000	\$35,000	\$0	\$35,000

Notes

WBS Definition -
Preproduction of Fiber Transition Modules. Preproduction quantity is 10.

M&S BOE -

Cost is based on the price of the Run Ila FTM card.
\$3,500 per board (includes components, assembling, connectors etc.).
This is less expensive than the prototypes due to the larger quantity.
Preproduction quantity is 10.
Total Cost is **\$35,000** (Engineering Estimate)
50% contingency added

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.2.9.3.5	Preproduction FTM: test and evaluation	\$12,000	\$0	\$12,000	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	240 hrs	0 days	May 25 '05	Aug 18 '05	\$0	\$0	\$0	\$0
17	ElecEngF	10%	48 hrs	0 days	May 25 '05	Aug 18 '05	\$2,640	\$2,640	\$0	\$2,640
18	ElecTechF	50%	240 hrs	0 days	May 25 '05	Aug 18 '05	\$9,360	\$9,360	\$0	\$9,360

Notes

WBS Definition -

Testing of the Fiber Transition Module card + evaluation of the FTMs performance with the DAQ system.

M&S BOE -

Labor BOE -

Assembling labor is costed in the manufacturing. The labor called out here is for testing the card functionality (test) and evaluating the FTM performance in within the DAQ chain (evaluation).

1. Electrical Tech (50%) for testing
2. Research Associate (50%) evaluation + testing software development
3. Electrical Eng. (10%) support

1.1.2.9.3.6	Preproduction FTM available	\$0	\$0	\$0	0	0	4
-------------	-----------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.9.4	FTM Production	\$145,088	\$108,000	\$37,088	0	0	0
-----------	----------------	-----------	-----------	----------	---	---	---

Notes

WBS Definition -

Prototype run of the Fiber Transition module. Production quantity is 26 + 10 spares for a total of 36.

M&S BOE -

Labor BOE -

1.1.2.9.4.1	Production FTM: spec, design and layout	\$26,960	\$0	\$26,960	0	0.4	0
-------------	---	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
17	ElecEngF	100%	320 hrs	0 days	Aug 19 '05	Oct 14 '05	\$17,600	\$17,600	\$0	\$17,600
18	ElecTechF	75%	240 hrs	0 days	Aug 19 '05	Oct 14 '05	\$9,360	\$9,360	\$0	\$9,360

Notes

WBS Definition -

M&S BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
"Production FTM: spec, design and layout" continued							
<u>Notes</u>							
Labor BOE -							

1.1.2.9.4.2	Production go ahead on FTMs	\$0	\$0	\$0	0	0	4
<u>Notes</u>							
WBS Definition -							
M&S BOE -							
Labor BOE -							
Schedule BOE - Linked to the production go-ahead for cables.							

1.1.2.9.4.3	Production FTM: procurement and assembly	\$108,000	\$108,000	\$0	0.5	0	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
7	MANDS	108,000	108,000	0 days	Oct 17 '05	Dec 13 '05	\$108,000	\$108,000	\$0	\$108,000

Notes

WBS Definition -
Procurement and assembly of the production FTM modules.

M&S BOE -

Cost is based on FTM cost for Run IIa.

\$3,000 per board (includes components, assembling, etc.).

Engineering estimate. See "Preproduction: procurement and assembly" for more details.

Need 28 + spares = 36 FTM (+ 10 from the preproduction).

We increase the number of spares because we plan to purchase the most recent parts available (especially the FPGA) for which backward compatibility with the pre-production parts is not guaranteed.

Total cost is **\$108,000** based on the engineering estimate with 50% contingency added.

Labor BOE -

1.1.2.9.4.4	Production FTM: test	\$10,128	\$0	\$10,128	0	0.4	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
11	Postdoc	20%	96 hrs	0 days	Dec 14 '05	Mar 14 '06	\$0	\$0	\$0	\$0
17	ElecEngF	10%	48 hrs	0 days	Dec 14 '05	Mar 14 '06	\$2,640	\$2,640	\$0	\$2,640
18	ElecTechF	40%	192 hrs	0 days	Dec 14 '05	Mar 14 '06	\$7,488	\$7,488	\$0	\$7,488

Notes

WBS Definition -

Test of the production of the Fiber Transition Modules cards. Production Quantity (including spares) = 36.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
"Production FTM: test" continued							
<u>Notes</u>							
M&S BOE -							
Labor BOE - Assembling labor is costed in the manufacturing. The labor called out here is just for testing the card functionality.							
Schedule BOE - Estimated time is based on testing 2 FTMs per day.							
1.1.2.9.4.5	Production FTM available	\$0	\$0	\$0	0	0	4
<u>Notes</u>							
WBS Definition -							
M&S BOE -							
Labor BOE -							
1.1.2.9.4.6	Production FTMs complete	\$0	\$0	\$0	0	0	4
<u>Notes</u>							
WBS Definition -							
M&S BOE -							
Labor BOE -							
1.1.2.10	DAQ Testing & Readiness	\$291,200	\$262,400	\$28,800	0	0	0
<u>Notes</u>							
WBS Definition - The upper data acquisition system will not change with respect to Run IIa. The lower data acquisition chain includes new pieces: svx4 chip, miniPC, JPC and FTM.							
These are all tests needed to assure proper functionality of the new pieces in the overall DAQ scheme. Includes the hardware necessary to perform these tests and all other electrical tests aimed at establishing good and reliable DAQ performance. It also includes the possible upgrade and obsolescent part procurement for the Upper DAQ system (FIB, VRB and SCR).							
M&S BOE -							
Labor BOE -							

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.2.10.1	DAQ: upper DAQ upgrade	\$140,000	\$140,000	\$0	0	0	0

Notes

WBS Definition -
Upgrade of the Upper Data Acquisition System (FIB, VRB and SRC).

The upper part of the Data Acquisition system should remain unchanged.
The number of channels needed for the the new silicon detector is ~25% less than what is now implemented for the present Ila detector. Number of spares is not a problem. Nonetheless obsolescence of parts, reliability and flexibility may of the key components (SRC, FIB and VRB) may become a problem.

M&S BOE -

Risk estimate is based on the need to re-do one board (the SRC) and to purchase spare components for the other boards (FIB and VRB) to cope with obsolescence.

1. new SRC \$120,000 Engineering Estimate
 2. new components for the FIB, VRB \$20,000 Engineering Estimate
- Total = \$140,000

We spread this over three fiscal years assuming that fy03 is spent primarily on the investigation of currently available parts, on the procurement of obsolescent parts and on the design and engineering (Labor will be University labor).

FY 2003 \$20,000
FY 2004 \$60,000
FY 2005 \$60,000

And assume a 50% contingency.

Labor BOE -

1.1.2.10.1.1	DAQ: SRC, FIB, VRB (FY 2003)	\$20,000	\$20,000	\$0	0.5	0	0
--------------	------------------------------	----------	----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	20,000	20,000	0 days	Jun 2 '03	Jun 6 '03	\$20,000	\$20,000	\$0	\$20,000

Notes

WBS Definition -
Cost of possible upgrade of the Upper DAQ system for Fiscal Year 2003.

M&S BOE -

Labor BOE -

1.1.2.10.1.2	DAQ: SRC, FIB, VRB (FY 2004)	\$60,000	\$60,000	\$0	0.5	0	0
--------------	------------------------------	----------	----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	60,000	60,000	0 days	Jun 2 '04	Jun 8 '04	\$60,000	\$60,000	\$0	\$60,000

Notes

WBS Definition -
Cost of possible upgrade of the Upper DAQ system for Fiscal Year 2004.

M&S BOE -

Labor BOE -

WBS	Name					Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.2.10.1.3	DAQ:SRC,FIB,VRB (FY 2005)					\$60,000	\$60,000	\$0	0.5	0	0
ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost	
7	MANDS	60,000	60,000	0 days	Jan 4 '05	Jan 10 '05	\$60,000	\$60,000	\$0	\$60,000	

Notes

WBS Definition -
Cost of possible upgrade of the Upper DAQ system for Fiscal Year 2005.

M&S BOE -

Labor BOE -

WBS	Name					Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.2.10.2	DAQ Testing Prototype					\$47,656	\$40,000	\$7,656	0	0	0

Notes

WBS Definition -
Testing of the Prototype DAQ chain.
runs:
prototype #1
prototype #2

M&S BOE -

Here is the cost of all electrical testing (M&S) at FNAL. Includes DAQ stands, Burn-in stations, computers, miscellaneous PC boards and material, cables, tools and instrument (oscilloscope etc. is needed).

Labor BOE -

WBS	Name					Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.2.10.2.1	Testing of Prototype DAQ Chain					\$47,656	\$40,000	\$7,656	0.5	0.4	0
ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost	
7	MANDS	40,000	40,000	0 days	Dec 6 '02	Mar 6 '03	\$40,000	\$40,000	\$36,000	\$4,000	
10	Physicist	20%	96 hrs	0 days	Dec 6 '02	Mar 6 '03	\$0	\$0	\$0	\$0	
11	Postdoc	100%	480 hrs	0 days	Dec 6 '02	Mar 6 '03	\$0	\$0	\$0	\$0	
17	ElecEngF	10%	48 hrs	0 days	Dec 6 '02	Mar 6 '03	\$2,640	\$2,640	\$2,376	\$264	
18	ElecTechF	5%	24 hrs	0 days	Dec 6 '02	Mar 6 '03	\$936	\$936	\$842	\$94	
20	MechEngSF	10%	48 hrs	0 days	Dec 6 '02	Mar 6 '03	\$2,448	\$2,448	\$2,203	\$245	
22	MechTechSF	10%	48 hrs	0 days	Dec 6 '02	Mar 6 '03	\$1,632	\$1,632	\$1,469	\$163	

Notes

WBS Definition -
Testing of the 1st prototype of DAQ system (1st prototype of stave).

M&S BOE -

Here is calculated the cost of all electrical testing (M&S) at FNAL up to this phase.

Includes upgrade to DAQ stands and Burn-in stations, new computers, bench power supplies, miscellaneous boards and material, cables, tools and instruments.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level			
"Testing of Prototype DAQ Chain" continued										
<u>Notes</u>										
Most of the above equipment is already available from the I1a effort. This is mostly to upgrade and modify what is already there.										
Labor BOE - This is based on Run I1a experience and is the labor specifically assigned to understand the DAQ issues and get all the testing equipment ready for production. It is in parallel with the labor assigned to test chips, hybrids, modules and staves.										
Schedule BOE - Test begins when 1st prototype electrical stave is available. These are specific tests aimed at understanding the functionality of the stave concept.										
1.1.2.10.2.2	Testing of Prototype DAQ Chain Complete- go ahead for #2	\$0	\$0	\$0	0	0	3			
<u>Notes</u>										
WBS Definition - This Milestone is the point where we decide which, if chips, hybrids, MPC, or the Bus cable need to have another prototype round before going into preproduction.										
M&S BOE -										
Labor BOE -										
1.1.2.10.2.3	Contingency: Go ahead for 2nd round prototypes (20)	\$0	\$0	\$0	0	0	5			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										
1.1.2.10.2.4	L2MS Testing #1 complete- go ahead for #2	\$0	\$0	\$0	0	0	2			
1.1.2.10.3	DAQ Testing 2nd Round	\$2,928	\$0	\$2,928	0	0	0			
1.1.2.10.3.1	Testing of proto #2 DAQ chain	\$2,928	\$0	\$2,928	0	0.4	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
10	Physicist	20%	64 hrs	0 days	Sep 10 '03	Nov 4 '03	\$0	\$0	\$0	\$0
11	Postdoc	100%	320 hrs	0 days	Sep 10 '03	Nov 4 '03	\$0	\$0	\$0	\$0
17	ElecEngF	10%	32 hrs	0 days	Sep 10 '03	Nov 4 '03	\$1,760	\$1,760	\$0	\$1,760
18	ElecTechF	5%	16 hrs	0 days	Sep 10 '03	Nov 4 '03	\$624	\$624	\$0	\$624
22	MechTechSF	5%	16 hrs	0 days	Sep 10 '03	Nov 4 '03	\$544	\$544	\$0	\$544

Notes
WBS Definition -
Testing of the 2nd prototype of the DAQ chain.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level			
"Testing of proto #2 DAQ chain" continued										
<u>Notes</u>										
M&S BOE - This assumes that the test stand is already setup from prototype 1 testing.										
Labor BOE - This is based on Run IIa experience. The additional resources are small, except for the physicist labor for the testing.										
1.1.2.10.3.2	Go ahead for Preproduction	\$0	\$0	\$0	0	0	3			
<u>Notes</u>										
WBS Definition - Ready for preproduction procurements for all DAQ parts (except svx4 chip). This is the completion of the tests of any second round prototypes for chips, hybrids, MPC or Bus cables. All modifications necessary for Production (preproduction) have been identified.										
M&S BOE -										
Labor BOE -										
1.1.2.10.3.3	Contingency: Go ahead for preproduction	\$0	\$0	\$0	0	0	5			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										
1.1.2.10.3.4	L2MS Go ahead for Preproduction	\$0	\$0	\$0	0	0	2			
1.1.2.10.4	DAQ Testing Preproduction and Production	\$100,616	\$82,400	\$18,216	0	0	0			
<u>Notes</u>										
WBS Definition - Testing of the Pre and Production DAQ chain.										
M&S BOE -										
Labor BOE -										
1.1.2.10.4.1	Develop a new test DAQ system	\$32,552	\$22,400	\$10,152	0.5	0.4	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
7	MANDS	22,400	22,400	0 days	Nov 5 '03	Mar 18 '04	\$22,400	\$22,400	\$0	\$22,400
10	Physicist	50%	360 hrs	0 days	Nov 5 '03	Mar 18 '04	\$0	\$0	\$0	\$0
17	ElecEngF	15%	108 hrs	0 days	Nov 5 '03	Mar 18 '04	\$5,940	\$5,940	\$0	\$5,940
18	ElecTechF	15%	108 hrs	0 days	Nov 5 '03	Mar 18 '04	\$4,212	\$4,212	\$0	\$4,212

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
"Develop a new test DAQ system" continued							
<u>Notes</u>							
WBS Definition - Develop of a simple DAQ system which can be used for hybrid testing. This system is based on a PMCI card wich generate the proper control an timing signals to the SVX4 chip							
M&S BOE - The estimate covers : a production run of 7 cards (considering spares). Cost: Based on actual cost of hte first prototye. 1. \$1,600 per complete card 2. \$1,400 for each PC 3. \$200 for connectors and cables Total \$3,200 per board for 7 boards = \$22,400 Contingency is 50%							
Labor BOE - (Engineering Estimate) 1. 15% of an electrical engineer for design and testing support 2. 50% of a physicist for design, programming and testing 3. 15% of an electrical technician for stuffing and testing. Contingency is 50%							
Schedule BOE - The system should be available by the time the 2nd DAQ full test start.							

1.1.2.10.4.2	Ready to test Preproduction DAQ chain	\$0	\$0	\$0	0	0	4
--------------	---------------------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -
This is an important milestone. All preproduction parts are meant to be "final" part with provision for minor changes if needed between preproduction and production.

Preproduction parts that need to be ready are:

1. Stave
2. JPC (prototype)
3. FTM (prototype)
4. MPC-JPC cables
5. JPC-crates cables
6. Power Supply (prototype)

M&S BOE -

Labor BOE -

1.1.2.10.4.3	Testing of Preproduction DAQ chain	\$68,064	\$60,000	\$8,064	0.5	0.4	0
--------------	------------------------------------	----------	----------	---------	-----	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	60,000	60,000	0 days	May 14 '04	Jul 12 '04	\$60,000	\$60,000	\$0	\$60,000
10	Physicist	20%	64 hrs	0 days	May 14 '04	Jul 12 '04	\$0	\$0	\$0	\$0

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Testing of Preproduction DAQ chain" continued

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	200%	640 hrs	0 days	May 14 '04	Jul 12 '04	\$0	\$0	\$0	\$0
17	ElecEngF	25%	80 hrs	0 days	May 14 '04	Jul 12 '04	\$4,400	\$4,400	\$0	\$4,400
18	ElecTechF	25%	80 hrs	0 days	May 14 '04	Jul 12 '04	\$3,120	\$3,120	\$0	\$3,120
22	MechTechSF	5%	16 hrs	0 days	May 14 '04	Jul 12 '04	\$544	\$544	\$0	\$544

Notes

WBS Definition -
Testing of the Preproduction and Production DAQ chain.

M&S BOE -
Further electrical testing equipment at FNAL, includes DAQ stands, Burn-in stations, computers, miscellaneous PC boards and material, cables, tools, and instruments. Most of the material is already in hand.

Labor BOE -
This is based on Run IIa experience.

Schedule BOE -
Testing begins when 1st preproduction stave is available. All of the various pieces should be ordered for production quantities based on this final test.

1.1.2.10.4.4	DAQ Production Go-Ahead	\$0	\$0	\$0	0	0	3
--------------	-------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -
Ready for production procurements of DAQ parts (except SVX4 chips). This date marks the end of all decisions regarding ordering production quantities for all DAQ parts.

M&S BOE -

Labor BOE -

1.1.2.10.4.5	Contingency: Go ahead for production	\$0	\$0	\$0	0	0	5
--------------	--------------------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.10.4.6	L2MS Goahead for DAQ production	\$0	\$0	\$0	0	0	2
--------------	---------------------------------	-----	-----	-----	---	---	---

1.1.2.11	Power Supply system	\$697,016	\$653,254	\$47,912	0	0	0
-----------------	----------------------------	------------------	------------------	-----------------	----------	----------	----------

Notes

WBS Definition -
Power supply system for the Staves, JPC and L0 (Low and High voltages). We need a new power supply system in order to provide power to the detector. The power distribution per stave is 1 AVDD, 1 DVDD and 2 High Voltages. Power distribution for L0 is 1 AVDD, 1DVDD and 1 HV per module. The Junction Port Card needs a separate 5V line per JPC. Channel count for the

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Power Supply system" continued

Notes
above scheme is provided in the table.

M&S BOE -
Labor BOE -

1.1.2.11.1	Power Supplies Prototype	\$20,000	\$20,000	\$0	0	0	0
------------	---------------------------------	-----------------	-----------------	------------	----------	----------	----------

Notes
WBS Definition -
Prototype System for the Power Supplies. This is for purchasing and testing the first prototype of the power supply system.

M&S BOE -
Labor BOE -

1.1.2.11.1.1	Selection of New Supplies	\$0	\$0	\$0	0	0	0
--------------	----------------------------------	------------	------------	------------	----------	----------	----------

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	25%	80 hrs	0 days	Apr 5 '02	May 31 '02	\$0	\$0	\$0	\$0
13	ElecTechU	25%	80 hrs	0 days	Apr 5 '02	May 31 '02	\$0	\$0	\$0	\$0

Notes
WBS Definition -
Search the market for available solutions and write preliminary specs.

M&S BOE -
Labor BOE -
Done at INFN-Padova.

1. Post Doc (25%) Preliminary specs and vendor search.
2. Elect. Technician (25%) Preliminary Specs.

1.1.2.11.1.2	Procure sample supplies	\$20,000	\$20,000	\$0	0	0	0
--------------	--------------------------------	-----------------	-----------------	------------	----------	----------	----------

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
9	INKIND	20,000	20,000	0 days	Jun 3 '02	Sep 24 '02	\$20,000	\$20,000	\$20,000	\$0

Notes
WBS Definition -
We need to have these ready to use for milestone#1.

M&S BOE -
Based on CAEN quotation:
1. Crate \$10,000
2. module A1551-HV \$3,100

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level			
"Procure sample supplies" continued										
<u>Notes</u>										
3. module A1518-LV \$2,900										
4 cables, connectors, load box, miscellaneous material \$1,500										
Total \$17,500 + \$2,500 contingency = \$20,000										
Labor BOE -										
1.1.2.11.1.3	Prototype Power Supplies available	\$0	\$0	\$0	0	0	4			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										
1.1.2.11.1.4	Test general features of Power supplies	\$0	\$0	\$0	0	0	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
11	Postdoc	75%	480 hrs	0 days	Sep 25 '02	Jan 23 '03	\$0	\$0	\$0	\$0
13	ElecTechU	50%	320 hrs	0 days	Sep 25 '02	Jan 23 '03	\$0	\$0	\$0	\$0
<u>Notes</u>										
WBS Definition -										
Test of functionality and specs compatibility of prototype power supplies. These tests are aimed at checking that the functionality of the new system is compatible with the Run IIb design and needs.										
M&S BOE -										
Labor BOE -										
Done at INFN-Padova.										
1. Post Doc (75%) Writing test Software and supervision.										
2. Elect. Technician (50%) Electrical tests.										
1.1.2.11.1.5	Tests at FNAL	\$0	\$0	\$0	0	0	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
13	ElecTechU	50%	240 hrs	0 days	Jan 24 '03	Apr 17 '03	\$0	\$0	\$0	\$0
1.1.2.11.2	Evaluation at FNAL	\$5,810	\$0	\$9,960	0	0	0			
1.1.2.11.2.1	Evaluate power supplies	\$5,810	\$0	\$9,960	0	0.4	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
11	Postdoc	50%	140 hrs	0 days	Mar 3 '03	Apr 18 '03	\$0	\$0	\$0	\$0

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Evaluate power supplies" continued

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
17	ElecEngF	20%	56 hrs	0 days	Mar 3 '03	Apr 18 '03	\$3,080	\$3,080	\$2,310	\$770
18	ElecTechF	25%	70 hrs	0 days	Mar 3 '03	Apr 18 '03	\$2,730	\$2,730	\$2,048	\$683

Notes

WBS Definition -

This is the final System test with the electrical stave and is done at FNAL by-Padova personnel. Sample power supplies will be used for milestone #1.

M&S BOE -

Labor BOE -

This is the final System test with the electrical stave and is done at FNAL by-Padova personnel.

1. Elect. Technician (50%) from INFN-Padova
2. Research Associate (50%) from INFN-Padova
3. Electrical Eng. (20%) from FNAL
4. Electrical Tech. (25%) from FNAL

1.1.2.11.2.2	Final Decision on Power Supply System	\$0	\$0	\$0	0	0	4
--------------	---------------------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

This milestone marks the decision point on the power supply system.

M&S BOE -

Labor BOE -

Schedule BOE -

Final decision taken after the preproduction DAQ chain is fully tested.

1.1.2.11.3	Power Supplies Production	\$626,206	\$588,254	\$37,952	0	0	0
------------	---------------------------	-----------	-----------	----------	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.11.3.1	Explicit Slack on Production power supplies and patch panel	\$0	\$0	\$0	0	0	5
--------------	---	-----	-----	-----	---	---	---

1.1.2.11.3.2	Patch Panel: design and test(Padova)	\$0	\$0	\$0	1	0.75	0
--------------	--------------------------------------	-----	-----	-----	---	------	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	40%	128 hrs	0 days	Sep 22 '04	Nov 16 '04	\$0	\$0	\$0	\$0
13	ElecTechU	30%	96 hrs	0 days	Sep 22 '04	Nov 16 '04	\$0	\$0	\$0	\$0

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
-----	------	------	-----	-------	-----------	-------------	-------

"Patch Panel: design and test(Padova)" continued

Notes

WBS Definition -

Patch panel is necessary to map the HV and LV power supply channels to the JPCs. Patch panel for power supply system: Design, procurement of parts, assembly and testing.

M&S BOE -

Cost is based on physicist estimate.

\$2,000 per panel including connectors, terminations, patch panel cabling etc.

Prototype is 1 panel.

100% contingency applied.

Labor BOE -

1. Research Associate at INFN-Padova (40%)

2. Elect. technician at INFN-Padova (30%)

3. Elect. engineer at FNAL (10%)

1.1.2.11.3.3	Patch Panel: design and test(FNAL)	\$3,760	\$2,000	\$1,760	1	0.75	0
--------------	------------------------------------	---------	---------	---------	---	------	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	2,000	2,000	0 days	Sep 22 '04	Nov 16 '04	\$2,000	\$2,000	\$0	\$2,000
17	ElecEngF	10%	32 hrs	0 days	Sep 22 '04	Nov 16 '04	\$1,760	\$1,760	\$0	\$1,760

Notes

WBS Definition -

Patch panel is necessary to map the HV and LV power supply channels to the JPCs. Patch panel for power supply system: Design, procurement of parts, assembly and testing.

M&S BOE -

Cost is based on physicist estimate.

\$2,000 per panel including connectors, terminations, patch panel cabling etc.

Prototype is 1 panel.

100% contingency applied.

Labor BOE -

1. Research Associate at INFN-Padova (40%)

2. Elect. technician at INFN-Padova (30%)

3. Elect. engineer at FNAL (10%)

1.1.2.11.3.4	Power supply Production go ahead	\$0	\$0	\$0	0	0	4
--------------	----------------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.2.11.3.5	Power Supply: procurement	\$571,254	\$571,254	\$0	0.3	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	571,254	571,254	0 days	Sep 22 '04	Mar 3 '05	\$571,254	\$571,254	\$0	\$571,254

Notes

WBS Definition -

Each JPC worth of staves can be power by a single A1511 module for the High Voltages and 2 A1517A modules for the Low Voltages. With 18 JPCs per side (we have 2 sides where the cables come out) the total number of modules required are 72 Low Voltage and 36 High Voltage. To the above we need to add L0 with 32 LV and 8 HV modules total.

M&S BOE -

Cost is based on a quote from CAEN (OF/32/2002 and OF/33/2002 as of 01/31/02)

LV module cost is 3,100 euro

HV module cost is 3,232 euro

Total cost (including spares) for 120 LV and 50 HV modules is 533,600 euro.

To the above we need to add the cost of 8 +2 spares crates at the cost of 8,677 euro each.

Total cost for the system is **620,370 euro (571,254 USD)**.

INFN contributes with 150Keuro = 132 K\$ (Buy Backs)

Contingency is 30%

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.2.11.3.6	Power Supply: Test Stand development	\$0	\$0	\$0	0	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	75%	480 hrs	0 days	Jul 13 '04	Nov 2 '04	\$0	\$0	\$0	\$0
13	ElecTechU	75%	480 hrs	0 days	Jul 13 '04	Nov 2 '04	\$0	\$0	\$0	\$0

Notes

WBS Definition -

This is the development of a test stand for testing Production Power supplies. It is mostly the development of the software needed for the tests. In addition there is the development of a test box which will be used to mimic the passive and active loads.

M&S BOE -

Labor BOE -

This work will be done at INFN-Padova.

1. Post Doc (75%) software development and supervision
2. Elect. Tech. (75%) equipment preparation and support

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.2.11.3.7	Production Power Supply Available	\$0	\$0	\$0	0	0	4

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level			
1.1.2.11.3.8	Power Supply: Testing	\$34,320	\$0	\$34,320	0	0.4	0			
ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	55%	968 hrs	0 days	Jan 21 '05	Dec 1 '05	\$0	\$0	\$0	\$0
13	ElecTechU	5%	88 hrs	0 days	Jan 21 '05	Dec 1 '05	\$0	\$0	\$0	\$0
18	ElecTechF	50%	880 hrs	0 days	Jan 21 '05	Dec 1 '05	\$34,320	\$34,320	\$0	\$34,320

Notes

WBS Definition -

M&S BOE -

Labor BOE -

Production tests will be done at FNAL. This is estimated from the Run IIa experience. We assume that 1 tech at 100% could test 1 power supply modules per day. 110 modules will be needed.

There will be some help from INFN-Padova at the beginning for test setup.

1.1.2.11.3.9	Power Supply Complete	\$0	\$0	\$0	0	0	4
--------------	-----------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level			
1.1.2.11.3.10	Patch Panel: production	\$16,872	\$15,000	\$1,872	1	0.4	0			
ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	15,000	15,000	0 days	Jan 21 '05	Apr 14 '05	\$15,000	\$15,000	\$0	\$15,000
18	ElecTechF	10%	48 hrs	0 days	Jan 21 '05	Apr 14 '05	\$1,872	\$1,872	\$0	\$1,872

Notes

WBS Definition -

Patch panel for power supply system: Design, procurement of parts, assembly and testing.

M&S BOE -

Based on Physicist estimate of 1.5K\$/panel for production.

Need 8 panels + 2 spares = 15K\$

Added 100% contingency.

Labor BOE -

This is for testing the panels (parts and assembly included in the cost).

1. Postdoc at INFN-Padova (10%) modification of the prototype design for production
2. Elect. Tech at INFN-Padova (15%) modification of the prototype design for production
3. Elect. Technician at FNAL (10%) testing the production patch panels

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.2.11.4	Power Supply Control system	\$45,000	\$45,000	\$0	0	0	0

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.2.11.4.1	Explicit Slack on Power supply control system	\$0	\$0	\$0	0	0	5
1.1.2.11.4.2	Design prototype control system	\$0	\$0	\$0	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	20%	64 hrs	0 days	May 9 '03	Jul 7 '03	\$0	\$0	\$0	\$0
11	Postdoc	100%	320 hrs	0 days	May 9 '03	Jul 7 '03	\$0	\$0	\$0	\$0

Notes

WBS Definition -

This is the system that controls the power supplies. It is independent of the interlock system, but must eventually be integrated with the interlock system.

M&S BOE -

Labor BOE -

Estimated based on Run IIa experience. Initial design follows the initial testing on the power supplies. It will be carried by a physicist (20%), a postdoc (50%), and a student (50%).

1.1.2.11.4.3	procure parts for PS controls	\$35,000	\$35,000	\$0	0.5	0	0
--------------	-------------------------------	----------	----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	35,000	35,000	0 days	Jul 8 '03	Sep 2 '03	\$35,000	\$35,000	\$0	\$35,000

Notes

WBS Definition -

M&S BOE -

Labor BOE -

Physicist estimate based on Run IIa experience.

Parts: \$10,000 for a crate, a processors (PC) and associated parts.

\$ 5,000 for a rack

\$20,000 for Caen net controllers

Total = \$35,000

1.1.2.11.4.4	Develop PS control software	\$0	\$0	\$0	0	0.4	0
--------------	-----------------------------	-----	-----	-----	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	20%	320 hrs	0 days	Sep 3 '03	Jun 18 '04	\$0	\$0	\$0	\$0
11	Postdoc	100%	1,600 hrs	0 days	Sep 3 '03	Jun 18 '04	\$0	\$0	\$0	\$0

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
-----	------	------	-----	-------	-----------	-------------	-------

"Develop PS control software" continued

Notes

WBS Definition -

M&S BOE -

Labor BOE -

Estimated based on Run Ila experience. Development of the controls software is an on-going task. The system will be setup at SiDet and all the development work will occur in conjunction with learning to run the staves before and after they are installed in the barrels. It will be supervised by a physicist (20%), and will be coded by a postdoc (50%) and a student (50%).

1.1.2.11.4.5	Monitor/update power supply control system	\$10,000	\$10,000	\$0	0.5	0.4	0
--------------	--	----------	----------	-----	-----	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	10,000	10,000	0 days	Jun 21 '04	Apr 7 '05	\$10,000	\$10,000	\$0	\$10,000
11	Postdoc	40%	640 hrs	0 days	Jun 21 '04	Apr 7 '05	\$0	\$0	\$0	\$0

Notes

WBS Definition -

M&S BOE -

Physicist estimate to cover additional purchases of components.

Labor BOE -

After the system is functional, the postdoc and student will only be needed to include new features. 20% each.

1.1.2.11.4.6	Integrate with interlock system at B0	\$0	\$0	\$0	0	0.4	0
--------------	---------------------------------------	-----	-----	-----	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	100%	640 hrs	0 days	Apr 8 '05	Aug 1 '05	\$0	\$0	\$0	\$0

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.3	Sensors	\$1,661,768	\$1,612,728	\$49,040	0	0	0
-------	---------	-------------	-------------	----------	---	---	---

Notes

WBS Definition -

M&S BOE -

The table below summarizes the type and number of sensors needed:

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Sensors" continued

Notes

Silicon Sensors

Layer	Type	Φ-seg.	Z-seg.	Length	Width	Pitch	Total
5	A	30	6	96.4	40.5	75/37.5	360
5	A	30	6	96.4	40.5	75/37.5	360
4	A	24	6	96.4	40.5	75/37.5	288
4	2.5°	24	6	96.4	43.1	80/40	288
3	A	18	6	96.4	40.5	75/37.5	216
3	2.5°	18	6	96.4	43.1	80/40	216
2	A	12	6	96.4	40.5	75/37.5	144
2	2.5°	12	6	96.4	43.1	80/40	144
1	A	6	6	96.4	40.5	75/37.5	72
1	A	6	6	96.4	40.5	75/37.5	72
0	A	12	6	96.4	14.8	50/25	144

	Sensors Quantity	Total (+ 20% spares)
Outer Axials	1512	1814
Outer Stereo	648	778
L0	144	172
TOTAL	2304	2764

Labor BOE -

1.1.3.1	Outer layers	\$1,565,011	\$1,521,619	\$43,392	0	0	0
---------	--------------	-------------	-------------	----------	---	---	---

Notes

WBS Definition -

We are going to prototype the outer stereo and Axial sensors.

Runs:

1. Prototypes Axials and Small Angle Stereo (30 grade "A"+30 grade "B" each)
2. Production (Axials, SAS and L0)
3. Purchase leftover L00 sensors (same design as used in Run IIa is used for Run IIb)

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Outer layers" continued

Notes

M&S BOE -

Labor BOE -

1.1.3.1.1	Outer Sensors Prototypes (FNAL)	\$142,705	\$113,873	\$28,832	0	0	0
-----------	---------------------------------	-----------	-----------	----------	---	---	---

Notes

WBS Definition -

M&S BOE -

The outer axial prototypes are provided by Tsukba with in-kind contribution. The prototype staves will be built using primarily the Axials. The SAS sensor order is placed through FNAL and follows the axial order due to extra design and layout time.

Labor BOE -

1.1.3.1.1.1	Dummy Sensors: layout	\$0	\$0	\$0	0	0	0
-------------	-----------------------	-----	-----	-----	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	25%	20 hrs	0 days	Apr 1 '02	Apr 12 '02	\$0	\$0	\$0	\$0

Notes

WBS Definition -

M&S BOE -

Labor BOE -

This is to prepare masks for dummy sensors (1 metal mask)

Schedule BOE -

This work can start once the real prototype sensor layout is finished.

1.1.3.1.1.2	Dummy Sensors: manufacturing	\$13,200	\$13,200	\$0	0.3	0	0
-------------	------------------------------	----------	----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	13,200	13,200	0 days	Jul 10 '02	Sep 4 '02	\$13,200	\$13,200	\$13,200	\$0

Notes

WBS Definition -

These are metalized dummy sensors for bonding and mechanical tests. We are also going to have real mechanicals (just silicon) which is diced at Fermilab.

M&S BOE -

Cost is based on quotation XXX from Polishing Corporation of America and quotation YYY from

Process Specialties:

1. 6" Silicon 100 wafers @ 30.00 each = \$3,000

2. 1 mask (metal) @ 1,700

3. metalization \$65.00/wafer = \$6,500

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Dummy Sensors: manufacturing" continued

Notes

4. dicing is about \$20.00/wafer = \$2,000
Total \$13,200
100 wafers yields 100 detectors Axials and 100 detectors stereo.

Contingency is 30%

Labor BOE -

1.1.3.1.1.3	Prototype Sensor Layout	\$22,592	\$0	\$22,592	0	0	0
-------------	-------------------------	----------	-----	----------	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	10%	64 hrs	0 days	Feb 4 '02	May 24 '02	\$0	\$0	\$0	\$0
19	DesignerSF	50%	320 hrs	0 days	Feb 4 '02	May 24 '02	\$12,800	\$12,800	\$12,800	\$0
20	MechEngSF	30%	192 hrs	0 days	Feb 4 '02	May 24 '02	\$9,792	\$9,792	\$9,792	\$0

Notes

WBS Definition -

M&S BOE -
Sensors designed to minimize cost by adopting many aspects of the CMS sensor specifications.

Labor BOE -

1.1.3.1.1.4	Prototype Sensors: submission (SAS)	\$0	\$0	\$0	0	0	4
-------------	-------------------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

Schedule BOE -
We estimate 40 days to complete the small angle stereo layout. This follows the axial layout.

1.1.3.1.1.5	Prototype Sensor manufacturing (SAS)	\$96,673	\$96,673	\$0	0.1	0	0
-------------	--------------------------------------	----------	----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	96,673	96,673	0 days	May 28 '02	Oct 30 '02	\$96,673	\$96,673	\$96,673	\$0

Notes

WBS Definition -

M&S BOE -
Based on quotation n. 030282002 from Hamamatsu (March 28 2002)
SAS:30 grade A @99,800 Yen + 30 grade B@59,900 Yen +7,211,000 Yen (NRE, masks, silicon)
total SAS = **12,002,000 Yen (96,673 USD)**

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Prototype Sensor manufacturing (SAS)" continued

Notes

Above originated from FNAL.
Based on quotation n. 03062002 from Hamamatsu (March 6 2002)
Axial:30 grade A @\$792.00 + 30 grade B@\$475.00 +\$43,000 (NRE, masks, silicon)
total Axial = **81,010 USD**
Above originated from Japan.
30% Contingency added

Labor BOE -

Schedule BOE -

The FNAL order is for the SAS sensors. These followed the submission of the axial sensors by 2 month (40 days). **The duration is longer than for the axial sensors due to vacations in August.**

1.1.3.1.1.6	Prototype Sensors Available (Axials in US))	\$0	\$0	\$0	0	0	4
-------------	---	-----	-----	-----	---	---	---

Notes

WBS Definition -
Prototype sensors are available for testing in the US.

M&S BOE -

Labor BOE -

Schedule BOE -

This allows 10 days for testing in Japan and shipping.

1.1.3.1.1.7	Prototype Sensors Available (SAS in US))	\$0	\$0	\$0	0	0	4
-------------	--	-----	-----	-----	---	---	---

Notes

WBS Definition -
Prototype sensors are available for testing in the US.

M&S BOE -

Labor BOE -

Schedule BOE -

This allows 10 days for testing in Japan and shipping.

1.1.3.1.1.8	Prototype Sensor evaluation and Radiation tests	\$10,240	\$4,000	\$6,240	0.5	0.4	0
-------------	---	----------	---------	---------	-----	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	4,000	4,000	0 days	Jul 31 '02	Nov 20 '02	\$4,000	\$4,000	\$4,000	\$0
10	Physicist	25%	160 hrs	0 days	Jul 31 '02	Nov 20 '02	\$0	\$0	\$0	\$0
11	Postdoc	50%	320 hrs	0 days	Jul 31 '02	Nov 20 '02	\$0	\$0	\$0	\$0
18	ElecTechF	25%	160 hrs	0 days	Jul 31 '02	Nov 20 '02	\$6,240	\$6,240	\$6,240	\$0

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Prototype Sensor evaluation and Radiation tests" continued

Notes

WBS Definition -
Radiation damage testing.

M&S BOE -

This is the FNAL cost related to setup some radiation damage test (special boards), and tests at the probe station. All needed equipment already in hand for a small task such as this (we estimate of the order of 20 detectors to be re-checked at this stage at FNAL)

Estimated from Run Ila as follows:

\$100 each rad-test board (10 boards)

\$500 box of needles for the probe station

\$1,500 PC with labview controlling the probestation equipment.

\$1,000 miscellaneous cables and connectors.

Total \$4,000

Labor BOE -

This is done mostly in Japan (Tsukuba and Okayama). FNAL will just verify some of the measurements and perform radiation damage tests.

Schedule BOE -

The tests at FNAL lag behind the testing at Tsukuba by 1month to allow for testing and delivery to FNAL.

1.1.3.1.2	Outer Sensors Production (FNAL)	\$614,754	\$600,194	\$14,560	0	0	0
-----------	---------------------------------	-----------	-----------	----------	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.3.1.2.1	Explicit Slack: production sensor order	\$0	\$0	\$0	0	0	5
-------------	---	-----	-----	-----	---	---	---

Notes

WBS Definition -

We are assuming that nothing should change in the design of the sensors. This re-work is scheduled only for very minor modifications if needed. This is contingency since we are not planning to change the sensors masks.

M&S BOE -

Labor BOE -

1.1.3.1.2.2	Sensor final design work (Axials)	\$7,280	\$0	\$7,280	0	0.4	0
-------------	-----------------------------------	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
19	DesignerSF	50%	80 hrs	0 days	Mar 24 '03	Apr 18 '03	\$3,200	\$3,200	\$3,200	\$0
20	MechEngSF	50%	80 hrs	0 days	Mar 24 '03	Apr 18 '03	\$4,080	\$4,080	\$4,080	\$0

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Sensor final design work (Axials)" continued

Notes

WBS Definition -

We are assuming that nothing should change in the design of the sensors. This re-work is scheduled only for very minor modifications if needed.

M&S BOE -

Labor BOE -

Schedule BOE -

Re-work begins 40 days after axial sensor testing begins in US.

1.1.3.1.2.3	Sensor final design work (SAS)	\$7,280	\$0	\$7,280	0	0.4	0
-------------	--------------------------------	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
19	DesignerSF	50%	80 hrs	0 days	Apr 21 '03	May 16 '03	\$3,200	\$3,200	\$3,200	\$0
20	MechEngSF	50%	80 hrs	0 days	Apr 21 '03	May 16 '03	\$4,080	\$4,080	\$4,080	\$0

Notes

WBS Definition -

We are assuming that nothing should change in the design of the sensors. This re-work is scheduled only for very minor modifications if needed.

M&S BOE -

Labor BOE -

Schedule BOE -

Re-work begins 40 days after axial sensor testing begins in US.

1.1.3.1.2.4	Production Sensor submission	\$0	\$0	\$0	0	0	2
-------------	------------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

Schedule BOE -

We can order production silicon after the final layout is finished. This milestone initiates the 1st half of the Japanese production sensor order. It is followed by the 1st half of the US production sensor order.

The second half the the Japanese and US orders lag in order to spread out the funding to correspond to US and Japan fiscal years.

1.1.3.1.2.5	Production Sensors manufacturing	\$300,097	\$300,097	\$0	0.1	0	0
-------------	----------------------------------	-----------	-----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	300,097	300,097	0 days	Nov 6 '03	Mar 19 '04	\$300,097	\$300,097	\$0	\$300,097

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Production Sensors manufacturing" continued

Notes

WBS Definition -

M&S BOE -

Based on quotation n. 030282002 from Hamamatsu (March 28 2002).

Axials:

1512 needed +20% spares = 1800 * 58,000Yen + 7,200,000Yen (masks + NRE +Silicon).

Total = **111,600,000 Yen (899,788 USD)**.

Stereo:

648 needed +20% spares = 770 * 61,000Yen + 6,400,000Yen (masks + NRE +Silicon).

Total = **53,370,000 Yen (430,300 USD)**.

Total Outer Sensors cost is **164,970,000 Yen (1,330,088 USD)**

Part of the bid is originated from FNAL and part of it directly from Japan.

The Japan originated part is a contribution in kind.

FNAL originated part is **74.63 MYen (600,193 USD)**

Japan originated part is **90.34 MYen (726,541 USD)**

Japan contribution is 100% of the total cost. 600,193 USD as Buy Backs

Contingency is 30%

Each order FNAL and Japan has been split into 2 separate 1/2 orders to spread the costs

over the fiscal year boundaries. They have been timed to correspond to the

Japanese and US fiscal years and when the money is available.

We assume Production sensors are available starting 4months (80days) after the 1st order is received.

The orders are placed with HPK such that production doesn't stop and delivery is continuous

The layer 0 production order will be submitted at the same time as the outer layers

but the actual sensor production will be delayed until after half the outer layer sensors

have been produced.

Labor BOE -

Schedule BOE -

Hamamatsu will deliver 200 detectors/month after a lag time of 4 months from receipt of order. 2,592 detectors/200/month = 13 + 4 month = 340 days. We need to add 1 month for the L0 production (see "L0 sensor production"). Total months 18 = 360 days.

1.1.3.1.2.6	Production Sensors manufacturing	\$300,097	\$300,097	\$0	0.1	0	0
-------------	----------------------------------	-----------	-----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	300,097	300,097	0 days	Oct 21 '04	Mar 4 '05	\$300,097	\$300,097	\$0	\$300,097

Notes

WBS Definition -

M&S BOE -

Based on quotation n. 030282002 from Hamamatsu (March 28 2002).

Axials:

1512 needed +20% spares = 1800 * 58,000Yen + 7,200,000Yen (masks + NRE +Silicon).

Total = **111,600,000 Yen (899,788 USD)**.

Stereo:

648 needed +20% spares = 770 * 61,000Yen + 6,400,000Yen (masks + NRE +Silicon).

Total = **53,370,000 Yen (430,300 USD)**.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
"Production Sensors manufacturing" continued							
<u>Notes</u>							
Total Outer Sensors cost is 164,970,000 Yen (1,330,088 USD) Part of the bid is originated from FNAL and part of it directly from Japan. The Japan originated part is a contribution in kind. FNAL originated part is 74.63 MYen (600,193 USD) Japan originated part is 90.34 MYen (726,541 USD) Japan contribution is 100% of the total cost. 600,193 USD as Buy Backs Contingency is 30%							
Each order FNAL and Japan has been split into 2 separate 1/2 orders to spread the costs over the fiscal year boundaries. They have been timed to correspond to the Japanese and US fiscal years and when the money is available. We assume Production sensors are available starting 4months (80days) after the 1st order is received. The orders are placed with HPK such that production doesn't stop and delivery is continuous. The layer 0 production order will be submitted at the same time as the outer layers but the actual sensor production will be delayed until after half the outer layer sensors have been produced.							
Labor BOE -							
Schedule BOE - Hamamatsu will deliver 200 detectors/month after a lag time of 4 months from receipt of order. 2,592 detectors/200/month = 13 + 4 month = 340 days. We need to add 1 month for the L0 production (see "L0 sensor production"). Total months 18 = 360 days.							
1.1.3.1.2.7	Production Sensors Available (in US)	\$0	\$0	\$0	0	0	4
<u>Notes</u>							
WBS Definition -							
M&S BOE -							
Labor BOE -							
Schedule BOE - We assume Production sensors are available in Japan for testing starting 4months (80 days) after the 1st order is received. Production sensors are available in the US 1 month after testing begins in Japan. The orders are placed with HPK such that production doesn't stop and delivery is continuous.							
1.1.3.1.2.8	Production Sensors Complete	\$0	\$0	\$0	0	0	4
<u>Notes</u>							
WBS Definition -							
M&S BOE -							
Labor BOE -							
Schedule BOE - We assume Production sensors are available starting 4months (80days) after the 1st order is received. The orders are placed with HPK such that production doesn't stop and delivery is continuous.							

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level																							
1.1.3.1.3	Outer Sensors (Japan - Prototyping)	\$81,010	\$81,010	\$0	0	0	0																							
	<u>Notes</u>																													
	WBS Definition -																													
	M&S BOE -																													
	Labor BOE -																													
1.1.3.1.3.1	Prototype Sensors: submission (Axials)	\$0	\$0	\$0	0	0	4																							
	<u>Notes</u>																													
	WBS Definition -																													
	M&S BOE -																													
	Labor BOE -																													
	Schedule BOE -																													
	We estimate 40 days to complete the axial sensor layout.																													
1.1.3.1.3.2	Prototype Sensor manufacturing	\$81,010	\$81,010	\$0	0	0	4																							
	<table border="1"> <thead> <tr> <th>ID</th> <th>Resource Name</th> <th>Units</th> <th>Work</th> <th>Delay</th> <th>Start</th> <th>Finish</th> <th>Cost</th> <th>Baseline Cost</th> <th>Act. Cost</th> <th>Rem. Cost</th> </tr> </thead> <tbody> <tr> <td>9</td> <td>INKIND</td> <td>81,010</td> <td>81,010</td> <td>0 days</td> <td>Apr 1 '02</td> <td>Jul 23 '02</td> <td>\$81,010</td> <td>\$81,010</td> <td>\$81,010</td> <td>\$0</td> </tr> </tbody> </table>	ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost	9	INKIND	81,010	81,010	0 days	Apr 1 '02	Jul 23 '02	\$81,010	\$81,010	\$81,010	\$0							
ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost																				
9	INKIND	81,010	81,010	0 days	Apr 1 '02	Jul 23 '02	\$81,010	\$81,010	\$81,010	\$0																				
	<u>Notes</u>																													
	WBS Definition -																													
	M&S BOE -																													
	Based on quotation n. 030282002 from Hamamatsu (March 28 2002)																													
	SAS:30 grade A @\$99,800 Yen + 30 grade B@\$59,900 Yen +7,211,000 Yen (NRE, masks, silicon)																													
	total SAS = 12,002,000 Yen (96,673 USD)																													
	Above originated from FNAL.																													
	Based on quotation n. 03062002 from Hamamatsu (March 6 2002)																													
	Axial:30 grade A @\$792.00 + 30 grade B@\$475.00 +\$43,000 (NRE, masks, silicon)																													
	total Axial = 81,010 USD																													
	Above originated from Japan.																													
	30% Contingency added																													
	Labor BOE -																													
1.1.3.1.3.3	Prototype Sensors Available (Axials in Japan)	\$0	\$0	\$0	0	0	4																							
	<u>Notes</u>																													
	WBS Definition -																													
	Prototype sensors are available for testing in Japan.																													

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level			
"Prototype Sensors Available (Axials in Japan)" continued										
<u>Notes</u>										
M&S BOE -										
Labor BOE -										
Schedule BOE - Prototype sensors are delivered to FNAL 20 days after they are available for testing in Japan. This 20 days allows for testing and shipping.										
1.1.3.1.3.4	Prototype Sensors Available (SAS in Japan)	\$0	\$0	\$0	0	0	4			
<u>Notes</u>										
WBS Definition - These are the Prototype small angle sensors and they are available for testing in Japan.										
M&S BOE -										
Labor BOE -										
Schedule BOE - Prototype sensors are delivered to FNAL 20 days after they are available for testing in Japan. This 20 days allows for testing and shipping.										
1.1.3.1.3.5	Prototype Sensors tests	\$0	\$0	\$0	0	0	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
11	Postdoc	100%	1,072 hrs	0 days	Jul 17 '02	Jan 30 '03	\$0	\$0	\$0	\$0
<u>Notes</u>										
WBS Definition - Quality assurance and tests made at the manufacturing company. U. Tsukuba and U. Okayama will thoroughly verify manufacturer's measurements with the prototypes.										
M&S BOE -										
Labor BOE - There are 30 axial (grade"A") and 30 stereo (grade "A") to be fully tested. There are also 30 axial (grade"B") and 30 stereo (grade "B") to be tested. This is a total of 120 sensors and we estimate we can test at least 10 sensors/week. At this rate we estimated 1 FTE.										
Schedule BOE -										
1.1.3.1.4	Outer Sensors (Japan - Production)	\$726,542	\$726,542	\$0	0	0	0			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level			
1.1.3.1.4.1	Production Sensors manufacturing	\$363,271	\$363,271	\$0	0.1	0	0			
ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
9	INKIND	363,271	363,271	0 days	May 19 '03	Sep 24 '03	\$363,271	\$363,271	\$0	\$363,271

Notes

WBS Definition -

M&S BOE -

Based on quotation n. 030282002 from Hamamatsu (March 28 2002).

Axials:

1512 needed +20% spares = 1800 * 58,000Yen + 7,200,000Yen (masks + NRE +Silicon).

Total = **111,600,000 Yen (899,788 USD)**.

Stereo:

648 needed +20% spares = 770 * 61,000Yen + 6,400,000Yen (masks + NRE +Silicon).

Total = **53,370,000 Yen (430,300 USD)**.

Total Outer Sensors cost is **164,970,000 Yen (1,330,088 USD)**

Part of the bid is originated from FNAL and part of it directly from Japan.

The Japan originated part is a contribution in kind.

FNAL originated part is **74.63 MYen (600,193 USD)**

Japan originated part is **90.34 MYen (726,541 USD)**

Japan contribution is 100% of the total cost. 600,193 USD as Buy Backs

Contingency is 30%

Each order FNAL and Japan has been split into 2 separate 1/2 orders, each 90 days long to spread the costs over the fiscal year boundaries. They have been timed to correspond to the Japanese and US fiscal years and when the money is available. We assume Production sensors are available starting 4months (80 days) after the 1st order is received.

The orders are placed with HPK such that production doesn't stop and delivery is continuous. The layer 0 production order will be submitted at the same time as the outer layers but the actual sensor production will be delayed until after half the outer layer sensors have been produced.

Labor BOE -

Schedule BOE -

Hamamatsu will deliver 200 detectors/month after a lag time of 4 months from receipt of order. 2,592 detectors/200/month = 13 + 4 month = 340 days. We need to add 1 month for the L0 production (see "L0 sensor production"). Total months 18 = 360 days

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level			
1.1.3.1.4.2	Production sensor manufacturing	\$363,271	\$363,271	\$0	0.1	0	0			
ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
9	INKIND	363,271	363,271	0 days	Feb 9 '04	Jun 14 '04	\$363,271	\$363,271	\$0	\$363,271

Notes

WBS Definition -

M&S BOE -

Based on quotation n. 030282002 from Hamamatsu (March 28 2002).

Axials:

1512 needed +20% spares = 1800 * 58,000Yen + 7,200,000Yen (masks + NRE +Silicon).

Total = **111,600,000 Yen (899,788 USD)**.

Stereo:

648 needed +20% spares = 770 * 61,000Yen + 6,400,000Yen (masks + NRE +Silicon).

Total = **53,370,000 Yen (430,300 USD)**.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Production sensor manufacturing" continued

Notes

Total Outer Sensors cost is **164,970,000 Yen (1,330,088 USD)**

Part of the bid is originated from FNAL and part of it directly from Japan.

The Japan originated part is a contribution in kind.

FNAL originated part is **74.63 MYen (600,193 USD)**

Japan originated part is **90.34 MYen (726,541 USD)**

Japan contribution is 100% of the total cost. 600,193 USD as Buy Backs

Contingency is 30%

Each order FNAL and Japan has been split into 2 separate 1/2 orders to spread the costs

over the fiscal year boundaries. They have been timed to correspond to the Japanese and US fiscal years and when the money is available. We assume Production sensors are available starting 4months (80 days) after the 1st order is received.

The orders are placed with HPK such that production doesn't stop and delivery is continuous.

The layer 0 production order will be submitted at the same time as the outer layers but the actual sensor production will be delayed until after half the outer layer sensors have been produced.

Labor BOE -

Schedule BOE -

Hamamatsu will deliver 200 detectors/month after a lag time of 4 months from receipt of order. 2,592 detectors/200/month = 13 + 4 month = 340 days. We need to add 1 month for the L0 production (see "L0 sensor production"). Total months 18 = 360 days.

1.1.3.1.4.3	Production Sensors Available (Japan)	\$0	\$0	\$0	0	0	4
-------------	--------------------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

Schedule BOE -

We assume Production sensors are available in Japan for testing starting 4months (80 days) after the 1st order is received. The orders are placed with HPK such that production doesn't stop and delivery is continuous.

1.1.3.1.4.4	Sensor Testing	\$0	\$0	\$0	0	0	0
-------------	----------------	-----	-----	-----	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	150%	4,860 hrs	0 days	Sep 11 '03	Apr 22 '05	\$0	\$0	\$0	\$0

Notes

WBS Definition -

Testing includes Outer Axials, Outer SAS and L0.

M&S BOE -

All equipment costs handled by Japan (Tsukuba and Okayama).

Labor BOE -

Provided by Japan and is estimated to be 1.5 FTE.

Schedule BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Sensor Testing" continued

Notes

Testing will be done by the vendor (included in the sensors price) and we will receive 200 sensors per month. Japan will probe a sample (<~10%) of the sensor production once the prototype gave us confidence on the quality and reliability of the vendor measurements. This is done in parallel with the production of the sensors. 10% of the 200 sensors, or 20 sensors, will be tested each month.

1.1.3.2	Layer 0	\$96,757	\$91,109	\$5,648	0	0	0
---------	---------	----------	----------	---------	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.3.2.1	layer L0	\$90,707	\$85,059	\$5,648	0	0	0
-----------	----------	----------	----------	---------	---	---	---

Notes

WBS Definition -

Given the small number of detectors needed and the use of the same technology as for the Outer sensors we directly order the production.

M&S BOE -

Need 144 for the project.

Labor BOE -

1.1.3.2.1.1	Explicit slack on L0 sensor design	\$0	\$0	\$0	0	0	5
-------------	------------------------------------	-----	-----	-----	---	---	---

1.1.3.2.1.2	L0 Sensor final design work	\$5,648	\$0	\$5,648	0	0.4	0
-------------	-----------------------------	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	10%	16 hrs	0 days	Sep 11 '03	Oct 8 '03	\$0	\$0	\$0	\$0
19	DesignerSF	50%	80 hrs	0 days	Sep 11 '03	Oct 8 '03	\$3,200	\$3,200	\$0	\$3,200
20	MechEngSF	30%	48 hrs	0 days	Sep 11 '03	Oct 8 '03	\$2,448	\$2,448	\$0	\$2,448

Notes

WBS Definition -

This work is linked with the mechanical understanding of the L0 structure. We are planning to use the same identical sensors used for L00 in which case no re-designing will be necessary. This task is contingency since no mask re-designing is planned.

M&S BOE -

Labor BOE -

Most of the work is in the general mechanical layout of the sensors. Also lots of detailing is needed.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.3.2.1.3	L0 Production sensor order	\$0	\$0	\$0	0	0	4

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.3.2.1.4	L0 sensors production	\$85,059	\$85,059	\$0	0.3	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	85,059	85,059	0 days	Jun 29 '04	Jul 27 '04	\$85,059	\$85,059	\$0	\$85,059

Notes

WBS Definition -

M&S BOE -

Based on quotation n. 030282002 from Hamamatsu (March 28 2002)
144 sensors needed + 20% spares = 170*28,000 Yen + 5,800,000 Yen (Masks, NRE, Silicon)

Total **10,560,000 Yen (85,059 USD)**.

Japan contributes 100% as Buy Back

Contingency is 30%

The layer 0 production order will be submitted at the same time as the outer layers but the actual sensor production will be delayed until after half the outer layer sensors have been produced.

Labor BOE -

Schedule BOE -

172 detectors are needed. This is approximately 1 month worth of production. We assume here this "dedicated" month to be in mid 2004.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.3.2.1.5	Sensor Testing	\$0	\$0	\$0	0	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	80 hrs	0 days	Jul 28 '04	Aug 24 '04	\$0	\$0	\$0	\$0

Notes

WBS Definition -

M&S BOE -

Labor BOE -

Already considered in the outer sensors testing.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.3.2.1.6	L0 Sensors Available	\$0	\$0	\$0	0	0	4

Notes

WBS Definition -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level																							
"L0 Sensors Available" continued																														
	<u>Notes</u>																													
	M&S BOE -																													
	Labor BOE -																													
1.1.3.2.1.7	L0 Sensors Complete	\$0	\$0	\$0	0	0	4																							
	<u>Notes</u>																													
	WBS Definition -																													
	M&S BOE -																													
	Labor BOE -																													
1.1.3.2.2	layer L00 left over	\$6,050	\$6,050	\$0	0	0	0																							
	<u>Notes</u>																													
	WBS Definition -																													
	These are left over sensors from the L00 production at Hamamatsu. They are identical to those we will use for the current L0 and we want to purchase them to have a jump start at testing.																													
	M&S BOE -																													
	Labor BOE -																													
1.1.3.2.2.1	L00 sensors purchase	\$6,050	\$6,050	\$0	0	0	0																							
	<table border="1"> <thead> <tr> <th>ID</th> <th>Resource Name</th> <th>Units</th> <th>Work</th> <th>Delay</th> <th>Start</th> <th>Finish</th> <th>Cost</th> <th>Baseline Cost</th> <th>Act. Cost</th> <th>Rem. Cost</th> </tr> </thead> <tbody> <tr> <td>9</td> <td>INKIND</td> <td>6,050</td> <td>6,050</td> <td>0 days</td> <td>Jul 10 '02</td> <td>Jul 16 '02</td> <td>\$6,050</td> <td>\$6,050</td> <td>\$6,050</td> <td>\$0</td> </tr> </tbody> </table>	ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost	9	INKIND	6,050	6,050	0 days	Jul 10 '02	Jul 16 '02	\$6,050	\$6,050	\$6,050	\$0							
ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost																				
9	INKIND	6,050	6,050	0 days	Jul 10 '02	Jul 16 '02	\$6,050	\$6,050	\$6,050	\$0																				
	<u>Notes</u>																													
	WBS Definition -																													
	L0 and L00 sensors are identical. There are 25 L00 sensors left over at Hamamatsu for us to purchase.																													
	M&S BOE -																													
	30 KYen/sensor (242.00 USD).																													
	Total cost is 6,050 USD .																													
	In kind contribution from Japan.																													
	30% contingency added.																													
	Labor BOE -																													

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.4	Cooling and Monitoring	\$354,304	\$240,000	\$114,304	0	0	0

Notes

WBS Definition -

This task covers the cooling system, the monitoring of the cooling and power to the detectors and the position monitors (RASNIKS). 50% contingency is included on all costed items.

M&S BOE -

Labor BOE -

1.1.4.1	Cooling system SiDet	\$43,392	\$20,000	\$23,392	0	0	0
---------	-----------------------------	-----------------	-----------------	-----------------	----------	----------	----------

Notes

WBS Definition -

This task covers updating the cooling system at SiDet and B0 and the cost of new manifolds at the detector.

M&S BOE -

Labor BOE -

1.1.4.1.1	Build system for cooling staves during burn-in	\$14,352	\$10,000	\$4,352	0.5	0.4	0
-----------	--	----------	----------	---------	-----	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	10,000	10,000	0 days	Aug 12 '03	Sep 9 '03	\$10,000	\$10,000	\$0	\$10,000
11	Postdoc	50%	80 hrs	0 days	Aug 12 '03	Sep 9 '03	\$0	\$0	\$0	\$0
20	MechEngSF	20%	32 hrs	0 days	Aug 12 '03	Sep 9 '03	\$1,632	\$1,632	\$0	\$1,632
22	MechTechSF	50%	80 hrs	0 days	Aug 12 '03	Sep 9 '03	\$2,720	\$2,720	\$0	\$2,720

Notes

WBS Definition -

This is the chiller system for the Stave burn-in system.

M&S BOE -

Engineering estimate based on Run IIa experience.

Labor BOE -

Engineering estimate based on Run IIa experience.

1.1.4.1.2	Update SiDet barrel cooling system	\$29,040	\$10,000	\$19,040	0.5	0.4	0
-----------	------------------------------------	----------	----------	----------	-----	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	10,000	10,000	0 days	Sep 16 '04	Nov 10 '04	\$10,000	\$10,000	\$0	\$10,000
11	Postdoc	50%	160 hrs	0 days	Sep 16 '04	Nov 10 '04	\$0	\$0	\$0	\$0
20	MechEngSF	50%	160 hrs	0 days	Sep 16 '04	Nov 10 '04	\$8,160	\$8,160	\$0	\$8,160
22	MechTechSF	100%	320 hrs	0 days	Sep 16 '04	Nov 10 '04	\$10,880	\$10,880	\$0	\$10,880

Notes

WBS Definition -

This is the cooling system that will be used during barrel construction testing of staves.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Update SiDet barrel cooling system" continued

Notes

Interlocks will be part of full interlock system.

M&S BOE -

Cost is based on Run IIa experience. Some parts are needed to upgrade the existing system.

Labor BOE -

Labor is based on Run IIa experience. Work is needed to upgrade the existing system.

1.1.4.2	Cooling Manifolds and chiller components	\$141,568	\$60,000	\$81,568	0	0	0
---------	---	------------------	-----------------	-----------------	----------	----------	----------

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.4.2.1	Build internal manifolds and tubing	\$58,560	\$20,000	\$38,560	0.5	0.4	0
-----------	-------------------------------------	----------	----------	----------	-----	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	20,000	20,000	0 days	Mar 18 '03	Aug 6 '03	\$20,000	\$20,000	\$0	\$20,000
11	Postdoc	20%	160 hrs	0 days	Mar 18 '03	Aug 6 '03	\$0	\$0	\$0	\$0
19	DesignerSF	10%	80 hrs	0 days	Mar 18 '03	Aug 6 '03	\$3,200	\$3,200	\$0	\$3,200
20	MechEngSF	20%	160 hrs	0 days	Mar 18 '03	Aug 6 '03	\$8,160	\$8,160	\$0	\$8,160
22	MechTechSF	100%	800 hrs	0 days	Mar 18 '03	Aug 6 '03	\$27,200	\$27,200	\$0	\$27,200

Notes

WBS Definition -

These are the manifolds/connections at the ends of the staves and the L0 cooling connections.

M&S BOE -

Cost is based on IIa experience, and includes plumbing support hardware.

PEEK tubing, Tube bending fixture,
Machined PEEK, Tubing and L0 parts

Labor BOE -

Needed for testing and assembling of parts.

1.1.4.2.2	Explicit slack: build external manifolds, chiller parts	\$0	\$0	\$0	0	0	5
-----------	---	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.4.2.3	Build external manifolds	\$18,736	\$10,000	\$8,736	0.5	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	10,000	10,000	0 days	Aug 5 '04	Oct 28 '04	\$10,000	\$10,000	\$0	\$10,000
11	Postdoc	20%	96 hrs	0 days	Aug 5 '04	Oct 28 '04	\$0	\$0	\$0	\$0
19	DesignerSF	20%	96 hrs	0 days	Aug 5 '04	Oct 28 '04	\$3,840	\$3,840	\$0	\$3,840
20	MechEngSF	20%	96 hrs	0 days	Aug 5 '04	Oct 28 '04	\$4,896	\$4,896	\$0	\$4,896

Notes
WBS Definition -
These are the manifolds at the end of the cot.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.4.2.4	production chiller components, manifolds, control valves	\$64,272	\$30,000	\$34,272	0.5	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	30,000	30,000	0 days	Oct 29 '04	Feb 16 '05	\$30,000	\$30,000	\$0	\$30,000
11	Postdoc	20%	115.2 hrs	0 days	Oct 29 '04	Feb 16 '05	\$0	\$0	\$0	\$0
20	MechEngSF	50%	288 hrs	0 days	Oct 29 '04	Feb 16 '05	\$14,688	\$14,688	\$0	\$14,688
22	MechTechSF	100%	576 hrs	0 days	Oct 29 '04	Feb 16 '05	\$19,584	\$19,584	\$0	\$19,584

Notes
WBS Definition -
M&S BOE -
These are the costs associated with updating the chillers at B0. The cost is based on an email from Rich Stanek (Lead cooling engineer on Run IIa project) in September 2001.

Labor BOE -
Engineering estimate based on Run IIa experience.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.4.3	Interlocks	\$100,000	\$100,000	\$0	0	0	0

Notes
WBS Definition -
This is the system that monitors the power and temperature of the detectors. It will re-use most of the existing system.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.4.3.1	Upgrade existing system	\$100,000	\$100,000	\$0	0.3	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	100,000	100,000	0 days	Mar 18 '05	Jan 4 '06	\$100,000	\$100,000	\$0	\$100,000
11	Postdoc	50%	800 hrs	0 days	Mar 18 '05	Jan 4 '06	\$0	\$0	\$0	\$0

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level			
"Upgrade existing system" continued										
<u>Notes</u>										
WBS Definition - Additional temperature and current channels will be needed.										
M&S BOE - Physicist estimate. This is the cost to upgrade the interlock system for Run IIb.										
Labor BOE -										
1.1.4.4	Position Monitoring	\$20,000	\$20,000	\$0	0	0	0			
<u>Notes</u>										
WBS Definition - This is to update the existing position monitoring system (RASNIK).										
M&S BOE - Cost is based on Run IIa experience and reusing the DAQ already setup.										
Labor BOE - There is no FNAL labor for this task, Toronto is taking on this entire project.										
1.1.4.4.1	prototype Rasniks	\$0	\$0	\$0	0	0	0			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										
1.1.4.4.1.1	Rasnik Prototype manufacturing and test	\$0	\$0	\$0	0	0.4	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
11	Postdoc	150%	1,200 hrs	0 days	Oct 18 '02	Mar 17 '03	\$0	\$0	\$0	\$0
<u>Notes</u>										
WBS Definition - This covers the cost to make and test a Rasnik module.										
M&S BOE - Toronto will cover this cost.										
Labor BOE - All assembly and testing will be done at U. Toronto. Estimated to be 1.5 FTE.										

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.4.4.2	production rasnik	\$20,000	\$20,000	\$0	0	0	0

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.4.4.2.1	Rasnik Production	\$20,000	\$20,000	\$0	0.5	0.4	0
-------------	-------------------	----------	----------	-----	-----	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
8	MANDSPASS	20,000	20,000	0 days	Mar 18 '03	May 12 '03	\$20,000	\$20,000	\$0	\$20,000
11	Postdoc	200%	640 hrs	0 days	Mar 18 '03	May 12 '03	\$0	\$0	\$0	\$0

Notes

WBS Definition -

M&S BOE -

Cost is based on cost to fabricate additional modules with assembling. The cost per module comes from UCLA experience on Run IIa.

Labor BOE -

Testing of modules will be done at U. Toronto and is estimated to total 2 FTE.

1.1.4.4.2.2	Rasniks Complete	\$0	\$0	\$0	0	0	4
-------------	------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.4.5	Radiation Monitoring	\$49,344	\$40,000	\$9,344	0	0	0
---------	----------------------	----------	----------	---------	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.4.5.1	Radiation monitors for inner(SVX and ISL) detector	\$24,672	\$20,000	\$4,672	0.5	0.4	0
-----------	--	----------	----------	---------	-----	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	20,000	20,000	0 days	Jan 14 '05	Mar 11 '05	\$20,000	\$20,000	\$0	\$20,000

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Radiation monitors for inner(SVX and ISL) detector" continued

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	10%	32 hrs	0 days	Jan 14 '05	Mar 11 '05	\$0	\$0	\$0	\$0
11	Postdoc	50%	160 hrs	0 days	Jan 14 '05	Mar 11 '05	\$0	\$0	\$0	\$0
18	ElecTechF	20%	64 hrs	0 days	Jan 14 '05	Mar 11 '05	\$2,496	\$2,496	\$0	\$2,496
22	MechTechSF	20%	64 hrs	0 days	Jan 14 '05	Mar 11 '05	\$2,176	\$2,176	\$0	\$2,176

Notes

WBS Definition -
These are the radiation monitors that will mount on the SVX and on the ISL.

M&S BOE -
Cost estimate is based on Run IIa experience.

Labor BOE -
Based on Run IIa experience. A physicist plus a postdoc design the system, a mechanical technician and an electrical technician are used to build the devices. These are installed in a later task during the final assembly sequence.

1.1.4.5.2	External radiation monitors and beam abort system	\$24,672	\$20,000	\$4,672	0.5	0.4	0
-----------	---	----------	----------	---------	-----	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	20,000	20,000	0 days	Aug 31 '05	Oct 26 '05	\$20,000	\$20,000	\$0	\$20,000
10	Physicist	10%	32 hrs	0 days	Aug 31 '05	Oct 26 '05	\$0	\$0	\$0	\$0
11	Postdoc	50%	160 hrs	0 days	Aug 31 '05	Oct 26 '05	\$0	\$0	\$0	\$0
18	ElecTechF	20%	64 hrs	0 days	Aug 31 '05	Oct 26 '05	\$2,496	\$2,496	\$0	\$2,496
22	MechTechSF	20%	64 hrs	0 days	Aug 31 '05	Oct 26 '05	\$2,176	\$2,176	\$0	\$2,176

Notes

WBS Definition -
This is to update the system of radiation monitors on the endplug and around the collision hall and also to the beam abort system.

M&S BOE -
Cost estimate is based on Run IIa experience.

Labor BOE -
Labor estimate is based on Run IIa experience. A physicist plus a postdoc are responsible for the design. A mechanical and electrical tech will help with the assembly.

Schedule BOE -
This task starts after the installation fixturing for svx into ISL is finished so that space conflicts can be avoided. Installation of these devices occurs during the shutdown when the collision hall is open.

1.1.5	Construction of Modules, Staves and L0	\$1,925,884	\$592,700	\$1,333,184	0	0	0
-------	--	-------------	-----------	-------------	---	---	---

Notes

WBS Definition -
Need 180 staves, 1080 modules for the outer 72 modules for L0.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level																																				
1.1.5.1	Beginning of Mechanical Project	\$0	\$0	\$0	0	0	4																																				
	<u>Notes</u>																																										
	WBS Definition - This task marks the end of the conceptual work and the beginning of the specific realization of mechanical parts.																																										
	M&S BOE -																																										
	Labor BOE -																																										
1.1.5.2	L0 Module Construction	\$206,136	\$69,600	\$136,536	0	0	0																																				
	<u>Notes</u>																																										
	WBS Definition - Required quantity for the L0 detector is 72 modules. We should schedule and cost 100 production modules based on the L00 experience. Modules are formed by 2 sensors glued "head-on", a pair of Kapton cables (analogue cable) and one 2-chips L0 hybrid.																																										
	M&S BOE -																																										
	Labor BOE -																																										
1.1.5.2.1	Layer 0 Module R&D	\$12,240	\$0	\$12,240	0	0	0																																				
	<u>Notes</u>																																										
	WBS Definition -																																										
	M&S BOE -																																										
	Labor BOE -																																										
1.1.5.2.1.1	L0 modules R&D and Prototype	\$12,240	\$0	\$12,240	0	0.4	0																																				
	<table border="1"> <thead> <tr> <th>ID</th> <th>Resource Name</th> <th>Units</th> <th>Work</th> <th>Delay</th> <th>Start</th> <th>Finish</th> <th>Cost</th> <th>Baseline Cost</th> <th>Act. Cost</th> <th>Rem. Cost</th> </tr> </thead> <tbody> <tr> <td>11</td> <td>Postdoc</td> <td>100%</td> <td>480 hrs</td> <td>0 days</td> <td>Jan 23 '03</td> <td>Apr 16 '03</td> <td>\$0</td> <td>\$0</td> <td>\$0</td> <td>\$0</td> </tr> <tr> <td>20</td> <td>MechEngSF</td> <td>50%</td> <td>240 hrs</td> <td>0 days</td> <td>Jan 23 '03</td> <td>Apr 16 '03</td> <td>\$12,240</td> <td>\$12,240</td> <td>\$0</td> <td>\$12,240</td> </tr> </tbody> </table>	ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost	11	Postdoc	100%	480 hrs	0 days	Jan 23 '03	Apr 16 '03	\$0	\$0	\$0	\$0	20	MechEngSF	50%	240 hrs	0 days	Jan 23 '03	Apr 16 '03	\$12,240	\$12,240	\$0	\$12,240									
ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost																																	
11	Postdoc	100%	480 hrs	0 days	Jan 23 '03	Apr 16 '03	\$0	\$0	\$0	\$0																																	
20	MechEngSF	50%	240 hrs	0 days	Jan 23 '03	Apr 16 '03	\$12,240	\$12,240	\$0	\$12,240																																	
	<u>Notes</u>																																										
	WBS Definition - This work is to establish whether the L0 electrical concept is sound. We could start earlier by using outer layer hybrids for testing purposes. At the beginning we will use test cables and sensors (old L00 sensors).																																										
	M&S BOE -																																										
	Labor BOE -																																										
1.1.5.2.2	L0 Module Preproduction	\$73,210	\$23,200	\$50,010	0	0	0																																				

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"L0 Module Preproduction" continued

1.1.5.2.2.1	Explicit Slack: L0 module preproduction fixture design	\$0	\$0	\$0	0	0	5
-------------	--	-----	-----	-----	---	---	---

Notes

WBS Definition -
Contingency on L0 preproduction module evaluation

M&S BOE -

Labor BOE -

1.1.5.2.2.2	L0 module: fixtures design	\$34,378	\$0	\$34,378	0	0.4	0
-------------	----------------------------	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
19	DesignerSF	100%	480 hrs	0 days	Sep 9 '03	Dec 3 '03	\$19,200	\$19,200	\$0	\$19,200
20	MechEngSF	62%	297.6 hrs	0 days	Sep 9 '03	Dec 3 '03	\$15,178	\$15,178	\$0	\$15,178

Notes

WBS Definition -
This includes all fixtures associated with holding sensors, hybrids and modules.

M&S BOE -

Labor BOE -
Engineering estimate based on L00 experience.

Hybrid fixtures: eng 5 days, des. 8 days
g10 frames: eng = 2 day, design 2 days
hybrid to cable bonding: eng 3days, design 6days.

Sensor fixtures: eng. 13 days, des. 24 days
end to end gluing eng 8days, design 14days
g10 frames: eng 2days, design 4 days
Bonding: eng: 3 days des. 6 days.

Cable gluing and handling: eng 19 days des. 29 days
Glue Alumina substrate to cable: eng 4 days, des. 6days
glue hybrid to cable: eng 4 days, des. 6 days
glue cable to sensor: eng 3 days, des. 5 days
splice alumina gluing: eng 5 days des 6 days
splice bonding: eng 3 days, des 5 days

Total Mechanical Engineer time = 37 days.

1.1.5.2.2.3	L0 module: material and fixtures	\$23,200	\$23,200	\$0	0.5	0	0
-------------	----------------------------------	----------	----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	23,200	23,200	0 days	Dec 4 '03	Feb 4 '04	\$23,200	\$23,200	\$0	\$23,200

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
"L0 module: material and fixtures" continued							
<u>Notes</u>							
WBS Definition - This includes all fixtures associated with holding sensors, hybrids and modules.							
M&S BOE - Engineering estimate based on L00 experience							
Hybrid fixtures: 5k\$ g10 frames: 4.2k\$ hybrid to cable bonding: 0.8k\$							
Sensor fixtures: 10.55k\$ end to end gluing: 5.5k\$ g10 frames: 4.2k\$ Bonding: 0.850k\$							
Cable gluing and handling: 7.65k\$ Glue Alumina substrate to cable: 1.6k\$ glue hybrid to cable: 1.6k\$ glue cable to sensor: 1.5k\$ splice alumina gluing: 1.7k\$ splice bonding: 1.25k\$							
Total \$23,300							
Labor BOE -							

1.1.5.2.2.4		L0 prototype module construction				\$10,952	\$0	\$10,952	0	0.4	0
ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost	
11	Postdoc	50%	80 hrs	0 days	Feb 5 '04	Mar 3 '04	\$0	\$0	\$0	\$0	
20	MechEngSF	25%	40 hrs	0 days	Feb 5 '04	Mar 3 '04	\$2,040	\$2,040	\$0	\$2,040	
22	MechTechSF	150%	240 hrs	0 days	Feb 5 '04	Mar 3 '04	\$8,160	\$8,160	\$0	\$8,160	
24	CMMProgrammerSF	10%	16 hrs	0 days	Feb 5 '04	Mar 3 '04	\$752	\$752	\$0	\$752	

Notes

WBS Definition -
This is done with Preproduction L0 hybrids, Preproduction cables and Production detectors.
Represents the FIRST milestone for the L0 project. We will make 6 modules to test the final concept.

M&S BOE -

Labor BOE -

1. mech. tech. (150%) gluing sensors and cables
2. CMM prog. (10%) for setting up program at the CMM to identify sensor fiducials
3. mech engineer (25%) support
4. Research Associate (50%) support

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level				
1.1.5.2.2.5	L0 Prototype modules available	\$0	\$0	\$0	0	0	4				
	<u>Notes</u>										
	WBS Definition -										
	M&S BOE -										
	Labor BOE -										
1.1.5.2.2.6	L0 prototype modules evaluation	\$4,680	\$0	\$4,680	0	0.4	0				
	<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
	10	Physicist	25%	120 hrs	0 days	Mar 4 '04	May 26 '04	\$0	\$0	\$0	\$0
	11	Postdoc	100%	480 hrs	0 days	Mar 4 '04	May 26 '04	\$0	\$0	\$0	\$0
	18	ElecTechF	25%	120 hrs	0 days	Mar 4 '04	May 26 '04	\$4,680	\$4,680	\$0	\$4,680
	<u>Notes</u>										
	WBS Definition -										
	This is the important test for L0, establishing that everything is working properly and that we can proceed to the production phase.										
	M&S BOE -										
	Labor BOE -										
	1. Research associate (100%) electrical test										
	2. Elect. Technician (25%) support										
	3. Scientist (25%) support										
1.1.5.2.2.7	L0 prototype modules complete	\$0	\$0	\$0	0	0	3				
	<u>Notes</u>										
	WBS Definition -										
	M&S BOE -										
	Labor BOE -										
1.1.5.2.2.8	L2MS L0 prototype modules complete	\$0	\$0	\$0	0	0	2				
1.1.5.2.3	Layer 0 Module Production	\$120,686	\$46,400	\$74,286	0	0	0				
	<u>Notes</u>										
	WBS Definition -										
	M&S BOE -										
	Labor BOE -										

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.5.2.3.1	Explicit slack: L0 module production	\$0	\$0	\$0	0	0	5

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.5.2.3.2	Production L0 module: fixture design	\$37,242	\$0	\$37,242	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	20%	104 hrs	0 days	Oct 19 '04	Jan 26 '05	\$0	\$0	\$0	\$0
19	DesignerSF	100%	520 hrs	0 days	Oct 19 '04	Jan 26 '05	\$20,800	\$20,800	\$0	\$20,800
20	MechEngSF	62%	322.4 hrs	0 days	Oct 19 '04	Jan 26 '05	\$16,442	\$16,442	\$0	\$16,442

Notes

WBS Definition -

We assume we need to redesign all the fixtures. This includes all fixtures associated with holding sensors, hybrids and modules.

M&S BOE -

Labor BOE -

Engineering estimate based on L00 experience

Hybrid fixtures: eng 5 days, des. 8 days

g10 frames: eng = 2 day, design 2 days

hybrid to cable bonding: eng 3days, design 6days.

Sensor fixtures: eng. 13 days, des. 24 days

end to end gluing eng 8days, design 14days

g10 frames: eng 2days, design 4 days

Bonding: eng: 3 days des. 6 days.

Cable gluing and handling: eng 19 days des. 29 days

Glue Alumina substrate to cable: eng 4 days, des. 6days

glue hybrid to cable: eng 4 days, des. 6 days

glue cable to sensor: eng 3 days, des. 5 days

splice alumina gluing: eng 5 days des 6 days

splice bonding: eng 3 days, des 5 days

Total Mechanical Engineering time =37 days.

Total Designer time = 60 days.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.5.2.3.3	Production L0 module: material and fixtures	\$46,400	\$46,400	\$0	0.5	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	46,400	46,400	0 days	Jan 27 '05	Mar 23 '05	\$46,400	\$46,400	\$0	\$46,400

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Production L0 module: material and fixtures" continued

Notes

WBS Definition -

We assume for production we need to remake all the fixtures. This time we need twice the quantity. This includes all fixtures associated with holding sensors, hybrids and modules.

M&S BOE -

Engineering estimate based on L00 experience

Hybrid fixtures: 5k\$ *2

g10 frames: 4.2k\$

hybrid to cable bonding: 0.8k\$

Sensor fixtures: 10.55k\$ *2

end to end gluing: 5.5k\$

g10 frames: 4.2k\$

Bonding: 0.850k\$

Cable gluing and handling: 7.65k\$ *2

Glue Alumina substrate to cable: 1.6k\$

glue hybrid to cable: 1.6k\$

glue cable to sensor: 1.5k\$

splice alumina gluing: 1.7k\$

splice bonding: 1.25k\$

Total \$23,300 times 2 = \$46,400.

Labor BOE -

1.1.5.2.3.4	L0 Module production	\$37,044	\$0	\$37,044	0	0.4	0
-------------	----------------------	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	360 hrs	0 days	Mar 24 '05	Jul 29 '05	\$0	\$0	\$0	\$0
20	MechEngSF	25%	180 hrs	0 days	Mar 24 '05	Jul 29 '05	\$9,180	\$9,180	\$0	\$9,180
22	MechTechSF	100%	720 hrs	0 days	Mar 24 '05	Jul 29 '05	\$24,480	\$24,480	\$0	\$24,480
24	CMMProgrammerSF	10%	72 hrs	0 days	Mar 24 '05	Jul 29 '05	\$3,384	\$3,384	\$0	\$3,384

Notes

WBS Definition -

M&S BOE -

Labor BOE -

one full time technician needed.

All other personnel are for support.

Schedule BOE -

We assume a rate of 1 L0 modules a day => ~90 days (need 72 modules, we'll build ~90)

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level																																																										
1.1.5.2.3.5	L0 Production Modules Available	\$0	\$0	\$0	0	0	4																																																										
	<u>Notes</u>																																																																
	WBS Definition -																																																																
	M&S BOE -																																																																
	Labor BOE -																																																																
1.1.5.2.3.6	L0 Production Modules Complete	\$0	\$0	\$0	0	0	4																																																										
	<u>Notes</u>																																																																
	WBS Definition -																																																																
	M&S BOE -																																																																
	Labor BOE -																																																																
1.1.5.3	Outer layer modules	\$574,664	\$130,600	\$444,064	0	0	0																																																										
	<u>Notes</u>																																																																
	WBS Definition -																																																																
	It consists of 2 sensors glued together "head-on". On top of one sensor one hybrid and one pitch adapter is also glued. Module is wirebonded and put on a G-10 frame for testing.																																																																
	M&S BOE -																																																																
	Need 882 modules for the project.																																																																
	Labor BOE -																																																																
1.1.5.3.1	Outer Layers Module Prototype	\$93,136	\$19,600	\$73,536	0	0	0																																																										
	<u>Notes</u>																																																																
	WBS Definition -																																																																
	M&S BOE -																																																																
	Labor BOE -																																																																
1.1.5.3.1.1	Prototype Module: fixtures design	\$38,088	\$0	\$38,088	0	0	0																																																										
	<table border="1"> <thead> <tr> <th>ID</th> <th>Resource Name</th> <th>Units</th> <th>Work</th> <th>Delay</th> <th>Start</th> <th>Finish</th> <th>Cost</th> <th>Baseline Cost</th> <th>Act. Cost</th> <th>Rem. Cost</th> </tr> </thead> <tbody> <tr> <td>11</td> <td>Postdoc</td> <td>50%</td> <td>240 hrs</td> <td>0 days</td> <td>Jan 30 '02</td> <td>Apr 23 '02</td> <td>\$0</td> <td>\$0</td> <td>\$0</td> <td>\$0</td> </tr> <tr> <td>17</td> <td>ElecEngF</td> <td>10%</td> <td>48 hrs</td> <td>0 days</td> <td>Jan 30 '02</td> <td>Apr 23 '02</td> <td>\$2,640</td> <td>\$2,640</td> <td>\$2,640</td> <td>\$0</td> </tr> <tr> <td>18</td> <td>ElecTechF</td> <td>10%</td> <td>48 hrs</td> <td>0 days</td> <td>Jan 30 '02</td> <td>Apr 23 '02</td> <td>\$1,872</td> <td>\$1,872</td> <td>\$1,872</td> <td>\$0</td> </tr> <tr> <td>19</td> <td>DesignerSF</td> <td>75%</td> <td>360 hrs</td> <td>0 days</td> <td>Jan 30 '02</td> <td>Apr 23 '02</td> <td>\$14,400</td> <td>\$14,400</td> <td>\$14,400</td> <td>\$0</td> </tr> </tbody> </table>	ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost	11	Postdoc	50%	240 hrs	0 days	Jan 30 '02	Apr 23 '02	\$0	\$0	\$0	\$0	17	ElecEngF	10%	48 hrs	0 days	Jan 30 '02	Apr 23 '02	\$2,640	\$2,640	\$2,640	\$0	18	ElecTechF	10%	48 hrs	0 days	Jan 30 '02	Apr 23 '02	\$1,872	\$1,872	\$1,872	\$0	19	DesignerSF	75%	360 hrs	0 days	Jan 30 '02	Apr 23 '02	\$14,400	\$14,400	\$14,400	\$0									
ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost																																																							
11	Postdoc	50%	240 hrs	0 days	Jan 30 '02	Apr 23 '02	\$0	\$0	\$0	\$0																																																							
17	ElecEngF	10%	48 hrs	0 days	Jan 30 '02	Apr 23 '02	\$2,640	\$2,640	\$2,640	\$0																																																							
18	ElecTechF	10%	48 hrs	0 days	Jan 30 '02	Apr 23 '02	\$1,872	\$1,872	\$1,872	\$0																																																							
19	DesignerSF	75%	360 hrs	0 days	Jan 30 '02	Apr 23 '02	\$14,400	\$14,400	\$14,400	\$0																																																							

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
-----	------	------	-----	-------	-----------	-------------	-------

"Prototype Module: fixtures design" continued

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
20	MechEngSF	75%	360 hrs	0 days	Jan 30 '02	Apr 23 '02	\$18,360	\$18,360	\$18,360	\$0
22	MechTechSF	5%	24 hrs	0 days	Jan 30 '02	Apr 23 '02	\$816	\$816	\$816	\$0

Notes

WBS Definition -

This is for fixture designing and also to get all other support material in place for prototype module construction (support are: boxes, storage, designing G-10 frames for holding/testing modulesetc.)

M&S BOE -

Labor BOE -

1. Mech engineer (75%) fixtures and supervision
2. Draftsman (75%) support for mech. engineer
3. postdoc (10%) Consultation
4. mech. technician (5%) feedback on design
5. Elect. Engineer (5%) designing test boards
6. Elect. technician (5%) feedback on design

1.1.5.3.1.2	Prototype Module: material and fixtures	\$19,600	\$19,600	\$0	0	0	4
-------------	---	----------	----------	-----	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	19,600	19,600	0 days	Apr 24 '02	Jul 18 '02	\$19,600	\$19,600	\$19,600	\$0

Notes

WBS Definition -

These are the fixtures for prototype module construction in summer 2002.

M&S BOE -

1. detector/detector alignment fixtures (5K each)
2. hybrid/pitch adapter gluing fixture (2k each)*2
3. wirebonding fixture (1k each)
4. testing mechanical setup (2k each)
5. G-10 frames (0.06k each) [*60]
6. miscellaneous material 4k

Total: \$19,600

Labor BOE -

1.1.5.3.1.3	Prototype Module: Assembling	\$30,936	\$0	\$30,936	0	0.5	0
-------------	------------------------------	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	10%	48 hrs	0 days	Aug 6 '02	Oct 29 '02	\$0	\$0	\$0	\$0
11	Postdoc	25%	120 hrs	0 days	Aug 6 '02	Oct 29 '02	\$0	\$0	\$0	\$0
19	DesignerSF	20%	96 hrs	0 days	Aug 6 '02	Oct 29 '02	\$3,840	\$3,840	\$2,688	\$1,152
20	MechEngSF	25%	120 hrs	0 days	Aug 6 '02	Oct 29 '02	\$6,120	\$6,120	\$4,284	\$1,836
22	MechTechSF	75%	360 hrs	0 days	Aug 6 '02	Oct 29 '02	\$12,240	\$12,240	\$8,568	\$3,672

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Prototype Module: Assembling " continued

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
23	WirebonderSF	50%	240 hrs	0 days	Aug 6 '02	Oct 29 '02	\$6,480	\$6,480	\$4,536	\$1,944
24	CMMPProgrammerSF	10%	48 hrs	0 days	Aug 6 '02	Oct 29 '02	\$2,256	\$2,256	\$1,579	\$677

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1. postdoc (25%) support
2. mech. technician (50%) gluing/aligning
3. mech. technician (25%) for miscellaneous (boxes, storage etc.)
4. mech. engineer (25%) support
5. wirebonder (50%)
6. draftsman (20%) for miscellaneous boxes, storage, modifications to fixtures etc.
7. scientist (10%) support

Schedule BOE -

30 modules will need to be built. We estimate that one module can be built every 2 days for the prototypes.

1.1.5.3.1.4	Prototype Module testing	\$4,512	\$0	\$4,512	0	0.4	0
-------------	--------------------------	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	50%	240 hrs	0 days	Aug 13 '02	Nov 5 '02	\$0	\$0	\$0	\$0
11	Postdoc	25%	120 hrs	0 days	Aug 13 '02	Nov 5 '02	\$0	\$0	\$0	\$0
17	ElecEngF	10%	48 hrs	0 days	Aug 13 '02	Nov 5 '02	\$2,640	\$2,640	\$1,848	\$792
18	ElecTechF	10%	48 hrs	0 days	Aug 13 '02	Nov 5 '02	\$1,872	\$1,872	\$1,310	\$562

Notes

WBS Definition -

This is for testing modules. It should be a short test, most of the testing is done at the stave level, and is just to make sure the modules work before mounting on a stave.

M&S BOE -

Labor BOE -

Based on Run IIa experience. We estimate approximately 1 hour per module at production. For this prototype setup there will be learning involved, but testing will easily keep up with module assembly. Most of the work will be done by physicists and Postdocs. The electrical engineer is used as a consultant and the electrical tech is for repairs or minor modifications to the prototype parts.

1.1.5.3.1.5	Prototype modules available	\$0	\$0	\$0	0	0	4
-------------	-----------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.5.3.1.6	Prototype modules complete	\$0	\$0	\$0	0	0	4

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.5.3.2	Outer Layer Modules Round 2	\$30,936	\$0	\$30,936	0	0	0
1.1.5.3.2.1	Module #2: Assembling	\$30,936	\$0	\$30,936	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	10%	48 hrs	0 days	Jul 29 '03	Oct 21 '03	\$0	\$0	\$0	\$0
11	Postdoc	25%	120 hrs	0 days	Jul 29 '03	Oct 21 '03	\$0	\$0	\$0	\$0
19	DesignerSF	20%	96 hrs	0 days	Jul 29 '03	Oct 21 '03	\$3,840	\$3,840	\$0	\$3,840
20	MechEngSF	25%	120 hrs	0 days	Jul 29 '03	Oct 21 '03	\$6,120	\$6,120	\$0	\$6,120
22	MechTechSF	75%	360 hrs	0 days	Jul 29 '03	Oct 21 '03	\$12,240	\$12,240	\$0	\$12,240
23	WirebonderSF	50%	240 hrs	0 days	Jul 29 '03	Oct 21 '03	\$6,480	\$6,480	\$0	\$6,480
24	CMMPProgrammerSF	10%	48 hrs	0 days	Jul 29 '03	Oct 21 '03	\$2,256	\$2,256	\$0	\$2,256

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1. postdoc (25%) support
2. mech. technician (50%) gluing/aligning
3. mech. technician (25%) for miscellaneous (boxes, storage etc.)
4. mech. engineer (25%) support
5. wirebonder (50%)
6. draftsman (20%) for miscellaneous boxes, storage, modifications to fixtures etc.
7. scientist (10%) support

Schedule BOE -

30 modules will need to be built. We estimate that 1 module can be built every 2 days as for the prototypes.

1.1.5.3.2.2	modules # 2 available	\$0	\$0	\$0	0	0	4
-------------	-----------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.5.3.3	Outer Layers Module Preproduction	\$158,180	\$42,000	\$116,180	0	0	0

Notes
WBS Definition -
M&S BOE -
Labor BOE -

1.1.5.3.3.1	Preproduction Module: fixtures design	\$19,452	\$0	\$19,452	0	0.4	0
-------------	---------------------------------------	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	120 hrs	0 days	Aug 12 '03	Sep 23 '03	\$0	\$0	\$0	\$0
17	ElecEngF	10%	24 hrs	0 days	Aug 12 '03	Sep 23 '03	\$1,320	\$1,320	\$0	\$1,320
18	ElecTechF	10%	24 hrs	0 days	Aug 12 '03	Sep 23 '03	\$936	\$936	\$0	\$936
19	DesignerSF	75%	180 hrs	0 days	Aug 12 '03	Sep 23 '03	\$7,200	\$7,200	\$0	\$7,200
20	MechEngSF	75%	180 hrs	0 days	Aug 12 '03	Sep 23 '03	\$9,180	\$9,180	\$0	\$9,180
22	MechTechSF	10%	24 hrs	0 days	Aug 12 '03	Sep 23 '03	\$816	\$816	\$0	\$816

Notes
WBS Definition -
This is for fixture re-designing and also to get all other support in place for production module construction (support are: boxes, storage, designing G-10 frames for holding/testing modules, etc.)

M&S BOE -
Labor BOE -
1. Mech engineer (75%) fixtures and supervision
2. Draftsman (75%) support for mech. engineer
3. postdoc (50%) support
4. mech. technician (10%) support
5. Elect. Engineer (10%) designing test boards
6. Elect. technician (10%) support

1.1.5.3.3.2	Preproduction Module: material and fixtures	\$48,944	\$42,000	\$6,944	0.5	0.4	0
-------------	---	----------	----------	---------	-----	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	42,000	42,000	0 days	Sep 24 '03	Nov 18 '03	\$42,000	\$42,000	\$0	\$42,000
20	MechEngSF	20%	64 hrs	0 days	Sep 24 '03	Nov 18 '03	\$3,264	\$3,264	\$0	\$3,264
22	MechTechSF	20%	64 hrs	0 days	Sep 24 '03	Nov 18 '03	\$2,176	\$2,176	\$0	\$2,176
24	CMMPProgrammerSF	10%	32 hrs	0 days	Sep 24 '03	Nov 18 '03	\$1,504	\$1,504	\$0	\$1,504

Notes
WBS Definition -
These are the fixtures for production of modules.

M&S BOE -
We can align 4 silicon pairs on a single fixture each day so we need two fixtures.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Preproduction Module: material and fixtures" continued

Notes

Each module needs a hybrid/pitch adapter fixture -> need 8 fixtures
Wirebonding fixtures -> need 4 fixtures
testing box -> need 6 (tests will be short, but there will be multiple test stands)
G10 frames - need 750 to hold and store completed modules.

We assume we remake all fixtures used for the prototype phase.

1. fixtures for detector-detector (5k each) [*2]
2. fixture for hybrid/pitch to detector (2k each) [*8]
3. fixture for wirebonding modules (1k each) [*4]
4. testing mechanical setup (2k each) [*6]
5. G-10 frames (0.04k each) [*750]
6. miscellaneous materials, boxes, storage cabinets (8K total)

Total: \$80,000

INFN-Bologna contributes to this task by machining all parts relative to the fixtures items
1 through 4. Mechanical parts are only part of the fixture cost. Total INFN-contribution is estimated to be \$38,000

Labor BOE -

Labor is to measure and assemble the fixtures

Schedule BOE -

We will need to sustain a rate of 8 modules per day.

1.1.5.3.3.3	Preproduction module: Assembling training	\$23,504	\$0	\$23,504	0	0.4	0
-------------	---	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	25%	80 hrs	0 days	Oct 22 '03	Dec 18 '03	\$0	\$0	\$0	\$0
20	MechEngSF	25%	80 hrs	0 days	Oct 22 '03	Dec 18 '03	\$4,080	\$4,080	\$0	\$4,080
22	MechTechSF	125%	400 hrs	0 days	Oct 22 '03	Dec 18 '03	\$13,600	\$13,600	\$0	\$13,600
23	WirebonderSF	50%	160 hrs	0 days	Oct 22 '03	Dec 18 '03	\$4,320	\$4,320	\$0	\$4,320
24	CMMProgrammerSF	10%	32 hrs	0 days	Oct 22 '03	Dec 18 '03	\$1,504	\$1,504	\$0	\$1,504

Notes

WBS Definition -

We need to provide enough modules to sustain the ramp up stave production: 24 staves = 144 modules.

M&S BOE -

Labor BOE -

Two Mech. techs each 75% occupied making sensor-sensors joints and 25% gluing hybrids and pitch adapters

Schedule BOE -

Production Rate is 8 modules/day on 2CMMs + a granite surface:

4 sensor-sensor joints/day on 2 Cams

8 modules of hybrids& pitch adapters glued on a 3rd machine (these do not require alignment)

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Preproduction module: Assembling training" continued

Notes

Rate for preproduction is ~2 modules/day - to allow extra time for ironing out details and getting setup, mechanical tech time is estimated at a half the production need although the rate is only ~25% of production rate.

For wire bonding at a production we estimate one person could bond 6 modules.day.
For preproduction we assume 50% of a bonder can maintain the rate of 2 modules/day to allow some time for learning and streamlining the setups.

Labor:

1. mech. technician (100%)
2. mech tech support (25%)
3. wirebonder (50%)
4. postdoc (25%) support
5. mech engineer (25%) support
6. CMM programmer (10%)

1.1.5.3.3.4 Preproduction module: Assembling \$58,760 \$0 \$58,760 0 0.4 0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	25%	200 hrs	0 days	Apr 16 '04	Sep 7 '04	\$0	\$0	\$0	\$0
20	MechEngSF	25%	200 hrs	0 days	Apr 16 '04	Sep 7 '04	\$10,200	\$10,200	\$0	\$10,200
22	MechTechSF	125%	1,000 hrs	0 days	Apr 16 '04	Sep 7 '04	\$34,000	\$34,000	\$0	\$34,000
23	WirebonderSF	50%	400 hrs	0 days	Apr 16 '04	Sep 7 '04	\$10,800	\$10,800	\$0	\$10,800
24	CMMPProgrammerSF	10%	80 hrs	0 days	Apr 16 '04	Sep 7 '04	\$3,760	\$3,760	\$0	\$3,760

Notes

WBS Definition -

We need to provide enough modules to sustain the ramp up stave production from June to October 2003 = 24 staves = 144 modules.

M&S BOE -

Labor BOE -

1. mech. technician (100%)
2. mech tech support (25%)
3. wirebonder (50%)
4. postdoc (25%) support
5. mech engineer (25%) support
6. CMM programmer (10%)

Schedule BOE -

Production Rate is 8 modules/day on 2CMMs + a granite surface:

4 sensor-sensor joints/day on 2 CMMs

8 modules of hybrids& pitch adapters glued on a 3rd machine (these do not require alignment)

Two Mech. techs each 75% occupied making sensor-sensors joints and 25% gluing hybrids and pitch adapters

Rate for preproduction is ~2 modules/day - to allow extra time for ironing out details and getting setup, mechanical tech time is estimated at a half the production need although the rate is only

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Preproduction module: Assembling" continued

Notes

~25% of production rate.

For wire bonding at a production we estimate one person could bond 6 modules.day.
For preproduction we assume 50% of a bonder can maintain the rate of 2 modules/day to allow some time for learning and streamlining the setups.

1.1.5.3.3.5	Preproduction Module testing	\$7,520	\$0	\$7,520	0	0.4	0
-------------	------------------------------	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	10%	80 hrs	0 days	Apr 23 '04	Sep 14 '04	\$0	\$0	\$0	\$0
11	Postdoc	100%	800 hrs	0 days	Apr 23 '04	Sep 14 '04	\$0	\$0	\$0	\$0
17	ElecEngF	10%	80 hrs	0 days	Apr 23 '04	Sep 14 '04	\$4,400	\$4,400	\$0	\$4,400
18	ElecTechF	10%	80 hrs	0 days	Apr 23 '04	Sep 14 '04	\$3,120	\$3,120	\$0	\$3,120

Notes

WBS Definition -
This for testing modules. It should be a short test, most of the testing is done at the stave level.
This test is just to make sure the modules work before mounting on a stave.

M&S BOE -

Labor BOE -

Based on the Run IIa experience. For this preproduction setup there will be learning involved, but testing will easily keep up with module assembly. Electrical engineers and technicians are for consultation and support.

Schedule BOE -

We estimate 1 hour per module at production.

1.1.5.3.3.6	Preproduction modules available	\$0	\$0	\$0	0	0	4
-------------	---------------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.5.3.3.7	Preproduction modules complete	\$0	\$0	\$0	0	0	4
-------------	--------------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.5.3.4	Outer Layers Module Production	\$242,412	\$19,000	\$223,412	0	0	0

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.5.3.4.1	Production Module: fixtures design	\$8,544	\$0	\$8,544	0	0.4	0
-------------	------------------------------------	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	10%	16 hrs	0 days	Apr 30 '04	May 27 '04	\$0	\$0	\$0	\$0
17	ElecEngF	10%	16 hrs	0 days	Apr 30 '04	May 27 '04	\$880	\$880	\$0	\$880
18	ElecTechF	10%	16 hrs	0 days	Apr 30 '04	May 27 '04	\$624	\$624	\$0	\$624
19	DesignerSF	25%	40 hrs	0 days	Apr 30 '04	May 27 '04	\$1,600	\$1,600	\$0	\$1,600
20	MechEngSF	50%	80 hrs	0 days	Apr 30 '04	May 27 '04	\$4,080	\$4,080	\$0	\$4,080
22	MechTechSF	25%	40 hrs	0 days	Apr 30 '04	May 27 '04	\$1,360	\$1,360	\$0	\$1,360

Notes

WBS Definition -

This is for fixture re-designing and also to get all other support in place for production module construction (support are: boxes, storage, designing G-10 frames for holding/testing modules, programming the CMM machines etc.)

M&S BOE -

Labor BOE -

Based on Run Ila experience.

1. Mech engineer (50%)
2. Draftsman (25%)
3. mech. technician (25%)
4. Elect. Engineer (10%)
5. Elect. Technician (10%)
6. postdoc (10%)

1.1.5.3.4.2	Production modules: material and fixtures	\$23,224	\$19,000	\$4,224	0.5	0.4	0
-------------	---	----------	----------	---------	-----	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	19,000	19,000	0 days	May 28 '04	Jul 26 '04	\$19,000	\$19,000	\$0	\$19,000
20	MechEngSF	10%	32 hrs	0 days	May 28 '04	Jul 26 '04	\$1,632	\$1,632	\$0	\$1,632
22	MechTechSF	10%	32 hrs	0 days	May 28 '04	Jul 26 '04	\$1,088	\$1,088	\$0	\$1,088
24	CMMProgrammerSF	10%	32 hrs	0 days	May 28 '04	Jul 26 '04	\$1,504	\$1,504	\$0	\$1,504

Notes

WBS Definition -

M&S BOE -

We assume all the fixtures were made for the preproduction. Here is the cost to make small modifications, or to order a few extra fixtures for production.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Production modules: material and fixtures" continued

Notes

1. fixtures for detector-detector (5k each) [*1] assume we order one more for production
2. fixture for hybrid/pitch to detector (2k each) [*2]
3. fixture for wirebonding modules (1k each) [*1]
4. testing mechanical setup (2k each) [*2]
5. G-10 frames (0.05k each) [*180]
6. miscellaneous materials, boxes, storage cabinets (8K total)

Total: \$31,000

INFN-Bologna contributes to this task by machining all parts relative to the fixtures items 1 through 4. Mechanical parts are only part of the fixture cost. Total INFN-contribution is estimated to be \$12,000

Labor BOE -

1.1.5.3.4.3	Production Modules: Assembling	\$193,704	\$0	\$193,704	0	0.4	0
-------------	--------------------------------	-----------	-----	-----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	25%	350 hrs	0 days	Dec 10 '04	Aug 22 '05	\$0	\$0	\$0	\$0
11	Postdoc	75%	1,050 hrs	0 days	Dec 10 '04	Aug 22 '05	\$0	\$0	\$0	\$0
20	MechEngSF	25%	350 hrs	0 days	Dec 10 '04	Aug 22 '05	\$17,850	\$17,850	\$0	\$17,850
22	MechTechSF	250%	3,500 hrs	0 days	Dec 10 '04	Aug 22 '05	\$119,000	\$119,000	\$0	\$119,000
23	WirebonderSF	133%	1,862 hrs	0 days	Dec 10 '04	Aug 22 '05	\$50,274	\$50,274	\$0	\$50,274
24	CMMProgrammerSF	10%	140 hrs	0 days	Dec 10 '04	Aug 22 '05	\$6,580	\$6,580	\$0	\$6,580

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1. mech technician (250%)
2. wirebonder (133%)
3. Scientist (25%) support
4. mech engineer (25%) support
5. CMM programmer (10%)
6. postdoc (75%) support

Two Mech. techs each 75% occupied making sensor-sensors joints and 25% gluing hybrids and pitch adapters. An additional 50% of a mech tech is needed for support of the two construction techs.

For wirebonding we estimate 1 person at 100% could bond 6 modules/day.
For each module there are 4 sets of bonds: Si-Si, Si to Pitch adapter,
PA to chips and hybrid to test board.
To maintain a rate of 8 modules/day we need 1.33 wirebonders.

Schedule BOE:

Production Rate is 8 modules/day on 2CMMs + a granite surface:

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Production Modules: Assembling" continued

Notes

4 sensor-sensor joints/day on 2 CMMs
8 modules of hybrids& pitch adapters glued on a 3rd machine (these do not require alignment)

For 200 staves we need 1200 modules. At a rate of 8 per day this is 150 days.
We add 25 more days to allow for all the spare hybrids to be tested and provided for module assembly

1.1.5.3.4.4 Production Module testing \$16,940 \$0 \$16,940 0 0.4 0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	10%	140 hrs	0 days	Dec 17 '04	Aug 29 '05	\$0	\$0	\$0	\$0
11	Postdoc	100%	1,400 hrs	0 days	Dec 17 '04	Aug 29 '05	\$0	\$0	\$0	\$0
17	ElecEngF	10%	140 hrs	0 days	Dec 17 '04	Aug 29 '05	\$7,700	\$7,700	\$0	\$7,700
21	ElecTechSF	20%	280 hrs	0 days	Dec 17 '04	Aug 29 '05	\$9,240	\$9,240	\$0	\$9,240

Notes

WBS Definition -
This for testing modules. It should be a short test, most of the testing is done at the stave level.
This test is just to make sure the modules work before mounting on a stave.

M&S BOE -

Labor BOE -
Estimate is based on Run IIa experience.

Schedule BOE -
We estimate 1 hour per module at production and will be paced by module availability.

1.1.5.3.4.5 Production modules available \$0 \$0 \$0 0 0 4

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.5.3.4.6 1st production module available \$0 \$0 \$0 0 0 3

Notes

WBS Definition -

M&S BOE -

Labor BOE -

Schedule BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level																							
1.1.5.3.4.7	Contingency on production module	\$0	\$0	\$0	0	0	5																							
	<u>Notes</u>																													
	WBS Definition -																													
	M&S BOE -																													
	Labor BOE -																													
1.1.5.3.4.8	L2MS Production module available	\$0	\$0	\$0	0	0	2																							
1.1.5.3.4.9	Module Production complete	\$0	\$0	\$0	0	0	4																							
	<u>Notes</u>																													
	WBS Definition -																													
	M&S BOE -																													
	Labor BOE -																													
1.1.5.3.5	Outer Layer Module Fixtures	\$50,000	\$50,000	\$0	0	0	0																							
1.1.5.3.5.1	Bologna contribution to preproduction	\$38,000	\$38,000	\$0	0	0	0																							
	<table border="1"> <thead> <tr> <th>ID</th> <th>Resource Name</th> <th>Units</th> <th>Work</th> <th>Delay</th> <th>Start</th> <th>Finish</th> <th>Cost</th> <th>Baseline Cost</th> <th>Act. Cost</th> <th>Rem. Cost</th> </tr> </thead> <tbody> <tr> <td>9</td> <td>INKIND</td> <td>38,000</td> <td>38,000</td> <td>0 days</td> <td>Sep 24 '03</td> <td>Nov 18 '03</td> <td>\$38,000</td> <td>\$38,000</td> <td>\$0</td> <td>\$38,000</td> </tr> </tbody> </table>	ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost	9	INKIND	38,000	38,000	0 days	Sep 24 '03	Nov 18 '03	\$38,000	\$38,000	\$0	\$38,000							
ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost																				
9	INKIND	38,000	38,000	0 days	Sep 24 '03	Nov 18 '03	\$38,000	\$38,000	\$0	\$38,000																				
1.1.5.3.5.2	Bologna contribution to production	\$12,000	\$12,000	\$0	0	0	0																							
	<table border="1"> <thead> <tr> <th>ID</th> <th>Resource Name</th> <th>Units</th> <th>Work</th> <th>Delay</th> <th>Start</th> <th>Finish</th> <th>Cost</th> <th>Baseline Cost</th> <th>Act. Cost</th> <th>Rem. Cost</th> </tr> </thead> <tbody> <tr> <td>9</td> <td>INKIND</td> <td>12,000</td> <td>12,000</td> <td>0 days</td> <td>May 28 '04</td> <td>Aug 2 '04</td> <td>\$12,000</td> <td>\$12,000</td> <td>\$0</td> <td>\$12,000</td> </tr> </tbody> </table>	ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost	9	INKIND	12,000	12,000	0 days	May 28 '04	Aug 2 '04	\$12,000	\$12,000	\$0	\$12,000							
ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost																				
9	INKIND	12,000	12,000	0 days	May 28 '04	Aug 2 '04	\$12,000	\$12,000	\$0	\$12,000																				
1.1.5.4	Outer layer Staves	\$1,145,084	\$392,500	\$752,584	0	0	0																							
	<u>Notes</u>																													
	WBS Definition -																													
	M&S BOE -																													
	Labor BOE -																													
1.1.5.4.1	Outer Layer Stave Prototype	\$254,684	\$83,500	\$171,184	0	0	0																							
	<u>Notes</u>																													
	WBS Definition -																													
	M&S BOE -																													

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Outer Layer Stave Prototype" continued

Notes

Labor BOE -

1.1.5.4.1.1	Prototype stave :Structural and cooling R&D	\$119,000	\$20,000	\$99,000	0	0	0
-------------	---	-----------	----------	----------	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	20,000	20,000	0 days	Jan 7 '02	May 24 '02	\$20,000	\$20,000	\$20,000	\$0
10	Physicist	25%	198 hrs	0 days	Jan 7 '02	May 24 '02	\$0	\$0	\$0	\$0
11	Postdoc	50%	396 hrs	0 days	Jan 7 '02	May 24 '02	\$0	\$0	\$0	\$0
19	DesignerSF	100%	792 hrs	0 days	Jan 7 '02	May 24 '02	\$31,680	\$31,680	\$31,680	\$0
20	MechEngSF	100%	792 hrs	0 days	Jan 7 '02	May 24 '02	\$40,392	\$40,392	\$40,392	\$0
22	MechTechSF	100%	792 hrs	0 days	Jan 7 '02	May 24 '02	\$26,928	\$26,928	\$26,928	\$0

Notes

WBS Definition -
Parts and fixtures to test various concepts.

M&S BOE -
Cost estimates are based on Run IIa experience.

Labor BOE -
Based on Run IIa experience and includes labor needed to come up with the design of the stave and fixtures to build staves.

1.1.5.4.1.2	Prototype Stave Design complete	\$0	\$0	\$0	0	0	4
-------------	---------------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -
Both the stave and fixtures.

M&S BOE -

Labor BOE -

1.1.5.4.1.3	Prototype Stave: material and fixtures	\$63,500	\$63,500	\$0	0.5	0	0
-------------	--	----------	----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	63,500	63,500	0 days	May 24 '02	May 24 '02	\$63,500	\$63,500	\$63,500	\$0

Notes

WBS Definition -
This is the time needed at the machine shop to prepare all fixtures.

M&S BOE -
1. mechanical stave related material and intermediate fixtures (7k total)
2. mechanical stave core assembly fixture (5k)

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
-----	------	------	-----	-------	-----------	-------------	-------

"Prototype Stave: material and fixtures" continued

Notes

3. bus cable lamination fixture (2k)
4. Module installation fixture (3k)*2]
5. One set of axial and stereo module alignment fixtures (10k each=20k)
6. stave wirebonding fixture (3k each) [*2]
7. stave inspection fixture (3k each)
8. stave storage boxes (0.4 each) [*15]
9. miscellaneous material, testing boxes, storage cabinets etc. (10k total)

Total: \$63,500

Labor BOE -

Schedule BOE -

This is the time needed at the machine shop to prepare all fixtures. It also includes the time needed for assembling, inspecting atc. the fixtures. We assume here that we get at least 1 fixture of each type in order to start the assembling process.

1.1.5.4.1.4	Prototype Stave: mechanical core construction	\$6,120	\$0	\$6,120	0	0	0
-------------	---	---------	-----	---------	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	10%	16 hrs	0 days	Jul 29 '02	Aug 23 '02	\$0	\$0	\$0	\$0
20	MechEngSF	25%	40 hrs	0 days	Jul 29 '02	Aug 23 '02	\$2,040	\$2,040	\$2,040	\$0
22	MechTechSF	75%	120 hrs	0 days	Jul 29 '02	Aug 23 '02	\$4,080	\$4,080	\$4,080	\$0

Notes

WBS Definition -

This is to prepare a few (~ 5) staves cores with the prototype design and mechanical parts (bus cables) as practice for electrical core production.

M&S BOE -

Labor BOE -

Based on Run IIa experience

1.1.5.4.1.5	Prototype Stave: electrical core construction	\$12,240	\$0	\$12,240	0	0.5	0
-------------	---	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	10%	32 hrs	0 days	Sep 10 '02	Nov 4 '02	\$0	\$0	\$0	\$0
20	MechEngSF	25%	80 hrs	0 days	Sep 10 '02	Nov 4 '02	\$4,080	\$4,080	\$2,448	\$1,632
22	MechTechSF	75%	240 hrs	0 days	Sep 10 '02	Nov 4 '02	\$8,160	\$8,160	\$4,896	\$3,264

Notes

WBS Definition -

This is to prepare (~30) stave cores with electrical parts (bus cables) as part of the electrical stave prototypes milestone.

M&S BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Prototype Stave: electrical core construction" continued

Notes

Based on Run Ila experience.

1. Mech Tech (75%) laminating CF sheets, gluing the stave on the mold, and preparing parts.
2. Mech Engineer (25%) Support/supervision
3. Research Associate (10%) Support

Schedule:

The start date is driven by the availability of the prototype bus cable. The end date is driven by being ready for stave prototype construction when all the other parts are ready.

1.1.5.4.1.6	Prototype Stave: Electrical Cores available	\$0	\$0	\$0	0	0	4
-------------	---	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.5.4.1.7	Prototype Stave: mechanical testing	\$21,120	\$0	\$21,120	0	0.5	0
-------------	-------------------------------------	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	25%	160 hrs	0 days	Aug 26 '02	Dec 18 '02	\$0	\$0	\$0	\$0
20	MechEngSF	25%	160 hrs	0 days	Aug 26 '02	Dec 18 '02	\$8,160	\$8,160	\$7,344	\$816
22	MechTechSF	25%	160 hrs	0 days	Aug 26 '02	Dec 18 '02	\$5,440	\$5,440	\$4,896	\$544
24	CMMProgrammerSF	25%	160 hrs	0 days	Aug 26 '02	Dec 18 '02	\$7,520	\$7,520	\$6,768	\$752

Notes

WBS Definition -

This is all those tests aimed at making sure that the design and assembling procedures are within our mechanical specs.

M&S BOE -

Labor BOE -

Based on Run Ila experience

1.1.5.4.1.8	Ready to begin Prototype Electrical Stave Construction	\$0	\$0	\$0	0	0	4
-------------	--	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.5.4.1.9	Prototype Stave: electrical assembly	\$22,144	\$0	\$22,144	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	160 hrs	0 days	Oct 16 '02	Dec 12 '02	\$0	\$0	\$0	\$0
20	MechEngSF	50%	160 hrs	0 days	Oct 16 '02	Dec 12 '02	\$8,160	\$8,160	\$3,264	\$4,896
22	MechTechSF	75%	240 hrs	0 days	Oct 16 '02	Dec 12 '02	\$8,160	\$8,160	\$3,264	\$4,896
23	WirebonderSF	50%	160 hrs	0 days	Oct 16 '02	Dec 12 '02	\$4,320	\$4,320	\$1,728	\$2,592
24	CMMProgrammerSF	10%	32 hrs	0 days	Oct 16 '02	Dec 12 '02	\$1,504	\$1,504	\$602	\$902

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1. Mech Technician (75%) gluing/aligning modules on staves
2. Wirebonding (50%)
3. Research Associate (50%) Support
4. Mech. Engineer (50%) Support
5. CMM programmer (10%)

Schedule BOE:

The beginning of this task is driven by having prototype modules and bus cables available. We assume it will take 2 weeks to make the 1st prototype electrical stave. We are buying enough prototype parts to make 5 electrical staves and the duration of 40 days is to make 5 staves.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.5.4.1.10	Prototype Stave: electrical evaluation and Radiation Tests	\$10,560	\$0	\$10,560	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	50%	240 hrs	0 days	Oct 30 '02	Jan 30 '03	\$0	\$0	\$0	\$0
11	Postdoc	50%	240 hrs	0 days	Oct 30 '02	Jan 30 '03	\$0	\$0	\$0	\$0
17	ElecEngF	25%	120 hrs	0 days	Oct 30 '02	Jan 30 '03	\$6,600	\$6,600	\$5,610	\$990
21	ElecTechSF	25%	120 hrs	0 days	Oct 30 '02	Jan 30 '03	\$3,960	\$3,960	\$3,366	\$594

Notes

WBS Definition -

M&S BOE -

Labor BOE -

- For this prototype stave testing we estimate needing
- 1 postdoc at 50%
 - 1 physicist 50%
 - 1 electrical tech and 1 electrical engineer for consultation at 25% each.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.5.4.1.11	Prototype Stave #1 available	\$0	\$0	\$0	0	0	3

Notes

WBS Definition -

M&S BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level			
"Prototype Stave #1 available" continued										
<u>Notes</u>										
Labor BOE -										
Schedule BOE -										
We estimate it will take 2 weeks (10 days) to put all the parts together to make the first prototype stave.										
1.1.5.4.1.12	Contingency on Prototype Stave #1	\$0	\$0	\$0	0	0	5			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										
1.1.5.4.1.13	L2MS Prototype stave #1 complete	\$0	\$0	\$0	0	0	2			
1.1.5.4.2	Outer layer Staves round 2	\$32,704	\$0	\$32,704	0	0	0			
1.1.5.4.2.1	#2 Stave: electrical assembly	\$22,144	\$0	\$22,144	0	0.4	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
11	Postdoc	50%	160 hrs	0 days	Aug 12 '03	Oct 7 '03	\$0	\$0	\$0	\$0
20	MechEngSF	50%	160 hrs	0 days	Aug 12 '03	Oct 7 '03	\$8,160	\$8,160	\$0	\$8,160
22	MechTechSF	75%	240 hrs	0 days	Aug 12 '03	Oct 7 '03	\$8,160	\$8,160	\$0	\$8,160
23	WirebonderSF	50%	160 hrs	0 days	Aug 12 '03	Oct 7 '03	\$4,320	\$4,320	\$0	\$4,320
24	CMMProgrammerSF	10%	32 hrs	0 days	Aug 12 '03	Oct 7 '03	\$1,504	\$1,504	\$0	\$1,504
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										
1. Mech Technician (75%) gluing/aligning modules on staves										
2. Wirebonding (50%)										
3. Research Associate (50%) Support										
4. Mech. Engineer (50%) Support										
5. CMM programmer (10%)										
Schedule BOE -										
The beginning of this task is driven by having #2 modules and bus cables available. We assume it will take 2 weeks to make the 1st electrical stave. We are buying enough parts to make 5 electrical staves and the duration of 40 days is to make 5 staves.										

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.5.4.2.2	#2 Stave: electrical testing and Rad. Tests	\$10,560	\$0	\$10,560	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	50%	240 hrs	0 days	Aug 26 '03	Nov 18 '03	\$0	\$0	\$0	\$0
11	Postdoc	50%	240 hrs	0 days	Aug 26 '03	Nov 18 '03	\$0	\$0	\$0	\$0
17	ElecEngF	25%	120 hrs	0 days	Aug 26 '03	Nov 18 '03	\$6,600	\$6,600	\$0	\$6,600
21	ElecTechSF	25%	120 hrs	0 days	Aug 26 '03	Nov 18 '03	\$3,960	\$3,960	\$0	\$3,960

Notes

WBS Definition -

M&S BOE -

Labor BOE -

This is ALL the electrical testing crew at FNAL. We don't divide it up between hybrid, modules, staves and burn-in stave parts. All SiDet electrical testing (up to the Stave) is considered here in terms of labor. The effort is estimated based on a total of 4 FTE Postdocs + 1 FTE scientist + 0.5 FTE electrical technician (for repair) for the PRODUCTION.

1.1.5.4.2.3	#2 Stave available	\$0	\$0	\$0	0	0	4
-------------	--------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

Schedule BOE -

We assume it will take 2 weeks (10 days) to put all the parts together to make the first stave.

1.1.5.4.3	Outer Layer Stave Preproduction	\$507,724	\$263,000	\$244,724	0	0	0
-----------	---------------------------------	-----------	-----------	-----------	---	---	---

Notes

WBS Definition -

M&S BOE -

This part also contains all material cost for the production.

Labor BOE -

1.1.5.4.3.1	PreProduction Stave: final design	\$39,800	\$0	\$39,800	0	0.4	0
-------------	-----------------------------------	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	200 hrs	0 days	Sep 10 '03	Nov 18 '03	\$0	\$0	\$0	\$0
19	DesignerSF	100%	400 hrs	0 days	Sep 10 '03	Nov 18 '03	\$16,000	\$16,000	\$0	\$16,000
20	MechEngSF	100%	400 hrs	0 days	Sep 10 '03	Nov 18 '03	\$20,400	\$20,400	\$0	\$20,400
22	MechTechSF	25%	100 hrs	0 days	Sep 10 '03	Nov 18 '03	\$3,400	\$3,400	\$0	\$3,400

Notes

WBS Definition -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"PreProduction Stave: final design" continued

Notes

This is the final design of the mechanical stave.

M&S BOE -

Labor BOE -

Based on Run Ila experience.

1.1.5.4.3.2	PreProduction Stave: Materials	\$142,000	\$142,000	\$0	0.5	0.4	0
-------------	--------------------------------	-----------	-----------	-----	-----	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	142,000	142,000	0 days	Nov 19 '03	Jan 22 '04	\$142,000	\$142,000	\$0	\$142,000

Notes

WBS Definition -

M&S BOE -

Cost estimate is based on Run Ila experience.

50k Carbon fiber for skins

20k for PEEK tubing/noxxels/fixtures/molds

2k Rohacell/jigs

70k precision mounting hardware (end of staves)

Labor BOE -

1.1.5.4.3.3	PreProduction Stave: fixtures	\$142,120	\$121,000	\$21,120	0.5	0	0
-------------	-------------------------------	-----------	-----------	----------	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	121,000	121,000	0 days	Nov 19 '03	Mar 18 '04	\$121,000	\$121,000	\$0	\$121,000
20	MechEngSF	25%	160 hrs	0 days	Nov 19 '03	Mar 18 '04	\$8,160	\$8,160	\$0	\$8,160
22	MechTechSF	25%	160 hrs	0 days	Nov 19 '03	Mar 18 '04	\$5,440	\$5,440	\$0	\$5,440
24	CMMProgrammerSF	25%	160 hrs	0 days	Nov 19 '03	Mar 18 '04	\$7,520	\$7,520	\$0	\$7,520

Notes

WBS Definition -

This is the time needed at the machine shop to prepare all fixtures for production.

M&S BOE -

Run Ila experience and quotations where possible. We assume we re-do all fixtures in number adequate to sustain production.

1. mechanical stave core assembly fixture (5k total) [*3]
2. laminating the bus cable fixture (2k) [*6]
3. axial and stereo module installation/alignment fixtures (15k each=30k)
4. stave wirebonding fixture (3k each) [*2]
5. stave inspection fixture (3k each)

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"PreProduction Stave: fixtures" continued

Notes

- 6. stave storage boxes (0.4 each) [*100]
- 7. miscellaneous material, testing boxes, storage cabinets etc. (15k total)

Total: \$121,000

Labor BOE -

The labor is to assemble and measure the fixtures

1.1.5.4.3.4	Preproduction Stave: training mechanical construction	\$20,400	\$0	\$20,400	0	0.4	0
-------------	---	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	160 hrs	0 days	Dec 19 '03	Feb 19 '04	\$0	\$0	\$0	\$0
20	MechEngSF	25%	80 hrs	0 days	Dec 19 '03	Feb 19 '04	\$4,080	\$4,080	\$0	\$4,080
22	MechTechSF	150%	480 hrs	0 days	Dec 19 '03	Feb 19 '04	\$16,320	\$16,320	\$0	\$16,320

Notes

WBS Definition -

This is to train 2 more technicians to build mechanical staves. This covers time to learn how to use the fixtures and to come up to speed in the SiDet environment.

M&S BOE -

Labor BOE -

Run IIa experience

- 1. Mech. tech = 1 lead tech and 2 learning the job all at 50% time each preparing parts and assembling
- 2. Mech Engineer (25%) support
- 3. Postdoc 50% QA/support

Schedule BOE -

The start date is driven by having them trained for the start of preproduction.

1.1.5.4.3.5	Preproduction Stave: mechanical construction	\$31,280	\$0	\$31,280	0	0.4	0
-------------	--	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	160 hrs	0 days	Feb 20 '04	Apr 15 '04	\$0	\$0	\$0	\$0
20	MechEngSF	25%	80 hrs	0 days	Feb 20 '04	Apr 15 '04	\$4,080	\$4,080	\$0	\$4,080
22	MechTechSF	250%	800 hrs	0 days	Feb 20 '04	Apr 15 '04	\$27,200	\$27,200	\$0	\$27,200

Notes

WBS Definition -

This is to prepare 24 electrical stave cores.

M&S BOE -

Labor BOE -

Based on prototype experience and Run IIa experience.

100% Mechtech bus cables + core assembly

100% Mechtech parts prep. (PEEK) and post processing

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Preproduction Stave: mechanical construction" continued

Notes

50% tech supervision
Total Mech. Tech 250%
Plus
Mech Engineer (25%) support
Research Associate (50%) support

Schedule BOE -

This task that ramps up to a rate of 1 stave core/day. The steps includes laminating the bus cables to the C, preparing the CF and Rohacell, forming the PEEK tubing, gluing the nozzles.

The start date is driven by having finished the final stave design and the readiness of the preproduction bus cable. Also, we assume that we commit to the final fixture design during the previous tasks. The end date is drivern by being ready for stave preproduction construction when all the other preproduction parts are ready.

1.1.5.4.3.6	Preproduction Stave: mechanicals available	\$0	\$0	\$0	0	0	4
-------------	--	-----	-----	-----	---	---	---

Notes

WBS Definition -
This is mechanical staves.

M&S BOE -

Labor BOE -

1.1.5.4.3.7	Preproduction Stave: mechanical testing	\$4,632	\$0	\$4,632	0	0.4	0
-------------	---	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	80 hrs	0 days	Mar 5 '04	Apr 1 '04	\$0	\$0	\$0	\$0
20	MechEngSF	25%	40 hrs	0 days	Mar 5 '04	Apr 1 '04	\$2,040	\$2,040	\$0	\$2,040
22	MechTechSF	20%	32 hrs	0 days	Mar 5 '04	Apr 1 '04	\$1,088	\$1,088	\$0	\$1,088
24	CMMPprogrammerSF	20%	32 hrs	0 days	Mar 5 '04	Apr 1 '04	\$1,504	\$1,504	\$0	\$1,504

Notes

WBS Definition -
This is the remaining tests aimed at making sure that the design and assembling procedures are within our mechanical specs. Already, extensive tests were made on the prototype stave. Nonetheless we need to re-verify for the production.

M&S BOE -

Labor BOE -
Based on Run IIa experience.

1.1.5.4.3.8	Preproduction Stave: training electrical assembly	\$35,448	\$0	\$35,448	0	0.4	0
-------------	---	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	240 hrs	0 days	Feb 6 '04	Apr 29 '04	\$0	\$0	\$0	\$0

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Preproduction Stave: training electrical assembly " continued

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
20	MechEngSF	25%	120 hrs	0 days	Feb 6 '04	Apr 29 '04	\$6,120	\$6,120	\$0	\$6,120
22	MechTechSF	150%	720 hrs	0 days	Feb 6 '04	Apr 29 '04	\$24,480	\$24,480	\$0	\$24,480
23	WirebonderSF	20%	96 hrs	0 days	Feb 6 '04	Apr 29 '04	\$2,592	\$2,592	\$0	\$2,592
24	CMMProgrammerSF	10%	48 hrs	0 days	Feb 6 '04	Apr 29 '04	\$2,256	\$2,256	\$0	\$2,256

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1. Mech Technician each 50% (100%) learning to install/align modules on the stave
2. Mech Tech (50%) teaching and troubleshooting
3. Wirebonder (20%) bonder
4. CMM driver (10%)
5. Mech. Engineer (25%) support
6. postdoc (50%)

Schedule:

This is driven by being ready for when preproduction modules are available. We will use leftover parts from the prototype stage along with dummy parts. This covers time to learn how to use the fixtures and CMMs and to come up to speed in the SiDet environment.

1.1.5.4.3.9	Preproduction Stave: electrical assembly	\$59,004	\$0	\$59,004	0	0.4	0
-------------	--	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	360 hrs	0 days	Apr 30 '04	Sep 7 '04	\$0	\$0	\$0	\$0
20	MechEngSF	25%	180 hrs	0 days	Apr 30 '04	Sep 7 '04	\$9,180	\$9,180	\$0	\$9,180
22	MechTechSF	150%	1,080 hrs	0 days	Apr 30 '04	Sep 7 '04	\$36,720	\$36,720	\$0	\$36,720
23	WirebonderSF	50%	360 hrs	0 days	Apr 30 '04	Sep 7 '04	\$9,720	\$9,720	\$0	\$9,720
24	CMMProgrammerSF	10%	72 hrs	0 days	Apr 30 '04	Sep 7 '04	\$3,384	\$3,384	\$0	\$3,384

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1. Mech Technician (100%) installing/aligning modules on the stave (2 techs at 50% each)
2. Wirebonder (50%) bonder
3. Mech Technician (50%) support, inspection, supervision
4. Mech. Engineer (25%) support
5. CMM programmer (10%)
6. Research Associate (50%) support

Schedule BOE -

This is driven by having preproduction modules available. We will use production bus cables, production sensors preproduction hybrids (we call these preproduction modules) and preproduction MiniPortcards.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Preproduction Stave: electrical assembly" continued

Notes

We want to build 24 electrical staves during the ramp up period. Preproduction modules are produced at a rate of ~2/day, or 1/3 stave/day. This corresponds to 72 days for preproduction construction. In addition, we allow 8 days after the parts are available to get everything ready for a total of 80 days.

1.1.5.4.3.10	Preproduction Stave: electricals available	\$0	\$0	\$0	0	0	4
--------------	--	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

Schedule BOE -

We assume it will take 2 weeks (10 days) to put all the parts together to make the first prototype stave.

1.1.5.4.3.11	Preproduction Stave: electrical testing (inc. Radiation tests)	\$16,000	\$0	\$16,000	0	0.4	0
--------------	--	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	50%	320 hrs	0 days	May 7 '04	Aug 30 '04	\$0	\$0	\$0	\$0
11	Postdoc	200%	1,280 hrs	0 days	May 7 '04	Aug 30 '04	\$0	\$0	\$0	\$0
21	ElecTechSF	50%	320 hrs	0 days	May 7 '04	Aug 30 '04	\$10,560	\$10,560	\$0	\$10,560
22	MechTechSF	25%	160 hrs	0 days	May 7 '04	Aug 30 '04	\$5,440	\$5,440	\$0	\$5,440

Notes

WBS Definition -

M&S BOE -

Labor BOE -

This is the stave electrical testing crew at FNAL. For preproduction, it is estimated to be a total of:

1. Postdocs (200%)
2. scientist (50%) responsible for quality control
3. electrical technician (50%) for repair and minor support jobs
4. mech technician (25%) for repair/redo bonds

1.1.5.4.3.12	Evaluation of preproduction stave cores	\$17,040	\$0	\$17,040	0	0.4	0
--------------	---	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	20%	64 hrs	0 days	Mar 5 '04	Apr 29 '04	\$0	\$0	\$0	\$0
11	Postdoc	50%	160 hrs	0 days	Mar 5 '04	Apr 29 '04	\$0	\$0	\$0	\$0
20	MechEngSF	25%	80 hrs	0 days	Mar 5 '04	Apr 29 '04	\$4,080	\$4,080	\$0	\$4,080
22	MechTechSF	50%	160 hrs	0 days	Mar 5 '04	Apr 29 '04	\$5,440	\$5,440	\$0	\$5,440
24	CMMPProgrammerSF	50%	160 hrs	0 days	Mar 5 '04	Apr 29 '04	\$7,520	\$7,520	\$0	\$7,520

Notes

WBS Definition -

This is a mechanical evaluation from the point of view of giving the green light to start production.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level			
"Evaluation of preproduction stave cores" continued										
<u>Notes</u>										
M&S BOE -										
Labor BOE -										
We assume here minor modification to the entire production structure. All this labor is ON TOP of the normal electrical testing labor. This estimate is based on the Run Ila experience.										
1.1.5.4.3.13	Stave Production go-ahead (Cores)	\$0	\$0	\$0	0	0	4			
<u>Notes</u>										
WBS Definition -										
This milestone allows to proceed into stave production..										
M&S BOE -										
Labor BOE -										
1.1.5.4.3.14	Preproduction Stave: electricals complete	\$0	\$0	\$0	0	0	4			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										
Schedule BOE -										
We assume it will take 2 weeks (10 days) to put all the parts together to make the first prototype stave.										
1.1.5.4.3.15	Training for production stave testing	\$0	\$0	\$0	0	0	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
11	Postdoc	300%	480 hrs	0 days	Jan 6 '05	Feb 3 '05	\$0	\$0	\$0	\$0
<u>Notes</u>										
WBS Definition -										
This is the time allocated to bring a large crew up to speed.										
M&S BOE -										
Labor BOE -										
Run Ila experience. The testing is done by Postdocs and students. 300% is 6 people, 1 teacher and 5 learning.										
1.1.5.4.4	Outer Layer Stave Production	\$349,972	\$46,000	\$303,972	0	0	0			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Outer Layer Stave Production" continued

Notes

Labor BOE -

1.1.5.4.4.1	Production Stave: modification to the final design	\$11,840	\$0	\$11,840	0	0.4	0
-------------	--	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
19	DesignerSF	100%	160 hrs	0 days	Apr 30 '04	May 27 '04	\$6,400	\$6,400	\$0	\$6,400
20	MechEngSF	50%	80 hrs	0 days	Apr 30 '04	May 27 '04	\$4,080	\$4,080	\$0	\$4,080
22	MechTechSF	25%	40 hrs	0 days	Apr 30 '04	May 27 '04	\$1,360	\$1,360	\$0	\$1,360

Notes

WBS Definition -

This to modify the final design of the stave (fixtures etc.)

M&S BOE -

Labor BOE -

Run IIa experience.

1.1.5.4.4.2	Production Stave: material and fixtures	\$46,000	\$46,000	\$0	0.5	0.4	0
-------------	---	----------	----------	-----	-----	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	46,000	46,000	0 days	May 28 '04	Jun 25 '04	\$46,000	\$46,000	\$0	\$46,000

Notes

WBS Definition -

M&S BOE -

Cost is based on Run IIa experience and vendor quotations. We assume that some fixture (or equivalent parts) needs to be redone or modified:

1. set of stave mechanical fixtures (10K)
2. bus cable laminating fixture (6k)
3. stave alignment fixture (20k)
4. more/modify boxes for storing/testing (10k total)

Labor BOE -

1.1.5.4.4.3	prepare final fixtures and materials for production	\$12,512	\$0	\$12,512	0	0.4	0
-------------	---	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	80 hrs	0 days	Jun 28 '04	Jul 26 '04	\$0	\$0	\$0	\$0
20	MechEngSF	20%	32 hrs	0 days	Jun 28 '04	Jul 26 '04	\$1,632	\$1,632	\$0	\$1,632
22	MechTechSF	200%	320 hrs	0 days	Jun 28 '04	Jul 26 '04	\$10,880	\$10,880	\$0	\$10,880

Notes

WBS Definition -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
-----	------	------	-----	-------	-----------	-------------	-------

"prepare final fixtures and materials for production" continued

Notes

This task is for final preparations of all fixtures to sustain a production rate.

M&S BOE -

Labor BOE -

Run Ila experience.

1.1.5.4.4.4	Production Stave: mechanical construction	\$84,320	\$0	\$84,320	0	0.4	0
-------------	---	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	320 hrs	0 days	Sep 8 '04	Jan 5 '05	\$0	\$0	\$0	\$0
20	MechEngSF	25%	160 hrs	0 days	Sep 8 '04	Jan 5 '05	\$8,160	\$8,160	\$0	\$8,160
22	MechTechSF	350%	2,240 hrs	0 days	Sep 8 '04	Jan 5 '05	\$76,160	\$76,160	\$0	\$76,160

Notes

WBS Definition -

This is to prepare ~200 mechanical staves with the final design.

M&S BOE -

Labor BOE -

Run Ila experience and experience with prototypes. Work is divided into 3 major sections each requires 100% of a Mech. Tech.:

- a. preparation of parts (includes bending peek tubing, cutting parts to size etc.)
- b. laminating the bus cable to the carbon fiber sheet
- c. assembly or cores.

1. Mech. tech (300%) preparing parts and assembling
2. Mech. tech (50%) supervision
3. Mech Engineer (25%) support
4. Research Associate (50%) support

Schedule BOE -

This task should start as soon as the mechanical design is shown to work and bus cables are available. We estimate a production rate of 3 mechanical staves per day: 240 staves = 80 days.

1.1.5.4.4.5	Production Stave: mechanicals available	\$0	\$0	\$0	0	0	4
-------------	---	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.5.4.4.6	Production Stave: electrical assembly	\$160,300	\$0	\$160,300	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	10%	140 hrs	0 days	Jan 28 '05	Oct 4 '05	\$0	\$0	\$0	\$0
11	Postdoc	100%	1,400 hrs	0 days	Jan 28 '05	Oct 4 '05	\$0	\$0	\$0	\$0
20	MechEngSF	25%	350 hrs	0 days	Jan 28 '05	Oct 4 '05	\$17,850	\$17,850	\$0	\$17,850
22	MechTechSF	225%	3,150 hrs	0 days	Jan 28 '05	Oct 4 '05	\$107,100	\$107,100	\$0	\$107,100
23	WirebonderSF	50%	700 hrs	0 days	Jan 28 '05	Oct 4 '05	\$18,900	\$18,900	\$0	\$18,900
24	CMMProgrammerSF	25%	350 hrs	0 days	Jan 28 '05	Oct 4 '05	\$16,450	\$16,450	\$0	\$16,450

Notes

WBS Definition -

M&S BOE -

Labor BOE -

Run IIa experience and experience with prototypes. We estimate that to build one stave, one mech tech would do the module alignment and fraction of a second mechanical tech is needed for general support (mixing glue etc). We will have two setups so that we could achieve a peak rate of 2 staves/day. Module production (8 modules/day) limits average stave production to 1.33 staves/day. We assume this rate and since we need 200 staves = 150 days. To maintain this rate we estimate needing 1.5 technicians for gluing modules to staves, plus 50% of another tech for support, along with 25% of a lead tech for supervision and trouble shooting.

25 days are added to the duration of the task to account for testing and assembly of spare hybrids.

For Wirebonding:

Each side of a stave has 3 sets of bonds for hybrid to bus cable and 1 set for MPC to bus cable. This is a total of 8 setups/stave. We estimate 1 person could maintain a rate of 3 staves/day. Stave production is limited to 1.33 staves/day so we estimate needing 50% of a wirebonder for stave production.

Labor breaks out as follows:

1. Mech Technician (150%) installing/aligning modules on the stave
2. Mech Technician (75%) support, inspection and supervision.
3. Wirebonder (50%)
4. Mech. Engineer (25%) support
5. Research Associate (100%) support
6. Scientist (10%) supervision

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.5.4.4.7	Production Stave: electrical testing	\$35,000	\$0	\$35,000	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	100%	1,400 hrs	0 days	Feb 4 '05	Oct 11 '05	\$0	\$0	\$0	\$0
11	Postdoc	350%	4,900 hrs	0 days	Feb 4 '05	Oct 11 '05	\$0	\$0	\$0	\$0
21	ElecTechSF	50%	700 hrs	0 days	Feb 4 '05	Oct 11 '05	\$23,100	\$23,100	\$0	\$23,100
22	MechTechSF	25%	350 hrs	0 days	Feb 4 '05	Oct 11 '05	\$11,900	\$11,900	\$0	\$11,900

Notes

WBS Definition -

This is for staves and burn-in stave parts.

M&S BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
"Production Stave: electrical testing" continued							
<u>Notes</u>							
Labor BOE - Run IIa experience This the stave electrical testing crew at FNAL. It is estimated to be a total of: 1. Postdocs (350%) 2. scientist (100%) responsible for quality control 3. electrical technician (50%) for repair and minor support jobs 4. mech technician (25%) bonder, for repair/redo bonds							
1.1.5.4.4.8	Production Staves Available	\$0	\$0	\$0	0	0	4
<u>Notes</u>							
WBS Definition - M&S BOE - Labor BOE -							
1.1.5.4.4.9	100 Production Staves complete	\$0	\$0	\$0	0	0	3
<u>Notes</u>							
WBS Definition - M&S BOE - Labor BOE -							
1.1.5.4.4.10	Contingency on 100 staves complete	\$0	\$0	\$0	0	0	5
<u>Notes</u>							
WBS Definition - This is a floating contingency on starting the electrical stave assembly task. M&S BOE - Labor BOE -							
1.1.5.4.4.11	L2MS 100 Production staves complete	\$0	\$0	\$0	0	0	2
<u>Notes</u>							
WBS Definition - This is contingency on finishing stave production and testing. M&S BOE -							

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.5.4.4.12	Stave Production Complete	\$0	\$0	\$0	0	0	3
	<u>Notes</u>						
	WBS Definition -						
	M&S BOE -						
	Labor BOE -						
1.1.5.4.4.13	Contingency on Stave production completion	\$0	\$0	\$0	0	0	5
	<u>Notes</u>						
	WBS Definition -						
	This is a floating contingency on starting the electrical stave assembly task.						
	M&S BOE -						
	Labor BOE -						
1.1.5.4.4.14	L2MS Production staves complete	\$0	\$0	\$0	0	0	2
	<u>Notes</u>						
	WBS Definition -						
	This is contingency on finishing stave production and testing.						
	M&S BOE -						
	Labor BOE -						
1.1.6	Support Mechanics	\$2,346,930	\$851,100	\$1,503,974	0	0	0
	<u>Notes</u>						
	WBS Definition -						
	This section covers infrastructure, the support structures for the staves, barrels, L0, and transportation and installation at B0.						
	M&S BOE -						
	50% cont. is included on all costed items.						
	Labor BOE -						
1.1.6.1	Silicon Support Structures	\$1,236,725	\$526,000	\$718,869	0	0	0
	<u>Notes</u>						
	WBS Definition -						
	This task covers the bulkheads which support the staves, the screens which attach the bulkheads to each other, the tube which supports the barrels (spacetube in Run IIa) and the support structure for L0.						
	M&S BOE -						

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Silicon Support Structures" continued

Notes

Labor BOE -

1.1.6.1.1	Bulkheads	\$222,517	\$111,000	\$111,517	0	0	0
-----------	------------------	------------------	------------------	------------------	----------	----------	----------

Notes

WBS Definition -

This task consists of:

1. pre-prototype studies with G10 and leftover CF sheets
2. Construction of prototypes: 2 external and 2 internal CF bulkheads with precision Al (internal) and Al (external) mounting features.
3. fixtures for gluing the precision alignment pins to the bulkheads
4. Construction of production bulkheads: 2 external and 2 internal CF bulkheads with precision Beryllium (internal) and AL (external) mounting features.

M&S BOE -

Labor BOE -

1.1.6.1.1.1	Bulkhead Prototype work	\$126,397	\$55,000	\$71,397	0	0	0
-------------	--------------------------------	------------------	-----------------	-----------------	----------	----------	----------

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.1.1.1.1	Bulkhead Initial Concept studies	\$27,677	\$5,000	\$22,677	0	0	0
---------------	---	-----------------	----------------	-----------------	----------	----------	----------

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	5,000	5,000	0 days	Jan 7 '02	Jan 7 '02	\$5,000	\$5,000	\$5,000	\$0
19	DesignerSF	10%	71.2 hrs	0 days	Jan 7 '02	May 10 '02	\$2,848	\$2,848	\$2,848	\$0
20	MechEngSF	50%	356 hrs	0 days	Jan 7 '02	May 10 '02	\$18,156	\$18,156	\$18,156	\$0
24	CMMPprogrammerSF	5%	35.6 hrs	0 days	Jan 7 '02	May 10 '02	\$1,673	\$1,673	\$1,673	\$0

Notes

WBS Definition -

Studies in this item are with preprototype bulkheads made from G10 and leftover CF sheets.

M&S BOE -

Cost estimate \$5,000 for materials.

Labor BOE -

Mostly engineer type labor.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.6.1.1.1.2	Bulkhead Prototype: Design	\$17,040	\$0	\$17,040	0	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
19	DesignerSF	25%	120 hrs	0 days	May 13 '02	Aug 6 '02	\$4,800	\$4,800	\$4,800	\$0
20	MechEngSF	50%	240 hrs	0 days	May 13 '02	Aug 6 '02	\$12,240	\$12,240	\$12,240	\$0

Notes

WBS Definition -

This is to finalize the first prototype of a bulkhead design to test the concept. Details of mounting hardware and fixturing will be included at this stage.

M&S BOE -

Detailed analysis of Bulkhead structure (FEA) will impact design.

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.6.1.1.1.3	Bulkhead Prototype: fabrication	\$50,000	\$50,000	\$0	0.5	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	50,000	50,000	0 days	Aug 7 '02	Aug 7 '02	\$50,000	\$50,000	\$50,000	\$0

Notes

WBS Definition -

We estimate the need for 2 CF bulkheads (inner and outer) plus a G-10 mockups.

M&S BOE -

Costs per estimate from engineers Greg Derylo and Youri Orlov April 18, 2002

CF material \$5,000

fabrication of plates \$5,000

plate machining \$5,000

pins \$5,000

Assembly fixtures: \$25,000

Test fixtures \$5,000

G10 mockups

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.6.1.1.1.4	Bulkhead Prototype: assembly and testing	\$31,680	\$0	\$31,680	0	0.5	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
20	MechEngSF	50%	240 hrs	0 days	Oct 31 '02	Jan 31 '03	\$12,240	\$12,240	\$2,448	\$9,792
22	MechTechSF	50%	240 hrs	0 days	Oct 31 '02	Jan 31 '03	\$8,160	\$8,160	\$1,632	\$6,528
24	CMMProgrammerSF	50%	240 hrs	0 days	Oct 31 '02	Jan 31 '03	\$11,280	\$11,280	\$2,256	\$9,024

Notes

WBS Definition -

This is the labor associated with gluing the precision pins to the bulkheads in correct locations. The alignment and construction of the fixture will be performed on a CMM. The stiffness of the bulkheads will be tested. Installation and positioning in a barrel will also be tested.

M&S BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level			
"Bulkhead Prototype: assembly and testing" continued										
<u>Notes</u>										
Labor BOE -										
1.1.6.1.1.1.5	Explicit Slack: prototype Barrel Mounts, inner screen design	\$0	\$0	\$0	0	0	5			
1.1.6.1.1.2	Bulkhead Production	\$96,120	\$56,000	\$40,120	0	0	0			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										
1.1.6.1.1.2.1	Explicit Slack: Bulkhead production design	\$0	\$0	\$0	0	0	5			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										
1.1.6.1.1.2.2	Bulkhead: Final Design	\$14,560	\$0	\$14,560	0	0.5	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
19	DesignerSF	50%	160 hrs	0 days	Mar 29 '04	May 21 '04	\$6,400	\$6,400	\$0	\$6,400
20	MechEngSF	50%	160 hrs	0 days	Mar 29 '04	May 21 '04	\$8,160	\$8,160	\$0	\$8,160
<u>Notes</u>										
WBS Definition - Design will be modified as needed by the results of the tests.										
M&S BOE -										
Labor BOE -										
1.1.6.1.1.2.3	Bulkhead Final Design Complete	\$0	\$0	\$0	0	0	4			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
-----	------	------	-----	-------	-----------	-------------	-------

"Bulkhead Final Design Complete" continued

Notes

Labor BOE -

1.1.6.1.1.2.4	Bulkhead: fabrication	\$56,000	\$56,000	\$0	0.5	0	0
---------------	-----------------------	----------	----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	56,000	56,000	0 days	May 24 '04	Sep 15 '04	\$56,000	\$56,000	\$0	\$56,000

Notes

WBS Definition -

M&S BOE -

Cost estimate from engineers Greg Derylo and Yuri Orlov April 18, 2002.

\$11,000 for CF material

\$5,000 for fabrication

\$5,000 for machining

\$10,000 for precision pins

\$25,000 assembly fixtures

Total = \$56,000

Labor BOE -

1.1.6.1.1.2.5	Bulkhead: assembly, testing	\$25,560	\$0	\$25,560	0	0.5	0
---------------	-----------------------------	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	240 hrs	0 days	Sep 16 '04	Dec 10 '04	\$0	\$0	\$0	\$0
20	MechEngSF	25%	120 hrs	0 days	Sep 16 '04	Dec 10 '04	\$6,120	\$6,120	\$0	\$6,120
22	MechTechSF	50%	240 hrs	0 days	Sep 16 '04	Dec 10 '04	\$8,160	\$8,160	\$0	\$8,160
24	CMMProgrammerSF	50%	240 hrs	0 days	Sep 16 '04	Dec 10 '04	\$11,280	\$11,280	\$0	\$11,280

Notes

WBS Definition -

This includes the labor for gluing the pins to the bulkheads and to test the quality of the bulkheads.

M&S BOE -

Labor BOE -

1.1.6.1.1.2.6	Bulkheads Complete	\$0	\$0	\$0	0	0	4
---------------	--------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Bulkheads Complete" continued

Notes

Labor BOE -

1.1.6.1.2	Barrel Mounts	\$61,576	\$25,000	\$36,576	0	0	0
-----------	---------------	----------	----------	----------	---	---	---

Notes

WBS Definition -

The barrel mounts support the barrels inside the spacetube. They provide the alignment from barrel to barrel and to the spacetube.

M&S BOE -

Cost estimated from G. Derylo and Y. Orlov, April 18, 2002.

\$10,000 for prototype barrel mounts

\$15,000 for the production set of mounts.

Labor BOE -

1.1.6.1.2.1	Barrel Mounts Prototypes	\$36,080	\$10,000	\$26,080	0	0	0
-------------	--------------------------	----------	----------	----------	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.1.2.1.1	Prototype barrel mount Design	\$17,040	\$0	\$17,040	0	0.4	0
---------------	-------------------------------	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
19	DesignerSF	25%	120 hrs	0 days	Nov 25 '02	Feb 21 '03	\$4,800	\$4,800	\$4,800	\$0
20	MechEngSF	50%	240 hrs	0 days	Nov 25 '02	Feb 21 '03	\$12,240	\$12,240	\$12,240	\$0

Notes

WBS Definition -

These support the barrels in the space tube. The design is based on experience with SVX, SVX' and SVXII.

M&S BOE -

Labor BOE -

1.1.6.1.2.1.2	Prototype barrel mount fabrication	\$10,000	\$10,000	\$0	0.5	0	0
---------------	------------------------------------	----------	----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	10,000	10,000	0 days	Feb 24 '03	Mar 21 '03	\$10,000	\$10,000	\$10,000	\$0

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Prototype barrel mount fabrication" continued

Notes

WBS Definition -

M&S BOE -

Cost est. from G. Derylo, Y. Orlov April 18, 2002.

Labor BOE -

1.1.6.1.2.1.3	Prototype barrel mount: assembly and testing	\$9,040	\$0	\$9,040	0	0.4	0
---------------	--	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	80 hrs	0 days	Mar 24 '03	Apr 18 '03	\$0	\$0	\$0	\$0
20	MechEngSF	25%	40 hrs	0 days	Mar 24 '03	Apr 18 '03	\$2,040	\$2,040	\$204	\$1,836
22	MechTechSF	25%	40 hrs	0 days	Mar 24 '03	Apr 18 '03	\$1,360	\$1,360	\$136	\$1,224
24	CMMProgrammerSF	75%	120 hrs	0 days	Mar 24 '03	Apr 18 '03	\$5,640	\$5,640	\$564	\$5,076

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.1.2.2	Barrel Mount Production	\$25,496	\$15,000	\$10,496	0	0	0
-------------	-------------------------	----------	----------	----------	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.1.2.2.1	Barrel mount design modifications	\$1,456	\$0	\$1,456	0	0.4	0
---------------	-----------------------------------	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
19	DesignerSF	10%	16 hrs	0 days	May 24 '04	Jun 21 '04	\$640	\$640	\$0	\$640
20	MechEngSF	10%	16 hrs	0 days	May 24 '04	Jun 21 '04	\$816	\$816	\$0	\$816

Notes

WBS Definition -

This task covers modifications identified with prototype mounts.

M&S BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.6.1.2.2.2	Production Barrel mount Fabrication	\$15,000	\$15,000	\$0	0.5	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	15,000	15,000	0 days	Jun 22 '04	Jul 20 '04	\$15,000	\$15,000	\$0	\$15,000

Notes

WBS Definition -

M&S BOE -

Cost estimated from G. Derylo and Y. Orlov, April 18,2002.

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.6.1.2.2.3	Production barrel mount: assembly	\$9,040	\$0	\$9,040	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	80 hrs	0 days	Jul 21 '04	Aug 17 '04	\$0	\$0	\$0	\$0
20	MechEngSF	25%	40 hrs	0 days	Jul 21 '04	Aug 17 '04	\$2,040	\$2,040	\$0	\$2,040
22	MechTechSF	25%	40 hrs	0 days	Jul 21 '04	Aug 17 '04	\$1,360	\$1,360	\$0	\$1,360
24	CMMProgrammerSF	75%	120 hrs	0 days	Jul 21 '04	Aug 17 '04	\$5,640	\$5,640	\$0	\$5,640

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.6.1.3	Outer screens	\$96,320	\$72,000	\$27,160	0	0	0

Notes

WBS Definition -

This task covers:

- 1) the Inner screen which is glued to the bulkheads before stave installation begins.
- 2) the alignment fixtures for holding the bulkheads before the screen is glued
- 3) the outer screens which are glued the the barrel after stave installation is complete.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.6.1.3.1	Outer Screens Preproduction	\$45,040	\$28,000	\$19,880	0	0	0

Notes

WBS Definition -

M&S BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Outer Screens Preproduction" continued

Notes
Labor BOE -

1.1.6.1.3.1.1	Design outer screen and mounts	\$8,520	\$0	\$11,360	0	0.4	0
---------------	--------------------------------	---------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
19	DesignerSF	50%	60 hrs	0 days	Mar 3 '03	Mar 21 '03	\$2,400	\$2,400	\$840	\$1,560
20	MechEngSF	100%	120 hrs	0 days	Mar 3 '03	Mar 21 '03	\$6,120	\$6,120	\$2,142	\$3,978

Notes
WBS Definition -
This is the outer screen of the barrel. It holds the relative alignment of the bulkheads after the axle is removed and provides protection for the staves.

M&S BOE -
Labor BOE -

1.1.6.1.3.1.2	Barrel outer screen preproduction fabrication	\$26,000	\$26,000	\$0	0.5	0	0
---------------	---	----------	----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	26,000	26,000	0 days	Mar 24 '03	May 16 '03	\$26,000	\$26,000	\$0	\$26,000

Notes
WBS Definition -
This is the cost to make a prototype set of outer screens for the outer barrel.

M&S BOE -
CF material - \$4,000
Mandrils - \$10,000
Fabrication costs - \$8,000
Test fixtures - \$4,000

Total = \$26,000

Labor BOE -

1.1.6.1.3.1.3	Barrel outer screen mount fabrication	\$2,000	\$2,000	\$0	0.5	0	0
---------------	---------------------------------------	---------	---------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	2,000	2,000	0 days	Mar 24 '03	Apr 18 '03	\$2,000	\$2,000	\$0	\$2,000

Notes
WBS Definition -
This is the fabrication the small parts that are glued to the bulkhead to provide a ledge for mounting the outer screen. The cost is estimated from similar parts in Run IIa.

M&S BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Barrel outer screen mount fabrication" continued

Notes

Labor BOE -

1.1.6.1.3.1.4	Test outer screen and mounts	\$8,520	\$0	\$8,520	0	0.4	0
---------------	------------------------------	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	80 hrs	0 days	May 19 '03	Jun 16 '03	\$0	\$0	\$0	\$0
20	MechEngSF	25%	40 hrs	0 days	May 19 '03	Jun 16 '03	\$2,040	\$2,040	\$0	\$2,040
22	MechTechSF	50%	80 hrs	0 days	May 19 '03	Jun 16 '03	\$2,720	\$2,720	\$0	\$2,720
24	CMMPProgrammerSF	50%	80 hrs	0 days	May 19 '03	Jun 16 '03	\$3,760	\$3,760	\$0	\$3,760

Notes

WBS Definition -

This is the outer screen of the barrel. It must be able to hold the relative alignment of the bulkheads after the axle is removed and provides protection for the staves.

M&S BOE -

Labor BOE -

1.1.6.1.3.2	Outer Screens Production	\$51,280	\$44,000	\$7,280	0	0	0
-------------	--------------------------	----------	----------	---------	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.1.3.2.1	Design final outer screen and mounts	\$7,280	\$0	\$7,280	0	0.4	0
---------------	--------------------------------------	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
19	DesignerSF	50%	80 hrs	0 days	Jun 22 '04	Jul 20 '04	\$3,200	\$3,200	\$0	\$3,200
20	MechEngSF	50%	80 hrs	0 days	Jun 22 '04	Jul 20 '04	\$4,080	\$4,080	\$0	\$4,080

Notes

WBS Definition -

Design of the final screen and mounts waits for the final bulkhead design to be complete and for the tests of the prototype screens and mounts.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.1.3.2.2	Barrel outer screen production mount fabrication	\$4,000	\$4,000	\$0	0.5	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	4,000	4,000	0 days	Jul 21 '04	Aug 17 '04	\$4,000	\$4,000	\$0	\$4,000

Notes

WBS Definition -

This is the cost to make the production set of outer screen mounts for the outer barrel.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.1.3.2.3	Barrel outer screen: production fabrication	\$40,000	\$40,000	\$0	0.5	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	40,000	40,000	0 days	Jul 21 '04	Sep 15 '04	\$40,000	\$40,000	\$0	\$40,000

Notes

WBS Definition -

This is the cost to fabricate the screens, assuming we buy them rather than make them in house.

M&S BOE -

Estimate from G. Derylo and Y. Orlov April 18,2002

CF materials - \$10,000

Mandrels - \$15,000

Fabrication costs - \$10,000

Fixturing - \$5,000

Total = \$40,000

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.1.4	Inner Screens	\$66,952	\$30,000	\$36,952	0	0	0

Notes

WBS Definition -

The inner screens are glued to the bulkheads before stave installation begins. They hold the relative alignment of the bulkheads during stave installation and after removal from the stave installation fixture.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.1.4.1	Inner Screen Prototypes	\$35,416	\$12,000	\$23,416	0	0	0

Notes

WBS Definition -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Inner Screen Prototypes" continued

Notes
M&S BOE -

Labor BOE -

1.1.6.1.4.1.1	Design Inner screen and mounts	\$11,360	\$0	\$11,360	0	0.4	0
---------------	--------------------------------	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
19	DesignerSF	50%	80 hrs	0 days	Nov 25 '02	Dec 20 '02	\$3,200	\$3,200	\$3,200	\$0
20	MechEngSF	100%	160 hrs	0 days	Nov 25 '02	Dec 20 '02	\$8,160	\$8,160	\$8,160	\$0

Notes
WBS Definition -
The inner screen will be designed in conjunction with FEA simulations to determine desired properties.

M&S BOE -

Labor BOE -

1.1.6.1.4.1.2	Inner Screen prototype fabrication	\$10,536	\$7,000	\$3,536	0.5	0.4	0
---------------	------------------------------------	----------	---------	---------	-----	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	7,000	7,000	0 days	Dec 23 '02	Jan 24 '03	\$7,000	\$7,000	\$7,000	\$0
20	MechEngSF	10%	16 hrs	0 days	Dec 23 '02	Jan 24 '03	\$816	\$816	\$816	\$0
22	MechTechSF	50%	80 hrs	0 days	Dec 23 '02	Jan 24 '03	\$2,720	\$2,720	\$2,720	\$0

Notes
WBS Definition -
The inner screen is glued to the bulkheads before stave installation and holds the relative bulkhead alignment.

M&S BOE -
Cost estimated by Derylo and Orlov April 2002
CF material = \$1,000
Mandril = \$5,000
test fixtures = \$1,000

Total M&S = \$7,000

Labor BOE -
We estimate 1 week of tech time for fabrication of one screen in Lab 3 and we would like 2 screens. This results in 50% of a tech for 4 weeks.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.6.1.4.1.3	Barrel inner screen mount fabrication	\$5,000	\$5,000	\$0	0.5	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	5,000	5,000	0 days	Dec 23 '02	Jan 24 '03	\$5,000	\$5,000	\$0	\$5,000

Notes

WBS Definition -

This are the mounts to be attached to the bulkhead for the inner screen. This is a special mount which needs to be electrically insulated.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.6.1.4.1.4	Test inner screen and mounts	\$8,520	\$0	\$8,520	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	80 hrs	0 days	Jan 27 '03	Feb 21 '03	\$0	\$0	\$0	\$0
20	MechEngSF	25%	40 hrs	0 days	Jan 27 '03	Feb 21 '03	\$2,040	\$2,040	\$0	\$2,040
22	MechTechSF	50%	80 hrs	0 days	Jan 27 '03	Feb 21 '03	\$2,720	\$2,720	\$0	\$2,720
24	CMMProgrammerSF	50%	80 hrs	0 days	Jan 27 '03	Feb 21 '03	\$3,760	\$3,760	\$0	\$3,760

Notes

WBS Definition -

The inner screen must be able to hold the relative alignment of the bulkheads during stave installation.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.6.1.4.2	Inner Screens Production	\$31,536	\$18,000	\$13,536	0	0	0

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.6.1.4.2.1	Design final inner screen and mounts	\$7,280	\$0	\$7,280	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
19	DesignerSF	50%	80 hrs	0 days	Jul 21 '04	Aug 17 '04	\$3,200	\$3,200	\$0	\$3,200
20	MechEngSF	50%	80 hrs	0 days	Jul 21 '04	Aug 17 '04	\$4,080	\$4,080	\$0	\$4,080

Notes

WBS Definition -

Design of the final screen and mounts waits for the final bulkhead design to be complete and for the tests of the prototype screens and mounts.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Design final inner screen and mounts" continued

Notes

M&S BOE -

Labor BOE -

1.1.6.1.4.2.2	Barrel inner screen production mount fabrication	\$10,000	\$10,000	\$0	0.5	0	0
---------------	--	----------	----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	10,000	10,000	0 days	Aug 18 '04	Sep 15 '04	\$10,000	\$10,000	\$0	\$10,000

Notes

WBS Definition -

This is the cost to make the production set of inner screen mounts for the outer barrel.

M&S BOE -

Labor BOE -

1.1.6.1.4.2.3	Inner screen production fabrication	\$14,256	\$8,000	\$6,256	0.5	0.4	0
---------------	-------------------------------------	----------	---------	---------	-----	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	8,000	8,000	0 days	Aug 18 '04	Sep 15 '04	\$8,000	\$8,000	\$0	\$8,000
20	MechEngSF	10%	16 hrs	0 days	Aug 18 '04	Sep 15 '04	\$816	\$816	\$0	\$816
22	MechTechSF	100%	160 hrs	0 days	Aug 18 '04	Sep 15 '04	\$5,440	\$5,440	\$0	\$5,440

Notes

WBS Definition -

M&S BOE -

Cost BOE: estimated from Derylo and Orlov April, 2002

CF material - \$2,000

Mandril - \$5,000

testing fixtures - \$1,000

Total = \$8,000

Labor BOE -

We estimate 1 week of tech time/screen.

We will fabricate 4 screens and pick the best ones. This results in 100% of a tech for 4 weeks.

1.1.6.1.5	Analysis of Barrel sturcture	\$28,056	\$0	\$33,360	0	0	0
------------------	-------------------------------------	-----------------	------------	-----------------	----------	----------	----------

1.1.6.1.5.1	analysis of barrel structure	\$11,016	\$0	\$16,320	0	0	0
-------------	------------------------------	----------	-----	----------	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
20	MechEngSF	20%	216 hrs	0 days	Mar 3 '03	Sep 10 '03	\$11,016	\$11,016	\$2,448	\$8,568

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level			
"analysis of barrel structure" continued										
1.1.6.1.5.2	Test structural stiffness	\$17,040	\$0	\$17,040	0	0	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
20	MechEngSF	10%	80 hrs	0 days	Apr 21 '03	Sep 10 '03	\$4,080	\$4,080	\$0	\$4,080
22	MechTechSF	20%	160 hrs	0 days	Apr 21 '03	Sep 10 '03	\$5,440	\$5,440	\$0	\$5,440
24	CMMPProgrammerSF	20%	160 hrs	0 days	Apr 21 '03	Sep 10 '03	\$7,520	\$7,520	\$0	\$7,520
1.1.6.1.6	Bulkhead alignment fixture	\$50,880	\$10,000	\$40,880	0	0	0			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										
1.1.6.1.6.1	Prototype bulkhead alignment fixture	\$29,280	\$5,000	\$24,280	0	0	0			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										
1.1.6.1.6.1.1	design prototype bulkhead alignment fixtures	\$14,560	\$0	\$14,560	0	0.4	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
19	DesignerSF	50%	160 hrs	0 days	Dec 23 '02	Feb 21 '03	\$6,400	\$6,400	\$1,280	\$5,120
20	MechEngSF	50%	160 hrs	0 days	Dec 23 '02	Feb 21 '03	\$8,160	\$8,160	\$1,632	\$6,528
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										
1.1.6.1.6.1.2	Fabricate prototype fixture	\$5,000	\$5,000	\$0	0.5	0	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
7	MANDS	5,000	5,000	0 days	Feb 24 '03	Apr 18 '03	\$5,000	\$5,000	\$0	\$5,000

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
-----	------	------	-----	-------	-----------	-------------	-------

"Fabricate prototype fixture" continued

Notes

WBS Definition -

These are small parts that allow the bulkheads to be precisely positioned before gluing to the inner screen. Cost is estimated from similar parts used in Run IIa.

M&S BOE -

Labor BOE -

1.1.6.1.6.1.3	Test bulkhead alignment fixture	\$9,720	\$0	\$9,720	0	0.4	0
---------------	---------------------------------	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	25%	40 hrs	0 days	Apr 21 '03	May 16 '03	\$0	\$0	\$0	\$0
20	MechEngSF	50%	80 hrs	0 days	Apr 21 '03	May 16 '03	\$4,080	\$4,080	\$0	\$4,080
24	CMMPprogrammerSF	75%	120 hrs	0 days	Apr 21 '03	May 16 '03	\$5,640	\$5,640	\$0	\$5,640

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.1.6.2	Production fixture	\$21,600	\$5,000	\$16,600	0	0	0
-------------	--------------------	----------	---------	----------	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.1.6.2.1	Design production fixture	\$3,640	\$0	\$3,640	0	0.4	0
---------------	---------------------------	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
19	DesignerSF	25%	40 hrs	0 days	Jul 16 '03	Aug 12 '03	\$1,600	\$1,600	\$0	\$1,600
20	MechEngSF	25%	40 hrs	0 days	Jul 16 '03	Aug 12 '03	\$2,040	\$2,040	\$0	\$2,040

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.1.6.2.2	Fabricate production fixture	\$17,960	\$5,000	\$12,960	0.5	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	5,000	5,000	0 days	Aug 13 '03	Oct 8 '03	\$5,000	\$5,000	\$0	\$5,000
22	MechTechSF	50%	160 hrs	0 days	Aug 13 '03	Oct 8 '03	\$5,440	\$5,440	\$0	\$5,440
24	CMMProgrammerSF	50%	160 hrs	0 days	Aug 13 '03	Oct 8 '03	\$7,520	\$7,520	\$0	\$7,520

Notes

WBS Definition -

These are small parts that allow the bulkheads to be precisely positioned before gluing to the inner screen. Cost is estimated from similar parts used in Run IIa.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.1.7	Outer Screen Installation Fixture	\$38,160	\$10,000	\$28,160	0	0	0

Notes

WBS Definition -

This fixture is used to install the outer screen on the barrel after stave installation is complete.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.1.7.1	preproduction screen installation fixture	\$19,080	\$5,000	\$14,080	0	0	0

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.1.7.1.1	Design preproduction screen installation fixture	\$7,280	\$0	\$7,280	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
19	DesignerSF	50%	80 hrs	0 days	Jul 16 '03	Aug 12 '03	\$3,200	\$3,200	\$320	\$2,880
20	MechEngSF	50%	80 hrs	0 days	Jul 16 '03	Aug 12 '03	\$4,080	\$4,080	\$408	\$3,672

Notes

WBS Definition -

This fixture holds the bulkheads while the inner screen is glued to them and holds the barrels while the outer screen is glued to the bulkheads.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.6.1.7.1.2	Fabricate preproduction screen installation fixture	\$11,800	\$5,000	\$6,800	0.5	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	5,000	5,000	0 days	Aug 13 '03	Sep 10 '03	\$5,000	\$5,000	\$0	\$5,000
20	MechEngSF	50%	80 hrs	0 days	Aug 13 '03	Sep 10 '03	\$4,080	\$4,080	\$0	\$4,080
22	MechTechSF	50%	80 hrs	0 days	Aug 13 '03	Sep 10 '03	\$2,720	\$2,720	\$0	\$2,720

Notes

WBS Definition -

This is the fixture that holds the outer screen in place while it is glued to the bulkheads.

M&S BOE -

Cost est. from G. Derylo and Y. Orlov April 18, 2002.

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.6.1.7.2	production screen installation fixture	\$19,080	\$5,000	\$14,080	0	0	0

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.6.1.7.2.1	Design Production screen installation fixture	\$7,280	\$0	\$7,280	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
19	DesignerSF	50%	80 hrs	0 days	Sep 16 '04	Oct 13 '04	\$3,200	\$3,200	\$0	\$3,200
20	MechEngSF	50%	80 hrs	0 days	Sep 16 '04	Oct 13 '04	\$4,080	\$4,080	\$0	\$4,080

Notes

WBS Definition -

This covers time to modify prototype design.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.6.1.7.2.2	Fabricate production screen installation fixture	\$11,800	\$5,000	\$6,800	0.5	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	5,000	5,000	0 days	Oct 14 '04	Nov 10 '04	\$5,000	\$5,000	\$0	\$5,000
20	MechEngSF	50%	80 hrs	0 days	Oct 14 '04	Nov 10 '04	\$4,080	\$4,080	\$0	\$4,080

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
-----	------	------	-----	-------	-----------	-------------	-------

"Fabricate production screen installation fixture" continued

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
22	MechTechSF	50%	80 hrs	0 days	Oct 14 '04	Nov 10 '04	\$2,720	\$2,720	\$0	\$2,720

Notes

WBS Definition -

M&S BOE -

Cost est. from G. Derylo and Y. Orlov April 18, 2002.

Labor BOE -

1.1.6.1.8	Axle Removal Fixture	\$46,556	\$20,000	\$26,556	0	0	0
-----------	-----------------------------	-----------------	-----------------	-----------------	----------	----------	----------

Notes

WBS Definition -

Once the outer screen is installed, the axle of the barrel assembly is extracted. This fixture supports the barrel during this process.

M&S BOE -

Labor BOE -

1.1.6.1.8.1	preproduction axle fixture	\$29,660	\$10,000	\$19,660	0	0	0
-------------	-----------------------------------	-----------------	-----------------	-----------------	----------	----------	----------

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.1.8.1.1	Design axle removal fixture	\$10,480	\$0	\$10,480	0	0.4	0
---------------	------------------------------------	-----------------	------------	-----------------	----------	------------	----------

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
19	DesignerSF	50%	160 hrs	0 days	Sep 16 '04	Nov 10 '04	\$6,400	\$6,400	\$0	\$6,400
20	MechEngSF	25%	80 hrs	0 days	Sep 16 '04	Nov 10 '04	\$4,080	\$4,080	\$0	\$4,080

Notes

WBS Definition -

This fixture holds the barrels while the axle is removed.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.1.8.1.2	Fabricate axel removalfixture	\$15,440	\$10,000	\$5,440	0.5	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	10,000	10,000	0 days	Nov 11 '04	Jan 13 '05	\$10,000	\$10,000	\$0	\$10,000
22	MechTechSF	50%	160 hrs	0 days	Nov 11 '04	Jan 13 '05	\$5,440	\$5,440	\$0	\$5,440

Notes

WBS Definition -
This is not a precision fixture.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.1.8.1.3	Test axle removal fixture	\$3,740	\$0	\$3,740	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
20	MechEngSF	25%	20 hrs	0 days	Jan 14 '05	Jan 28 '05	\$1,020	\$1,020	\$0	\$1,020
22	MechTechSF	100%	80 hrs	0 days	Jan 14 '05	Jan 28 '05	\$2,720	\$2,720	\$0	\$2,720

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.1.8.2	production axle fixture	\$16,896	\$10,000	\$6,896	0	0	0

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.1.8.2.1	Design Production axle removal fixture	\$1,456	\$0	\$1,456	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
19	DesignerSF	10%	16 hrs	0 days	Jan 31 '05	Feb 25 '05	\$640	\$640	\$0	\$640
20	MechEngSF	10%	16 hrs	0 days	Jan 31 '05	Feb 25 '05	\$816	\$816	\$0	\$816

Notes

WBS Definition -
This covers time to modify prototype design.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Design Production axle removal fixture" continued

Notes
M&S BOE -

Labor BOE -

1.1.6.1.8.2.2	Fabricate production axle removal fixture	\$15,440	\$10,000	\$5,440	0.5	0	0
---------------	---	----------	----------	---------	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	10,000	10,000	0 days	Feb 28 '05	Apr 22 '05	\$10,000	\$10,000	\$0	\$10,000
22	MechTechSF	50%	160 hrs	0 days	Feb 28 '05	Apr 22 '05	\$5,440	\$5,440	\$0	\$5,440

Notes
WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.1.9	Barrel into Spacetube Fixture	\$52,670	\$20,000	\$32,670	0	0	0
-----------	-------------------------------	----------	----------	----------	---	---	---

Notes
WBS Definition -
The barrel must be transported to the spacetube. This fixture will be used to carry the barrels and support the associated cables and cooling tubes.

M&S BOE -

Labor BOE -

1.1.6.1.9.1	preproduction fixture	\$31,990	\$10,000	\$21,990	0	0	0
-------------	-----------------------	----------	----------	----------	---	---	---

Notes
WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.1.9.1.1	Explicit Slack: design barrel to spacetube fixture	\$0	\$0	\$0	0	0	5
---------------	--	-----	-----	-----	---	---	---

Notes
WBS Definition -

M&S BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Explicit Slack: design barrel to spacetube fixture" continued

Notes

Labor BOE -

1.1.6.1.9.1.2	Design fixture	\$11,790	\$0	\$11,790	0	0.4	0
---------------	----------------	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
19	DesignerSF	50%	180 hrs	0 days	Sep 30 '04	Dec 3 '04	\$7,200	\$7,200	\$0	\$7,200
20	MechEngSF	25%	90 hrs	0 days	Sep 30 '04	Dec 3 '04	\$4,590	\$4,590	\$0	\$4,590

Notes

WBS Definition -

This fixture supports the barrel and associated cables and cooling during installation into the spacetube.

M&S BOE -

Labor BOE -

1.1.6.1.9.1.3	Fabricate fixture	\$15,440	\$10,000	\$5,440	0.5	0	0
---------------	-------------------	----------	----------	---------	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	10,000	10,000	0 days	Dec 6 '04	Feb 4 '05	\$10,000	\$10,000	\$0	\$10,000
22	MechTechSF	50%	160 hrs	0 days	Dec 6 '04	Feb 4 '05	\$5,440	\$5,440	\$0	\$5,440

Notes

WBS Definition -

This is fixture which allows the completed barrel to be lifted and then lowered into the spacetube.
It is not a precision fixture and is larger than in Run IIa.

M&S BOE -

Labor BOE -

1.1.6.1.9.1.4	Test fixture	\$4,760	\$0	\$4,760	0	0.4	0
---------------	--------------	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
20	MechEngSF	25%	40 hrs	0 days	Feb 7 '05	Mar 4 '05	\$2,040	\$2,040	\$0	\$2,040
22	MechTechSF	50%	80 hrs	0 days	Feb 7 '05	Mar 4 '05	\$2,720	\$2,720	\$0	\$2,720

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level			
"Test fixture" continued										
<u>Notes</u>										
1.1.6.1.9.2	production fixture	\$20,680	\$10,000	\$10,680	0	0	0			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										
1.1.6.1.9.2.1	Design Production fixture	\$5,240	\$0	\$5,240	0	0.4	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
19	DesignerSF	50%	80 hrs	0 days	Mar 7 '05	Apr 1 '05	\$3,200	\$3,200	\$0	\$3,200
20	MechEngSF	25%	40 hrs	0 days	Mar 7 '05	Apr 1 '05	\$2,040	\$2,040	\$0	\$2,040
<u>Notes</u>										
WBS Definition -										
This covers time to modify prototype design .										
M&S BOE -										
Labor BOE -										
1.1.6.1.9.2.2	Fabricate production fixture	\$15,440	\$10,000	\$5,440	0.5	0	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
7	MANDS	10,000	10,000	0 days	Apr 4 '05	May 27 '05	\$10,000	\$10,000	\$0	\$10,000
22	MechTechSF	50%	160 hrs	0 days	Apr 4 '05	May 27 '05	\$5,440	\$5,440	\$0	\$5,440
<u>Notes</u>										
WBS Definition -										
This is fixture which allows the completed barrel to be lifted and then lowered into the spacetube. It is not a precision fixture and is larger than in Run IIa.										
M&S BOE -										
Labor BOE -										
1.1.6.1.10	Spacetube and cradle and rails	\$198,994	\$95,000	\$103,994	0	0	0			
<u>Notes</u>										
WBS Definition -										

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
-----	------	------	-----	-------	-----------	-------------	-------

"Spacetube and cradle and rails" continued

Notes

The spacetube will be nearly identical to the Run IIa spacetube. The spacetube spans the 2m length between mount points on the ISL and supports the weight of the barrels. The mounts which attach to ISL need to be in precisely the same locations as in Run IIa. The tube is actually a cylinder split lengthwise to allow barrel installation from the top.

M&S BOE -

Labor BOE -

1.1.6.1.10.1	Spacetube preproduction	\$62,640	\$20,000	\$42,640	0	0	0
--------------	-------------------------	----------	----------	----------	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.1.10.1.1	Explicit Slack: start preproduction space tube design	\$0	\$0	\$0	0	0	5
----------------	---	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.1.10.1.2	Design spacetube	\$22,720	\$0	\$22,720	0	0.4	0
----------------	------------------	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
19	DesignerSF	25%	160 hrs	0 days	Apr 14 '03	Aug 5 '03	\$6,400	\$6,400	\$1,920	\$4,480
20	MechEngSF	50%	320 hrs	0 days	Apr 14 '03	Aug 5 '03	\$16,320	\$16,320	\$4,896	\$11,424

Notes

WBS Definition -

This is similar to the Run IIa space tube and will follow the Run IIa design. The estimated labor includes the FEA analyses needed to complete the design.

M&S BOE -

Labor BOE -

1.1.6.1.10.1.3	Fabricate preproduction spacetube	\$20,000	\$20,000	\$0	0.5	0	0
----------------	-----------------------------------	----------	----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	20,000	20,000	0 days	Aug 6 '03	Nov 26 '03	\$20,000	\$20,000	\$0	\$20,000

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Fabricate preproduction spacetube" continued

Notes

WBS Definition -
This is similar to the Run IIa spacetube.

M&S BOE -
Cost is estimated from Run IIa experience.

Labor BOE -

1.1.6.1.10.1.4	Test preproduction spacetube	\$19,920	\$0	\$19,920	0	0.4	0
----------------	------------------------------	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
20	MechEngSF	25%	120 hrs	0 days	Dec 1 '03	Feb 27 '04	\$6,120	\$6,120	\$0	\$6,120
22	MechTechSF	50%	240 hrs	0 days	Dec 1 '03	Feb 27 '04	\$8,160	\$8,160	\$0	\$8,160
24	CMMProgrammerSF	25%	120 hrs	0 days	Dec 1 '03	Feb 27 '04	\$5,640	\$5,640	\$0	\$5,640

Notes

WBS Definition -
The structural characteristics of the prototype will be tested and compared to the FEA predictions.

M&S BOE -

Labor BOE -

1.1.6.1.10.2	Spacetube Production	\$66,512	\$50,000	\$16,512	0	0	0
--------------	----------------------	----------	----------	----------	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.1.10.2.1	explicit slack: start production space tube design	\$0	\$0	\$0	0	0	5
----------------	--	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.1.10.2.2	Design production spacetube	\$5,680	\$0	\$5,680	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
19	DesignerSF	25%	40 hrs	0 days	Jun 22 '04	Jul 20 '04	\$1,600	\$1,600	\$0	\$1,600
20	MechEngSF	50%	80 hrs	0 days	Jun 22 '04	Jul 20 '04	\$4,080	\$4,080	\$0	\$4,080

Notes

WBS Definition -
This covers the time needed to update drawings and adjust the design as a result of the prototype tests.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.1.10.2.3	Fabricate production Spacetube	\$50,000	\$50,000	\$0	0.5	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	50,000	50,000	0 days	Jul 21 '04	Nov 10 '04	\$50,000	\$50,000	\$0	\$50,000

Notes

WBS Definition -

M&S BOE -
Cost is estimated form Run IIa experience.

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.1.10.2.4	Test production spacetube	\$10,832	\$0	\$10,832	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
20	MechEngSF	10%	32 hrs	0 days	Nov 11 '04	Jan 13 '05	\$1,632	\$1,632	\$0	\$1,632
22	MechTechSF	50%	160 hrs	0 days	Nov 11 '04	Jan 13 '05	\$5,440	\$5,440	\$0	\$5,440
24	CMMPprogrammerSF	25%	80 hrs	0 days	Nov 11 '04	Jan 13 '05	\$3,760	\$3,760	\$0	\$3,760

Notes

WBS Definition -
Structural characteristics will be measured and compared to FEA.

M&S BOE -

Labor BOE -
Cost is labor.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.1.10.3	Support Cradle	\$39,890	\$15,000	\$24,890	0	0	0

Notes

WBS Definition -

M&S BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Support Cradle" continued

Notes
Labor BOE -

1.1.6.1.10.3.1	Design support cradle	\$11,100	\$0	\$11,100	0	0.4	0
----------------	-----------------------	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
19	DesignerSF	75%	150 hrs	0 days	Aug 6 '03	Sep 10 '03	\$6,000	\$6,000	\$0	\$6,000
20	MechEngSF	50%	100 hrs	0 days	Aug 6 '03	Sep 10 '03	\$5,100	\$5,100	\$0	\$5,100

Notes
WBS Definition -
This cradle supports the space tube while the barrels and installed and aligned. It is mounted on roller bearings which ride the rails on the CMM. This allows it to move around during installation of the beam pipe and during installation into ISL.
M&S BOE -
Labor BOE -

1.1.6.1.10.3.2	Fabricate support cradle	\$28,790	\$15,000	\$13,790	0.5	0.4	0
----------------	--------------------------	----------	----------	----------	-----	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	15,000	15,000	0 days	Sep 11 '03	Nov 4 '03	\$15,000	\$15,000	\$0	\$15,000
20	MechEngSF	20%	62.4 hrs	0 days	Sep 11 '03	Nov 4 '03	\$3,182	\$3,182	\$0	\$3,182
22	MechTechSF	100%	312 hrs	0 days	Sep 11 '03	Nov 4 '03	\$10,608	\$10,608	\$0	\$10,608

Notes
WBS Definition -
This cradle supports the space tube while the barrels and installed and aligned. It is mounted on roller bearings which ride the rails on the CMM. This allows it to move around during installation of the beam pipe and during installation into ISL.
M&S BOE -
Cost estimate frm G. Derylo and Y. Orlov April 18, 2002.
Labor BOE -

1.1.6.1.10.4	Update cradle support rail system	\$29,952	\$10,000	\$19,952	0	0	0
--------------	-----------------------------------	----------	----------	----------	---	---	---

Notes
WBS Definition -
This is to update the current rail support system for positioning the barrel spacetube.
M&S BOE -
Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.6.1.10.4.1	rail system: Design	\$10,752	\$0	\$10,752	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
19	DesignerSF	50%	160 hrs	0 days	Aug 6 '03	Oct 1 '03	\$6,400	\$6,400	\$0	\$6,400
20	MechEngSF	10%	32 hrs	0 days	Aug 6 '03	Oct 1 '03	\$1,632	\$1,632	\$0	\$1,632
22	MechTechSF	25%	80 hrs	0 days	Aug 6 '03	Oct 1 '03	\$2,720	\$2,720	\$0	\$2,720

Notes

WBS Definition -
Update the current rail system and fabricate a duplicate for the new CMM.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.6.1.10.4.2	rail system: Fabrication	\$10,000	\$10,000	\$0	0.5	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	10,000	10,000	0 days	Oct 2 '03	Oct 29 '03	\$10,000	\$10,000	\$0	\$10,000

Notes

WBS Definition -
Fabricate duplicate rail system and parts for upgrading the existing one.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.6.1.10.4.3	rail system: assembly and alignment	\$9,200	\$0	\$9,200	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
22	MechTechSF	100%	160 hrs	0 days	Oct 30 '03	Nov 26 '03	\$5,440	\$5,440	\$0	\$5,440
24	CMMPProgrammerSF	50%	80 hrs	0 days	Oct 30 '03	Nov 26 '03	\$3,760	\$3,760	\$0	\$3,760

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.6.1.11	Layer 0 CF structure	\$374,043	\$133,000	\$241,043	0	0	0

Notes

WBS Definition -
This is the Carbon Fiber Support for L0. It is mounted on outer bulkheads and has an integrated cooling system. This includes the structure which supports and cools the hybrids outside the end of the barrel.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level			
"Layer 0 CF structure" continued										
<u>Notes</u>										
M&S BOE -										
Labor BOE -										
1.1.6.1.11.1	Layer 0 CF support R&D	\$87,570	\$0	\$87,570	0	0	0			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										
1.1.6.1.11.1.1	CF Support R&D	\$87,570	\$0	\$87,570	0	0.2	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
19	DesignerSF	90%	952 hrs	0 days	May 13 '02	Dec 13 '02	\$38,080	\$38,080	\$38,080	\$0
20	MechEngSF	83%	970.4 hrs	0 days	May 13 '02	Dec 13 '02	\$49,490	\$49,490	\$49,490	\$0
<u>Notes</u>										
WBS Definition -										
The L0 CF support structure design starts together with the design of the bulk head. This includes the support structure for the L0 hybrids which extend outside the outer barrel in z.										
M&S BOE -										
Labor BOE -										
Engineering estimate based on Run IIa experience with L00.										
CF structure (tube + ledges): eng 40 days, des. 40 days										
Inner screen attachment to L0 total: eng 45days, des. 55days Mounts for L0 to inner screen: eng 20 days, des. 30 days fixture for installation of mounts: eng. 5 days des. 5 days electrical passivation fixture: eng. 15 days des. 10 days electrical grounding fixture: eng. 5 days, des. 10 days										
Hybrid support structure: eng 40 days des. 40 days										
Total: Eng 125 days Total: Des 135 days Task is set at 150 days: 83% of eng. and 90% of designer										
1.1.6.1.11.2	L0 CF support Proproduction	\$132,290	\$66,500	\$65,790	0	0	0			

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"L0 CF support Proproduction" continued

1.1.6.1.11.2.1 Explicit Slack: CF Support manufacturing evaluation and testing \$0 \$0 \$0 0 0 5

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.1.11.2.2 CF Support Design \$46,998 \$0 \$46,998 0 0.4 0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
19	DesignerSF	90%	540 hrs	0 days	Mar 3 '03	Jun 16 '03	\$21,600	\$21,600	\$10,800	\$10,800
20	MechEngSF	83%	498 hrs	0 days	Mar 3 '03	Jun 16 '03	\$25,398	\$25,398	\$12,699	\$12,699

Notes

WBS Definition -

The L0 CF support structure design is already done. This task is to redo parts which need modification and thus the task has the same resources as the R&D task, but is only half the duration.

M&S BOE -

Labor BOE for R&D task-
Engineering estimate based on Run IIa experience with L00.

CF structure (tube + ledges): eng 40 days, des. 40 days

Inner screen attachment to L0 total: eng 45days, des. 55days
Mounts for L0 to inner screen: eng 20 days, des. 30 days
fixture for installation of mounts: eng. 5 days des. 5 days
electrical passivation fixture: eng. 15 days des. 10 days
electrical grounding fixture: eng. 5 days, des. 10 days

Hybrid support structure: eng 40 days des. 40 days

Total: Eng 125 days
Total: Des 135 days
Task is set at 150 days: 83% of eng. and 90% of designer

1.1.6.1.11.2.3 CF Support Preproduction: manufacturing \$66,500 \$66,500 \$0 0.5 0 0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	66,500	66,500	0 days	Jun 17 '03	Nov 5 '03	\$66,500	\$66,500	\$0	\$66,500

Notes

WBS Definition -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"CF Support Preproduction: manufacturing" continued

Notes

M&S BOE -

Cost is based on Run IIa experience with L00.

2 prototypes of the CF support structure: \$30,000

Inner screen attachment to L0 total: \$16,500

Hybrid support structure: \$20,000

Total \$66,500

Labor BOE -

1.1.6.1.11.2.4	CF Support: evaluation and testing	\$18,792	\$0	\$18,792	0	0.4	0
----------------	------------------------------------	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	240 hrs	0 days	Mar 4 '04	May 26 '04	\$0	\$0	\$0	\$0
20	MechEngSF	25%	120 hrs	0 days	Mar 4 '04	May 26 '04	\$6,120	\$6,120	\$0	\$6,120
22	MechTechSF	50%	240 hrs	0 days	Mar 4 '04	May 26 '04	\$8,160	\$8,160	\$0	\$8,160
24	CMMPProgrammerSF	20%	96 hrs	0 days	Mar 4 '04	May 26 '04	\$4,512	\$4,512	\$0	\$4,512

Notes

WBS Definition -

Testing consists of both mechanical and electrical since now pre-production L0 modules are available.

M&S BOE -

Labor BOE -

Run IIa experience

1.1.6.1.11.2.5	preproduction CF support ready and tested	\$0	\$0	\$0	0	0	4
----------------	---	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.1.11.3	Layer 0 CF support production	\$154,183	\$66,500	\$87,683	0	0	0
--------------	-------------------------------	-----------	----------	----------	---	---	---

Notes

WBS Definition -

M&S BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Layer 0 CF support production" continued

Notes

Labor BOE -

1.1.6.1.11.3.1	CF Support: Design	\$46,163	\$0	\$46,163	0	0.4	0
----------------	--------------------	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	25%	132 hrs	0 days	May 27 '04	Aug 30 '04	\$0	\$0	\$0	\$0
19	DesignerSF	100%	528 hrs	0 days	May 27 '04	Aug 30 '04	\$21,120	\$21,120	\$0	\$21,120
20	MechEngSF	93%	491.03 hrs	0 days	May 27 '04	Aug 30 '04	\$25,043	\$25,043	\$0	\$25,043

Notes

WBS Definition -

This is the final design for the L0 Cf support structure and the hybrid support structure. We assume that the final design requires only half the time of the initial design.

M&S BOE -

Labor BOE -

Engineering estimate based on Run IIa experience with L00

The L0 CF support structure design starts together with the design of the bulk head.

This includes the support structure for the L0 hybrids which extend outside the outer barrel in z.

CF structure (tube + ledges): eng 20days, des. 20 days

Inner screen attachment to L0 total: eng 20days, des. 25days

Hybrid support structure: eng 20days des. 20 days

Total: eng 60 days des. 65 days

Task is set at 60 days: 93% of eng. and 10% of designer

1.1.6.1.11.3.2	CF Support: manufacturing	\$66,500	\$66,500	\$0	0.5	0	0
----------------	---------------------------	----------	----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	66,500	66,500	0 days	Aug 31 '04	Dec 23 '04	\$66,500	\$66,500	\$0	\$66,500

Notes

WBS Definition -

We assume we remake all the parts for the production round.

M&S BOE -

Cost is based on Run IIa experience with L00.

2 final CF support structures: \$30,000

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level			
"CF Support: manufacturing" continued										
<u>Notes</u>										
Inner screen attachment to L0 total: \$16,500										
Hybrid support structure: \$20,000										
Total \$66,500										
Labor BOE -										
1.1.6.1.11.3.3	Explicit Slack: CF Support manufacturing evaluation and testing	\$0	\$0	\$0	0	0	5			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										
1.1.6.1.11.3.4	CF Support: assembly and test	\$41,520	\$0	\$41,520	0	0.4	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
11	Postdoc	100%	320 hrs	0 days	Mar 11 '05	May 5 '05	\$0	\$0	\$0	\$0
20	MechEngSF	75%	240 hrs	0 days	Mar 11 '05	May 5 '05	\$12,240	\$12,240	\$0	\$12,240
22	MechTechSF	200%	640 hrs	0 days	Mar 11 '05	May 5 '05	\$21,760	\$21,760	\$0	\$21,760
24	CMMPprogrammerSF	50%	160 hrs	0 days	Mar 11 '05	May 5 '05	\$7,520	\$7,520	\$0	\$7,520
<u>Notes</u>										
WBS Definition -										
Tests include alignment and cooling tests for hybrid structure and for silicon supports.										
M&S BOE -										
Labor BOE -										
Based on Run IIa experience with L00.										
1.1.6.1.11.3.5	L0 Supports Complete	\$0	\$0	\$0	0	0	2			
<u>Notes</u>										
WBS Definition -										
M&S BOE -										
Labor BOE -										

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.2.1.1.3	Preproduction Inner Detector Installation Fixtures: fabrication	\$20,000	\$20,000	\$0	0.5	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	20,000	20,000	0 days	Dec 9 '04	Mar 9 '05	\$20,000	\$20,000	\$0	\$20,000

Notes

WBS Definition -

M&S BOE -

Price is based on L00 installation fixtures.

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.2.1.1.4	Preproduction Inner Detector Installation Fixtures: test	\$6,640	\$0	\$6,640	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	80 hrs	0 days	Mar 10 '05	Apr 6 '05	\$0	\$0	\$0	\$0
20	MechEngSF	25%	40 hrs	0 days	Mar 10 '05	Apr 6 '05	\$2,040	\$2,040	\$0	\$2,040
22	MechTechSF	50%	80 hrs	0 days	Mar 10 '05	Apr 6 '05	\$2,720	\$2,720	\$0	\$2,720
24	CMMProgrammerSF	25%	40 hrs	0 days	Mar 10 '05	Apr 6 '05	\$1,880	\$1,880	\$0	\$1,880

Notes

WBS Definition -

This test is setup on a CMM and the alignment is tested.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.2.1.2	L0 inst. Fixture Production	\$43,020	\$20,000	\$23,020	0	0	0

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.2.1.2.1	Inner Detector Installation Fixtures: Final Design	\$16,380	\$0	\$16,380	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
19	DesignerSF	50%	180 hrs	0 days	Apr 7 '05	Jun 9 '05	\$7,200	\$7,200	\$0	\$7,200
20	MechEngSF	50%	180 hrs	0 days	Apr 7 '05	Jun 9 '05	\$9,180	\$9,180	\$0	\$9,180

Notes

WBS Definition -

This covers the redesign/ adjustments to the prototype fixtures.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
-----	------	------	-----	-------	-----------	-------------	-------

"Inner Detector Installation Fixtures: Final Design" continued

Notes

M&S BOE -

Labor BOE -

1.1.6.2.1.2.2	Inner Detector Installation Fixtures: fabrication	\$20,000	\$20,000	\$0	0.5	0	0
---------------	---	----------	----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	20,000	20,000	0 days	Jun 10 '05	Sep 2 '05	\$20,000	\$20,000	\$0	\$20,000

Notes

WBS Definition -

M&S BOE -

Price is based on L00 installation fixtures

Labor BOE -

1.1.6.2.1.2.3	Inner Detector Installation Fixtures: test	\$6,640	\$0	\$6,640	0	0.4	0
---------------	--	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	80 hrs	0 days	Sep 6 '05	Oct 3 '05	\$0	\$0	\$0	\$0
20	MechEngSF	25%	40 hrs	0 days	Sep 6 '05	Oct 3 '05	\$2,040	\$2,040	\$0	\$2,040
22	MechTechSF	50%	80 hrs	0 days	Sep 6 '05	Oct 3 '05	\$2,720	\$2,720	\$0	\$2,720
24	CMMProgrammerSF	25%	40 hrs	0 days	Sep 6 '05	Oct 3 '05	\$1,880	\$1,880	\$0	\$1,880

Notes

WBS Definition -

Setup on CMM and test alignment.

M&S BOE -

Labor BOE -

1.1.6.2.1.2.4	Ready to integrate inner and outer detectors	\$0	\$0	\$0	0	0	4
---------------	--	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level																																															
1.1.6.2.2	Beampipe supports	\$53,276	\$25,000	\$28,276	0	0	0																																															
	<u>Notes</u>																																																					
	WBS Definition -																																																					
	M&S BOE -																																																					
	Labor BOE -																																																					
1.1.6.2.2.1	Beampipe supports preproduction	\$30,608	\$10,000	\$20,608	0	0	0																																															
	<u>Notes</u>																																																					
	WBS Definition -																																																					
	M&S BOE -																																																					
	Labor BOE -																																																					
1.1.6.2.2.1.1	Explicit Slack: start beampipe support design	\$0	\$0	\$0	0	0	5																																															
	<u>Notes</u>																																																					
	WBS Definition -																																																					
	M&S BOE -																																																					
	Labor BOE -																																																					
1.1.6.2.2.1.2	Design preproduction beampipe supports	\$7,280	\$0	\$7,280	0	0.4	0																																															
	<table border="1"> <thead> <tr> <th>ID</th> <th>Resource Name</th> <th>Units</th> <th>Work</th> <th>Delay</th> <th>Start</th> <th>Finish</th> <th>Cost</th> <th>Baseline Cost</th> <th>Act. Cost</th> <th>Rem. Cost</th> </tr> </thead> <tbody> <tr> <td>11</td> <td>Postdoc</td> <td>50%</td> <td>80 hrs</td> <td>0 days</td> <td>Feb 28 '05</td> <td>Mar 25 '05</td> <td>\$0</td> <td>\$0</td> <td>\$0</td> <td>\$0</td> </tr> <tr> <td>19</td> <td>DesignerSF</td> <td>50%</td> <td>80 hrs</td> <td>0 days</td> <td>Feb 28 '05</td> <td>Mar 25 '05</td> <td>\$3,200</td> <td>\$3,200</td> <td>\$0</td> <td>\$3,200</td> </tr> <tr> <td>20</td> <td>MechEngSF</td> <td>50%</td> <td>80 hrs</td> <td>0 days</td> <td>Feb 28 '05</td> <td>Mar 25 '05</td> <td>\$4,080</td> <td>\$4,080</td> <td>\$0</td> <td>\$4,080</td> </tr> </tbody> </table>	ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost	11	Postdoc	50%	80 hrs	0 days	Feb 28 '05	Mar 25 '05	\$0	\$0	\$0	\$0	19	DesignerSF	50%	80 hrs	0 days	Feb 28 '05	Mar 25 '05	\$3,200	\$3,200	\$0	\$3,200	20	MechEngSF	50%	80 hrs	0 days	Feb 28 '05	Mar 25 '05	\$4,080	\$4,080	\$0	\$4,080									
ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost																																												
11	Postdoc	50%	80 hrs	0 days	Feb 28 '05	Mar 25 '05	\$0	\$0	\$0	\$0																																												
19	DesignerSF	50%	80 hrs	0 days	Feb 28 '05	Mar 25 '05	\$3,200	\$3,200	\$0	\$3,200																																												
20	MechEngSF	50%	80 hrs	0 days	Feb 28 '05	Mar 25 '05	\$4,080	\$4,080	\$0	\$4,080																																												
	<u>Notes</u>																																																					
	WBS Definition -																																																					
	M&S BOE -																																																					
	Labor BOE -																																																					
	Based on Run Ila experience.																																																					
1.1.6.2.2.1.3	Fabricate preproduction beampipe supports	\$15,848	\$10,000	\$5,848	0.5	0.4	0																																															
	<table border="1"> <thead> <tr> <th>ID</th> <th>Resource Name</th> <th>Units</th> <th>Work</th> <th>Delay</th> <th>Start</th> <th>Finish</th> <th>Cost</th> <th>Baseline Cost</th> <th>Act. Cost</th> <th>Rem. Cost</th> </tr> </thead> <tbody> <tr> <td>7</td> <td>MANDS</td> <td>10,000</td> <td>10,000</td> <td>0 days</td> <td>Mar 28 '05</td> <td>Apr 22 '05</td> <td>\$10,000</td> <td>\$10,000</td> <td>\$0</td> <td>\$10,000</td> </tr> </tbody> </table>	ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost	7	MANDS	10,000	10,000	0 days	Mar 28 '05	Apr 22 '05	\$10,000	\$10,000	\$0	\$10,000																															
ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost																																												
7	MANDS	10,000	10,000	0 days	Mar 28 '05	Apr 22 '05	\$10,000	\$10,000	\$0	\$10,000																																												

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Fabricate preproduction beampipe supports" continued

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	25%	40 hrs	0 days	Mar 28 '05	Apr 22 '05	\$0	\$0	\$0	\$0
20	MechEngSF	5%	8 hrs	0 days	Mar 28 '05	Apr 22 '05	\$408	\$408	\$0	\$408
22	MechTechSF	100%	160 hrs	0 days	Mar 28 '05	Apr 22 '05	\$5,440	\$5,440	\$0	\$5,440

Notes

WBS Definition -

M&S BOE -

These are made from CF as in Run IIa and costs estimated from Run IIa experience.

Two types of supports are used to support the pipe in four places:

- 1) at either end of the spacetube (called 2-inch webs in Run IIa)
- 2) at either end of the ISL extension cylinder (called 4-inch webs in Run IIa)

The cost is in fabricating the mold fixtures for the supports (two sizes) and in the CF material. For the prototype round we only fabricate one set of each type.

Labor BOE -

1.1.6.2.2.1.4	Test preproduction beampipe supports	\$7,480	\$0	\$7,480	0	0.4	0
---------------	--------------------------------------	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	80 hrs	0 days	Apr 25 '05	May 20 '05	\$0	\$0	\$0	\$0
20	MechEngSF	25%	40 hrs	0 days	Apr 25 '05	May 20 '05	\$2,040	\$2,040	\$0	\$2,040
22	MechTechSF	100%	160 hrs	0 days	Apr 25 '05	May 20 '05	\$5,440	\$5,440	\$0	\$5,440

Notes

WBS Definition -

Use mockup beampipe to test concept for beampipe supports.

M&S BOE -

Labor BOE -

1.1.6.2.2.2	Beampipe Supports (production)	\$22,668	\$15,000	\$7,668	0	0	0
-------------	--------------------------------	----------	----------	---------	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.6.2.2.1	Design final beampipe supports	\$1,820	\$0	\$1,820	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	40 hrs	0 days	May 23 '05	Jun 6 '05	\$0	\$0	\$0	\$0
19	DesignerSF	25%	20 hrs	0 days	May 23 '05	Jun 6 '05	\$800	\$800	\$0	\$800
20	MechEngSF	25%	20 hrs	0 days	May 23 '05	Jun 6 '05	\$1,020	\$1,020	\$0	\$1,020

Notes

WBS Definition -

This should go faster than prototype since we anticipate few if any changes.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.6.2.2.2	Fabricate final beampipe supports	\$20,848	\$15,000	\$5,848	0.5	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	15,000	15,000	0 days	Jun 7 '05	Jul 5 '05	\$15,000	\$15,000	\$0	\$15,000
11	Postdoc	50%	80 hrs	0 days	Jun 7 '05	Jul 5 '05	\$0	\$0	\$0	\$0
20	MechEngSF	5%	8 hrs	0 days	Jun 7 '05	Jul 5 '05	\$408	\$408	\$0	\$408
22	MechTechSF	100%	160 hrs	0 days	Jun 7 '05	Jul 5 '05	\$5,440	\$5,440	\$0	\$5,440

Notes

WBS Definition -

We assume we need to remake the molds and the beampipe supports and that we make a full set this time (two sets of each type).

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.6.2.3	Beampipe Installation Fixtures	\$20,080	\$6,000	\$14,080	0	0	0

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.6.2.3.1	Beampipe installation fixture: Design	\$7,280	\$0	\$7,280	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
19	DesignerSF	50%	80 hrs	0 days	Apr 25 '05	May 20 '05	\$3,200	\$3,200	\$0	\$3,200
20	MechEngSF	50%	80 hrs	0 days	Apr 25 '05	May 20 '05	\$4,080	\$4,080	\$0	\$4,080

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Beampipe installation fixture: Design" continued

Notes

WBS Definition -
Start date is set by evaluation of production space tube plus a lag of 20 days.

M&S BOE -

Labor BOE -
This is based on Run IIa experience.

1.1.6.2.3.2	Beampipe installation fixture: fabrication	\$5,000	\$5,000	\$0	0.5	0	0
-------------	--	---------	---------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	5,000	5,000	0 days	May 23 '05	Jun 20 '05	\$5,000	\$5,000	\$0	\$5,000

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.2.3.3	procure mockup beampipe	\$1,000	\$1,000	\$0	0.5	0	0
-------------	-------------------------	---------	---------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	1,000	1,000	0 days	Jun 21 '05	Jul 19 '05	\$1,000	\$1,000	\$0	\$1,000

Notes

WBS Definition -
This is an estimate to construct a Stainless Steel mockup beampipe for testing installation and supports.

M&S BOE -

Labor BOE -

1.1.6.2.3.4	Beampipe installation fixture: test	\$6,800	\$0	\$6,800	0	0.4	0
-------------	-------------------------------------	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
20	MechEngSF	50%	80 hrs	0 days	Jul 20 '05	Aug 16 '05	\$4,080	\$4,080	\$0	\$4,080
22	MechTechSF	50%	80 hrs	0 days	Jul 20 '05	Aug 16 '05	\$2,720	\$2,720	\$0	\$2,720

Notes

WBS Definition -

M&S BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
"Beampipe installation fixture: test" continued							
<u>Notes</u>							
Labor BOE -							

1.1.6.2.4	Transportation Fixtures	\$99,440	\$20,000	\$79,440	0	0	0
<u>Notes</u>							
WBS Definition - This is the fixture for transporting ISL+SVXIIa or ISL+SVXIIb from/to the Assembly Hall. It has to be finished before runiia ends. The fixtures for Run IIa will be reused as much as possible.							
M&S BOE -							
Labor BOE -							

1.1.6.2.4.1	transportation fixture: update design	\$40,000	\$0	\$40,000	0	0.4	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
19	DesignerSF	100%	320 hrs	0 days	May 23 '05	Jul 19 '05	\$12,800	\$12,800	\$0	\$12,800
20	MechEngSF	100%	320 hrs	0 days	May 23 '05	Jul 19 '05	\$16,320	\$16,320	\$0	\$16,320
22	MechTechSF	100%	320 hrs	0 days	May 23 '05	Jul 19 '05	\$10,880	\$10,880	\$0	\$10,880

Notes
WBS Definition -
This is the labor cost to update the design of the Run IIa transportation fixture.

M&S BOE -

Labor BOE -

1.1.6.2.4.2	transportation fixture: fabrication	\$30,880	\$20,000	\$10,880	0.5	0	0			
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>
7	MANDS	20,000	20,000	0 days	Jul 20 '05	Sep 14 '05	\$20,000	\$20,000	\$0	\$20,000
22	MechTechSF	100%	320 hrs	0 days	Jul 20 '05	Sep 14 '05	\$10,880	\$10,880	\$0	\$10,880

Notes
WBS Definition -
This is the cost to update the Run IIa transportation fixtures.

M&S BOE -
The cost is estimated from the Run IIa transportation fixtures which cost \$18k,000. We assume some of the parts can be reused.

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.2.4.3	transportation fixture: final assembly and test	\$28,560	\$0	\$28,560	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
20	MechEngSF	50%	240 hrs	0 days	Sep 15 '05	Dec 9 '05	\$12,240	\$12,240	\$0	\$12,240
22	MechTechSF	100%	480 hrs	0 days	Sep 15 '05	Dec 9 '05	\$16,320	\$16,320	\$0	\$16,320

Notes

WBS Definition -
This is the labor for assembly of the transportation fixture .

M&S BOE -

Labor BOE -

1.1.6.2.5	Positioning system (inchworms)	\$45,032	\$17,000	\$28,032	0	0	0
-----------	--------------------------------	----------	----------	----------	---	---	---

Notes

WBS Definition -
This system allows adjustment of the position of the entire silicon detector (ISL+SVXIIb+L0+ beampipe) relative the the outer tracker (COT) and the beamline.

M&S BOE -

Labor BOE -

1.1.6.2.5.1	Positioning System preproduction	\$22,960	\$2,000	\$20,960	0	0	0
-------------	----------------------------------	----------	---------	----------	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.2.5.1.1	Explicit Slack: Design replacement for inchworms	\$0	\$0	\$0	0	0	5
---------------	--	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.2.5.1.2	positioning jacks(inchworms): design	\$20,960	\$0	\$20,960	0	0.4	0
---------------	--------------------------------------	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	100%	320 hrs	0 days	Jan 5 '04	Mar 1 '04	\$0	\$0	\$0	\$0

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"positioning jacks(inchworms): design" continued

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
19	DesignerSF	100%	320 hrs	0 days	Jan 5 '04	Mar 1 '04	\$12,800	\$12,800	\$0	\$12,800
20	MechEngSF	50%	160 hrs	0 days	Jan 5 '04	Mar 1 '04	\$8,160	\$8,160	\$0	\$8,160

Notes

WBS Definition -

This is the replacement for the remote positioning system (the inchworms) which attach to the outer flange of ISL and COT. These will be mechanical jacks that can only be adjusted when the plugs are open.

M&S BOE -

Labor BOE -

Design will be done in collaboration with U. Toronto.

1.1.6.2.5.1.3	positioning jack prototype manufacturing	\$2,000	\$2,000	\$0	0.5	0	0
---------------	--	---------	---------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	2,000	2,000	0 days	Mar 2 '04	Apr 26 '04	\$2,000	\$2,000	\$0	\$2,000

Notes

WBS Definition -

This is the cost of manufacturing the prototype hardware. This may be covered by U. Toronto depending on a grant. This is a much simpler design than for the Run IIa system.

M&S BOE -

Labor BOE -

1.1.6.2.5.1.4	Preproduction positioning jack testing	\$0	\$0	\$0	0	0.4	0
---------------	--	-----	-----	-----	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	200%	640 hrs	0 days	Apr 27 '04	Jun 22 '04	\$0	\$0	\$0	\$0

Notes

WBS Definition -

M&S BOE -

Labor BOE -

This will be done by physicists at Toronto. Estimated to be 2 FTE.

1.1.6.2.5.2	Positioning System Production	\$22,072	\$15,000	\$7,072	0	0	0
-------------	-------------------------------	----------	----------	---------	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.2.5.2.1	positioning jacks: manufacturing	\$15,000	\$15,000	\$0	0.5	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
8	MANDSPASS	15,000	15,000	0 days	Jun 23 '04	Aug 18 '04	\$15,000	\$15,000	\$0	\$15,000

Notes

WBS Definition -

M&S BOE -

Estimate \$10,000 for jacks and \$5,000 for new pieces to attach to COT. Toronto may cover some of the costs.

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.2.5.2.2	positioning jacks: Assemble and test	\$7,072	\$0	\$7,072	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	200%	640 hrs	0 days	Aug 19 '04	Oct 14 '04	\$0	\$0	\$0	\$0
20	MechEngSF	10%	32 hrs	0 days	Aug 19 '04	Oct 14 '04	\$1,632	\$1,632	\$0	\$1,632
22	MechTechSF	50%	160 hrs	0 days	Aug 19 '04	Oct 14 '04	\$5,440	\$5,440	\$0	\$5,440

Notes

WBS Definition -

This assembly and testing will mostly be done at Toronto.

M&S BOE -

Labor BOE -

Labor estimated to be 2 FTE

Some eng, and tech. time will be needed for tests and FNAL.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.2.6	Installation fixture for SVXIIB into ISL	\$126,304	\$40,000	\$86,304	0	0	0

Notes

WBS Definition -

These are the fixtures that allows for both extracting SVXIIB from ISL and inserting SVXIIB into ISL.

M&S BOE -

Labor BOE -

Schedule BOE -

This task needs to be done in time for the removal of SVXIIB from ISL.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.2.6.1	Design Fixtures for removal of SVXII and installation of SVXIIB	\$40,000	\$0	\$40,000	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	160 hrs	0 days	Jan 14 '05	Mar 11 '05	\$0	\$0	\$0	\$0
19	DesignerSF	100%	320 hrs	0 days	Jan 14 '05	Mar 11 '05	\$12,800	\$12,800	\$0	\$12,800
20	MechEngSF	100%	320 hrs	0 days	Jan 14 '05	Mar 11 '05	\$16,320	\$16,320	\$0	\$16,320

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
-----	------	------	-----	-------	-----------	-------------	-------

"Design Fixtures for removal of SVXII and installation of SVXIIB" continued

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
22	MechTechSF	100%	320 hrs	0 days	Jan 14 '05	Mar 11 '05	\$10,880	\$10,880	\$0	\$10,880

Notes

WBS Definition -

M&S BOE -

Labor BOE -

Schedule BOE -

This task needs to be done in time for the removal of SVXIla from ISL.

1.1.6.2.6.2	Fabricate fixtures for SVX removal and installation of SVXIIB	\$46,320	\$30,000	\$16,320	0.5	0	0
-------------	---	----------	----------	----------	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	30,000	30,000	0 days	May 9 '05	Aug 2 '05	\$30,000	\$30,000	\$0	\$30,000
22	MechTechSF	100%	480 hrs	0 days	May 9 '05	Aug 2 '05	\$16,320	\$16,320	\$0	\$16,320

Notes

WBS Definition -

This is the cost to purchase the fixtures from outside.

M&S BOE -

Cost is based on an engineering estimate and Ila experience.

Labor BOE -

1.1.6.2.6.3	Assemble and Test fixtures for SVX removal and installation of SV	\$13,280	\$0	\$13,280	0	0.4	0
-------------	---	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	80 hrs	0 days	Aug 3 '05	Aug 30 '05	\$0	\$0	\$0	\$0
20	MechEngSF	50%	80 hrs	0 days	Aug 3 '05	Aug 30 '05	\$4,080	\$4,080	\$0	\$4,080
22	MechTechSF	100%	160 hrs	0 days	Aug 3 '05	Aug 30 '05	\$5,440	\$5,440	\$0	\$5,440
24	CMMProgrammerSF	50%	80 hrs	0 days	Aug 3 '05	Aug 30 '05	\$3,760	\$3,760	\$0	\$3,760

Notes

WBS Definition -

This involves alignment and assembly of fixtures on the CMM at SiDet.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.6.2.6.4	Design and fabricate parts for ISL extension cylinder	\$26,704	\$10,000	\$16,704	0.5	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	10,000	10,000	0 days	Aug 31 '05	Dec 27 '05	\$10,000	\$10,000	\$0	\$10,000
19	DesignerSF	10%	64 hrs	0 days	Aug 31 '05	Dec 27 '05	\$2,560	\$2,560	\$0	\$2,560
20	MechEngSF	10%	64 hrs	0 days	Aug 31 '05	Dec 27 '05	\$3,264	\$3,264	\$0	\$3,264
22	MechTechSF	50%	320 hrs	0 days	Aug 31 '05	Dec 27 '05	\$10,880	\$10,880	\$0	\$10,880

Notes

WBS Definition -

This item covers the replacement and modification of the hardware that resides in the ISL extension cylinder. This consists of

- 1) Junction card support rings
- 2) beampipe deflection damper (dashpots)
- 3) support for cooling manifolds

M&S BOE -

Labor BOE -

1.1.6.3	Final Assembly (Stave Installation, L0 module inst.)	\$567,793	\$177,100	\$390,693	0	0	0
----------------	---	------------------	------------------	------------------	----------	----------	----------

Notes

WBS Definition -

This task covers installation of staves into the barrels, installation of L0 modules on the CF supports and the integration of L0 and beampipe with the outer barrel.

M&S BOE -

Labor BOE -

1.1.6.3.1	Stave Installation (Outer)	\$364,840	\$100,000	\$264,840	0	0	0
------------------	-----------------------------------	------------------	------------------	------------------	----------	----------	----------

Notes

WBS Definition -

This covers installation of all layers except for L0.

The stave installation fixture will be similar to the fixture used in Run IIa, but it will be larger.

This fixture holds the bulkheads and staves while the staves are installed. It has a precision angular encoder. The staves are supported on long arms which are attached to roller bearings. Precise adjustment capability is incorporated into the arms.

M&S BOE -

In Run IIa the prototype + production fixture cost \$50,000 (two sets). Here we estimate \$30,000 for the prototype and \$70,000 for the two production fixtures. We need two complete production fixtures so that two barrels can be assembled in parallel.

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.3.1.1	Stave Installation Fixture Preproduction	\$101,360	\$30,000	\$71,360	0	0	0

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.3.1.1.1	Explicit Slack: tests of Stave installation and associated parts	\$0	\$0	\$0	0	0	5
---------------	--	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.3.1.1.2	Preproduction stave installation fixture: Design	\$37,280	\$0	\$37,280	0	0.4	0
---------------	--	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
19	DesignerSF	50%	320 hrs	0 days	Mar 24 '03	Jul 15 '03	\$12,800	\$12,800	\$3,840	\$8,960
20	MechEngSF	75%	480 hrs	0 days	Mar 24 '03	Jul 15 '03	\$24,480	\$24,480	\$7,344	\$17,136

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.3.1.1.3	Preproduction stave installation fixture: fabrication	\$30,000	\$30,000	\$0	0.5	0	0
---------------	---	----------	----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	30,000	30,000	0 days	Jul 16 '03	Oct 8 '03	\$30,000	\$30,000	\$0	\$30,000

Notes

WBS Definition -

The stave installation fixture will be similar to the fixture used in Run IIa, but it will be larger. This fixture holds the bulkheads and staves while the staves are installed. It has a precision angular encoder. The staves are supported on long arms which are attached to roller bearings. Precise adjustment capability is incorporated into the arms.

M&S BOE -

In Run IIa the prototype + production fixture cost \$50,000 (two sets). Here we estimate \$30,000 for the prototype and \$70,000 for the two production fixtures. We need two complete production fixtures so that two barrels can be assembled in parallel.

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.6.3.1.1.4	Preproduction stave installation fixture: setup and test	\$34,080	\$0	\$34,080	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	160 hrs	0 days	Oct 9 '03	Dec 5 '03	\$0	\$0	\$0	\$0
20	MechEngSF	50%	160 hrs	0 days	Oct 9 '03	Dec 5 '03	\$8,160	\$8,160	\$0	\$8,160
22	MechTechSF	100%	320 hrs	0 days	Oct 9 '03	Dec 5 '03	\$10,880	\$10,880	\$0	\$10,880
24	CMMProgrammerSF	100%	320 hrs	0 days	Oct 9 '03	Dec 5 '03	\$15,040	\$15,040	\$0	\$15,040

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.3.1.1.5	Milestone: all tests of stave installation, screen mounting, complet	\$0	\$0	\$0	0	0	2
---------------	--	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.3.1.2	Stave Installation Fixture Production	\$186,864	\$70,000	\$116,864	0	0	0
-------------	---------------------------------------	-----------	----------	-----------	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.3.1.2.1	Stave installation fixtures: design	\$20,960	\$0	\$20,960	0	0.4	0
---------------	-------------------------------------	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
19	DesignerSF	50%	320 hrs	0 days	May 24 '04	Sep 15 '04	\$12,800	\$12,800	\$0	\$12,800
20	MechEngSF	25%	160 hrs	0 days	May 24 '04	Sep 15 '04	\$8,160	\$8,160	\$0	\$8,160

Notes

WBS Definition -

Final Stave installation fixture design will start as soon as the final bulk-head design is finished and the R&D is completed.

M&S BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level			
1.1.6.3.1.2.2	Stave installation fixtures: fabrication	\$70,000	\$70,000	\$0	0.5	0	0			
ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	70,000	70,000	0 days	Sep 16 '04	Dec 10 '04	\$70,000	\$70,000	\$0	\$70,000

Notes

WBS Definition -

The stave installation fixture will be similar to the fixture used in Run IIa, but it will be larger. This fixture holds the bulkheads and staves while the staves are installed. It has a precision angular encoder. The staves are supported on long arms which are attached to roller bearings. Precise adjustment capability is incorporated into the arms.

M&S BOE -

In Run IIa the prototype + production fixture cost \$50,000 (two sets). Here we estimate \$30,000 for the prototype and \$70,000 for the two production fixtures. We need two complete production fixtures so that two barrels can be assembled in parallel.

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level			
1.1.6.3.1.2.3	Stave installation fixture: setup and Alignment	\$66,720	\$0	\$66,720	0	0.4	0			
ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	100%	320 hrs	0 days	Dec 13 '04	Feb 11 '05	\$0	\$0	\$0	\$0
20	MechEngSF	50%	160 hrs	0 days	Dec 13 '04	Feb 11 '05	\$8,160	\$8,160	\$0	\$8,160
22	MechTechSF	400%	1,280 hrs	0 days	Dec 13 '04	Feb 11 '05	\$43,520	\$43,520	\$0	\$43,520
24	CMMProgrammerSF	100%	320 hrs	0 days	Dec 13 '04	Feb 11 '05	\$15,040	\$15,040	\$0	\$15,040

Notes

WBS Definition -

This will be setup on a CMM and mechanical staves will be used to test the installation procedures. Two technicians will be needed to set up each fixture. There are two fixtures.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level			
1.1.6.3.1.2.4	Bulkhead installation and alignment	\$29,184	\$0	\$29,184	0	0.4	0			
ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	25%	80 hrs	0 days	Feb 14 '05	Apr 8 '05	\$0	\$0	\$0	\$0
20	MechEngSF	20%	64 hrs	0 days	Feb 14 '05	Apr 8 '05	\$3,264	\$3,264	\$0	\$3,264
22	MechTechSF	100%	320 hrs	0 days	Feb 14 '05	Apr 8 '05	\$10,880	\$10,880	\$0	\$10,880
24	CMMProgrammerSF	100%	320 hrs	0 days	Feb 14 '05	Apr 8 '05	\$15,040	\$15,040	\$0	\$15,040

Notes

WBS Definition -

Bulkheads must be precisely aligned to each other and to the CMM reference system. Material Costs are covered in inner and outer screen installation item. This task includes the time to glue the bulkheads together onto the inner screen.

M&S BOE -

Labor BOE -

WBS Dictionary as of Mar 13 '03
CDF Run2b Silicon Detector Schedule

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level																																															
1.1.6.3.1.2.5	Ready for stave installation	\$0	\$0	\$0	0	0	4																																															
	<u>Notes</u>																																																					
	WBS Definition -																																																					
	M&S BOE -																																																					
	Labor BOE -																																																					
1.1.6.3.1.3	Stave Installation	\$76,616	\$0	\$76,616	0	0	0																																															
	<u>Notes</u>																																																					
	WBS Definition -																																																					
	M&S BOE -																																																					
	Labor BOE -																																																					
1.1.6.3.1.3.1	Stave installation begins	\$0	\$0	\$0	0	0	3																																															
	<u>Notes</u>																																																					
	WBS Definition -																																																					
	M&S BOE -																																																					
	Labor BOE -																																																					
1.1.6.3.1.3.2	Contingency on Stave Installation begins	\$0	\$0	\$0	0	0	5																																															
	<u>Notes</u>																																																					
	WBS Definition -																																																					
	This is a floating contingency on starting the electrical stave assembly task.																																																					
	M&S BOE -																																																					
	Labor BOE -																																																					
1.1.6.3.1.3.3	L2MS Stave Installation Begins	\$0	\$0	\$0	0	0	2																																															
1.1.6.3.1.3.4	Installation of staves	\$31,536	\$0	\$31,536	0	0.4	0																																															
	<table border="1"> <thead> <tr> <th>ID</th> <th>Resource Name</th> <th>Units</th> <th>Work</th> <th>Delay</th> <th>Start</th> <th>Finish</th> <th>Cost</th> <th>Baseline Cost</th> <th>Act. Cost</th> <th>Rem. Cost</th> </tr> </thead> <tbody> <tr> <td>11</td> <td>Postdoc</td> <td>75%</td> <td>540 hrs</td> <td>0 days</td> <td>Jul 19 '05</td> <td>Nov 22 '05</td> <td>\$0</td> <td>\$0</td> <td>\$0</td> <td>\$0</td> </tr> <tr> <td>20</td> <td>MechEngSF</td> <td>10%</td> <td>72 hrs</td> <td>0 days</td> <td>Jul 19 '05</td> <td>Nov 22 '05</td> <td>\$3,672</td> <td>\$3,672</td> <td>\$0</td> <td>\$3,672</td> </tr> <tr> <td>22</td> <td>MechTechSF</td> <td>100%</td> <td>720 hrs</td> <td>0 days</td> <td>Jul 19 '05</td> <td>Nov 22 '05</td> <td>\$24,480</td> <td>\$24,480</td> <td>\$0</td> <td>\$24,480</td> </tr> </tbody> </table>	ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost	11	Postdoc	75%	540 hrs	0 days	Jul 19 '05	Nov 22 '05	\$0	\$0	\$0	\$0	20	MechEngSF	10%	72 hrs	0 days	Jul 19 '05	Nov 22 '05	\$3,672	\$3,672	\$0	\$3,672	22	MechTechSF	100%	720 hrs	0 days	Jul 19 '05	Nov 22 '05	\$24,480	\$24,480	\$0	\$24,480									
ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost																																												
11	Postdoc	75%	540 hrs	0 days	Jul 19 '05	Nov 22 '05	\$0	\$0	\$0	\$0																																												
20	MechEngSF	10%	72 hrs	0 days	Jul 19 '05	Nov 22 '05	\$3,672	\$3,672	\$0	\$3,672																																												
22	MechTechSF	100%	720 hrs	0 days	Jul 19 '05	Nov 22 '05	\$24,480	\$24,480	\$0	\$24,480																																												

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
-----	------	------	-----	-------	-----------	-------------	-------

"Installation of staves" continued

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
24	CMMProgrammerSF	10%	72 hrs	0 days	Jul 19 '05	Nov 22 '05	\$3,384	\$3,384	\$0	\$3,384

Notes

WBS Definition -

Installing and aligning/measuring staves should be a rather fast task. We foresee that it will be done in batches (i.e. wait for a certain number of staves to be ready for installation and the install them).

M&S BOE -

Labor BOE -

Schedule BOE -

This was estimated based on Run IIa experience. We estimate that we can install 2 staves/day (for Run IIA we installed as many as 6/day) for a total of 90 days. As in the Run IIa project, stave installation will gradually catch up with stave production so that stave installation finishes as the last stave is produced.

1.1.6.3.1.3.5	Installation of Stave: electrical testing	\$0	\$0	\$0	0	0.4	0
---------------	---	-----	-----	-----	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	25%	180 hrs	0 days	Jul 26 '05	Dec 1 '05	\$0	\$0	\$0	\$0
11	Postdoc	250%	1,800 hrs	0 days	Jul 26 '05	Dec 1 '05	\$0	\$0	\$0	\$0

Notes

WBS Definition -

M&S BOE -

This is the electrical testing of staves after installation into the barrels. The staves were extensively tested and burned in during the stave production testing task. The testing here is a quick test to prove that the staves were not damaged during the installation.

Labor BOE -

We estimate 1 hour per stave based on Run IIa experience. Labor is all postdoc and physicists. This is a task that spans the stave installation but is only done once a week, or after a significant number of staves have been installed.

1.1.6.3.1.3.6	Stave installation complete	\$0	\$0	\$0	0	0	3
---------------	-----------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.3.1.3.7	Contingency on Stave Installation	\$0	\$0	\$0	0	0	5

Notes

WBS Definition -
This is a floating contingency on starting the electrical stave assembly task.

M&S BOE -

Labor BOE -

1.1.6.3.1.3.8	L2MS Stave Installation Complete	\$0	\$0	\$0	0	0	2
1.1.6.3.1.3.9	Final system tests	\$20,920	\$0	\$20,920	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	100%	160 hrs	0 days	Dec 16 '05	Jan 19 '06	\$0	\$0	\$0	\$0
11	Postdoc	400%	640 hrs	0 days	Dec 16 '05	Jan 19 '06	\$0	\$0	\$0	\$0
17	ElecEngF	50%	80 hrs	0 days	Dec 16 '05	Jan 19 '06	\$4,400	\$4,400	\$0	\$4,400
18	ElecTechF	25%	40 hrs	0 days	Dec 16 '05	Jan 19 '06	\$1,560	\$1,560	\$0	\$1,560
20	MechEngSF	50%	80 hrs	0 days	Dec 16 '05	Jan 19 '06	\$4,080	\$4,080	\$0	\$4,080
22	MechTechSF	200%	320 hrs	0 days	Dec 16 '05	Jan 19 '06	\$10,880	\$10,880	\$0	\$10,880

Notes

WBS Definition -
This is the final system test. Goal should be to establish that all staves are working, cooling is working, and everything is aligned to specs.

M&S BOE -

Labor BOE -

The assumption is that it takes 10 days per barrel. The 1st barrel is fully tested while the second barrel is being finished. Thus, this task is 20 days and will be finished 10 days after stave installation is completed.

1.1.6.3.1.3.10	installation of outer screen	\$3,400	\$0	\$3,400	0	0.4	0
----------------	------------------------------	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
20	MechEngSF	50%	40 hrs	0 days	Jan 12 '06	Jan 26 '06	\$2,040	\$2,040	\$0	\$2,040
22	MechTechSF	50%	40 hrs	0 days	Jan 12 '06	Jan 26 '06	\$1,360	\$1,360	\$0	\$1,360

Notes

WBS Definition -

M&S BOE -

Material costs are covered by inner and outer screen installation fixtures in earlier item. We assume that we will be able to continue our final system tests even after the outer screen is installed.

Labor BOE -

Schedule BOE -

We estimate that it will take 5 days to glue the outer screen on to each barrel. The outer screen will be in 3 parts and we allow 2 days for setup and 1 day for gluing each part. We assume the 1st barrel is done in parallel with finishing the 2nd barrel, thus this task ends 5 days after testing is completed.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.3.1.3.11	remove axle	\$5,280	\$0	\$5,280	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
20	MechEngSF	50%	40 hrs	0 days	Jan 20 '06	Feb 2 '06	\$2,040	\$2,040	\$0	\$2,040
22	MechTechSF	50%	40 hrs	0 days	Jan 20 '06	Feb 2 '06	\$1,360	\$1,360	\$0	\$1,360
24	CMMProgrammerSF	50%	40 hrs	0 days	Jan 20 '06	Feb 2 '06	\$1,880	\$1,880	\$0	\$1,880

Notes

WBS Definition -

M&S BOE -

Labor BOE -

Schedule BOE -

We assume it takes 5 days per barrel to remove the axle extract the barrel from the stave installation fixturing. The 1st barrel is done while the stave installation is continuing on the 2nd barrel.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.3.1.3.12	Installation of barrel in spacetube	\$8,680	\$0	\$8,680	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	40 hrs	0 days	Jan 27 '06	Feb 9 '06	\$0	\$0	\$0	\$0
20	MechEngSF	100%	80 hrs	0 days	Jan 27 '06	Feb 9 '06	\$4,080	\$4,080	\$0	\$4,080
22	MechTechSF	100%	80 hrs	0 days	Jan 27 '06	Feb 9 '06	\$2,720	\$2,720	\$0	\$2,720
24	CMMProgrammerSF	50%	40 hrs	0 days	Jan 27 '06	Feb 9 '06	\$1,880	\$1,880	\$0	\$1,880

Notes

WBS Definition -

The barrels are placed in the space tube and then aligned.

M&S BOE -

Material Cost based on estimate from G. Derylo and Y. Orlov April 18, 2002

Transport to spacetube - \$5,000

Total = \$5,000

Labor BOE -

Schedule:

Based on the time required for the Ila silicon system. We assume it takes 5 days for each barrel and the 1st barrel is done in parallel with finishing the stave installation in the 2nd barrel.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.3.1.3.13	dressung of cables and cooling	\$6,800	\$0	\$6,800	0	0.4	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	200%	160 hrs	0 days	Feb 3 '06	Feb 16 '06	\$0	\$0	\$0	\$0
20	MechEngSF	100%	80 hrs	0 days	Feb 3 '06	Feb 16 '06	\$4,080	\$4,080	\$0	\$4,080
22	MechTechSF	100%	80 hrs	0 days	Feb 3 '06	Feb 16 '06	\$2,720	\$2,720	\$0	\$2,720

Notes

WBS Definition -

M&S BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
"dressing of cables and cooling" continued							
<u>Notes</u>							
Labor BOE -							
Schedule BOE -							
Based on the time required for the Ila silicon system. We estimate it will take 5 days per barrel and that the 1st barrel is finished before the 2nd one is installed.							
1.1.6.3.1.3.14	Outer Detector Complete	\$0	\$0	\$0	0	0	3
<u>Notes</u>							
WBS Definition -							
M&S BOE -							
Labor BOE -							
1.1.6.3.1.3.15	Contingency on Completion of outer detector	\$0	\$0	\$0	0	0	5
<u>Notes</u>							
WBS Definition -							
M&S BOE -							
Labor BOE -							
1.1.6.3.1.3.16	Outer detector complete	\$0	\$0	\$0	0	0	2
1.1.6.3.2	L0 Module Installation	\$202,953	\$77,100	\$125,853	0	0	0
<u>Notes</u>							
WBS Definition -							
These are the fixtures for installing the L0 modules onto the CF structure.							
M&S BOE -							
Labor BOE -							
1.1.6.3.2.1	L0 installation fixture preproduction	\$66,981	\$25,700	\$41,281	0	0	0
<u>Notes</u>							
WBS Definition -							
M&S BOE -							
Labor BOE -							

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.3.2.1.1	Explicit Slack: L0 Module installation fixture design	\$0	\$0	\$0	0	0	5
1.1.6.3.2.1.2	L0 module installation fixtures: design	\$14,721	\$0	\$14,721	0	0.5	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	20%	84.8 hrs	0 days	Nov 6 '03	Jan 28 '04	\$0	\$0	\$0	\$0
19	DesignerSF	46%	195.03 hrs	0 days	Nov 6 '03	Jan 28 '04	\$7,802	\$7,802	\$0	\$7,802
20	MechEngSF	32%	135.68 hrs	0 days	Nov 6 '03	Jan 28 '04	\$6,920	\$6,920	\$0	\$6,920

Notes

WBS Definition -

M&S BOE -

Labor BOE -

Run Ila experience with L00.

Main assembly Fixture: eng. 12 days des. 17days

Vac. pickup : eng. 4 days, des. 6 days

Total eng. = 16 days, des= 23 days.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.3.2.1.3	L0 module installation fixtures: fabrication	\$25,700	\$25,700	\$0	0.5	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	25,700	25,700	0 days	Jan 29 '04	Mar 24 '04	\$25,700	\$25,700	\$0	\$25,700

Notes

WBS Definition -

M&S BOE -

Experience with Run Ila L00

Main assembly Fixture: \$22,800

Vac. pickup : \$2,900

Total: \$25,700.

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.3.2.1.4	L0 module installation fixtures: assembly and test	\$26,560	\$0	\$26,560	0	0.5	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	20%	64 hrs	0 days	Mar 25 '04	May 19 '04	\$0	\$0	\$0	\$0
20	MechEngSF	50%	160 hrs	0 days	Mar 25 '04	May 19 '04	\$8,160	\$8,160	\$0	\$8,160
22	MechTechSF	100%	320 hrs	0 days	Mar 25 '04	May 19 '04	\$10,880	\$10,880	\$0	\$10,880
24	CMMPProgrammerSF	50%	160 hrs	0 days	Mar 25 '04	May 19 '04	\$7,520	\$7,520	\$0	\$7,520

Notes

WBS Definition -

This task involves testing installation and alignment procedures.

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"L0 module installation fixtures: assembly and test" continued

Notes

M&S BOE -

Labor BOE -
Run Ila experience.

1.1.6.3.2.2	L0 installation fixture Production	\$80,664	\$51,400	\$29,264	0	0	0
-------------	------------------------------------	----------	----------	----------	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.3.2.2.1	L0 module installation fixtures: design	\$6,784	\$0	\$6,784	0	0.5	0
---------------	---	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	20%	40 hrs	0 days	Aug 31 '04	Oct 5 '04	\$0	\$0	\$0	\$0
19	DesignerSF	44%	88 hrs	0 days	Aug 31 '04	Oct 5 '04	\$3,520	\$3,520	\$0	\$3,520
20	MechEngSF	32%	64 hrs	0 days	Aug 31 '04	Oct 5 '04	\$3,264	\$3,264	\$0	\$3,264

Notes

WBS Definition -

M&S BOE -

Labor BOE -
Run Ila experience with L00.

Assume these fixtures need a redesign, but the changes only require half the original time.

Main assembly Fixture: eng. 6 days des. 8 days
Vac. pickup : eng. 2 days, des. 3 days

Total eng. = 8 days, des= 11 days.

1.1.6.3.2.2.2	L0 module installation fixtures: fabrication	\$51,400	\$51,400	\$0	0.5	0	0
---------------	--	----------	----------	-----	-----	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
7	MANDS	51,400	51,400	0 days	Oct 6 '04	Dec 2 '04	\$51,400	\$51,400	\$0	\$51,400

Notes

WBS Definition -

M&S BOE -
Experience with Run Ila L00

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"L0 module installation fixtures: fabrication" continued

Notes

Same costs at prototype, but now we need two sets

Main assembly Fixture: \$22,800 * 2

Vac. pickup : \$2,900 * 2

Total: \$25,700 * 2 = \$51,400.

Labor BOE -

1.1.6.3.2.2.3	L0 module installation fixtures: assembly and setup	\$22,480	\$0	\$22,480	0	0.5	0
---------------	---	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	20%	64 hrs	0 days	Dec 3 '04	Feb 3 '05	\$0	\$0	\$0	\$0
20	MechEngSF	25%	80 hrs	0 days	Dec 3 '04	Feb 3 '05	\$4,080	\$4,080	\$0	\$4,080
22	MechTechSF	100%	320 hrs	0 days	Dec 3 '04	Feb 3 '05	\$10,880	\$10,880	\$0	\$10,880
24	CMMProgrammerSF	50%	160 hrs	0 days	Dec 3 '04	Feb 3 '05	\$7,520	\$7,520	\$0	\$7,520

Notes

WBS Definition -

This task involves testing installation and alignment procedures.

M&S BOE -

Labor BOE -

Based on Run Ila experience.

1.1.6.3.2.3	L0 installation	\$55,308	\$0	\$55,308	0	0	0
-------------	-----------------	----------	-----	----------	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.3.2.3.1	Explicit slack: inner detector complete	\$0	\$0	\$0	0	0	5
---------------	---	-----	-----	-----	---	---	---

1.1.6.3.2.3.2	Installation of L0 Modules	\$45,600	\$0	\$45,600	0	0.5	0
---------------	----------------------------	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	50%	320 hrs	0 days	Jul 5 '05	Oct 25 '05	\$0	\$0	\$0	\$0
20	MechEngSF	50%	320 hrs	0 days	Jul 5 '05	Oct 25 '05	\$16,320	\$16,320	\$0	\$16,320
22	MechTechSF	100%	640 hrs	0 days	Jul 5 '05	Oct 25 '05	\$21,760	\$21,760	\$0	\$21,760
24	CMMProgrammerSF	25%	160 hrs	0 days	Jul 5 '05	Oct 25 '05	\$7,520	\$7,520	\$0	\$7,520

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Installation of L0 Modules" continued

Notes

WBS Definition -

M&S BOE -

Labor BOE -

Schedule BOE -

Run IIa experience.

We expect to install 2 modules/day: 144 modules = 72 days

Dressing the HDIs to the HDI support structure ~8 days based on Run IIa experience

1.1.6.3.2.3.3	L0 System Tests	\$7,328	\$0	\$7,328	0	0.5	0
---------------	-----------------	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	100%	320 hrs	0 days	Oct 26 '05	Dec 22 '05	\$0	\$0	\$0	\$0
11	Postdoc	200%	640 hrs	0 days	Oct 26 '05	Dec 22 '05	\$0	\$0	\$0	\$0
17	ElecEngF	20%	64 hrs	0 days	Oct 26 '05	Dec 22 '05	\$3,520	\$3,520	\$0	\$3,520
20	MechEngSF	10%	32 hrs	0 days	Oct 26 '05	Dec 22 '05	\$1,632	\$1,632	\$0	\$1,632
22	MechTechSF	20%	64 hrs	0 days	Oct 26 '05	Dec 22 '05	\$2,176	\$2,176	\$0	\$2,176

Notes

WBS Definition -

These tests will determine final grounding and shielding.

M&S BOE -

Labor BOE -

Schedule BOE -

Run IIa experience

We assume one month of testing for each half of L0.

1.1.6.3.2.3.4	Installation of Screens	\$2,380	\$0	\$2,380	0	0.5	0
---------------	-------------------------	---------	-----	---------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	100%	40 hrs	0 days	Dec 27 '05	Jan 4 '06	\$0	\$0	\$0	\$0
20	MechEngSF	50%	20 hrs	0 days	Dec 27 '05	Jan 4 '06	\$1,020	\$1,020	\$0	\$1,020
22	MechTechSF	100%	40 hrs	0 days	Dec 27 '05	Jan 4 '06	\$1,360	\$1,360	\$0	\$1,360

Notes

WBS Definition -

This represents an additional electrical shield around L0.

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.6.3.2.3.5	Inner Detector Complete	\$0	\$0	\$0	0	0	3

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.3.2.3.6	L2MS Inner detector complete	\$0	\$0	\$0	0	0	2
1.1.6.4	Detector Integration	\$97,680	\$0	\$97,680	0	0	0

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.4.1	Combine Inner and Outer Detectors	\$24,160	\$0	\$24,160	0	0.5	0
-----------	-----------------------------------	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	200%	160 hrs	0 days	Mar 17 '06	Mar 30 '06	\$0	\$0	\$0	\$0
11	Postdoc	200%	160 hrs	0 days	Mar 17 '06	Mar 30 '06	\$0	\$0	\$0	\$0
20	MechEngSF	300%	240 hrs	0 days	Mar 17 '06	Mar 30 '06	\$12,240	\$12,240	\$0	\$12,240
22	MechTechSF	300%	240 hrs	0 days	Mar 17 '06	Mar 30 '06	\$8,160	\$8,160	\$0	\$8,160
24	CMMProgrammerSF	100%	80 hrs	0 days	Mar 17 '06	Mar 30 '06	\$3,760	\$3,760	\$0	\$3,760

Notes

WBS Definition -

This assumes the fixtures were already setup and aligned. This includes the connections for L0 cooling and dressing.

M&S BOE -

Labor BOE -

1.1.6.4.2	Install Beampipe and supports	\$21,120	\$0	\$21,120	0	0.5	0
-----------	-------------------------------	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	200%	160 hrs	0 days	Mar 31 '06	Apr 13 '06	\$0	\$0	\$0	\$0
11	Postdoc	200%	160 hrs	0 days	Mar 31 '06	Apr 13 '06	\$0	\$0	\$0	\$0
20	MechEngSF	200%	160 hrs	0 days	Mar 31 '06	Apr 13 '06	\$8,160	\$8,160	\$0	\$8,160
22	MechTechSF	200%	160 hrs	0 days	Mar 31 '06	Apr 13 '06	\$5,440	\$5,440	\$0	\$5,440
24	CMMProgrammerSF	200%	160 hrs	0 days	Mar 31 '06	Apr 13 '06	\$7,520	\$7,520	\$0	\$7,520

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Install Beampipe and supports" continued

Notes

WBS Definition -
This assumes the fixtures were already setup and aligned.

M&S BOE -

Labor BOE -

1.1.6.4.3	Final survey	\$21,120	\$0	\$21,120	0	0.5	0
-----------	--------------	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	200%	160 hrs	0 days	Apr 14 '06	Apr 27 '06	\$0	\$0	\$0	\$0
20	MechEngSF	200%	160 hrs	0 days	Apr 14 '06	Apr 27 '06	\$8,160	\$8,160	\$0	\$8,160
22	MechTechSF	200%	160 hrs	0 days	Apr 14 '06	Apr 27 '06	\$5,440	\$5,440	\$0	\$5,440
24	CMMProgrammerSF	200%	160 hrs	0 days	Apr 14 '06	Apr 27 '06	\$7,520	\$7,520	\$0	\$7,520

Notes

WBS Definition -
Relative alignment of the barrels is determined along with alignment to external reference system.

M&S BOE -

Labor BOE -

1.1.6.4.4	Final Cooling and electrical Tests	\$13,920	\$0	\$13,920	0	0.5	0
-----------	------------------------------------	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
10	Physicist	200%	160 hrs	0 days	Apr 28 '06	May 11 '06	\$0	\$0	\$0	\$0
11	Postdoc	400%	320 hrs	0 days	Apr 28 '06	May 11 '06	\$0	\$0	\$0	\$0
17	ElecEngF	100%	80 hrs	0 days	Apr 28 '06	May 11 '06	\$4,400	\$4,400	\$0	\$4,400
20	MechEngSF	100%	80 hrs	0 days	Apr 28 '06	May 11 '06	\$4,080	\$4,080	\$0	\$4,080
22	MechTechSF	200%	160 hrs	0 days	Apr 28 '06	May 11 '06	\$5,440	\$5,440	\$0	\$5,440

Notes

WBS Definition -
Large fraction of system will be run.

M&S BOE -

Labor BOE -

1.1.6.4.5	Close top of spacetube (final dressing, position monitors)	\$17,360	\$0	\$17,360	0	0.5	0
-----------	--	----------	-----	----------	---	-----	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
11	Postdoc	200%	160 hrs	0 days	May 12 '06	May 25 '06	\$0	\$0	\$0	\$0
20	MechEngSF	200%	160 hrs	0 days	May 12 '06	May 25 '06	\$8,160	\$8,160	\$0	\$8,160

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
-----	------	------	-----	-------	-----------	------------	-------

"Close top of spacetube (final dressing, position monitors)" continued

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
22	MechTechSF	200%	160 hrs	0 days	May 12 '06	May 25 '06	\$5,440	\$5,440	\$0	\$5,440
24	CMMPprogrammerSF	100%	80 hrs	0 days	May 12 '06	May 25 '06	\$3,760	\$3,760	\$0	\$3,760

Notes

WBS Definition -
This includes the final dressing of everything, installation of position monitors, radiation monitors, etc.

M&S BOE -

Labor BOE -

1.1.6.4.6	SVX2b Ready for Installation into ISL	\$0	\$0	\$0	0	0	3
-----------	---------------------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.4.7	Contingency on closing spacetube	\$0	\$0	\$0	0	0	5
-----------	----------------------------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.6.4.8	L2MS SVX2b Ready for Installation into ISL	\$0	\$0	\$0	0	0	2
-----------	--	-----	-----	-----	---	---	---

1.1.7	Italy Buy Backs	\$3	\$3	\$0	0	0	0
-------	-----------------	-----	-----	-----	---	---	---

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont	Level
1.1.7.1	I-BB- on 1st chip layout	\$1	\$1	\$0	0	0	0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
2	FNALR&D	0%	0 hrs	0 days	Feb 8 '02	Feb 8 '02	(\$24,999)	(\$24,999)	(\$24,999)	\$0
3	Italy EQ	0%	0 hrs	0 days	Feb 8 '02	Feb 8 '02	\$25,000	\$25,000	\$25,000	\$0

Notes
WBS Definition -
M&S BOE -
Labor BOE -

1.1.7.2	I-BB on Production SVX4 chip manufacturing	\$1	\$1	\$0	0	0	0
---------	--	-----	-----	-----	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
1	FNALR&D	0%	0 hrs	0 days	Oct 8 '03	Oct 8 '03	(\$99,999)	(\$99,999)	\$0	(\$99,999)
3	Italy EQ	0%	0 hrs	0 days	Oct 8 '03	Oct 8 '03	\$100,000	\$100,000	\$0	\$100,000

Notes
WBS Definition -
M&S BOE -
Labor BOE -

1.1.7.3	I-BB on Power Supplies Procurement	\$1	\$1	\$0	0	0	0
---------	------------------------------------	-----	-----	-----	---	---	---

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
1	FNALR&D	0%	0 hrs	0 days	Sep 22 '04	Sep 22 '04	(\$131,999)	(\$131,999)	\$0	(\$131,999)
3	Italy EQ	0%	0 hrs	0 days	Sep 22 '04	Sep 22 '04	\$132,000	\$132,000	\$0	\$132,000

Notes
WBS Definition -
M&S BOE -
Labor BOE -

1.1.8	Japan Buy Backs	\$4	\$4	\$0	0	0	0
-------	-----------------	-----	-----	-----	---	---	---

Notes
WBS Definition -
M&S BOE -

WBS	Name	Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
-----	------	------	-----	-------	-----------	-------------	-------

"Japan Buy Backs" continued

Notes

Labor BOE -

1.1.8.1 J-BB on prototype sensors manufacturing \$1 \$1 \$0 0 0 0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
2	FNALR&D	0%	0 hrs	0 days	Mar 1 '02	Mar 1 '02	(\$96,672)	(\$96,672)	(\$96,672)	\$0
9	INKIND	96,673	96,673	0 days	Mar 1 '02	Mar 7 '02	\$96,673	\$96,673	\$96,673	\$0

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.8.2 J-BB on production sensors manufacturing I \$1 \$1 \$0 0 0 0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
1	FNALR&D	0%	0 hrs	0 days	Mar 3 '03	Mar 3 '03	(\$378,326)	(\$378,326)	\$0	(\$378,326)
9	INKIND	378,327	378,327	0 days	Mar 3 '03	Mar 7 '03	\$378,327	\$378,327	\$0	\$378,327

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.8.3 J-BB on production sensors manufacturing II \$1 \$1 \$0 0 0 0

ID	Resource Name	Units	Work	Delay	Start	Finish	Cost	Baseline Cost	Act. Cost	Rem. Cost
1	FNALR&D	0%	0 hrs	0 days	Mar 1 '04	Mar 1 '04	(\$221,865)	(\$221,865)	\$0	(\$221,865)
9	INKIND	221,866	221,866	0 days	Mar 1 '04	Mar 5 '04	\$221,866	\$221,866	\$0	\$221,866

Notes

WBS Definition -

M&S BOE -

Labor BOE -

WBS	Name					Cost	M&S	Labor	M&S Cont.	Labor Cont.	Level
1.1.8.4	J-BB on L0 production sensors manufacturing					\$1	\$1	\$0	0	0	0
<i>ID</i>	<i>Resource Name</i>	<i>Units</i>	<i>Work</i>	<i>Delay</i>	<i>Start</i>	<i>Finish</i>	<i>Cost</i>	<i>Baseline Cost</i>	<i>Act. Cost</i>	<i>Rem. Cost</i>	
1	FNALEQ	0%	0 hrs	0 days	Mar 1 '04	Mar 1 '04	(\$85,058)	(\$85,058)	\$0	(\$85,058)	
9	INKIND	85,059	85,059	0 days	Mar 1 '04	Mar 5 '04	\$85,059	\$85,059	\$0	\$85,059	

Notes

WBS Definition -

M&S BOE -

Labor BOE -

1.1.9	Level 1 Milestones	\$0	\$0	\$0	0	0	0
1.1.9.17	Production Modules Available	\$0	\$0	\$0	0	0	1
1.1.9.18	Outer detector Complete	\$0	\$0	\$0	0	0	1