U.S. ATLAS Upgrade Estimate
Cost Book AY$

Funding All **Funding Type:** Research Program

Institutions: All

U.S. ATLAS Upgrade Estimate Cost 12/30/2008 10:39:52 AM

WBS Number: 4 **Description:** U.S. ATLAS Upgrade Estimate

Institution : **Contact**

U.S. ATLAS Upgrade Estimate includes the costs in the US ATLAS Upgrade proposal for upgrading the ATLAS detector for improved detection capabilities and replace detector elements deteriorated by radiation.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	16982	0	0	16982	9976	0	7006	0	5667.9	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Designer R	0	0	1130	880	900	730	730
	0	0	66.605	63.157	85.17	69.328	71.132
Electrical Engineer R	0	0	18336	14007	10787	6118	5798
	0	0	1493.898	1186.333	1026.415	639.911	621.199
Gen Lab R	0	0	1770	1186	640	1186	1186
	0	0	26.763	18.398	10.187	19.367	19.871
Grad Student R	0	0	5420	4244	3644	3044	3044
	0	0	115.598	91.781	77.874	57.431	58.925
Mechanical Engineer R	0	0	1270	1797	1500	1000	1000
	0	0	150.346	168.725	156.082	93.39	95.82
Technician R	0	0	12048	11931	11400	11468	11488
	0	0	630.048	699.104	716.071	713.495	733.142

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	1160.8	1216.9	1019.6	1416.0	1405.7
Travel R	0.0	0.0	49.8	27.9	18.1	12.1	12.4

WBS Number: 4.1 **Description:** Inner Detector Upgrade R&D

Institution : **Contact**

This is an R&D program to develop several of the key technologies, integrated into detector structures, to be used in the Upgrade of the ATLAS inner detector. Items include novel detector configurations, new electronics, optical readout and stave integrated structures. The upgarded inner detector will be composed entirely of silicon detector

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	10696	0	0	10696	6230	0	4465	0	3539.9	0.0

MANPOWER SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Designer R	0	0	1130	880	750	520	520
	0	0	66.605	63.157	70.387	48.094	49.346
Electrical Engineer R	0	0	13060	9365	7100	2780	2780
	0	0	985.456	735.913	607.334	242.914	249.236
Gen Lab R	0	0	1770	1186	640	1186	1186
	0	0	26.763	18.398	10.187	19.367	19.871
Grad Student R	0	0	3676	2500	1900	1300	1300
	0	0	82.307	57.624	42.828	21.477	22.036
Mechanical Engineer R	0	0	1270	737	1500	1000	1000
	0	0	150.346	90.038	156.082	93.39	95.82
Technician R	0	0	7212	6745	8190	7900	7900
	0	0	374.098	396.945	485.406	468.282	480.465

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	852.2	834.7	592.3	869.0	839.5
Travel R	0.0	0.0	29.8	22.8	18.1	12.1	12.4

WBS Number: 4.1.1 **Description:** Detectors

Institution : **Contact**

This WBS element provides for the R&D required for the novel detectors required by an Upgrades ATLAS. Key constraints on a design are the large depletion voltages and charge trapping in heavily irradiated silicon detectors. The novel detector configurations attempt to work around these problems.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	1847	0	0	1847	819	0	1028	0	465.2	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Designer R	0	0	440	220	0	0	0
	0	0	4.8	2.463	0	0	0
Electrical Engineer R	0	0	2770	1820	0	0	0
	0	0	213.2	119.094	0	0	0
Gen Lab R	0	0	990	0	0	0	0
	0	0	14.969	0	0	0	0
Mechanical Engineer R	0	0	0	37	0	0	0
	0	0	0	3.037	0	0	0
Technician R	0	0	1650	1320	1460	1320	1320
	0	0	76.923	90.741	99.973	95.517	98.002

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	252.5	195.7	157.9	150.1	149.6
Travel R	0.0	0.0	12.0	7.8	4.6	4.8	4.9

WBS Number: 4.1.1.1 **Description:** Innermost Pixel Layer

Institution : **Contact**

Work on 3-D pixel detectors. These detectors provide one of a very small number of alternatives for detectors inside of a radius of about 10 cm. In fact, the only other choice on the time scale required seems to be a more conventional inner pixel layer which is replaced every year. This is a collaboration of the Univ. of Hawaii and the Univ. of New Mexico. They will provide detectors and evaluate their properties after irradiation. The LBNL pixel group collaborates regarding bump bonding and readout issues.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	370	0	0	370	266	0	104	0	151.1	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Designer R	0	0	440	220	0	0	0
	0	0	4.8	2.463	0	0	0
Electrical Engineer R	0	0	2150	1820	0	0	0
	0	0	136.573	119.094	0	0	0
Mechanical Engineer R	0	0	0	37	0	0	0
	0	0	0	3.037	0	0	0

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	44.2	49.4	0.0	0.0	0.0
Travel R	0.0	0.0	3.2	3.3	0.0	0.0	0.0

WBS Number: 4.1.1.1.1 **Description:** Innermost Pixel Layer - U. Hawaii

Institution : U. Hawaii **Contact** Not available

Hawaii is responsible for fabrication of the novel 3-D detectors. These have columns of p and n material embedded in the silicon to allow a minimal drift distance, to mitigate the effects of charge trapping. Fabrication of a set of full – 3D wafers takes about 4 months if new masks need to be designed and fabricated, and about 3 months if not (one month for implants, field oxide, and bonding, one month for patterning, etching, doping, and filling the electrode holes, and one month for metal, low-temperature-oxide deposition, dicing, support wafer removal, and cleaning.)

Costs per Run **Details of Estimate:**

			Totals				
Fab Time1	$2,500.00	per person month	7	months		Total Fab =	$17,500.00
Masks $500.00	per mask	8	masks		Masks =	$4,000.00	
FZ Wafers	$80.00	per wafer	12	wafers		FZ Wafers =	$960.00
CZ Wafers	$25.00	per wafer	20	CZ wafers		CZ Wafers =	$500.00
Implants	$550.00	per batch	2	per batch		Implants =	$1,100.00
Polishing	$40.00	per wafer	12	per batch		Polishing =	$480.00
Misc. Supplies	$1,000.00	per batch				Supplies =	$1,000.00
Senior Eng.2	$10,000.00	per month	3	months		Senior Eng =	$30,000.00
Associate Eng.3	$1,600.00	per month	3	months		Ass. Eng. =	$4,800.00
Consulting Eng.4	$80.00	per hour	75	hours		Consulting Eng. =	$6,000.00

Cost per Run = $66,340.00

Sputter (Au, In, Ti)	$2,500.00				Sputter Sources =	$2,500.00
		Total =	$2,500.00			
GPIB Board	$600.00					
DAQ Software	$1,600.00					
DAQ Computer	$3,000.00					
Analysis Software	$2,000.00					
Micro Probe Tips	$500.00				Total Equipment =	$7,700.00

Stanford to LBL + return	$43.00	per day trip	5	trips	$215.00	
$200.00	overnight for 2	5	trips	$1,000.00		
CERN, beam test, conf.	$2000.00	per trip per person	4			$8,000.00
		Travel =	$9,215.00			

Total Funds Needed:

Equipment + 2 runs $149,515.00

Notes:
1. Charges are per machine-hour, but are limited to $2,500 / person / month.
2. C. Kenney
3. J. Hasi or Stanford Nanofabrication Facility employee
4. E. Perozziello (Electrical Engineering Ph. D., Stanford University)

Base Cost Summary: (R)	Cont	Total	EDIA Cost (k$)	Mfg Cost (k$)	EDIA Cont %	Mfg Cost (k$)	FTEs Labor (k$)	FTEs Labor (k$)	Matls (k$)	Matls (k$)	R	Other
			258	0	0	258	172	0	85	0	98.0	0.0

FY 06 **MANPOWER** (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs) (k$)	(hrs)
SUMMARY:							
U.S. ATLAS Upgrade Estimate Cost	12/30/2008 10:39:53 AM						
Designer R	0	0	440	220	0	0	0
	0	0	4.8	2.463	0	0	0
Electrical Engineer R	0	0	1250	1100	0	0	0
	0	0	85.225	76.948	0	0	0
Mechanical Engineer R	0	0	0	37	0	0	0
	0	0	0	3.037	0	0	0

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	40.2	45.2	0.0	0.0	0.0

CONTINGENCY FACTORS:	*Risk*				*Weight*			Cont %
	Technical	C o s t	Schedule	Des i gn	Technical	C o s t	Schedule	
	0	0	0	0	0	0	0	0

WBS Number: 4.1.1.1.2 **Description:** Innermost Pixel Layer - U. New Mexico

Institution : U of New Mexico **Contact** Not available

New Mexico is responsible for bench testing the 3-D detectors to verify perofmance, particularly after heavy

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	112	0	0	112	93	0	18	0	53.1	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Electrical Engineer R	0	0	900	720	0	0	0
	0	0	51.348	42.146	0	0	0

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	4.0	4.1	0.0	0.0	0.0
Travel R	0.0	0.0	3.2	3.3	0.0	0.0	0.0

CONTINGENCY FACTORS:	*Risk* Technical	*Risk* C o s t	*Risk* Schedule	*Risk* Des i gn	*Weight* Technical	*Weight* C o s t	*Weight* Schedule	Cont %
	0	0	0	0	0	0	0	0

WBS Number: 4.1.1.1.3 **Description:** Innermost Pixel Layer - LBNL

Institution : LBNL **Contact** Not available

LBNL is responsible for bump bonding the 3-D detctors to pixel readout chips and checking that the detector-chip module works and has reasonable signal-to-noise.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	0	0	0	0	0	0	0	0	0.0	0.0

CONTINGENCY FACTORS:	*Risk*				*Weight*			Cont %
	Technical	C o s t	Schedule	Des i gn	Technical	C o s t	Schedule	
	0	0	0	0	0	0	0	0

WBS Number: 4.1.1.2 **Description:** Investigation of Strip Technology

Institution : **Contact**

Evaluation of detector materials, and development of a short strip detector. This work, which will be done at UCSC and BNL leverages the effort within the RD50 collaboration on materials based on collaborative work that has been established. A goal is to eventually integrate a radiation hard detector into the stave structure in WBS4.1.4.1. The use of n-on-p strip detectors at intermediate radii isviewed as essential and they may provide a good solution at all

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	108	0	0	108	61	0	47	0	34.7	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Gen Lab R	0	0	990	0	0	0	0
	0	0	14.969	0	0	0	0
Technician R	0	0	990	0	0	0	0
	0	0	46.154	0	0	0	0

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	36.0	0.0	0.0	0.0	0.0
Travel R	0.0	0.0	4.4	0.0	0.0	0.0	0.0

WBS Number: 4.1.1.2.1 **Description:** Invest. of Strip Technology - UCSC

Institution : U. of California, Santa Cruz **Contact** Not available

UCSC has taken the lead in working with our foreign collaborators to develop the optimum n-on-p detector for the short strip region of the upgraded detector. This involves fabrication of test detectors, irradiating these and measuring performance. The use of n-on-p detectors allows the detector to be run below full depletion and the collection of electrons instead of holes should reduce the effect of charge trapping.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	108	0	0	108	61	0	47	0	34.7	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Gen Lab R	0	0	990	0	0	0	0
	0	0	14.969	0	0	0	0
Technician R	0	0	990	0	0	0	0
	0	0	46.154	0	0	0	0

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	36.0	0.0	0.0	0.0	0.0
Travel R	0.0	0.0	4.4	0.0	0.0	0.0	0.0

CONTINGENCY FACTORS:	*Risk* Technical	*Risk* C o s t	*Risk* Schedule	*Risk* Des i gn	*Weight* Technical	*Weight* C o s t	*Weight* Schedule	Cont %
	0	0	0	0	0	0	0	0

WBS Number: 4.1.1.2.2 **Description:** Invest. of Strip Technology - BNL

Institution : BNL-M&O **Contact** Not available

BNL collaborates with UCSC in the generic investigations of detector materials. For FY06 they will concentrate on specific detectors fabricated at BNL, which is part of WBS element 4.1.1.3.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	0	0	0	0	0	0	0	0	0.0	0.0

CONTINGENCY FACTORS:	*Risk*				*Weight*			Cont %
	Technical	C o s t	Schedule	Des i gn	Technical	C o s t	Schedule	
	0	0	0	0	0	0	0	0

WBS Number: 4.1.1.3 **Description:** Short Strips

Institution : **Contact**

The goal in this WBS is to produce a short strip detector that can be used in the upgrade. This will eventually be on an approriate n-on-p substrate. One option for the detector patterning is the convential strip detector configuration. The second is the stripixel configuration. BNL aims at the development of a stripixel detector with small angle stereo readout and other features required to survive high integrated luminosity. These detectors look like a promising choice for radii between about 25 and 65 cm. This effort leverages past work on these detectors at BNL for application at RHIC. This work will be done at BNL, but the detectors developed will be integrated into the stave structure in WBS4.1.4.1 and will fit together with the work on detector materials in WBS4.1.1.2. A determination of

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	1369	0	0	1369	492	0	877	0	279.3	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Electrical Engineer R	0	0	620	0	0	0	0
	0	0	76.627	0	0	0	0
Technician R	0	0	660	1320	1460	1320	1320
	0	0	30.769	90.741	99.973	95.517	98.002

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	172.3	146.3	157.9	150.1	149.6
Travel R	0.0	0.0	4.4	4.5	4.6	4.8	4.9

WBS Number: 4.1.1.3.1 **Description:** Short Strips - UCSC

Institution : U. of California, Santa Cruz **Contact** Not available

UCSC will participate in validating the design of short strip detectors. This includes measurement of capacitance and sign-to-noise.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	493	0	0	493	169	0	324	0	96.0	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Technician R	0	0	660	660	800	660	660
	0	0	30.769	31.569	39.261	33.231	34.095

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	28.3	59.1	68.4	58.3	55.4
Travel R	0.0	0.0	4.4	4.5	4.6	4.8	4.9

CONTINGENCY FACTORS:	*Risk* Technical	*Risk* C o s t	*Risk* Schedule	*Risk* Des i gn	*Weight* Technical	*Weight* C o s t	*Weight* Schedule	Cont %
	0	0	0	0	0	0	0	0

WBS Number: 4.1.1.3.2 **Description:** Short Strips - BNL

Institution : BNL-M&O **Contact** Not available

BNL is presently working on the stripixel option for the short strip region. As our understanding matures, they will work on fabrication of key options for short strip detectors.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	770	0	0	770	323	0	447	0	183.4	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Electrical Engineer R	0	0	620	0	0	0	0
	0	0	76.627	0	0	0	0
Technician R	0	0	0	660	660	660	660
	0	0	0	59.172	60.712	62.286	63.907

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	124.0	66.7	68.4	70.2	72.0

CONTINGENCY FACTORS:	*Risk* Technical	*Risk* C o s t	*Risk* Schedule	*Risk* Des i gn	*Weight* Technical	*Weight* C o s t	*Weight* Schedule	Cont %
	0	0	0	0	0	0	0	0

WBS Number: 4.1.1.3.3 **Description:** Short Strip Technology-NYU

Institution : New York University **Contact** Not available

Goal is to develop Short Strips for the inner Strip layers of an Upgraded ATLAS detector.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	105	0	0	105	0	0	105	0	0.0	0.0

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	20.0	20.5	21.1	21.6	22.2

CONTINGENCY FACTORS:	*Risk* Technical	*Risk* C o s t	*Risk* Schedule	*Risk* Des i gn	*Weight* Technical	*Weight* C o s t	*Weight* Schedule	Cont %
	0	0	0	0	0	0	0	0

WBS Number: 4.1.2 **Description:** Front-End Electronics

Institution : **Contact**

This WBS element concerns the R&D to develop new frontend electronics. In the case of pixel detectors it requires migration of the existing chip to the next Deep Sub-Micron technology that is expected to be the one commercially available when we start construction activities. This is expected to be a 0.13 micronprocess. For the strips a new opportunity is provided by the SiGe bicmos process. This process should allow significant power reductions compared to all other options under consideration and much more radiation resistance than the now defunct DMILL

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	3075	0	0	3075	1712	0	1363	0	972.6	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Electrical Engineer R	0	0	3600	2860	2860	1100	1100
	0	0	437.981	351.839	360.995	126.185	129.469
Gen Lab R	0	0	640	640	640	640	640
	0	0	9.677	9.928	10.187	10.451	10.723
Grad Student R	0	0	1476	1460	1460	860	860
	0	0	35.439	35.792	36.723	15.214	15.61
Technician R	0	0	482	440	530	440	440
	0	0	22.823	21.046	26.804	22.154	22.73

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	320.5	327.8	115.3	237.1	243.2
Travel R	0.0	0.0	3.0	3.1	3.2	3.2	3.3

WBS Number: 4.1.2.1 **Description:** Deep Sub Micron for Pixels

Institution : LBNL **Contact**

The LBNL activity will involve the characterization and development of a pixel readout chips using 0.13 micron CMOS. For FY06 the main activity will involve characterization of a test chip fabricated earlier. In subsequent years LBNL will continue the development of this chip.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	1129	0	0	1129	863	0	266	0	490.5	0.0

MANPOWER SUMMARY: (k$)	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Electrical Engineer R	0	0	2500	1760	1760	0	0
	0	0	321.142	231.963	237.999	0	0
Grad Student R	0	0	616	600	600	0	0
	0	0	21.352	21.339	21.894	0	0
Technician R	0	0	42	0	90	0	0
	0	0	2.31	0	5.21	0	0

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	121.0	123.1	0.0	0.0	0.0

CONTINGENCY FACTORS:	*Risk* Technical	*Risk* C o s t	*Risk* Schedule	*Risk* Des i gn	*Weight* Technical	*Weight* C o s t	*Weight* Schedule	Cont %
	0	0	0	0	0	0	0	0

WBS Number: 4.1.2.2 **Description:** SiGe for Strips

Institution : U. of California, Santa Cruz **Contact**

UCSC will be developing a strip detector frontend in SiGe tehcnology. This includes irradiation and test of test structures and design, layout, and fabrication of circuit blocks to characterize the performance of SiGe circuits and choose between several potential vendors.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	1367	0	0	1367	331	0	1035	0	188.2	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Electrical Engineer R	0	0	440	440	440	440	440
	0	0	32.71	33.56	34.433	35.326	36.246
Gen Lab R	0	0	640	640	640	640	640
	0	0	9.677	9.928	10.187	10.451	10.723
Technician R	0	0	440	440	440	440	440
	0	0	20.513	21.046	21.594	22.154	22.73

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	192.0	197.0	107.4	229.0	234.9
Travel R	0.0	0.0	3.0	3.1	3.2	3.2	3.3

CONTINGENCY FACTORS:	*Risk* Technical	*Risk* C o s t	*Risk* Schedule	*Risk* Des i gn	*Weight* Technical	*Weight* C o s t	*Weight* Schedule	Cont %
	0	0	0	0	0	0	0	0

WBS Number: 4.1.2.3 **Description:** Controller Chip Development.

Institution : U of Pennsylvania **Contact** Not available

Development of controller chip for strip readout.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	579	0	0	579	517	0	62	0	293.9	0.0

MANPOWER SUMMARY: (k$)	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Electrical Engineer R	0	0	660	660	660	660	660
	0	0	84.129	86.316	88.563	90.859	93.223
Grad Student R	0	0	860	860	860	860	860
	0	0	14.087	14.453	14.829	15.214	15.61

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	7.5	7.7	7.9	8.1	8.3

CONTINGENCY FACTORS:	*Risk* Technical	*Risk* C o s t	*Risk* Schedule	*Risk* Des i gn	*Weight* Technical	*Weight* C o s t	*Weight* Schedule	Cont %
	0	0	0	0	0	0	0	0

WBS Number: 4.1.3 **Description:** Optical Readout

Institution : **Contact**

Development of a data transmission scheme is a very challenging multi-group project. Some critical questions to answer: can we take signals off the detector at high rates on metal to a location where fiber readout is located? What are radiation limits to receivers, drivers, and fibers? How fast a link can we make and how do we get multiple data streams into it? The solutions also require integration with the stave for strips and the pixel readout for the pixels.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	1689	0	0	1689	1105	0	584	0	627.9	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Electrical Engineer R	0	0	3260	2325	2200	1480	1480
	0	0	178.89	141.36	144.544	100.672	103.292
Grad Student R	0	0	2200	1040	440	440	440
	0	0	46.868	21.832	6.105	6.263	6.426
Technician R	0	0	1760	1180	2000	1680	1680
	0	0	58.823	47.594	89.9	75.274	77.232

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	40.7	42.7	50.1	205.8	163.6
Travel R	0.0	0.0	12.3	7.0	8.2	4.1	4.2

WBS Number: 4.1.3.1 **Description:** Diode Receivers

Institution : **Contact**

The clock and command signal carried by fibers is locally decoded by pin diodes. These have never been checked at the fluences expected at the LHC upgrade. Goal is to check these and qualify for use.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	99	0	0	99	83	0	16	0	47.4	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Grad Student R	0	0	1760	600	0	0	0
	0	0	41.069	15.882	0	0	0
Technician R	0	0	880	0	0	0	0
	0	0	26.421	0	0	0	0

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	3.1	0.0	0.0	0.0	0.0
Travel R	0.0	0.0	6.0	3.1	0.0	0.0	0.0

WBS Number: 4.1.3.1.1 **Description:** Diode Receivers - Oklahoma

Institution : U. Oklahoma **Contact** Not available

Oklahoma and Oklahoma State will be working collaboratively to qualify the pin diode receivers.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	26	0	0	26	18	0	7	0	10.4	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Grad Student R	0	0	880	0	0	0	0
	0	0	18.365	0	0	0	0

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	3.1	0.0	0.0	0.0	0.0
Travel R	0.0	0.0	3.0	0.0	0.0	0.0	0.0

CONTINGENCY FACTORS:	*Risk*				*Weight*			Cont %
	Technical	C o s t	Schedule	Des i gn	Technical	C o s t	Schedule	
	0	0	0	0	0	0	0	0

WBS Number: 4.1.3.1.2 **Description:** Diode Receivers - Oklahoma State

Institution : Oklahoma State **Contact** Not available

Oklahoma State and Oklahoma will be working collaboratively to qualify the pin diode receivers.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	73	0	0	73	65	0	8	0	36.9	0.0

MANPOWER SUMMARY: (k$)	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Grad Student R	0	0	880	600	0	0	0
	0	0	22.704	15.882	0	0	0
Technician R	0	0	880	0	0	0	0
	0	0	26.421	0	0	0	0

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Travel R	0.0	0.0	3.0	3.1	0.0	0.0	0.0

CONTINGENCY FACTORS:	*Risk*				*Weight*			Cont %
	Technical	C o s t	Schedule	Des i gn	Technical	C o s t	Schedule	
	0	0	0	0	0	0	0	0

WBS Number: 4.1.3.2 **Description:** Fiber Drivers

Institution : **Contact**

The fiber driver system at present consists of VCSELs which are directly driven. There are two important tasks, which are to qualify the VCSELs at the fluence levels expected at the upgraded LHC and to develop a multiplexer scheme to collect the greater increased data volume and then drive the appropriate VCSEL.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	866	0	0	866	646	0	221	0	366.8	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Electrical Engineer R	0	0	3160	1725	1300	880	880
	0	0	171.456	95.596	74.112	52.5	53.866
Grad Student R	0	0	440	440	440	440	440
	0	0	5.799	5.95	6.105	6.263	6.426
Technician R	0	0	880	880	800	880	880
	0	0	32.402	33.244	31.008	34.994	35.904

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	25.6	18.1	12.2	75.2	29.5
Travel R	0.0	0.0	6.3	3.9	4.0	4.1	4.2

WBS Number: 4.1.3.2.1 **Description:** Fiber Drivers - Ohio State

Institution : Ohio State University **Contact** Not available

Ohio state will be doing the R&D to qualify the present VCSEL and if inadequate for look for an approriate replacement. They are also testing our present drivers and receivers to understand their operational limits.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	643	0	0	643	441	0	202	0	250.4	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Electrical Engineer R	0	0	1400	525	500	880	880
	0	0	77.336	29.755	29.076	52.5	53.866
Grad Student R	0	0	440	440	440	440	440
	0	0	5.799	5.95	6.105	6.263	6.426
Technician R	0	0	880	880	800	880	880
	0	0	32.402	33.244	31.008	34.994	35.904

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	13.6	18.1	12.2	75.2	29.5
Travel R	0.0	0.0	3.3	3.9	4.0	4.1	4.2

CONTINGENCY FACTORS:	*Risk* Technical	*Risk* C o s t	*Risk* Schedule	*Risk* Des i gn	*Weight* Technical	*Weight* C o s t	*Weight* Schedule	Cont %
	0	0	0	0	0	0	0	0

WBS Number: 4.1.3.2.2 **Description:** Fiber Drivers - SMU

Institution : Southern Methodist University **Contact** Not available

SMU is working on a multiplexer receiver chip (called the GOL chip - Gigabit Optical Link) which could solve our need for multiplexing. This has been developed at CERN but never qualified for our applications.

Details of Estimate:

1. Optical link system design using GOL, HDMP-1024 and TLK2501.

1.1 System design, schematics capturing and PCB layout.
10.1.2005 - 2.28.2006, work done at SMU
3 months EE FTE, $12.5k, w/ 25% benefit, 45% oh ==> $22.7k
1.2 PCB fabrication.
3.1.2006 - 3.31.2006, work done by Eagle Circuits
PCB fab. + assembly $8k (BGA mounting, 6 to 8 layer board)
Components $2k
Total w/ 45% overhead ==> $14.5k
2. Lab tests on system performance including jitter, eye diagram and sensitivities.
4.1.2006 - 7.31.2006, work done at SMU
2 months EE FTE, $8.3k, w/ 25% benefit, 45% oh ==> $15.1k
3. Irradiation tests on the GOL chip, the lasers and the fiber.
Fall of 2006, depends on available beam time (proton 200 MeV).
Preparation and tests, data analysis, work done at SMU
1.5 months FTE $6.3k, w/ 25% benefit, 45% oh ==> $11.4k
Proton beam (MGH) time $650/hr*5hr = $3.3k
Travel to BNL + Boston: $2.5k*2 = $5k
w/ 45% overhead, total ==> $12.0k

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	224	0	0	224	205	0	19	0	116.5	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Electrical Engineer R	0	0	1760	1200	800	0	0
	0	0	94.12	65.841	45.036	0	0

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	12.0	0.0	0.0	0.0	0.0
Travel R	0.0	0.0	3.0	0.0	0.0	0.0	0.0

CONTINGENCY FACTORS:	*Risk*				*Weight*			Cont %
	Technical	C o s t	Schedule	Des i gn	Technical	C o s t	Schedule	
	0	0	0	0	0	0	0	0

WBS Number: 4.1.3.3 **Description:** Fibers

Institution : U. of California, Santa Cruz **Contact**

UCSC is radiation testing various choices for the fiber on which to transmit signals at the upgraded LHC. This includes rate limits and radiation behavior.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	0	0	0	0	0	0	0	0	0.0	0.0

CONTINGENCY FACTORS:	*Risk*				*Weight*			Cont %
	Technical	C o s t	Schedule	Des i gn	Technical	C o s t	Schedule	
	0	0	0	0	0	0	0	0

WBS Number: 4.1.3.4 **Description:** Multiplexers and Interconnect Circuits

Institution : **Contact**

The increase in data for the upgrade will require new schemes for connecting individual modules to the fiber systems being qualified under WBS4.1.3. This can involve some amount of electrical transmission as well as development of protocols and chips for transmitting and receiving data.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	724	0	0	724	376	0	348	0	213.7	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Electrical Engineer R	0	0	100	600	900	600	600
	0	0	7.434	45.764	70.432	48.172	49.426
Technician R	0	0	0	300	1200	800	800
	0	0	0	14.35	58.892	40.28	41.328

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	12.0	24.6	37.9	130.7	134.1
Travel R	0.0	0.0	0.0	0.0	4.2	0.0	0.0

WBS Number: 4.1.3.4.1 **Description:** Multipl. And Interconnect - Ohio St

Institution : Ohio State University **Contact** Not available

Ohio State will be looking at the possibilities and limits for transmission via electrical signals as presently done for the pixel system.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	0	0	0	0	0	0	0	0	0.0	0.0

CONTINGENCY FACTORS:	*Risk*				*Weight*			Cont %
	Technical	C o s t	Schedule	Des i gn	Technical	C o s t	Schedule	
	0	0	0	0	0	0	0	0

WBS Number: 4.1.3.4.2 **Description:** Multipl. And Interconnect - UCSC

Institution : U. of California, Santa Cruz **Contact** Not available

UCSC will be looking at strip specific issues. This includes interfacing to the frontend electronics and development of suitable multiplexing schemes. A possible element in this chain will be the GOL chip being tested under

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	724	0	0	724	376	0	348	0	213.7	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Electrical Engineer R	0	0	100	600	900	600	600
	0	0	7.434	45.764	70.432	48.172	49.426
Technician R	0	0	0	300	1200	800	800
	0	0	0	14.35	58.892	40.28	41.328

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	12.0	24.6	37.9	130.7	134.1
Travel R	0.0	0.0	0.0	0.0	4.2	0.0	0.0

CONTINGENCY FACTORS:	*Risk* Technical	*Risk* C o s t	*Risk* Schedule	*Risk* Des i gn	*Weight* Technical	*Weight* C o s t	*Weight* Schedule	Cont %
	0	0	0	0	0	0	0	0

WBS Number: 4.1.4 **Description:** Modules

Institution : **Contact**

This WBS includes the R&D for the development of a suitable module structure to replace the individual module that is the primary element of the present SCT detector of ATLAS.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	4084	0	0	4084	2595	0	1489	0	1474.2	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Designer R	0	0	690	660	750	520	520
	0	0	61.805	60.694	70.387	48.094	49.346
Electrical Engineer R	0	0	3430	2360	2040	200	200
	0	0	155.385	123.62	101.795	16.057	16.475
Gen Lab R	0	0	140	546	0	546	546
	0	0	2.117	8.47	0	8.916	9.148
Mechanical Engineer R	0	0	1270	700	1500	1000	1000
	0	0	150.346	87.001	156.082	93.39	95.82
Technician R	0	0	3320	3805	4200	4460	4460
	0	0	215.529	237.564	268.729	275.337	282.501

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	238.5	268.5	269.0	275.9	283.1
Travel R	0.0	0.0	2.5	4.9	2.1	0.0	0.0

WBS Number: 4.1.4.1 **Description:** Stave Structures

Institution : **Contact**

Development of a stave readout structure. This is a collaboration of BNL, Hampton, and LBNL, with UCSC participating through the work on detectors and electronics of WBS4.1.1 and WBS4.1.2. This work leverages past effort for CDF in developing stave structures that minimize material, cabling, and power connections. Improvements in these areas are essential to fit a new tracker with many more channels into the space available in the ATLAS detector. The use of staves is viewed as essential for an upgraded inner detector. There are many areas requiring new effort to make the stave successful. These include interfacing to the frontends in a low noise fashion, development of suitable powering schemes, collecting data from the many modules on a stave, and providing

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	3438	0	0	3438	2190	0	1248	0	1244.2	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Designer R	0	0	690	660	750	520	520
	0	0	61.805	60.694	70.387	48.094	49.346
Electrical Engineer R	0	0	280	280	280	0	0
	0	0	34.606	35.506	36.43	0	0
Mechanical Engineer R	0	0	1270	700	1500	1000	1000
	0	0	150.346	87.001	156.082	93.39	95.82
Technician R	0	0	3220	3425	4060	4120	4120
	0	0	210.867	218.185	260.624	256.952	263.638

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	133.0	227.5	247.9	254.3	261.0
Travel R	0.0	0.0	0.0	2.4	2.1	0.0	0.0

WBS Number: 4.1.4.1.1 **Description:** Stave Structures - LBNL Jr

Institution : LBNL **Contact** Not available

LBNL is taking the lead inadapting the CDF stave as a test bed for ideas for an ATLAS stave. The eventual stave will be longer, probably about 1 meters in the short strip region and about 2 meters in the outer detector. This will involve breaking new ground, since staves of this length have not be used before.

Details of Estimate:

	Stave Mechanics		Material	Labor hrs.	Labor Cost
Design study	200	$23,000			
Inner strip stave design study					
parts	$3,000				
fixtures construction		130	$11,050		
mechanical assy		140	$11,060		
electrical assy	80	$4,400			
fixtures assembly		30	$2,550		
misc parts	$1,000	See also 4.1.4.1.4			

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	1887	0	0	1887	949	0	938	0	539.3	0.0

MANPOWER SUMMARY: (k$)	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Designer R	0	0	350	330	420	520	520
	0	0	29.973	28.995	37.863	48.094	49.346
Mechanical Engineer R	0	0	770	200	600	600	600
	0	0	88.55	23.598	72.636	74.52	76.459
Technician R	0	0	1720	665	1300	1760	1760
	0	0	94.586	37.52	75.257	104.528	107.248

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	90.0	184.7	189.5	194.4	199.5
Travel R	0.0	0.0	0.0	0.0	2.1	0.0	0.0

CONTINGENCY FACTORS:	*Risk* Technical	Cost	Schedule	Design	*Weight* Technical	Cost	Schedule	Cont %
	0	0	0	0	0	0	0	0

WBS Number: 4.1.4.1.2 **Description:** Stave Structures - BNL

Institution : BNL-M&O **Contact** Not available

BNL is working on development of the eventual stave. They will provide some of the test detectors to be integrated onto the stave and do measurements to quantify performance.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	1050	0	0	1050	785	0	265	0	446.2	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Designer R	0	0	340	330	330	0	0
	0	0	31.832	31.699	32.524	0	0
Electrical Engineer R	0	0	280	280	280	0	0
	0	0	34.606	35.506	36.43	0	0
Mechanical Engineer R	0	0	500	500	500	0	0
	0	0	61.796	63.403	65.053	0	0
Technician R	0	0	1100	1000	1000	600	600
	0	0	96.121	89.655	91.988	56.624	58.097

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	36.5	37.7	53.2	54.5	56.0

CONTINGENCY FACTORS:	*Risk* Technical	*Risk* C o s t	*Risk* Schedule	*Risk* Des i gn	*Weight* Technical	*Weight* C o s t	*Weight* Schedule	Cont %
	0	0	0	0	0	0	0	0

WBS Number: 4.1.4.1.3 **Description:** Stave Structures - Hampton

Institution : Hampton U. **Contact** Not available

Hampton will provide performance measurements relevant to functioning of the stave.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	0	0	0	0	0	0	0	0	0.0	0.0

CONTINGENCY FACTORS:	*Risk*				*Weight*			Cont %
	Technical	C o s t	Schedule	Des i gn	Technical	C o s t	Schedule	
	0	0	0	0	0	0	0	0

WBS Number: 4.1.4.1.4 **Description:** Stave Structures - LBNL Sr

Institution : LBNL/UC-Berkeley **Contact** Not available

General labor is shops. **Details of Estimate:**

Stave Mechanics	Material	Labor hrs.	Labor Cost
Design study	200	$23,000	
Inner strip stave design study			
parts $3,000			
fixtures construction		130	$11,050
mechanical assy		140	$11,060
electrical assy	80	$4,400	
fixtures assembly		30	$2,550
misc parts $1,000			

Cost Summary: (R)	**Base Cost (k$)**	**Cont Cost (k$)**	**Cont %**	**Total Cost (k$)**	**EDIA Labor (k$)**	**Mfg Labor (k$)**	**EDIA Matls (k$)**	**Mfg Matls (k$)**	**FTEs R**	**FTEs Other**
	0	0	0	0	0	0	0	0	0.0	0.0

CONTINGENCY FACTORS:	***Risk***				***Weight***			**Cont %**
	Technical	**C o s t**	**Schedule**	**Des i gn**	**Technical**	**C o s t**	**Schedule**	
	0	0	0	0	0	0	0	0

WBS Number: 4.1.4.1.5 **Description:** Stave Structures - Yale

Institution : Yale University **Contact** Not available

Yale is participating with LBNL, BNL, and Hampton on stave R&D.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	500	0	0	500	455	0	45	0	258.7	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Mechanical Engineer R	0	0	0	0	400	400	400
	0	0	0	0	18.393	18.87	19.361
Technician R	0	0	400	1760	1760	1760	1760
	0	0	20.16	91.01	93.379	95.8	98.293

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	6.5	5.1	5.3	5.4	5.5
Travel R	0.0	0.0	0.0	2.4	0.0	0.0	0.0

CONTINGENCY FACTORS:	*Risk* Technical	*Risk* C o s t	*Risk* Schedule	*Risk* Des i gn	*Weight* Technical	*Weight* C o s t	*Weight* Schedule	Cont %
	0	0	0	0	0	0	0	0

WBS Number: 4.1.4.2 **Description:** Hybrids

Institution : U. of California, Santa Cruz **Contact**

UCSC will be working on hybrid design to go along with the short strip detector options in WBS4.1.1.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	133	0	0	133	128	0	5	0	72.8	0.0

MANPOWER SUMMARY: (k$)	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Electrical Engineer R	0	0	80	320	0	200	200
	0	0	5.947	24.407	0	16.057	16.475
Gen Lab R	0	0	140	546	0	546	546
	0	0	2.117	8.47	0	8.916	9.148
Technician R	0	0	100	240	0	200	200
	0	0	4.662	11.48	0	10.07	10.332

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	4.0	0.0	0.0	0.0	0.0

CONTINGENCY FACTORS:	*Risk* Technical	*Risk* C o s t	*Risk* Schedule	*Risk* Des i gn	*Weight* Technical	*Weight* C o s t	*Weight* Schedule	Cont %
	0	0	0	0	0	0	0	0

WBS Number: 4.1.4.3 **Description:** Cooling Channels

Institution : LBNL/UC-Berkeley **Contact**

Thermal and mechanical simulation studies of stave structures at LBNL. This includes delineating choices for the stave material and mechanical performance of these choices. Also of interest is the choice of cooling technique for a range of stave temperatures. The temperature is an important parameter, since it affects rather strongly the leakage current of the detector and the associated noise and heating.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	0	0	0	0	0	0	0	0	0.0	0.0

CONTINGENCY FACTORS:	*Risk*				*Weight*			Cont %
	Technical	C o s t	Schedule	Des i gn	Technical	C o s t	Schedule	
	0	0	0	0	0	0	0	0

WBS Number: 4.1.4.4 **Description:** Powering Schemes

Institution : **Contact**

Development of a power conversion scheme. The use of a power conversion scheme for the detector front-end readout is essential for the safety of the frontend electronics and also to arrive at a cable plant that can fit into the detector configuration given by the present ATLAS detector.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	513	0	0	513	277	0	236	0	157.2	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Electrical Engineer R	0	0	3070	1760	1760	0	0
	0	0	114.832	63.707	65.365	0	0
Technician R	0	0	0	140	140	140	140
	0	0	0	7.899	8.105	8.315	8.531

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	101.5	41.0	21.1	21.6	22.2
Travel R	0.0	0.0	2.5	2.6	0.0	0.0	0.0

WBS Number: 4.1.4.4.1 **Description:** Powering Schemes - LBNL

Institution : LBNL **Contact** Not available

Will look at both DC-DC converters and serial powering schemes. For FY06 will try to construct a potentially usable DC-DC converter for the stave. Will work with BNL on such schemes.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	260	0	0	260	42	0	218	0	23.8	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Electrical Engineer R	0	0	70	0	0	0	0
	0	0	8.992	0	0	0	0
Technician R	0	0	0	140	140	140	140
	0	0	0	7.899	8.105	8.315	8.531

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	94.5	41.0	21.1	21.6	22.2

CONTINGENCY FACTORS:	*Risk* Technical	*Risk* C o s t	*Risk* Schedule	*Risk* Des i gn	*Weight* Technical	*Weight* C o s t	*Weight* Schedule	Cont %
	0	0	0	0	0	0	0	0

WBS Number: 4.1.4.4.2 **Description:** Powering Schemes - BNL

Institution : BNL-M&O **Contact** Not available

Will work with LBNL on DC-DC converter schemes and serial powering. Will provide a general analysis of how the two options compare.

Cost Summary: (R)

Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
0	0	0	0	0	0	0	0	0.0	0.0

CONTINGENCY FACTORS:

Risk				*Weight*			
Technical	C o s t	Schedule	Des i gn	Technical	C o s t	Schedule	Cont %
0	0	0	0	0	0	0	0

WBS Number: 4.1.4.4.3 **Description:** Powering Schemes - Yale

Institution : Yale University **Contact** Not available

Work on power conversion systems for the stave.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	253	0	0	253	235	0	18	0	133.5	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Electrical Engineer R	0	0	3000	1760	1760	0	0
	0	0	105.84	63.707	65.365	0	0

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	7.0	0.0	0.0	0.0	0.0
Travel R	0.0	0.0	2.5	2.6	0.0	0.0	0.0

CONTINGENCY FACTORS:	*Risk*				*Weight*			Cont %
	Technical	C o s t	Schedule	Des i gn	Technical	C o s t	Schedule	
	0	0	0	0	0	0	0	0

WBS Number: 4.1.4.4.4 **Description:**

Institution : **Contact** Not available

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	0	0	0	0	0	0	0	0	0.0	0.0

CONTINGENCY FACTORS:	*Risk*				*Weight*			Cont %
	Technical	C o s t	Schedule	Des i gn	Technical	C o s t	Schedule	
	0	0	0	0	0	0	0	0

WBS Number: 4.3 **Description:** Liquid Argon Upgrade R&D

Institution : **Contact**

This estimate is for the U.S. ATLAS Liquid Argon calorimeter R&D for a high luminosity LHC upgrade. The R&D program addresses several issues for Lar calorimetry related to an increase in luminosity by a factor 10 over the present design luminosity.
The Lar Calorimeters will be affected by a higher luminosity environment in different ways, classified in to two main categories, related either to the operation of the detectors or to the performances and characteristics of the readout electronics.

The Detector issues are primarily:

o Increased radiation leading to possible break down of the charge collection in Lar (particularly severe in the end-cap region for high values of the pseudo-rapidity).
O Radiation induced poisoning and layer build-up effects on the readout electrodes that would reduce the charge collection efficiency and ultimately the detector performance.
O Direct activation of the Lar that would increase the calorimeter noise level (compared to the electronics noise) and would have possible implications for safety in case of leaks.
O High Voltage (HV) degradation depending on the HV distribution uniformity among the different calorimeter sections and on the average DC current draw due to the higher ionization rate in the active gaps. It may require new HV power supplies as well as a redesign of the HV protection resistors and feedthrough filter circuits.
O Beam heating of Lar: the problem would be particularly severe in the Forward Calorimeters (FCAL). At the upgraded luminosity the heat dissipation would be 400 Watts in the FCAL detectors. Preliminary calculations foresee an 11degree C difference between beam on and off at an operating pressure where the difference between the freezing and boiling temperature is 9 degrees C. Operating the detector in such conditions would be extremely difficult if not impossible.

Readout Electronics issues:

o The current readout is based on a complex architecture with 13 different technology Ics spread over several boards.

O Each component has been qualified for 10 years operation at nominal LHC luminosity. Some components will likely not qualify for 10 years operations at 10**35cm**-2 s**-1 .
O Reliability/Lifetime of the components are also not well known. There are some worries, particularly about DMILL and DSM Ics.
o Most components (in particular DMILL ASICs) cannot be replaced if they start failing. Furthermore, would be difficult if not impossible to upgrade only a few components in the current system given the evolution of technologies, changes in the required voltages etc.

Cost Summary: (R)	**Base Cost (k$)**	**Cont Cost (k$)**	**Cont %**	**Total Cost (k$)**	**EDIA Labor (k$)**	**Mfg Labor (k$)**	**EDIA Matls (k$)**	**Mfg Matls (k$)**	**FTEs R**	**FTEs Other**
	6286	0	0	6286	3745	0	2541	0	2128.1	0.0

MANPOWER (k$) SUMMARY:	**FY 06 (hrs) (k$)**	**FY 07 (hrs) (k$)**	**FY 08 (hrs) (k$)**	**FY 09 (hrs) (k$)**	**FY 10 (hrs) (k$)**	**FY 11 (hrs) (k$)**	**FY 12 (hrs)**
Designer R	0	0	0	0	150	210	210
	0	0	0	0	14.783	21.234	21.786
Electrical Engineer R	0	0	5276	4642	3687	3338	3018
	0	0	508.442	450.42	419.081	396.997	371.963
Grad Student R	0	0	1744	1744	1744	1744	1744
	0	0	33.291	34.157	35.046	35.954	36.889
Mechanical Engineer R	0	0	0	1060	0	0	0
	0	0	0	78.687	0	0	0

Technician R	0	0	4836	5186	3210	3568	3588
	0	0	255.95	302.159	230.665	245.213	252.677

MATERIAL SUMMARY:	**FY 06 (k$)**	**FY 07 (k$)**	**FY 08 (k$)**	**FY 09 (k$)**	**FY 10 (k$)**	**FY 11 (k$)**	**FY 12 (k$)**
Other R	0.0	0.0	308.6	382.3	427.4	547.0	566.2
Travel R	0.0	0.0	20.0	5.1	0.0	0.0	0.0

WBS Number: 4.3.1 **Description:** Layer Buildup due to Radiation

Institution : U. of Arizona **Contact**

This task will provide the information on radiation induced effects in the Lar at the very high fluences expected at an upgraded LHC.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	238	0	0	238	159	0	79	0	90.1	0.0

MANPOWER SUMMARY: (k$)	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Mechanical Engineer R	0	0	0	1060	0	0	0
	0	0	0	78.687	0	0	0
Technician R	0	0	1294	1294	0	0	0
	0	0	39.431	40.456	0	0	0

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	34.6	27.8	0.0	0.0	0.0
Travel R	0.0	0.0	0.0	5.1	0.0	0.0	0.0

CONTINGENCY FACTORS:	*Risk* Technical	*Risk* C o s t	*Risk* Schedule	*Risk* Des i gn	*Weight* Technical	*Weight* C o s t	*Weight* Schedule	Cont %
	0	0	0	0	0	0	0	0

WBS Number: 4.3.2 **Description:** Readout Electronics

Institution : **Contact**

The goal is to develop the new readout required for the Lar for an upgraded LHC. The goal is to have a comprehensive solution using modern technology.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	4264	0	0	4264	2833	0	1431	0	1609.8	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Designer R	0	0	0	0	150	210	210
	0	0	0	0	14.783	21.234	21.786
Electrical Engineer R	0	0	4372	4302	3347	3174	2854
	0	0	396.715	407.306	374.845	375.106	349.503
Grad Student R	0	0	1744	1744	1744	1744	1744
	0	0	33.291	34.157	35.046	35.954	36.889
Technician R	0	0	1938	1794	1860	2634	2654
	0	0	121.886	112.146	118.463	169.361	174.852

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	165.0	237.5	289.5	284.6	291.4
Travel R	0.0	0.0	10.0	0.0	0.0	0.0	0.0

WBS Number: 4.3.2.1 **Description:** Study of System Architecture

Institution : **Contact**

This is a collaboration of BNL, Columbia/Nevis, Pitt and SMU to study the system architecture, board layout, to design an approriately integrated readout electronics system, encomposing the frontend readout system and optical

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	133	0	0	133	133	0	0	0	75.8	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Designer R	0	0	0	0	150	210	210
	0	0	0	0	14.783	21.234	21.786
Electrical Engineer R	0	0	0	0	145	210	210
	0	0	0	0	18.865	28.031	28.76

WBS Number: 4.3.2.1.1 **Description:** Study of SA - BNL

Institution : BNL-M&O **Contact** Not available

BNL will participate in the studies and has a particular role in the development of an optimum analog front-end.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	133	0	0	133	133	0	0	0	75.8	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Designer R	0	0	0	0	150	210	210
	0	0	0	0	14.783	21.234	21.786
Electrical Engineer R	0	0	0	0	145	210	210
	0	0	0	0	18.865	28.031	28.76

CONTINGENCY FACTORS:	*Risk* Technical	*Risk* C o s t	*Risk* Schedule	*Risk* Des i gn	*Weight* Technical	*Weight* C o s t	*Weight* Schedule	Cont %
	0	0	0	0	0	0	0	0

WBS Number: 4.3.2.1.2 **Description:** Study of SA - Nevis

Institution : Columbia U. (Nevis Laboratory) **Contact** Not available

Combia/Nevis will participate in the system architecture desing with a particular role in data flow and development of a digital readout.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	0	0	0	0	0	0	0	0	0.0	0.0

CONTINGENCY FACTORS:	*Risk*				*Weight*			Cont %
	Technical	C o s t	Schedule	Des i gn	Technical	C o s t	Schedule	
	0	0	0	0	0	0	0	0

WBS Number: 4.3.2.1.3 **Description:** Study of SA - Pitt

Institution : University of Pittsburg **Contact** Not available

Pittsburgh will participate in the study of the system architecture with a particular role in thre Level 1 trigger interface.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	0	0	0	0	0	0	0	0	0.0	0.0

CONTINGENCY FACTORS:	*Risk*				*Weight*			Cont %
	Technical	C o s t	Schedule	Des i gn	Technical	C o s t	Schedule	
	0	0	0	0	0	0	0	0

WBS Number: 4.3.2.1.4 **Description:** Study of SA - SMU

Institution : Southern Methodist University **Contact** Not available

SMU will participate in the system architecture studies with a particular role in the optical data link.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	0	0	0	0	0	0	0	0	0.0	0.0

CONTINGENCY FACTORS:	*Risk*				*Weight*			Cont %
	Technical	C o s t	Schedule	Des i gn	Technical	C o s t	Schedule	
	0	0	0	0	0	0	0	0

WBS Number: 4.3.2.2 **Description:** Development of Analog Front-End

Institution : **Contact**

Develop a frontend ASIC with approriate radiation hardness, dynamic range, and minimum power requirement.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	1310	0	0	1310	900	0	411	0	511.1	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Electrical Engineer R	0	0	1008	858	858	800	600
	0	0	126.442	110.709	113.589	108.794	83.374
Grad Student R	0	0	640	640	640	640	640
	0	0	10.483	10.756	11.036	11.322	11.616
Technician R	0	0	704	560	560	720	720
	0	0	61.517	50.207	51.513	68.234	70.01

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	48.0	74.9	79.0	68.6	69.8
Travel R	0.0	0.0	10.0	0.0	0.0	0.0	0.0

WBS Number: 4.3.2.2.1 **Description:** Devel of Analog FE - BNL

Institution : BNL-M&O **Contact** Not available

BNL will work on the development of an approriate analog frontend. Included in this is the exploration of SiGe, a new technology which looks to provide an optimimal solution in terms of linearity, radiation hardness and low power.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	843	0	0	843	519	0	323	0	295.0	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Electrical Engineer R	0	0	528	378	378	320	320
	0	0	65.257	47.933	49.18	42.714	43.825
Technician R	0	0	704	560	560	560	560
	0	0	61.517	50.207	51.513	52.849	54.224

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	28.0	68.7	72.6	52.9	54.3
Travel R	0.0	0.0	10.0	0.0	0.0	0.0	0.0

CONTINGENCY FACTORS:	*Risk* Technical	*Risk* C o s t	*Risk* Schedule	*Risk* Des i gn	*Weight* Technical	*Weight* C o s t	*Weight* Schedule	Cont %
	0	0	0	0	0	0	0	0

WBS Number: 4.3.2.2.2 **Description:** Devel of Analog FE - SBU

Institution : SUNY SB **Contact** Not available

Stony Brook will collaborate with BNL on the development of a suitable analog frontend.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	55	0	0	55	31	0	24	0	17.7	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Technician R	0	0	0	0	0	160	160
	0	0	0	0	0	15.385	15.786

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	0.0	0.0	0.0	9.2	8.9

CONTINGENCY FACTORS:	*Risk* Technical	*Risk* C o s t	*Risk* Schedule	*Risk* Des i gn	*Weight* Technical	*Weight* C o s t	*Weight* Schedule	Cont %
	0	0	0	0	0	0	0	0

WBS Number: 4.3.2.2.3 **Description:** Development of Analog FE-Penn

Institution : U of Pennsylvania **Contact** Not available

Penn will collaborate on the development of a suitable analog frontend electronics for the Liquid Argon

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	397	0	0	397	349	0	48	0	198.4	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Electrical Engineer R	0	0	480	480	480	480	280
	0	0	61.185	62.776	64.409	66.08	39.549
Grad Student R	0	0	640	640	640	640	640
	0	0	10.483	10.756	11.036	11.322	11.616

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	5.0	6.2	6.3	6.5	6.6

CONTINGENCY FACTORS:	*Risk* Technical	*Risk* C o s t	*Risk* Schedule	*Risk* Des i gn	*Weight* Technical	*Weight* C o s t	*Weight* Schedule	Cont %
	0	0	0	0	0	0	0	0

WBS Number: 4.3.2.2.4 **Description:** Radiation testing of SiGe

Institution : Columbia U. (Nevis Laboratory) **Contact** Not available

Columbia will work with the other groups to expedite radiation testing of SiGe parts.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	15	0	0	15	0	0	15	0	0.0	0.0

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	15.0	0.0	0.0	0.0	0.0

CONTINGENCY FACTORS:	*Risk* Technical	*Risk* C o s t	*Risk* Schedule	*Risk* Des i gn	*Weight* Technical	*Weight* C o s t	*Weight* Schedule	Cont %
	0	0	0	0	0	0	0	0

WBS Number: 4.3.2.3 **Description:** Digital Readout System

Institution : Columbia U. (Nevis Laboratory) **Contact**

Goal is to produce a digital readout system with the level 1 pipeline moved off-detector. Requires development of an ADC, gain selector, a MUX, and a serializer to couple to an optical transmission system.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	1903	0	0	1903	1329	0	573	0	755.2	0.0

MANPOWER SUMMARY: (k$)	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Electrical Engineer R	0	0	1244	1444	1444	1444	1444
	0	0	156.901	186.862	191.725	196.697	201.814
Technician R	0	0	1234	1234	1300	1914	1934
	0	0	60.369	61.939	66.95	101.127	104.842

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	63.0	121.6	126.3	129.6	133.0

CONTINGENCY FACTORS:	*Risk* Technical	*Risk* C o s t	*Risk* Schedule	*Risk* Des i gn	*Weight* Technical	*Weight* C o s t	*Weight* Schedule	Cont %
	0	0	0	0	0	0	0	0

WBS Number: 4.3.2.4 **Description:** Optical Data Link

Institution : Southern Methodist University **Contact**

Goal is to develop a novel Link on chip solution for the readout of the data from the Lar. Goal will be to increase the bandwidth in a radiation hard system. Use of Silicon on Sapphire will be developed to take advantage of the speed and radiation hardness of this technology.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	918	0	0	918	471	0	446	0	267.6	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Electrical Engineer R	0	0	2120	2000	900	720	600
	0	0	113.372	109.735	50.666	41.584	35.555
Grad Student R	0	0	1104	1104	1104	1104	1104
	0	0	22.808	23.401	24.01	24.632	25.273

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	54.0	41.0	84.2	86.4	88.6

CONTINGENCY FACTORS:	*Risk* Technical	*Risk* C o s t	*Risk* Schedule	*Risk* Des i gn	*Weight* Technical	*Weight* C o s t	*Weight* Schedule	Cont %
	0	0	0	0	0	0	0	0

WBS Number: 4.3.3 **Description:** Trigger

Institution : **Contact**

Do the R&D needed to develop a level 1 interface and driver and receiver system consistent with the architecture of the upgraded Lar readout established through the system architecture studies of WBS4.3.2.1.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	123	0	0	123	0	0	123	0	0.0	0.0

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	0.0	0.0	0.0	51.8	58.7

WBS Number: 4.3.3.1 **Description:** L1 Trigger Interface

Institution : **Contact**

This is a collaboration of BNL and Pitt. To do the R&D required in order to develop the L1 trigger interface required for the new readout architecture of the upgraded Liquid Argon readout chain.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	123	0	0	123	0	0	123	0	0.0	0.0

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	0.0	0.0	0.0	51.8	58.7

WBS Number: 4.3.3.1.1 **Description:** L1 Trigger Interface - BNL

Institution : BNL-M&O **Contact** Not available

This is a collaboration of BNL and Pittsburgh on the R&D needed for a new Level 1 trigger interface to fit into the upgraded electronics.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	123	0	0	123	0	0	123	0	0.0	0.0

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	0.0	0.0	0.0	51.8	58.7

CONTINGENCY FACTORS:	*Risk* Technical	*Risk* C o s t	*Risk* Schedule	*Risk* Des i gn	*Weight* Technical	*Weight* C o s t	*Weight* Schedule	Cont %
	0	0	0	0	0	0	0	0

WBS Number: 4.3.3.1.2 **Description:** L1 Trigger Interface - Pitt

Institution : University of Pittsburg **Contact** Not available

This is a collaboration of BNL and Pitt. To develop the level 1 trigger interface needed for the upgraded electronics.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	0	0	0	0	0	0	0	0	0.0	0.0

CONTINGENCY FACTORS:	*Risk*				*Weight*			Cont %
	Technical	C o s t	Schedule	Des i gn	Technical	C o s t	Schedule	
	0	0	0	0	0	0	0	0

WBS Number: 4.3.3.2 **Description:** Analog Optical Link for L1 Trigger

Institution : BNL-M&O **Contact**

An alternative to digital data transfer is the development of an analog optical link. This is veruy challenging from the point of view of linearity. However, newer VCSELs provide the possibility for better performance. The goal of this task is to do the research on this option.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	0	0	0	0	0	0	0	0	0.0	0.0

CONTINGENCY FACTORS:	*Risk*				*Weight*			Cont %
	Technical	C o s t	Schedule	Des i gn	Technical	C o s t	Schedule	
	0	0	0	0	0	0	0	0

WBS Number: 4.3.4 **Description:** Next Generation ROD

Institution : **Contact**

The ROD is the vital back end of the new upgraded Liquid Argon electronics. Goal is to do the R&D for a new ROD implementation that can handle the larger data flow expected for the upgrade.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	1040	0	0	1040	446	0	594	0	253.6	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Electrical Engineer R	0	0	704	340	340	164	164
	0	0	87.009	43.114	44.236	21.891	22.46
Technician R	0	0	1504	1364	616	200	200
	0	0	85.895	83.751	44.683	6.582	6.753

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	58.0	77.0	85.3	145.8	149.6
Travel R	0.0	0.0	5.0	0.0	0.0	0.0	0.0

WBS Number: 4.3.4.1 **Description:** Development of new Rod - BNL

Institution : BNL-M&O **Contact** Not available

This is BNL effort on the new ROD.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	876	0	0	876	382	0	494	0	216.8	0.0

MANPOWER SUMMARY: (k$)	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Electrical Engineer R	0	0	704	340	340	164	164
	0	0	87.009	43.114	44.236	21.891	22.46
Technician R	0	0	704	704	416	0	0
	0	0	61.517	63.117	38.267	0	0

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	43.0	61.6	69.5	129.6	133.0
Travel R	0.0	0.0	5.0	0.0	0.0	0.0	0.0

CONTINGENCY FACTORS:	*Risk* Technical	*Risk* C o s t	*Risk* Schedule	*Risk* Des i gn	*Weight* Technical	*Weight* C o s t	*Weight* Schedule	Cont %
	0	0	0	0	0	0	0	0

WBS Number: 4.3.4.2 **Description:** Development of new ROD-Arizona

Institution : U. of Arizona **Contact** Not available

This is the Arizona cobntribution to the ROD development

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	164	0	0	164	65	0	100	0	36.8	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Technician R	0	0	800	660	200	200	200
	0	0	24.378	20.634	6.416	6.582	6.753

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	15.0	15.4	15.8	16.2	16.6

CONTINGENCY FACTORS:	*Risk* Technical	*Risk* C o s t	*Risk* Schedule	*Risk* Des i gn	*Weight* Technical	*Weight* C o s t	*Weight* Schedule	Cont %
	0	0	0	0	0	0	0	0

WBS Number: 4.3.5 **Description:** Rad Hard LV Power Supplies

Institution : BNL-M&O **Contact**

The upgrade will require the redesign and requalification for radiation resistance of the power supply for the front end crate. The high currents required make it impractical to locate these far from the detector requiring increased radiation resistance for the future.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	621	0	0	621	307	0	314	0	174.5	0.0

MANPOWER (k$) SUMMARY:	FY 06 (hrs) (k$)	FY 07 (hrs) (k$)	FY 08 (hrs) (k$)	FY 09 (hrs) (k$)	FY 10 (hrs) (k$)	FY 11 (hrs) (k$)	FY 12 (hrs)
Electrical Engineer R	0	0	200	0	0	0	0
	0	0	24.718	0	0	0	0
Technician R	0	0	100	734	734	734	734
	0	0	8.738	65.806	67.519	69.27	71.072

MATERIAL SUMMARY:	FY 06 (k$)	FY 07 (k$)	FY 08 (k$)	FY 09 (k$)	FY 10 (k$)	FY 11 (k$)	FY 12 (k$)
Other R	0.0	0.0	51.0	40.0	52.6	64.8	66.5
Travel R	0.0	0.0	5.0	0.0	0.0	0.0	0.0

CONTINGENCY FACTORS:	*Risk* Technical	*Risk* C o s t	*Risk* Schedule	*Risk* Des i gn	*Weight* Technical	*Weight* C o s t	*Weight* Schedule	Cont %
	0	0	0	0	0	0	0	0

WBS Number: 4.5 **Description:** Radiation Monitors-Arizona

Institution : U. of Arizona **Contact**

This is for monitors placed in the muon area. These will be used to validate or update our radiation models - crucial for predicting lifetimes of detector comments outside the inner detector.

Cost Summary: (R)	Base Cost (k$)	Cont Cost (k$)	Cont %	Total Cost (k$)	EDIA Labor (k$)	Mfg Labor (k$)	EDIA Matls (k$)	Mfg Matls (k$)	FTEs R	FTEs Other
	0	0	0	0	0	0	0	0	0.0	0.0

CONTINGENCY FACTORS:	*Risk*				*Weight*			Cont %
	Technical	C o s t	Schedule	Des i gn	Technical	C o s t	Schedule	
	0	0	0	0	0	0	0	0