How do D0 and CDF compare?

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1. Designs
2. M&S Costs
3. Labor
4. Schedule

Thanks to CDF for help!

Comments

1. Buyer Beware: some comparisons may not be valid at all levels

2. Both Collaborations would like a chance to justify their current costs to the committee.

3. Both groups have leaders at Sidet that talk to each other every day! There is more collaboration between collaborations than one might think.

4. The presenter could have made numerous errors so corrections are welcome.

1. Designs

	D0	CDF
# Layers	6	6
# Stereo Layer	4	3
# Sensors	2184	2304
# Hybrids	888	1152
# SVX4 chips	7440	4464
# Staves	168	180
L0 Radius(mm)	18.55	21.0
L5 Radius(mm)	163.6	166.0

Biggest difference in the detectors is how they handle L1:

CDF uses a few staves, D0 separate infrastructure

Design - L0

CDF and D0 designs are quite similar,

The major difference is that CDF gangs together 2 sensors in z by wirebonding

Sensors: 144 with about same width and pitch
but CDF has longer sensors

Analog Cables connect sensors to hybrids
CDF needs 144, D0 needs 288

Hybrids - each has a 2 chip hybrid
CDF needs 72, D0 needs 144

Mechanical designs:

CDF uses Fermilab Engineering

D0 uses Univ. of Washington Engineering

Design - Sensors

Both use only single sided sensors
All sensors have intermediate strips
The thickness is 320μm

		D0	CDF
# types		3	3
Description	T1	L1	Outer(A)
	T2	Outer(A)	Outer(S)
Width	T1	24.97	40.5
(mm)	T2	41.1	43.1
Length	T1	80	96.4
(mm)	T2	100	96.4
Read. Pitch	T1	58	75
(μm)	T2	60	80

Design - Readout

CDF and D0 both use the SVX4 chip,

CDF uses it in deadtimeless mode,

D0 uses the chip in SVX2 mode

so the downstream DAQ is different.

Outer Layer Hybrids:

CDF uses one sided hybrids (fewer chips/hybrid)

D0 uses double sided hybrids (smaller cable plant)

Stave Readout Digital Cable:

CDF wirebonds hybrid to cable on stave core

D0 uses connector on hybrid, cable on top of stave

Outside of active region:

CDF

junction card → miniport card →junction port card →FTM

D0

junction card → adapter card →interface board

2. M&S Costs

Reported costs which include all funding sources

	D0	CDF
Sensors	$2,512,531	$1,807,154
Electrical	$4,302,865	$4,181,700
Mechanical & Installation	$1,460,196	$1,567,393
Capital Eq.	$308,100	$200,000
Monitoring	$55,000	$20,000
Computing	$101,000	0
TOTAL	$8,739,692	$7,776,247

M&S Costs-comp

To make 2 projects look alike:

CDF: take out SVT $294K

D0: take out admin. and labor $894K

	D0	CDF
Sensors	$2,128,800	$1,807,154
Electrical	$4,045,065	$3,887,700
Mechanical & Installation	$1,249,846	$1,567,393
Capital Eq.	$308,100	$200,000
Monitoring	$55,000	$20,000
Computing	$58,540	0
TOTAL	$7,845,351	$7,482,247

M&S Costs - Sensors

	D0	CDF
Outer Prototyp.	$115,000	$162,200
Outer Product.	$1,579,000	$1,552,354
L0	$182,800	$84,100
L1(D0)	$212,000	0
Other	$40,000	$8,500
TOTAL	$2,128,800	$1,807,154

Both assume 20% spares and 30% contingency

Production Sensor costs per sensor:

L0	$300	$222
L1 [D0]	$500	
Outer (A)	$675	$460
Outer (S) [CDF]		$484

Note: D0 has recently received a direct quote from HPK for outer layer sensors of $470 per sensor. The total cost savings would be $450K in the M&S.

M&S Costs- Electrical

	D0	CDF
SVX4 chips	$918,140	$740,000
hybrids	$638,125	$1,443,600
L1 hybrids (D0)	$112,750	
Jumper/Bus Cables	$383,000	$41,000
Adapter Card/MPC	$316,600	$317,400
Int. Board/JPC	$63,100	$114,000
Junction Cards	$124,000	$56,000
L0 analog cables	$222,000	$156,200
Other cables	$398,000	$183,500
FTMs (CDF)		$183,000
DAQ testing	$100,000	$100,000
Power Supplies	$329,600	$553,000
Teststands (D0)	$444,250	
TOTAL	$4,049,565	$3,887,700

Note that both CDF and D0 get their SVX4 chip costs from Ray Yarema

M&S Costs- Mechanical

	D0	CDF
L0 modules & fixtures	$36,500	$70,000
L0 support	$59,000	$100,000
L0 Module Install.	$8,000	$40,000
L0 integration (L1-D0)	$40,500	$65,000
L1 support (D0)	$67,850	
Outer modules & fixt.	$138,100	$107,750
Staves	$149,856	$408,750
Stave Installation	$38,400	$100,000
Beampipe	$125,000	$149,893
Bulkheads	$99,940	$180,000
JC mounts/Screens	$6,000	$170,000
Cooling Manifolds,etc.	$280,700	$60,000
Interlocks	$160,000	$20,000
Install. Into ISL (CDF)		$50,000
Transport fixtures	$40,000	$20,000
Positioning sys. (CDF)		$26,000
TOTAL	$1,249,846	$1,567,393

3. Labor

CDF and D0 have adopted the same categories for Fermilab labor and use the same base rates. (we think!)

Both groups have added in some sort of efficiency factor in each of the tasks and used the Microsoft Project vacation days.

FTEs are calculated by taking the number of hours in 52 weeks and dividing by another efficiency factor (0.7) that is used for sick days, etc. so that 1FTE year = 1456 hours

Labor hours by type

	D0	CDF
Physicist	117,907	50,436
University Technical	27,848	20,096*
FERMILAB		
Mechanical Engineer	19,295	14,901
Electrical Engineer	14,826	6,533
Wirebonder (S)	3,220	3,960
CMM Programmer (S)	1,124	2,948
CMM Technician (S)	8,616	
Sidet Mechanical Tech. (S)	24,186	29,156
Sidet Electrical Tech. (S)	8,660	1,090
Designer (S)	13,247	9,956
Mechanical Tech.	9,160	
Electrical Tech.	8,638	14,308
Computing Professional	5,000	
TOTAL (Sidet Techs)	59,053	47,110
TOTAL(Fermilab, no phys)	115,972	82,852
TOTAL	261,727	153,384

* The SVX4 chip labor is taken out

Module Fixturing Labor hours

	D0	CDF
Physicist	3,672	440
FERMILAB		
Mechanical Engineer	1,800	1,080
Electrical Engineer		220
CMM Technician (S)	480	
Sidet Mechanical Tech. (S)		220
Designer (S)	1,776	1,080
Electrical Tech.		440
TOTAL (Sidet Techs)	2,256	1,300
TOTAL(Fermilab, no phys)	4,056	3,040
TOTAL	7,728	3,480

Module constr. labor hours

	D0	CDF
Physicist	23,038	4,100
University Technical	320	
FERMILAB		
Mechanical Engineer	1,360	934
Wirebonder (S)	3,220	2,640
CMM Programmer (S)		180
CMM Technician (S)	1,430	
Sidet Mechanical Tech. (S)	8,298	6,920
Sidet Electrical Tech. (S)	4,080	
Designer (S)	1,320	416
Electrical Tech.		120
Computing Professional	4,000	
TOTAL (Sidet Techs)	15,450	10,156
TOTAL(Fermilab, no phys)	20,810	11,210
TOTAL	44,168	15,310

Staves, labor hours

	D0	CDF
Physicist	7,311	16,300
FERMILAB		
Mechanical Engineer	4,884	2,500
Electrical Engineer		210
Wirebonder (S)		1,240
CMM Programmer (S)	80	796
CMM Technician (S)	1,920	
Sidet Mechanical Tech. (S)	4,520	10,240
Sidet Electrical Tech. (S)		1,090
Designer (S)	2,632	1,360
TOTAL (Sidet Techs)	9,152	14,726
TOTAL(Fermilab, no phys)	14,036	17,436
TOTAL	21,347	33,736

D0 non-FNAL labor

There is a total of $810K in the M&S cost that is from labor:

$516K is covered by NSF MRI

- $334K for sensor masks and probing
- $91K for hybrid testing
- $33K for database work
- $70K for mechicanical on L0

$131K for KSU electronics engineering

an additional $130K for UW engineering for L0/L1 (total UW engineering $200K)

In addition, there is off-project labor ($127K):

- Hybrid testing at KU
- Radiation monitors at NIKHEF
- Technician Time at La Tech

CDF non-FNAL labor

Task group	hours in project
Hybrids	11,040
Power Supplies	976
Sensor Testing	2,880
L0 cables	1,760
Positioning Jacks	1,600
Raznik	1,840
SVX4 chip	1,496
TOTAL	21,592
	=15 FTE

4. Schedule

Some selected milestones

	D0	CDF
Outer layer sensor prod order	10/02	10/02
All sensors delivered	9/04	3/04
1st SVX4 submission	4/01	4/01
Production SVX4 submission	4/03	4/03
Outer hybrid production order	7/03	11/03
Hybrid production complete	4/04	9/04
Electrical prototype stave built	7/03	10/02
Outer module production begun	2/04	3/04
Outer module production complete	8/04	12/04
L0 module production begun	2/04	1/04
L0 done	10/04	10/04
Detector done at Sidet	5/31/05	5/31/05