LIGO Future Operations (FY 2002-2006)

Budgets, Schedules, and Milestones

NSF Review February 26, 2000

Hanford, Washington

Operations Sub Panel

Objectives

- Describe the methods used to manage the LIGO Construction Project and the concurrent Operations.
- Present financial data demonstrating these processes and the current status.
- Describe the the process used to develop the proposal budgets for “Future Operations,” FY 2002-2006.
- Present the “budget model” and various views of the cost estimate and staffing plans.

LIGO Funding History

Revised cost estimate – presented to NSF September 1994

- NSB review and resolution – November 1994
- LIGO Construction Project (NSF PHY-9210038) $272,100,000
- Construction related R&D (NSF PHY-9210038) $20,000,000
- Operations (NSF PHY-9210038) $68,700,000 ($68,580,000 actually funded)
- Advanced R&D (NSF PHY-9700601, PHY-9801158) $10,200,000

Subsequent Funding

- REU Program (NSF PHY-9210038) $48,000
- LIGO Visitor's Program (NSF PHY-99528300) $34,245 (1996)
- LIGO Visitor's Program (NSF PHY-9603177) $656,025 (1997-99)
- LIGO Visitor's Program (NSF PHY-9986274) $280,000
- 1999 Edoardo Amaldi Conference (NSF PHY-9972068) $25,000

Funding History (Continued)

MRE Funds

Fiscal Year	Construction ($M)	R&D ($M)	Operations ($M)	Advanced R&D ($M)	Total ($M)
1992-94	35.90	11.19	-	-	47.09
1995	85.00	3.95	-	-	88.95
1996	70.00	2.38	-	-	72.38
1997	55.00	1.62	0.30	0.80	57.72
1998	26.00	0.86	7.30	1.82	35.98
1999	0.20	-	20.78	2.28	23.26
2000	-	-	21.10	2.60	23.70
2001 (10 mo.)	-	-	19.10 (10 mo.)	2.70	21.80 (10 mo.)
2001 (12 mo.)			22.92 (12 mo.)	2.70	25.62 (12 mo.)
Total (10 mo.)	272.10	20.00	68.58	10.20	370.88

Construction Project | **Operations**

Construction Project (PHY-9210038)

- Project management approach – LIGO implemented a full cost schedule reporting and control system
  - » Budget baseline reviewed by NSF May 1995
  - » Early focus on budgets and performance measurement baseline
  - » Focus shifted to ETC and contingency management
- Reporting, internal and external – cost schedule status report and performance charts
  - » Budget, earned value, actual costs, budget-at-completion, estimate-at-completion
- Change requests, change control board, and change log
  - » Threshold for approval required set at $50,000
- Contingency tracking, contingency needs forecasting
- Weekly project controls meetings attended by PI, PM, group heads, key personnel as required

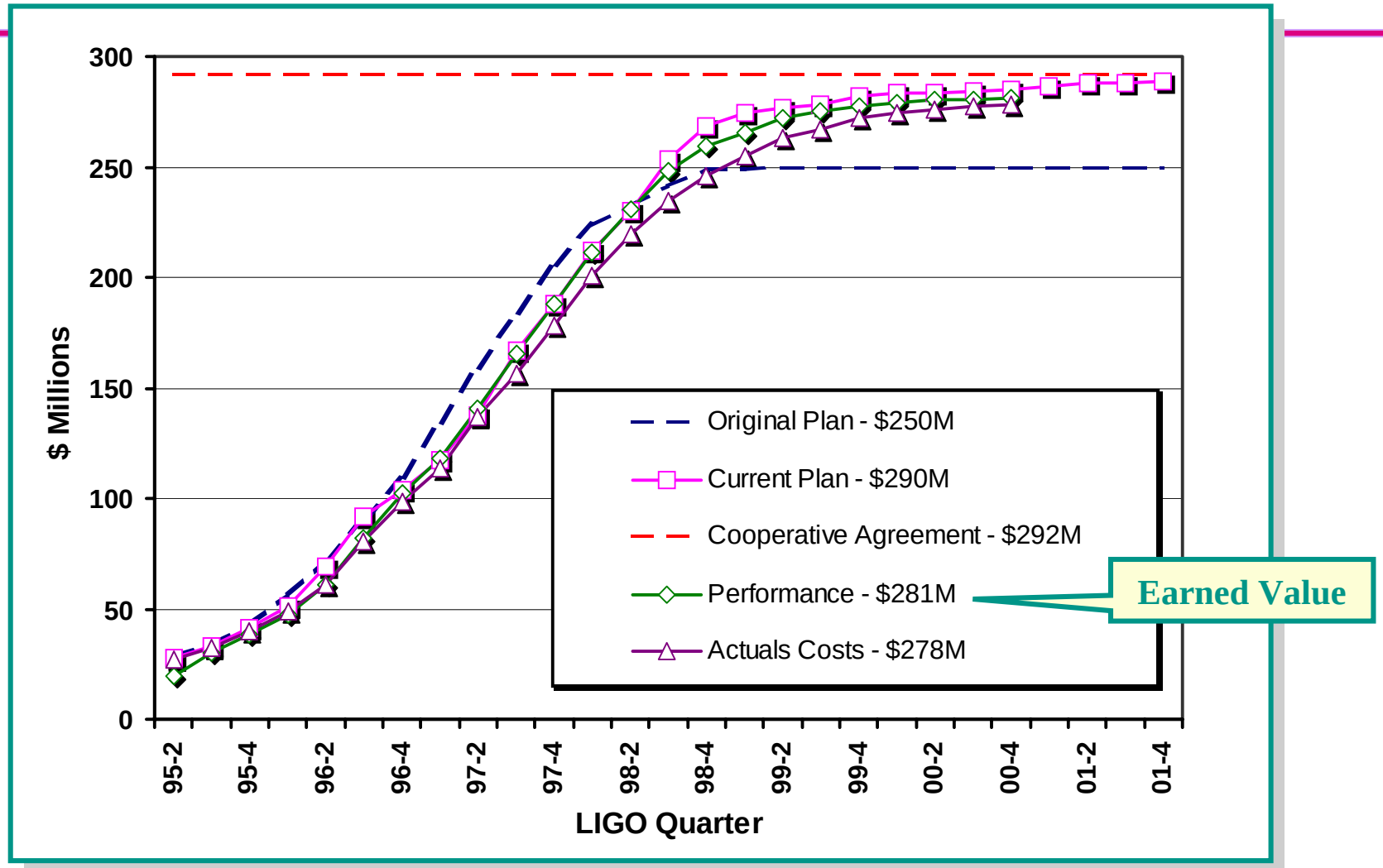
Cost Schedule Status Report

End of November 2000

Reporting Level	Cumulative To Date					At Completion		
Work Breakdown Structure	Budgeted Cost of Work Scheduled (BCWS)	Budgeted Cost of Work Performed (BCWP)	Actual Cost of Work Performed (ACWP)	Schedule Variance (2-1)	Cost Variance (2-3)	Budget-at-Completion (BAC)	Estimate-at-Completion (EAC)	Variance-at-Completion (6-7)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1.1.1 Vacuum Equipment	43,970	43,970	44,047	-	(77)	43,970	44,047	(77)
1.1.2 Beam Tubes	46,967	46,967	47,004	-	(37)	46,967	47,004	(37)
1.1.3 Beam Tube Enclosure	19,338	19,338	19,338	-	-	19,338	19,338	-
1.1.4 Facility Design & Construction	53,722	53,656	53,580	(66)	76	56,226	55,775	451
1.1.5 Beam Tube Bake	5,695	5,695	5,559	-	136	5,695	5,559	136
1.2 Detector	60,252	59,698	56,390	(554)	3,308	60,252	59,752	500
1.3 Research & Development	22,089	22,089	22,100	-	(11)	22,089	22,100	(11)
1.4 Project Office	32,597	29,934	29,934	(2,663)	-	35,509	35,509	-
Subtotal	284,630	281,347	277,952	(3,283)	3,395	290,046	289,084	962
Contingency						-	3,016	(3,016)
Management Reserve						2,054	-	2,054
Total	284,630	281,347	277,952	(3,283)	3,395	292,100	292,100	-

All values in $K

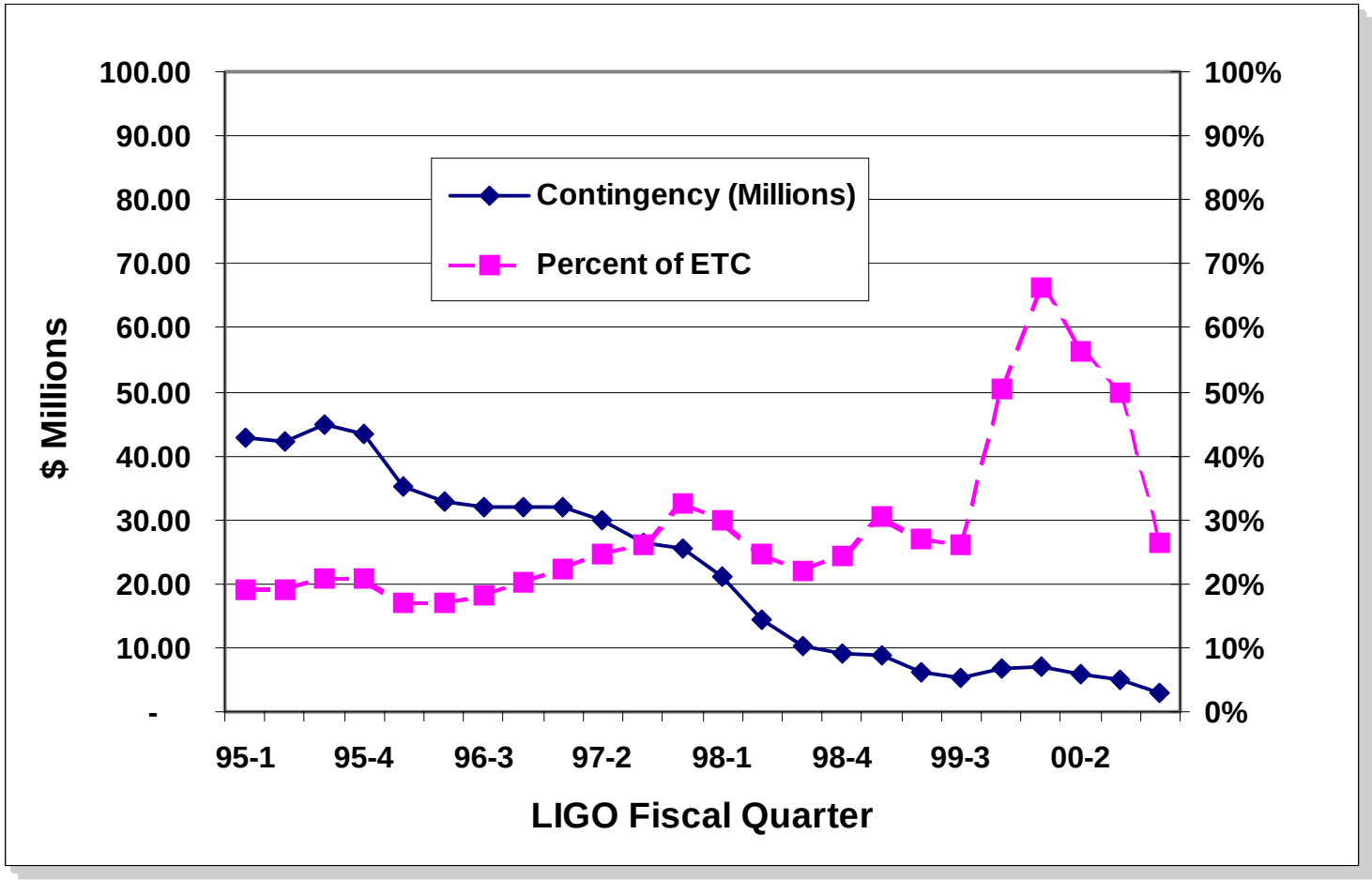
Cost Schedule Performance



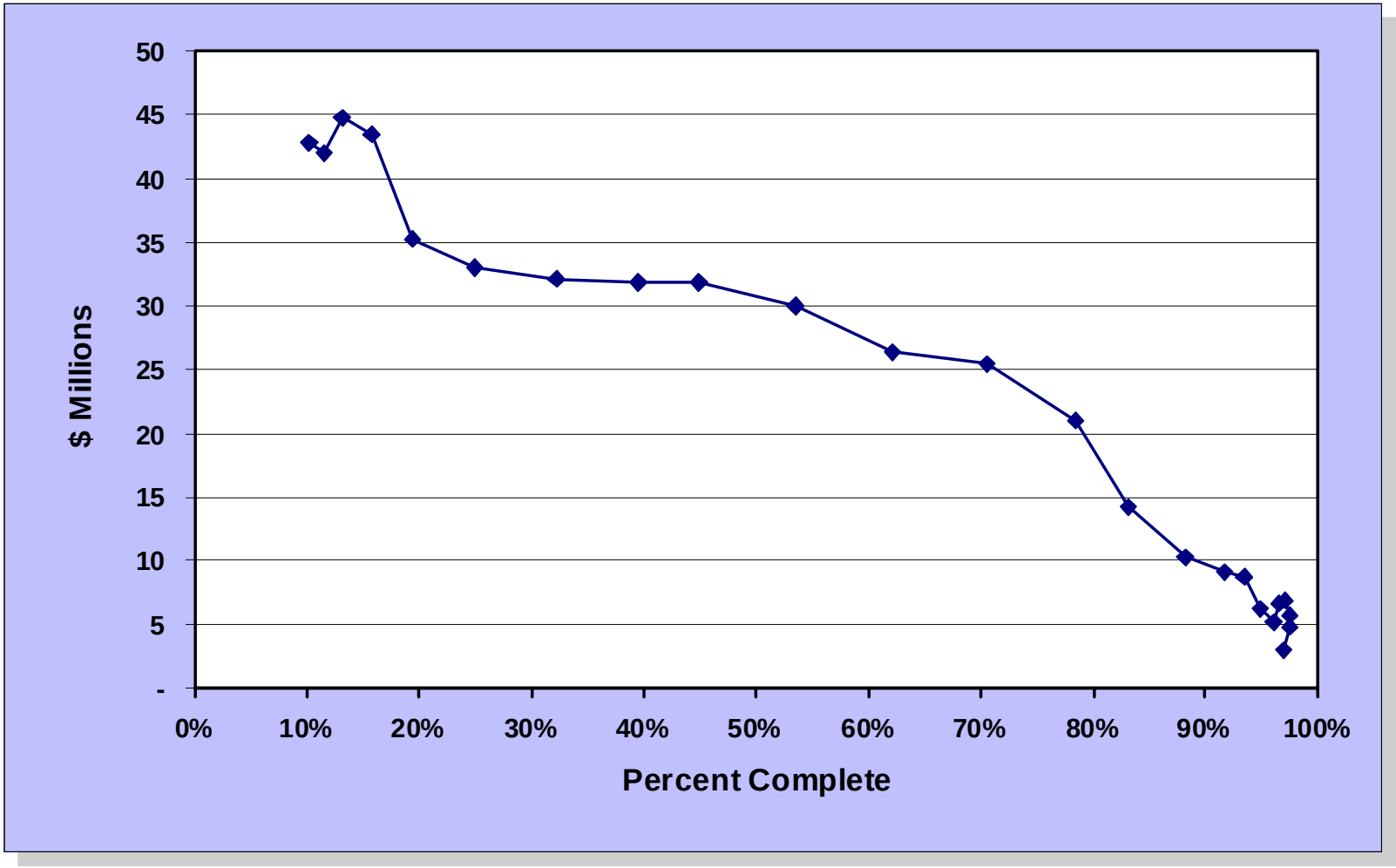
Change Request Log

Change Request No.§	Description§	Submitted By§	Submittal¶ Date§	Current¶ Status§	Disposition Date§	Baseline Date§	Net¶ Contin-gency§
CR-000004§	1.1.4--LVEA Concrete Floor Protection at Hanford§	O. Math-erny§	April 4, 2000§	Approved $86,500 (to be paid from OPs)§	April 11, 2000 M000142§	NA§	$4,619,301§
CR-000005§	1.2.1--Upgrade Prestabilized Lasers§	S. Whit-comb§	April 21, 2000§	Approved $215,000§	August 1, 2000 M000237§	July 2000§	$4,404,301§
CR-000006§	1.2.1--Repolish Core Optics Components§	S. Whit-comb§	April 21, 2000§	Approved $25,200 (to be paid from OPs)§	August 1, 2000 M000237§	NA§	$4,404,301§
CR-000007§	1.2.1--Replace Optical Lever Lasers§	S. Whit-comb§	May 8, 2000§	Approved $120,000 (to be paid from OPs)§	August 1, 2000 M000237§	NA§	$4,404,301§
CR-000008§	1.1.4--Cameras and Projec-tion System for LIGO Liv-ingston Observatory§	F. Asiri§	June 6, 2000§	Approved $26,000§	August 1, 2000 M000237§	July 2000§	$4,378,301§
CR-000009§	1.1.4--Cameras and Projec-tion System for LIGO Han-ford Observatory§	F. Asiri§	June 6, 2000§	Approved $26,000§	August 1, 2000 M000237§	July 2000§	$4,352,301§
CR-000010§	1.2.2--Redesign Suspension Controllers (Large Optics Suspensions)§	S. Whit-comb§	June 2, 2000§	Approved $356,000 (to be paid from OPs)§	August 1, 2000 M000237§	NA§	$4,352,301§

Contingency vs. Time



Contingency vs. Percent Complete

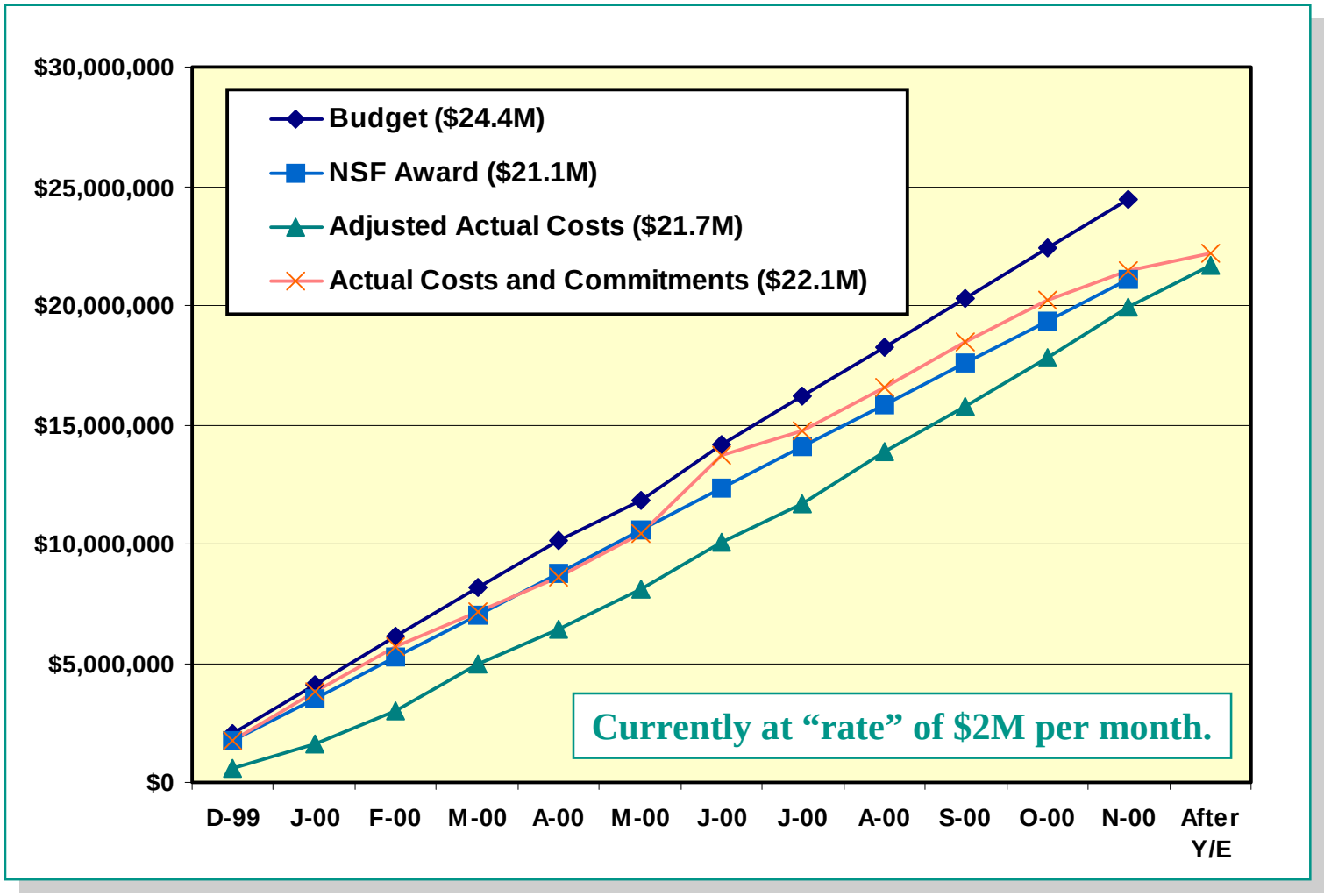


Operations and Advanced R&D

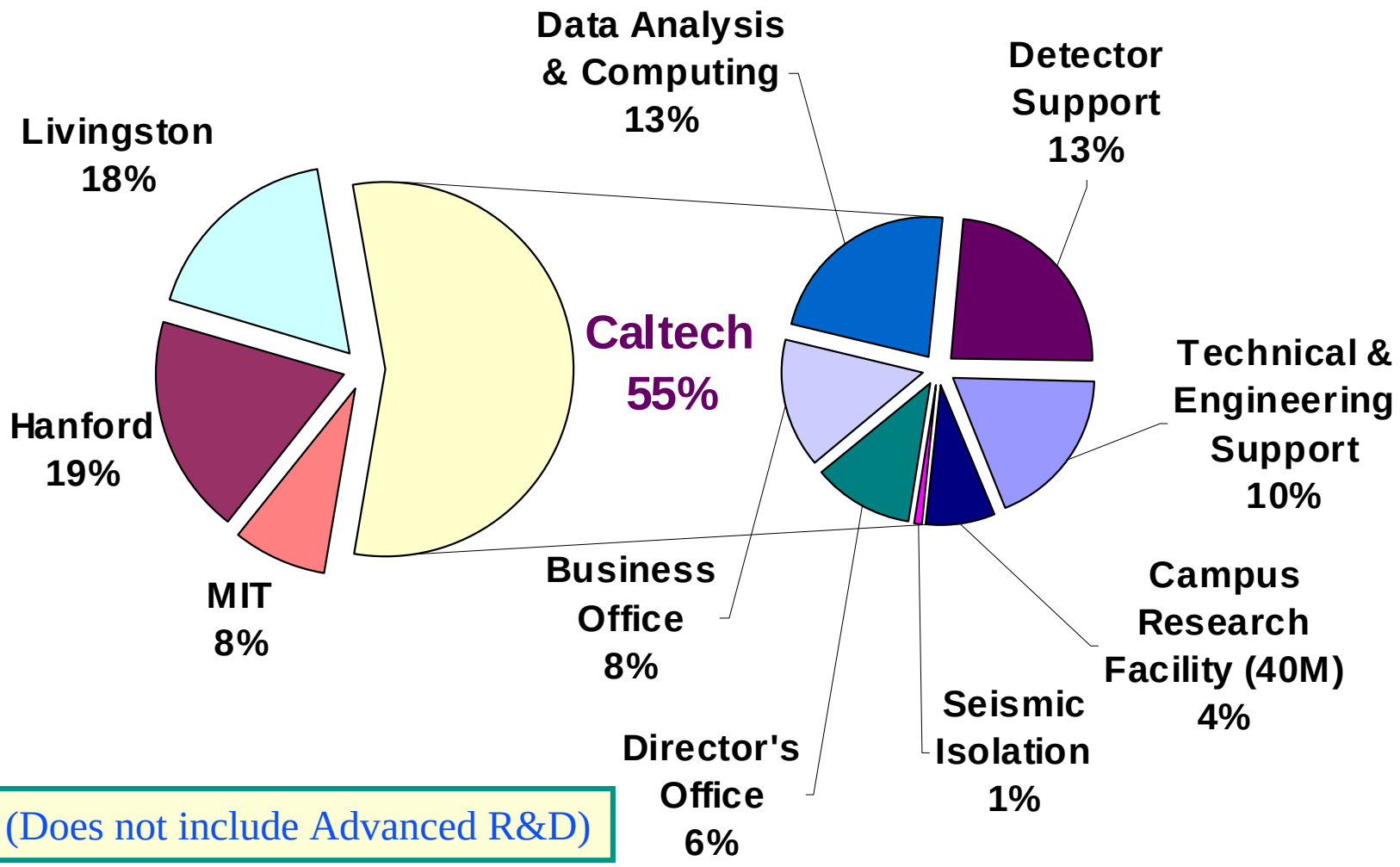
Approach

- Tracking actual costs and commitments vs. Budgets (we make no attempt to measure earned value)
- Budgets prepared and negotiated with group leaders prior to the beginning of the fiscal year
- The Change Control Board (CCB) is used to modify budgets and allocate management reserve as required; threshold requirements same as Construction Project ($50,000)
- Actual cost data derived directly from Caltech's ORACLE financial systems
- Costs and commitments tracked closely within LIGO organization and adjustments made to enhance comparisons, e.g., accruals for known costs that have not yet been booked
- Monthly reports prepared and distributed (see examples)
- Weekly site teleconferences (Caltech, MIT, Hanford, Livingston)

FY 2000 Operations Costs Summary



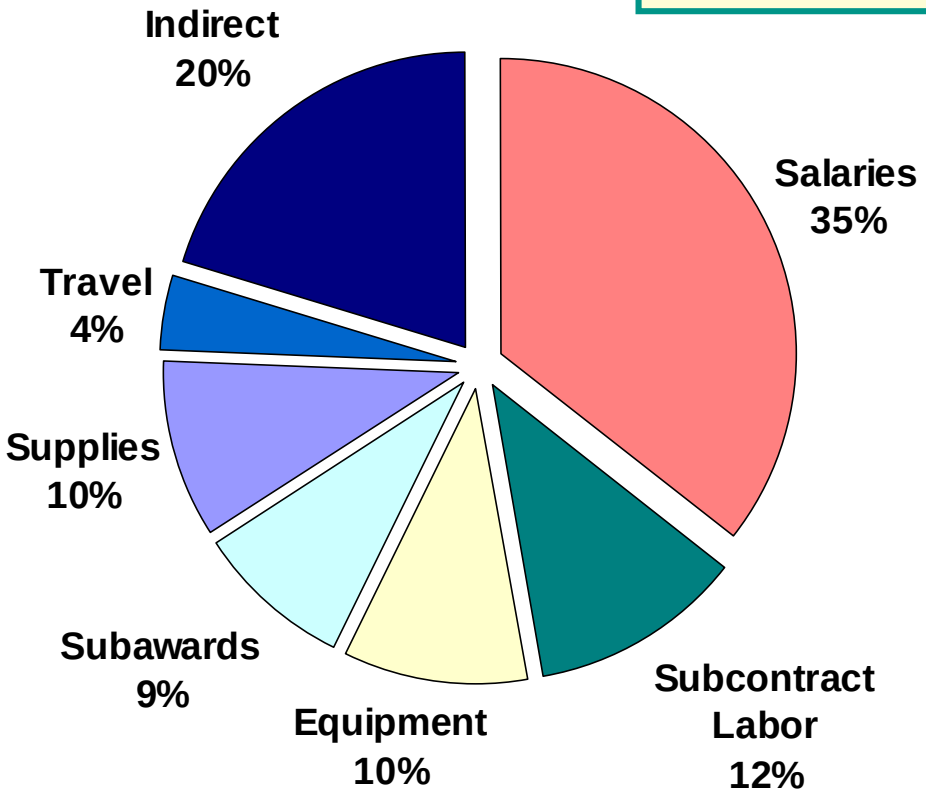
FY 2000 Expenses



(Does not include Advanced R&D)

FY 2000 Expenses (cont.)

(Does not include Advanced R&D)



Proposed Management Approach

- LIGO Operations and Advanced R&D
  - » Continuation of systems developed above (e.g., will continue to establish budgets at the beginning of the year and report costs against the budget)
- LSC Advanced R&D
  - » Use different management approaches to control the broad community effort
  - » Establish Memoranda of Understanding (MOU) with each participant updated every six months http://www.ligo.caltech.edu/LIGO_web/mou/mou.html
  - » Initiate Monthly Working Group teleconferences
- Future Proposed Construction (MRE)
  - » Full cost schedule control system
  - » Integrate with Advanced R&D deliverables (directed R&D)

Future Operations Cost Estimates

How developed

- Based on current operating experience and costs
- Based on WBS
- Separate line item for each cost element
  - » Labor - each position identified
  - » Equipment
  - » Domestic and foreign travel
  - » Participant costs
  - » Other direct costs include materials and supplies, subawards, contract labor
- Burden application
  - » Approved Caltech structure

Also developing Cost book (Web-Based Cost Estimating Tool)

Work Breakdown Structure – CIT

Operations

WBS	WBS Element
1.1	Director's Office (DIR)
1.2	Business Office (BUS)
1.3	Technical and Engineering Support (TEC)
1.4	Detector Support (DET)
1.5.1	Data Analysis
1.5.2	Modeling & Simulation
1.5.3	General Computing
1.6	Campus Research Facilities (40M)
1.7	Seismic Prototype (Livingston)
0.4.2.1	Seismic Isolation R&D Equipment
0.4.3.1	Suspensions R&D Equipment
0.4.6.1	Core Optics R&D Equipment

Equipment in support of LSC R&D

Advanced R&D

WBS	WBS Element
A.2	Thermal Noise Interferometer (TNI)
A.3	Advanced Stabilized Lasers (LAS)
A.4	Advanced Core Optics (Including Sapphire)
A.6	Advanced ISC (Including Photodetectors)
A.8	Seismic Isolation System (Livingston)
A.9	Auxiliary Optics and Thermal Control
A.10	Advanced Suspensions and Fibers
A.11	Low Frequency Noise Suppression
A.12	Resonant Sideband Extraction (40M)
A.13	Advanced Controls and System Identification
A.14	Advanced Input Optics System
A.15	New Advanced R&D CIT

Work Breakdown Structure
Hanford and Livingston

Hanford

WBS	WBS Element
2.1	Site Office
2.2	Facility Maintenance
2.3	Vacuum Equipment
2.4	Optics
2.5	Data Analysis and Computing
2.6	Electronics
2.7	Administration
2.8	Installation Support
2.9	Stockroom
2.10	Outreach
2.11	CDS Maintenance
2.12	LDAS Maintenance

Livingston

WBS	WBS Element
3.1	Site Office
3.2	Facility Maintenance
3.3	Vacuum Equipment
3.4	Optics
3.5	Data Analysis and Computing
3.6	Electronics
3.7	Administration
3.8	Installation Support
3.9	Stockroom
3.10	Outreach
3.11	CDS Maintenance
3.12	LDAS Maintenance

Work Breakdown Structure - MIT

WBS	WBS Element
4.1	MIT Project Office
4.2	MIT Business Office
4.3	MIT LSC Support
4.4	MIT Detector Support
4.5	MIT Data Analysis & Computing
4.6	MIT Campus Research (LASTI)
A.1	MIT Stochastic Noise R&D
A.6	Advanced ISC (Including Photodetectors)
A.9	Auxiliary Optics and Thermal Control
A.16	New Advanced R&D MIT

Example Cost Elements

WBS	Line	Labo Category	Description	FY 2002 FTEs	FY 2002 Amount	FY 2003 FTEs	FY 2003 Amount	Budget Code
1.3	B2	Engineer	Abbott	1.00		1.00		BOP
1.3	B2	Engineer	Billingsley	1.00		1.00		BOP
1.3	B2	Senior Engineer	Bork	1.00		1.00		BOP
1.3	B2	Senior Engineer	Coyne	1.00		1.00		BOP
1.3	B2	Senior Engineer	Heefner	1.00		1.00		BOP
1.3	B2	Engineer	Romie	1.00		1.00		BOP
1.3	B2	Technician	Russell	1.00		1.00		BOP
1.3	B2	Engineer	Mageswarean	1.00		1.00		BOP
1.3	B2	Technician	Hoang	1.00		1.00		BOP
1.3	B2	Technician	Cardenas	1.00		1.00		BOP
1.3	B2	Engineer	Mailand	1.00		1.00		BOP
1.3	B2	Engineer	Nocero	1.00		1.00		BOP
1.3	C	Benefits	Benefits (22.5 percent)		88		230,707	BOP
1.3	D1	Equipment	Equipment under $5000		00		12,360	BOP
1.3	D2	Equipment	Equipment over $5000		00		41,200	BOP
1.3	E1	Travel Domestic	Domestic Travel		00		12,360	BOP
1.3	E2	Travel Foreign	Foreign Travel		00		16,480	BOP
1.3	G1	Supplies	Supplies		65,000		66,950	BOP
1.3	G5C	Senior Engineer	Karwoski	1.00		1.00		BOP
1.3	I	Indirect	Campus Overhead (58 percent)		768,203		791,249	BOP
1.3	B4	Undergraduate	Undergraduate (Robinson)	0.40		0.40		DSE
1.3	B4	Undergraduate	Undergraduate (Lopez)	0.40		0.40		DSE
1.3	B2	Engineer	Liu	1.00		1.00		DSE
1.3	C	Benefits	Benefits (22.5 percent)		16,313		16,802	DSE
1.3	G5C	Senior Engineer	Senior Electronic Engineer	1.00		1.00		DSE
1.3	G5C	Technician	Senior Electronic Technician	1.00		1.00		DSE
1.3	I	Indirect	Campus Overhead (58 percent)		61,255		63,093	DSE

LIGO uses contract labor for flexibility

Basic Oper-ations

Increase For Engr Support

Indirect Cost Rate Agreement

Cognizant Agency & Date:	**Office of Naval Research, 08/31/00**
On Campus Overhead Rate[1]:	**58% MTDC**
Off Campus Overhead Rate[1]:	**26% MTDC**
Staff Benefits Rate[2]:	**22.5%**
GRA Benefit Rate:	**60% of GRA Stipend[3]**
MIT:	**Numbers provided by MIT based on MIT negotiated rates**

Modified Total Direct Costs

1. Excludes: Equipment, Caltech transfers (funds from campus to JPL), subcontract amounts over $25,000, GRA Benefit and participant support costs.
2. Excludes: Undergraduate and Graduate Student salaries.
3. Applicable to all federal grants and contracts, and all other awards that provide full indirect cost recovery. The GRA Tuition Remission Benefit for all non-federal awards (gifts, grants, contracts) that do not provide full overhead is 80% of GRA salary.

Future Operations Proposal Budget

	FY 2001 ($M)	FY 2002 ($M)	FY 2003 ($M)	FY 2004 ($M)	FY 2005 ($M)	FY 2006 ($M)	Total 2002-6 ($M)
Currently funded Operations	22.92	23.63	24.32	25.05	25.87	26.65	125.52
Increase for Full Operations		5.21	5.20	4.79	4.86	4.95	25.01
Advanced R&D	2.70	2.77	2.86	2.95	3.04	3.13	14.76
R&D Equipment for LSC Research		3.30	3.84	3.14			10.28
Total Budgets	25.62	34.91	36.21	35.93	33.77	34.74	175.57

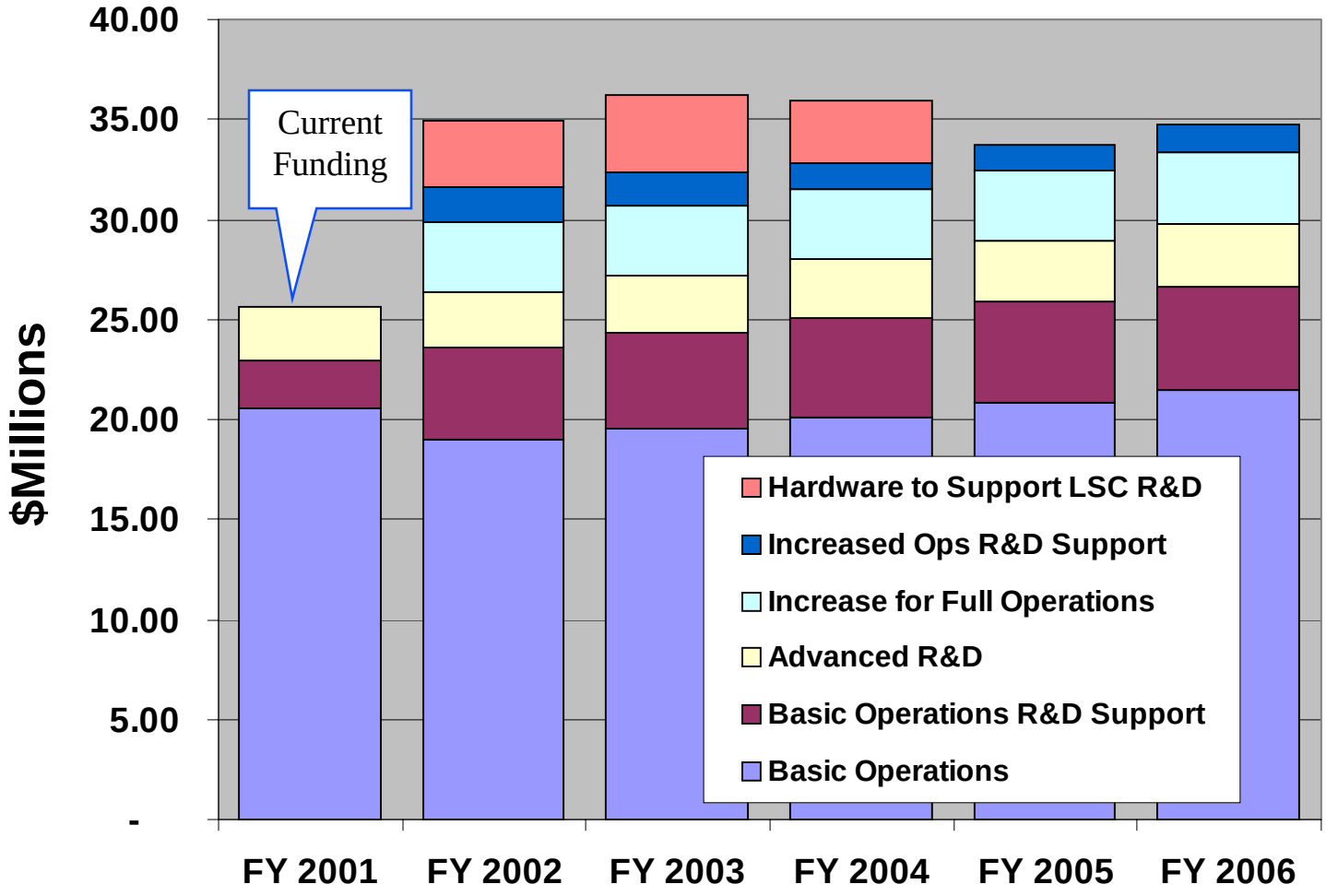
FY 2001 currently funded Operations ($19.1M for ten months) is normalized to 12 months and provided for comparison only and is not included in totals.

Future Operations Proposal (cont.)

- Advanced R&D Subpanel requested a breakout of all costs associated with the support of Advanced R&D.

Budget Category	Funding Issue	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
R&D						
	Advanced R&D	2,772,611	2,864,430	2,950,363	3,038,874	3,130,040
	Basic Ops R&D Support	4,663,972	4,796,151	4,932,296	5,072,525	5,216,961
	Increased Ops R&D Support	1,709,652	1,677,017	1,282,562	1,324,029	1,367,062
R&D Total		**9,146,235**	**9,337,598**	**9,165,221**	**9,435,428**	**9,714,062**
Ops						
	Basic Operations	18,967,517	19,523,471	20,115,396	20,797,746	21,437,206
	Increased Basic Operations	3,496,039	3,518,263	3,509,689	3,537,275	3,588,114
Ops Total		**22,463,555**	**23,041,734**	**23,625,085**	**24,335,020**	**25,025,319**
LSC						
	Equipment in Support of LSC R&D	3,301,075	3,835,556	3,140,345		
LSC Total		**3,301,075**	**3,835,556**	**3,140,345**		
Grand Total		**34,910,865**	**36,214,889**	**35,930,651**	**33,770,448**	**34,739,382**

Future Operations Proposal (cont.)



FY 2001 funding normalized to 12 months shown for comparison

Advanced R&D Effort (FY2002)

Stochastic Noise. LASTI integrated system tests of the advanced seismic isolation and suspension prototypes.	**$275,222**
Thermal Noise Interferometer. Direct measurement of test mass thermal noise for initial and advanced LIGO designs.	**$176,697**
Advanced Core Optics including sapphire optics.	**$283,937**
Advanced Interferometer Sensing and Control including Photodetector Development.	**$298,779**
Stiff Seismic Isolation Development.	**$46,353**
Auxiliary Optics Systems including Active Thermal Control.	**$366,088**
Advanced Suspensions including Fiber Research.	**$208,725**
Improved Low Frequency Strain Sensitivity.	**$345,637**
40-Meter Advanced R&D. Tests of controls and electronics for a signal and power recycled configuration with read-out scheme and control topology intended for advanced LIGO.	**$235,075**
Advanced Controls and System Identification. Research on application of advanced system identification and control concepts to LIGO.	**$188,677**
Advanced (highly stabilized) Input Optic Systems.	**$347,423**

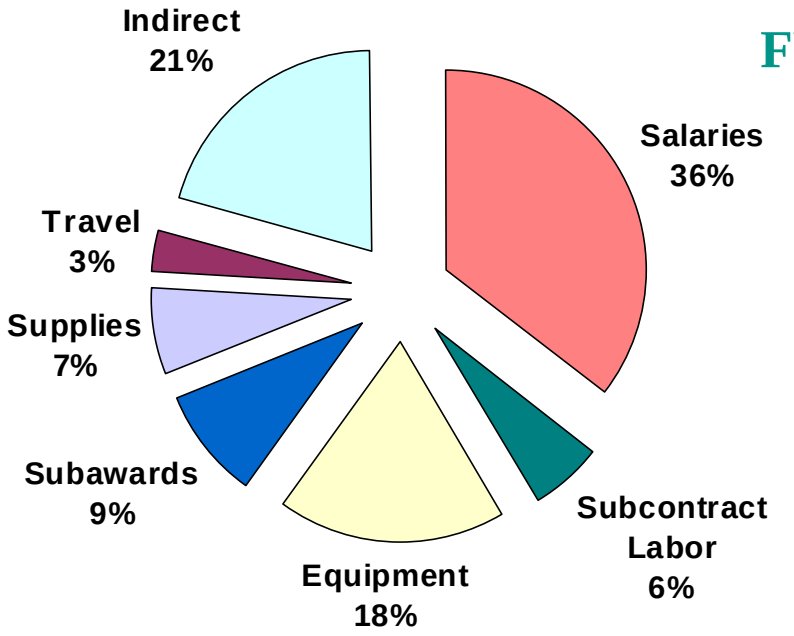
Increase for Full Operations

Budget Category		Increase	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
Basic Operations							
	*	CDS Hardware Maintenance	513,800	502,434	517,507	533,032	549,023
	*	LDAS Maintenance	1,378,728	1,378,728	1,322,235	1,303,163	1,303,163
		Outreach	249,848	257,343	265,063	273,015	281,206
		Observatory Operations	558,485	575,240	592,497	610,272	628,580
	*	Telecommunications / Networking	540,500	542,200	542,200	539,500	539,500
		LIGO Staff for LSC	254,678	262,318	270,187	278,293	286,642
Basic Operations Total			**3,496,039**	**3,518,263**	**3,509,689**	**3,537,275**	**3,588,114**
Operations Support of Advanced R&D							
		Seismic Development	506,300	434,574			
		Engineering Staff	920,868	948,494	976,949	1,006,257	1,036,445
	*	Simulation & Modeling Staff	282,485	293,949	305,614	317,772	330,617
Advanced R&D Support Total			**1,709,652**	**1,677,017**	**1,282,562**	**1,324,029**	**1,367,062**
Grand Total			**5,205,691**	**5,195,280**	**4,792,252**	**4,861,304**	**4,955,176**

*** Need recognized by NSF Review Panel**

Proposal Budget by Cost Category

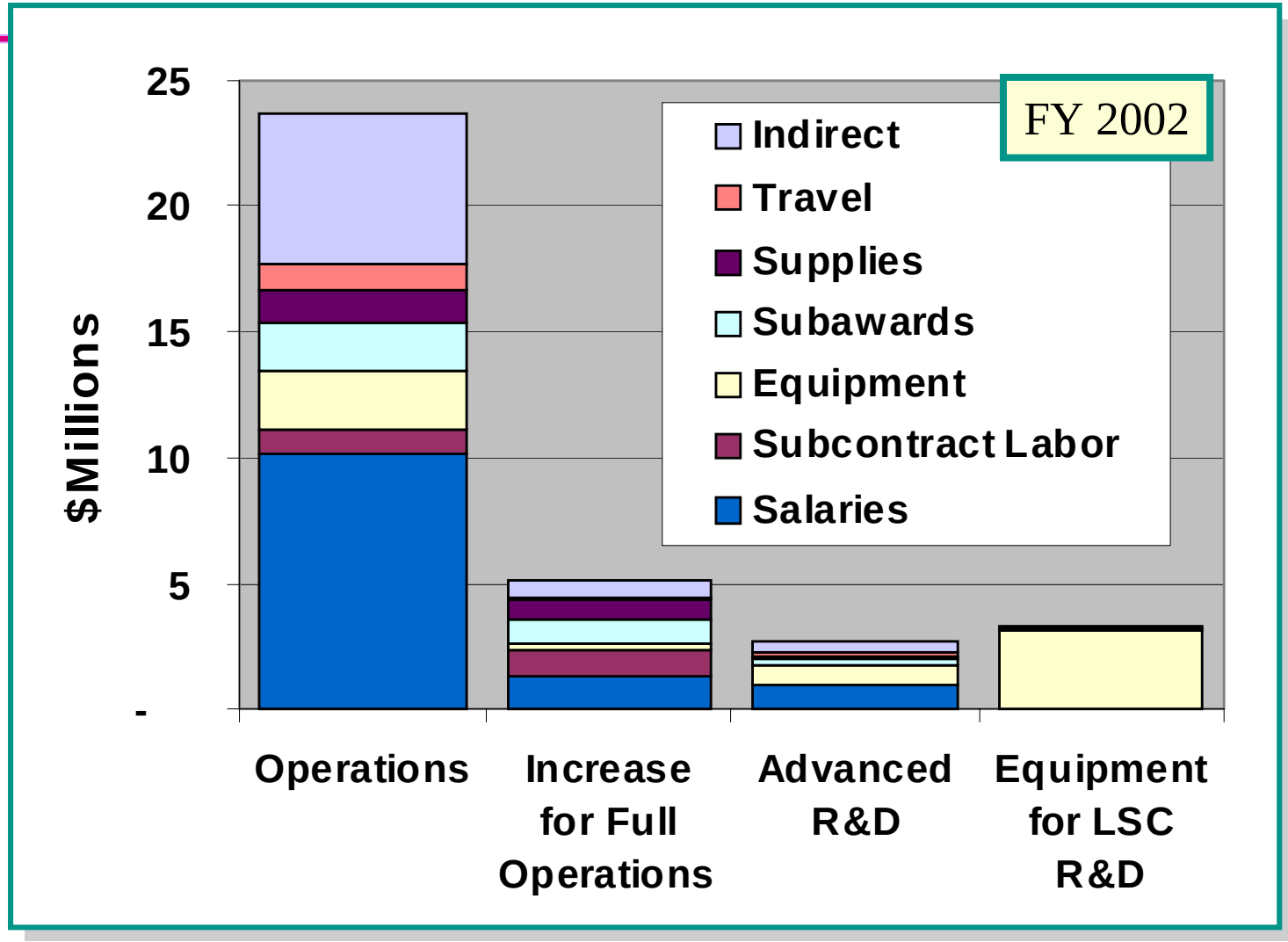
Cost Category	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
Salaries	12,451,415	12,826,004	12,858,588	13,356,635	13,829,893
Subcontract Labor	2,038,000	2,104,870	2,173,680	2,162,816	2,233,769
Equipment	6,362,448	7,206,883	7,057,561	4,155,678	4,136,905
Subawards	3,207,223	2,994,144	3,002,745	3,073,862	3,149,893
Supplies	2,459,296	2,464,861	2,170,455	2,034,321	2,092,037
Travel	1,118,600	1,134,605	1,082,299	1,130,594	1,180,000
Indirect	7,273,884	7,483,522	7,585,321	7,856,542	8,116,886
Grand Total	**34,910,865**	**36,214,889**	**35,930,651**	**33,770,448**	**34,739,382**



FY 2002

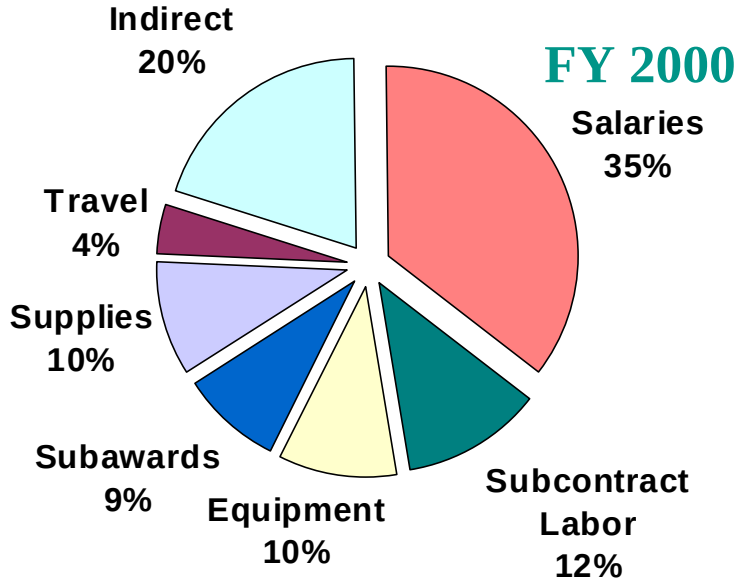
Operations
including Advanced R&D

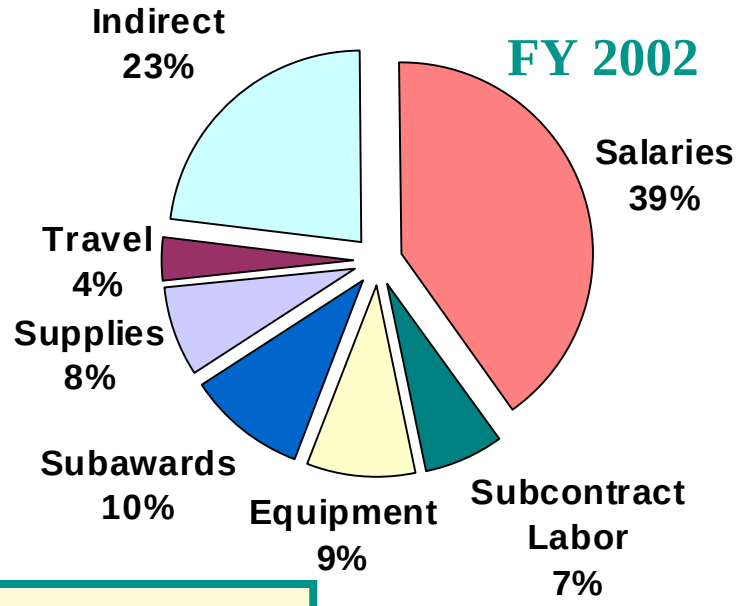
Proposal Budget by Cost Category



Proposal Budget by Category (2)

Cost Category	FY 2000 Actual Costs	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
Salaries	$7,657,911	11,511,859	11,804,699	11,809,411	12,184,066	12,570,548
Subcontract Labor	$2,499,533	1,963,000	2,027,620	2,094,113	2,162,816	2,233,769
Equipment	$2,162,367	2,569,771	2,604,437	2,923,586	3,110,967	3,158,532
Subawards	$1,846,189	2,859,800	2,931,079	3,002,745	3,073,862	3,149,893
Supplies	$2,052,735	2,239,018	2,272,304	2,035,805	1,983,807	2,035,264
Travel	$908,740	1,044,500	1,062,136	1,023,450	1,054,154	1,085,778
Indirect	$4,368,267	6,649,232	6,812,627	6,950,832	7,161,903	7,375,558
Grand Total	**21,495,742**	**28,837,180**	**29,514,903**	**29,839,943**	**30,731,574**	**31,609,342**





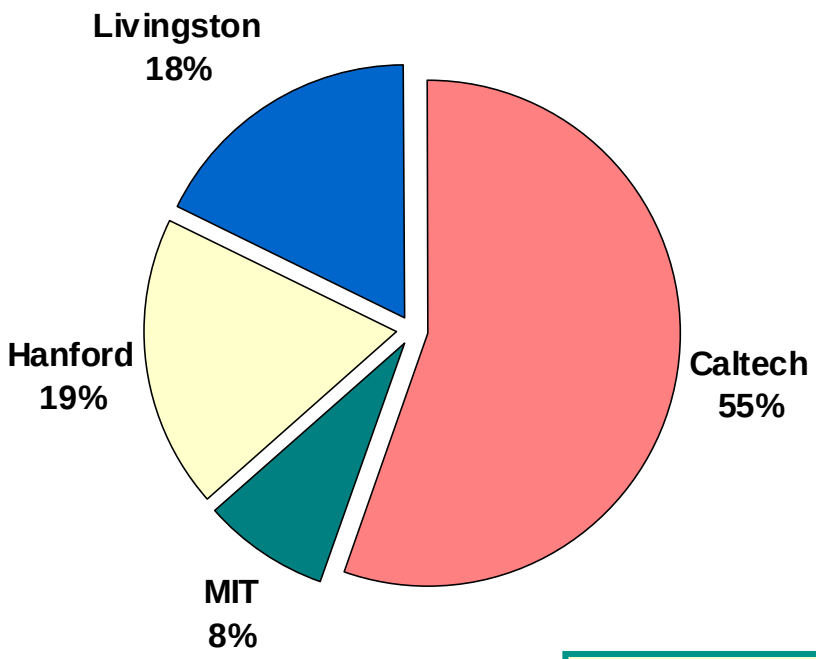
Operations excluding Advanced R&D

Proposal Budget by Location

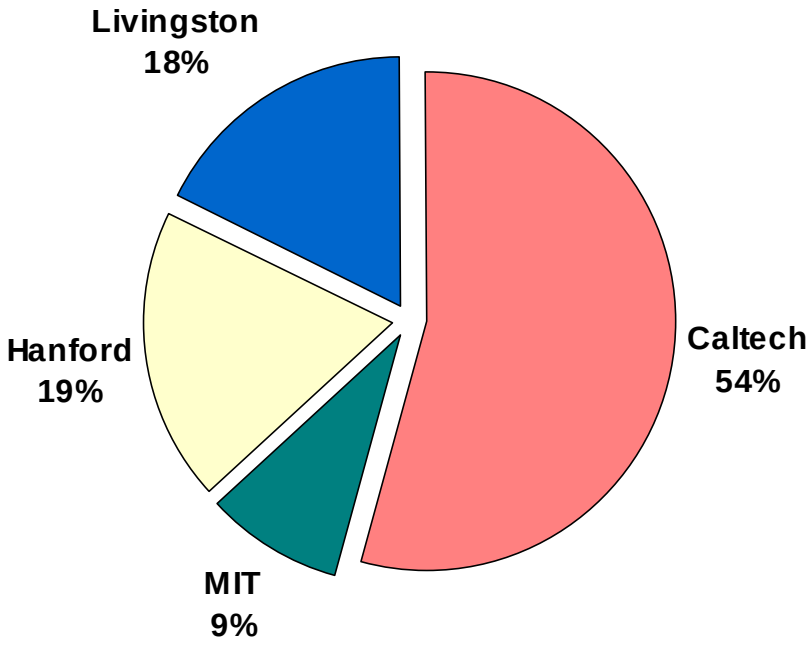
	FY 2002 ($M)	FY 2003 ($M)	FY 2004 ($M)	FY 2005 ($M)	FY 2006 ($M)	Total ($M)
Caltech	21.21	22.14	21.47	18.90	19.44	102.23
MIT	3.02	3.11	3.20	3.30	3.39	16.01
Hanford	5.57	5.72	5.87	6.04	6.21	29.42
Livingston	5.11	5.24	5.38	5.54	5.70	26.97
Total	34.91	36.21	35.93	33.77	34.74	175.57

Proposal Budget by Location

FY 2000 actual costs



FY 2002 proposal budget



Excludes Advanced R&D

Proposal Budget Summary for Caltech

WBS	Description	FY 2000 Actual Costs ($M)	FY 2002 ($M)	FY 2003 ($M)	FY 2004 ($M)	FY 2005 ($M)	FY 2006 ($M)
1.1	Director's Office	1.33	2.23	2.30	2.37	2.44	2.51
1.2	Business Office	1.76	1.60	1.65	1.70	1.75	1.80
1.3	Technical and Engineering Supt	2.15	2.79	2.88	2.96	3.05	3.14
1.4	Detector Support	2.86	2.22	2.29	2.36	2.43	2.50
1.5	Data and Computing	2.74	5.50	5.62	5.71	5.91	6.06
1.6	40-Meter Facility	0.92	0.74	0.76	0.77	0.79	0.80
1.7	Seismic Facility	0.12	0.51	0.43			
	Subtotal	11.87	15.60	15.92	15.87	16.37	16.83
0.	LSC R&D Support		3.30	3.84	3.14		
A.	Advanced R&D	(est.) 1.87	2.31	2.39	2.46	2.53	2.61
	Total	13.74	21.21	22.15	21.47	18.90	19.44

Balancing Administrative Activities Across Sites

Advantages for administrative functions at Caltech

- Large number of administrative functions provided as part of the Caltech infrastructure
- Efficiency of scale (no duplications at the sites)
- Close interaction required with Caltech-provided support functions

Advantages for administrative functions at sites

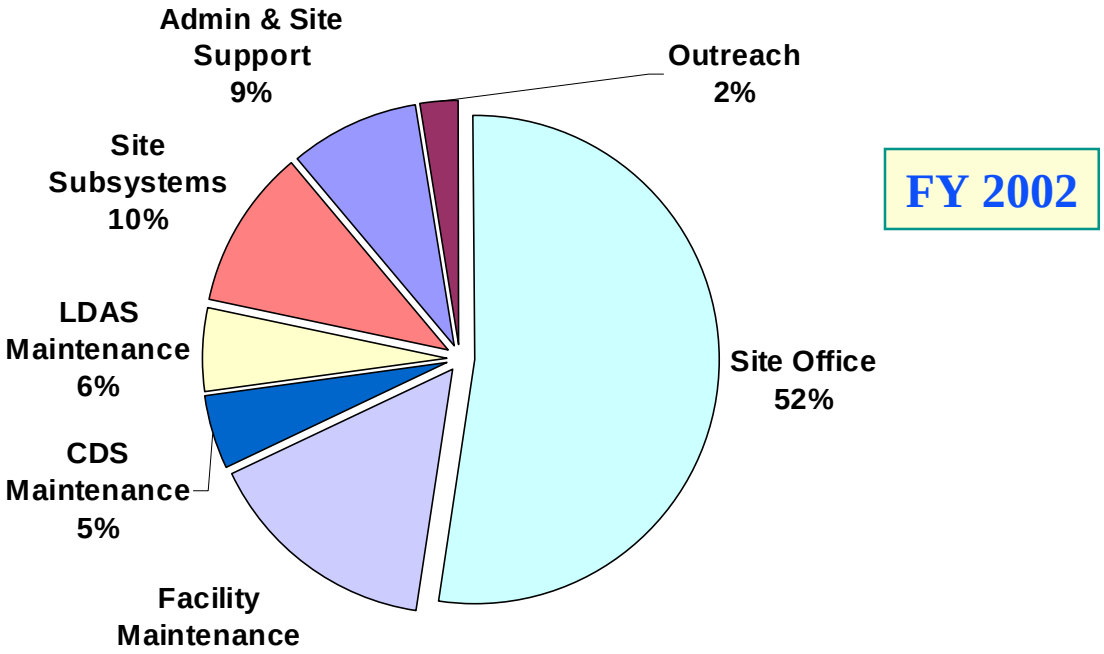
- Reduced overhead
- Provides a measure of autonomy for site operations
  - » Caltech has issued purchasing cards for use at sites
  - » Petty cash checking accounts have been established
  - » Blanket purchase orders have been established for supplies and temporary labor

Administrative Activities at CIT

- Procurement, subcontracts management
- Accounts Payable, Invoice Processing
- Account and Cost Reporting
- Project Financial Reporting and Data Audit
- Property Management
- Human Resources
- Payroll and Benefits
- Legal
- Travel
- Document Control Center
- Safety
- Web Development

Proposal Budget Summary for Hanford

WBS Group	FY 2000 Actual Costs	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
Site Office	2,066,265	2,912,987	3,000,376	3,090,387	3,183,099	3,278,592
Facility Maintenance	652,085	864,840	890,785	917,509	945,034	973,385
CDS Maintenance		281,900	276,967	285,276	293,834	302,649
LDAS Maintenance		314,218	314,218	307,531	304,638	304,638
Site Subsystems	468,071	574,130	591,354	609,095	627,367	646,188
Admin & Site Support	797,700	491,400	506,142	521,326	536,966	553,075
Outreach	34,817	134,831	138,875	143,041	147,332	151,753
	4,018,938	**5,574,305**	**5,718,718**	**5,874,165**	**6,038,271**	**6,210,280**



Lower Level Budgets at Hanford

WBS Group	Cost Category	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
Hanford						
Site Office						
	Salaries	2,081,275	2,143,713	2,208,025	2,274,265	2,342,493
	Equipment	150,000	154,500	159,135	163,909	168,826
	Subawards	10,000	10,300	10,609	10,927	11,255
	Supplies	3,000	3,090	3,183	3,278	3,377
	Travel	80,000	82,400	84,872	87,418	90,041
	Indirect	588,712	606,373	624,564	643,301	662,600
Site Office Total		**2,912,987**	**3,000,376**	**3,090,387**	**3,183,099**	**3,278,592**
Facility Maintenance						
	Equipment	36,000	37,080	38,192	39,338	40,518
	Subawards	552,000	568,560	585,617	603,185	621,281
	Supplies	216,000	222,480	229,154	236,029	243,110
	Indirect	60,840	62,665	64,545	66,482	68,476
Facility Maintenance Total		**864,840**	**890,785**	**917,509**	**945,034**	**973,385**
Hanford Total		**3,777,827**	**3,891,161**	**4,007,896**	**4,128,133**	**4,251,977**

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Proposal Budgets by Location and WBS

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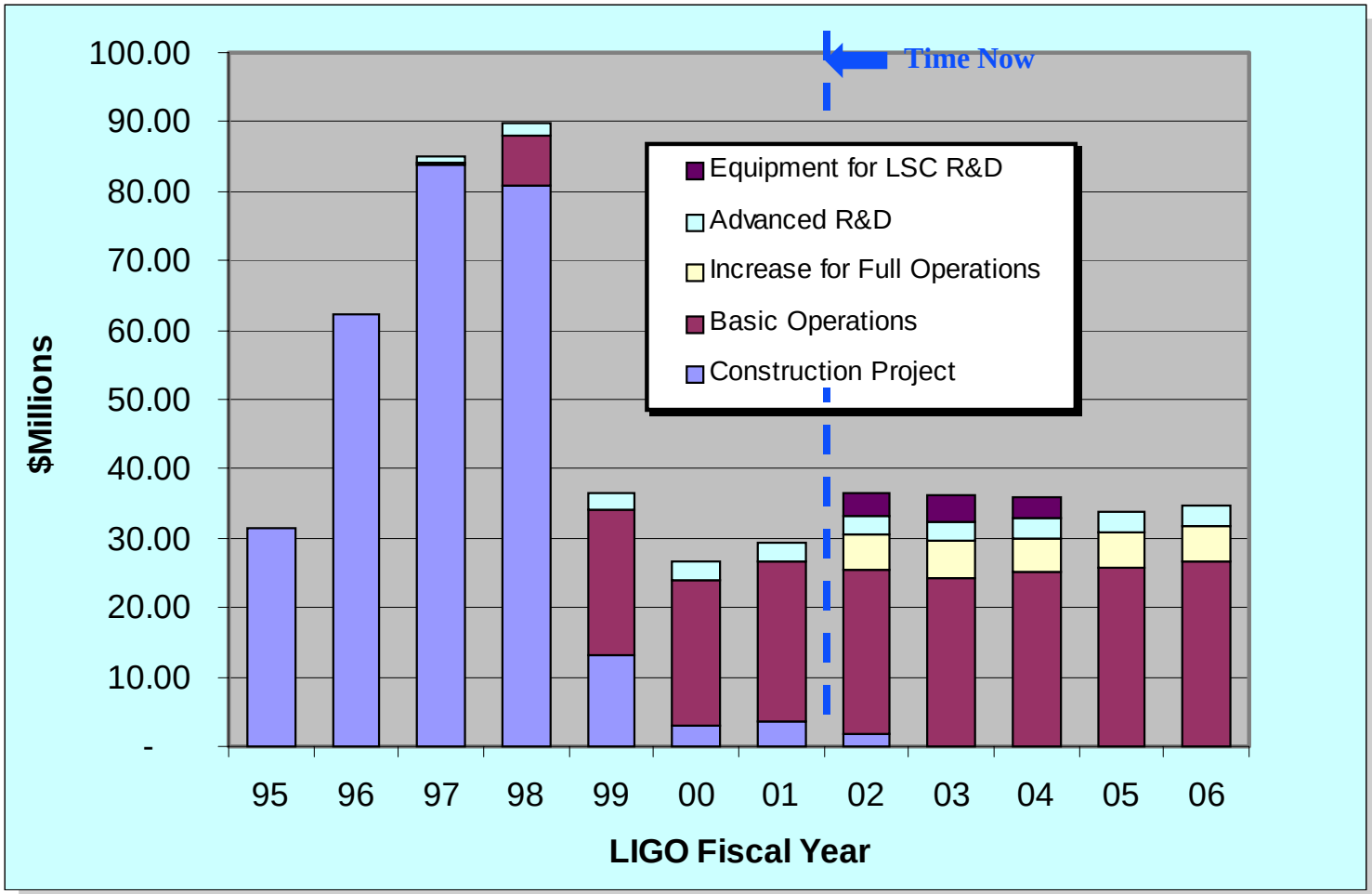
Proposal Budgets by NSF Cost Code

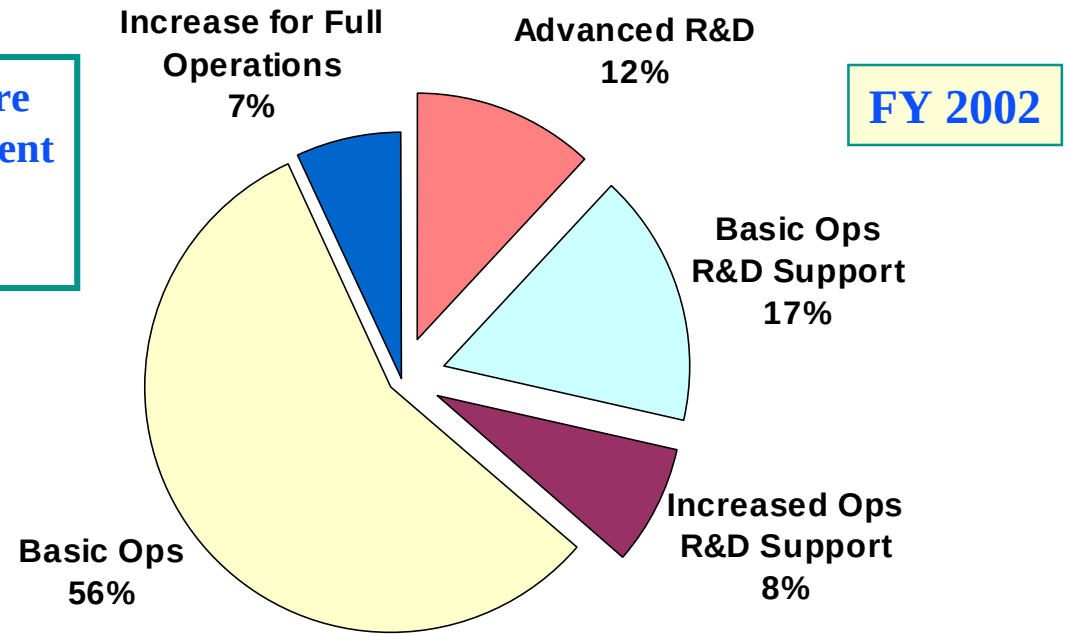
Budget History and Request



Staffing by Funding Source

Funding Issue	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
Advanced R&D	21.8	21.8	21.8	21.8	21.8
Basic Ops R&D Support	30.9	30.9	30.9	30.9	30.9
Increased Ops R&D Support	14.3	14.3	9.8	9.8	9.8
Basic Ops	104.2	104.2	104.2	104.2	104.2
Increase for Full Operations	13.0	13.0	13.0	13.0	13.0
Grand Total	**184.1**	**184.1**	**179.6**	**179.6**	**179.6**

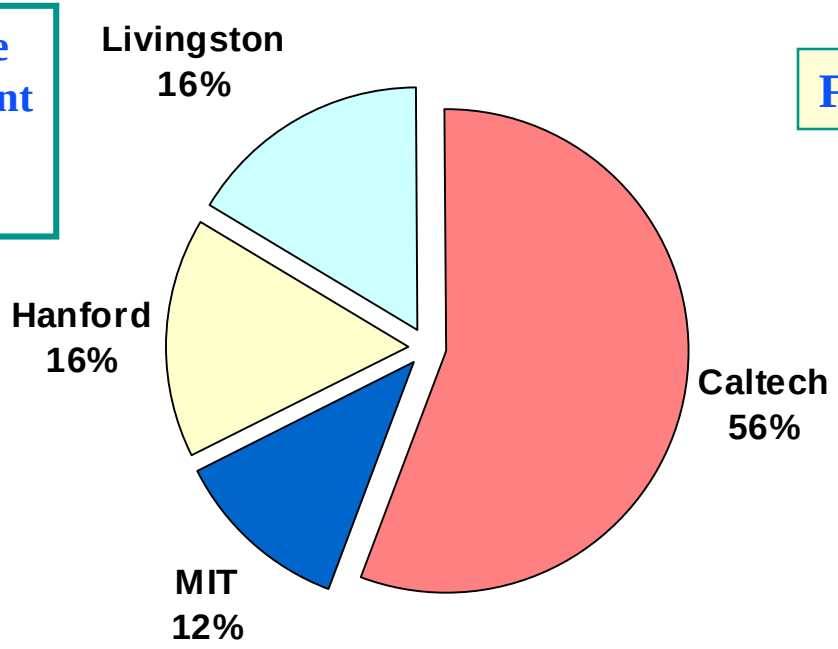
Numbers shown are Full Time Equivalent Employees (FTEs) actually charged



Staffing by Location

Location	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
Caltech	102.3	102.3	97.8	97.8	97.8
Hanford	30.0	30.0	30.0	30.0	30.0
Livingston	30.0	30.0	30.0	30.0	30.0
MIT	21.8	21.8	21.8	21.8	21.8
Grand Total	**184.1**	**184.1**	**179.6**	**179.6**	**179.6**

Numbers shown are Full Time Equivalent Employees (FTEs) actually charged

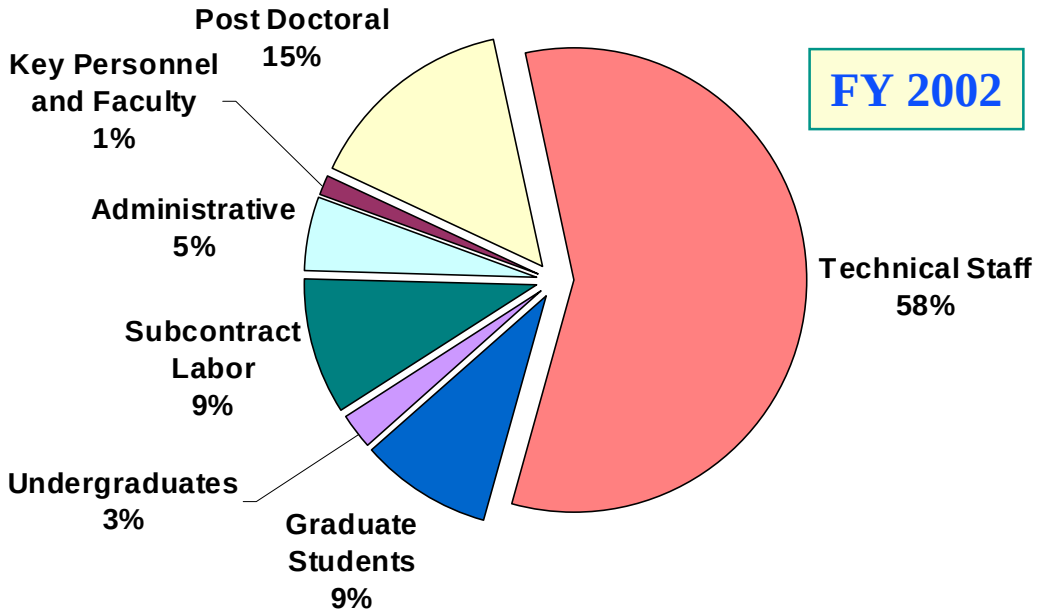


FY 2002

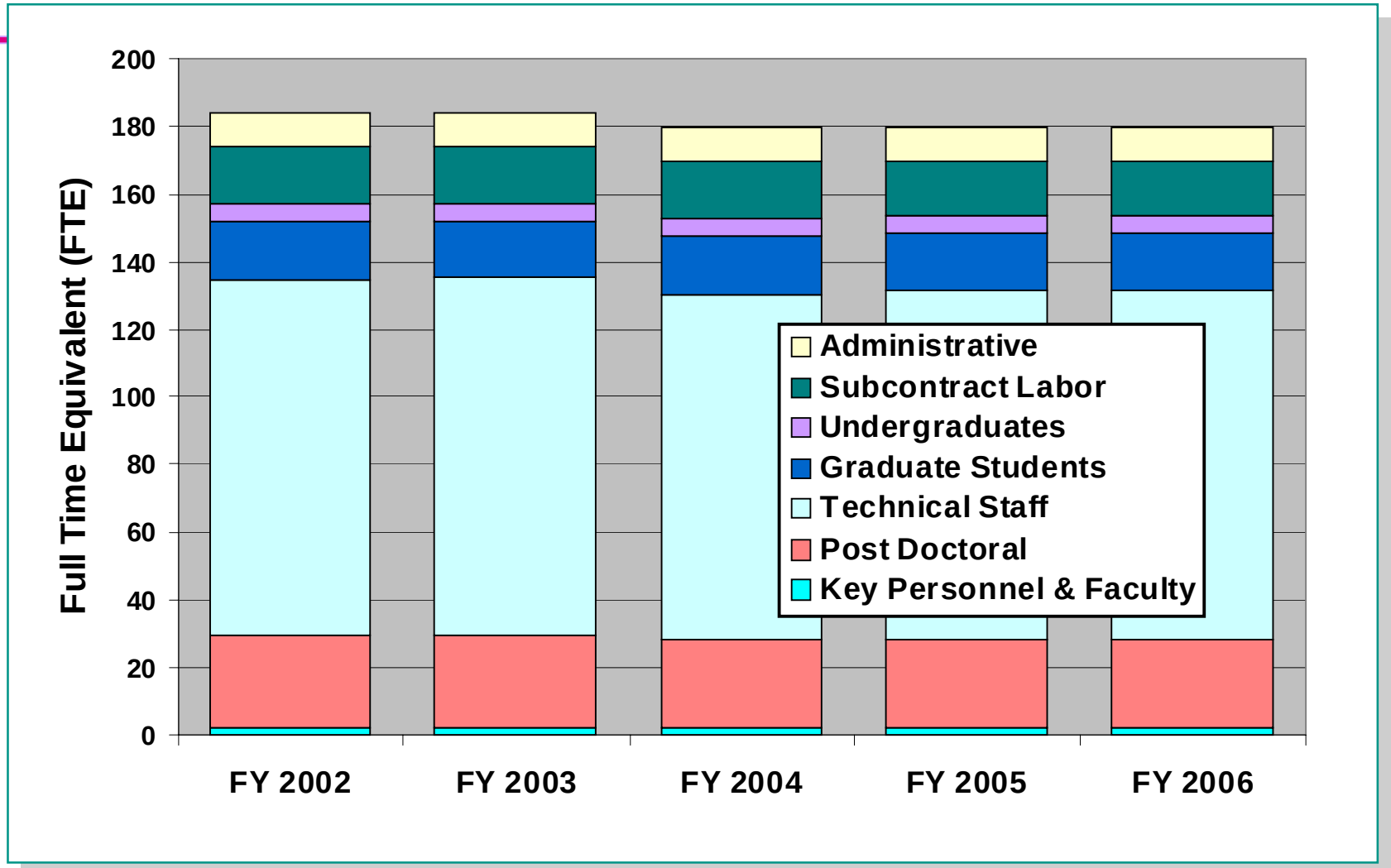
Staffing by Labor Category

Category	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
Key Personnel / Faculty	2.6	2.6	2.6	2.6	2.6
Post Doctoral	27.0	27.0	26.0	26.0	26.0
Technical Staff	104.7	105.7	101.7	102.7	102.7
Graduate Students	18.0	17.0	17.5	17.5	17.5
Undergraduate	4.9	4.9	4.9	4.9	4.9
Subcontract Labor	17.0	17.0	17.0	16.0	16.0
Administrative	9.9	9.9	9.9	9.9	9.9
Grand Total	**184.1**	**184.1**	**179.6**	**179.6**	**179.6**

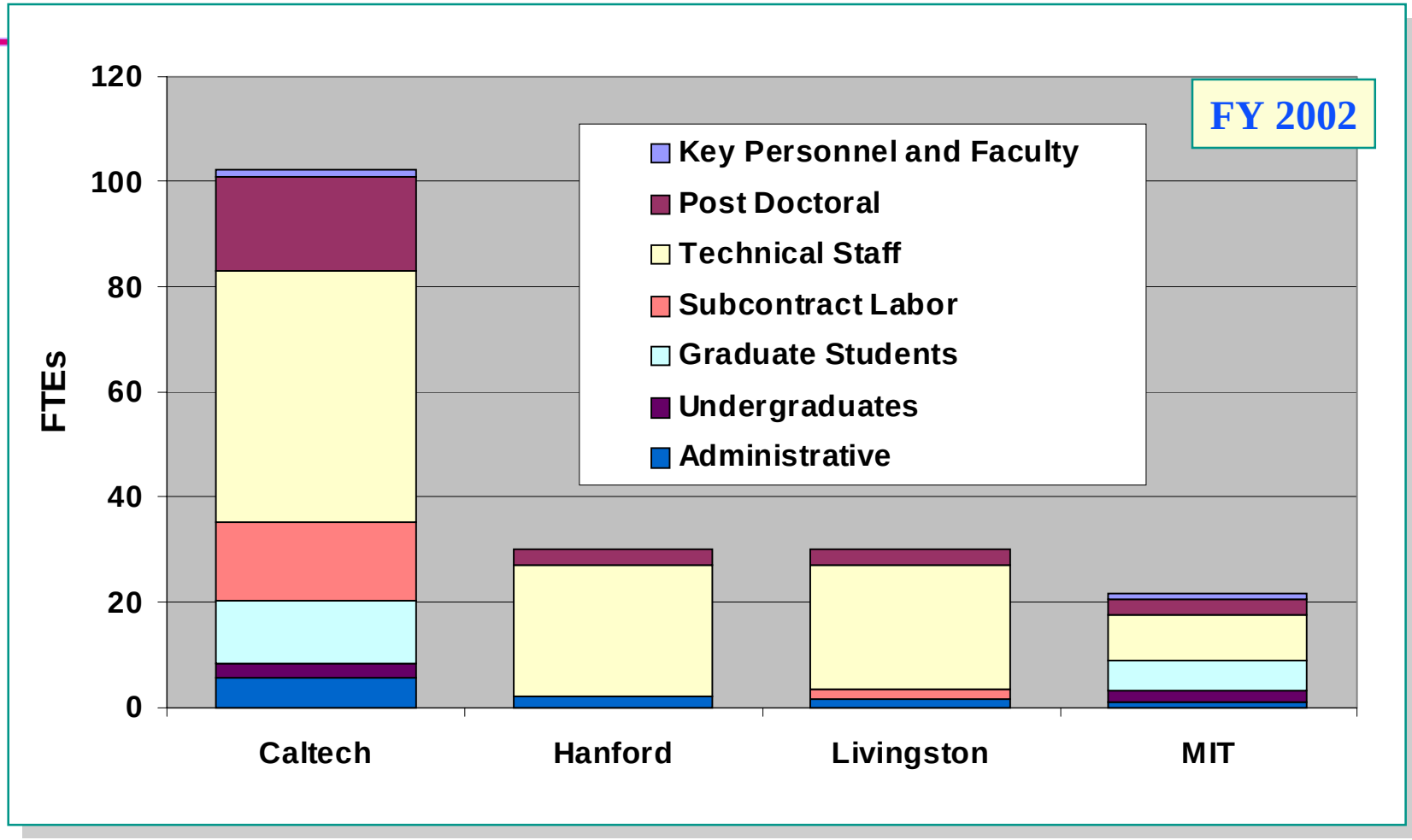
Numbers shown Are Full Time Equivalent Employees (FTEs) actually charged



Staffing by Fiscal Year



Labor Category by Site



Staffing by WBS - Caltech

WBS	WBS Description	FY 2002 FTEs	FY 2003 FTEs	FY 2004 FTEs	FY 2005 FTEs	FY 2006 FTEs
1.1	Director's Office (DIR)	5.4	5.4	5.4	5.4	5.4
1.2	Business Office (BUS)	11.5	11.5	11.5	11.5	11.5
1.3	Technical and Engineering Support (TEC)	16.8	16.8	16.8	16.8	16.8
1.4	Detector Support (DET)	16.0	16.0	16.0	16.0	16.0
1.5.1	Data Analysis	16.6	16.6	16.6	16.6	16.6
1.5.2	Modeling & Simulation	7.0	7.0	7.0	7.0	7.0
1.5.3	General Computing	4.0	4.0	4.0	4.0	4.0
1.6	Campus Research Facilities (40M)	5.0	5.0	5.0	5.0	5.0
1.7	Seismic Prototype (Livingston)	4.5	4.5			
A.2	Thermal Noise Interferometer (TNI)	2.0	2.0	2.0	2.0	
A.3	Advanced Stabilized Lasers (LAS)				1.0	
A.4	Advanced Core Optics (Including Sapphire)	0.5				
A.6	Advanced ISC (Including Photodetectors)					
A.9	Auxiliary Optics and Thermal Control	2.0				
A.10	Advanced Suspensions and Fibers	2.5	3.0	3.0		
A.11	Low Frequency Noise Suppression	3.0	3.0	3.0	3.0	3.0
A.12	Resonant Sideband Extraction (40M)	3.0	3.0	3.0	3.0	3.0
A.13	Advanced Controls and System Identification	2.0	2.0	2.0	2.0	2.0
A.14	Advanced Input Optics System		2.0	2.0		
A.15	New Advanced R&D CIT			0.5	4.5	7.5
Total		102.3	102.3	97.8	97.8	97.8

AR&D Does not Include LSC Support

Staffing by WBS
Hanford and Livingston

WBS	WBS Description	FY 2002 FTEs	FY 2003 FTEs	FY 2004 FTEs	FY 2005 FTEs	FY 2006 FTEs
Hanford						
2.1	Site Office	**29.0**	**29.0**	**29.0**	**29.0**	**29.0**
2.10	Outreach	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**
Hanford Total		**30.0**	**30.0**	**30.0**	**30.0**	**30.0**
3.1	Site Office	**29.0**	**29.0**	**29.0**	**29.0**	**29.0**
3.10	Outreach	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**
Livingston Total		**30.0**	**30.0**	**30.0**	**30.0**	**30.0**

- 2.10, 3.10 is incremental support for Outreach

Staffing by WBS - MIT

WBS	WBS Description	FY 2002 FTEs	FY 2003 FTEs	FY 2004 FTEs	FY 2005 FTEs	FY 2006 FTEs
4.1	MIT Project Office	1.3	1.3	1.3	1.3	1.3
4.2	MIT Business Office	1.0	1.0	1.0	1.0	1.0
4.3	MIT LSC Support	1.3	1.3	1.3	1.3	1.3
4.4	MIT Detector Support	7.5	7.5	7.5	7.5	7.5
4.5	MIT Data Analysis & Computing	4.5	4.5	4.5	4.5	4.5
A.1	MIT Stochastic Noise R&D	4.3	4.3	4.3	4.3	
A.6	Advanced ISC (Including Photodetectors)	1.0	1.0	1.0		
A.9	Auxiliary Optics and Thermal Control	1.0	1.0	1.0		
A.16	New Advanced R&D MIT				2.0	6.3
Total		21.8	21.8	21.8	21.8	21.8

FTEs do not reflect support provided by LIGO Scientific Collaboration.

Schedule and Milestones

- Schedules and Milestones will be discussed in the subsequent presentations
- The only remaining NSF milestone for the Construction Project is “Begin Coincidence Tests”
  - » Project Management Plan – 12/00
  - » Current Projection – 03/01
- Level of Effort for Operations – remaining milestones include (*see D. Coyne’s presentation*):
  - » Initiate LIGO Science Run –2002
  - » Complete Initial LIGO Science Run –2006
- Directed R&D tasks will be matrixed into any future Construction (MRE) schedule.