Schedule & Cost

Mike Tuts

DOE Review

June 17, 1999

- Schedule Milestones
- Manpower
- Cost
- Contingency
- Conclusions

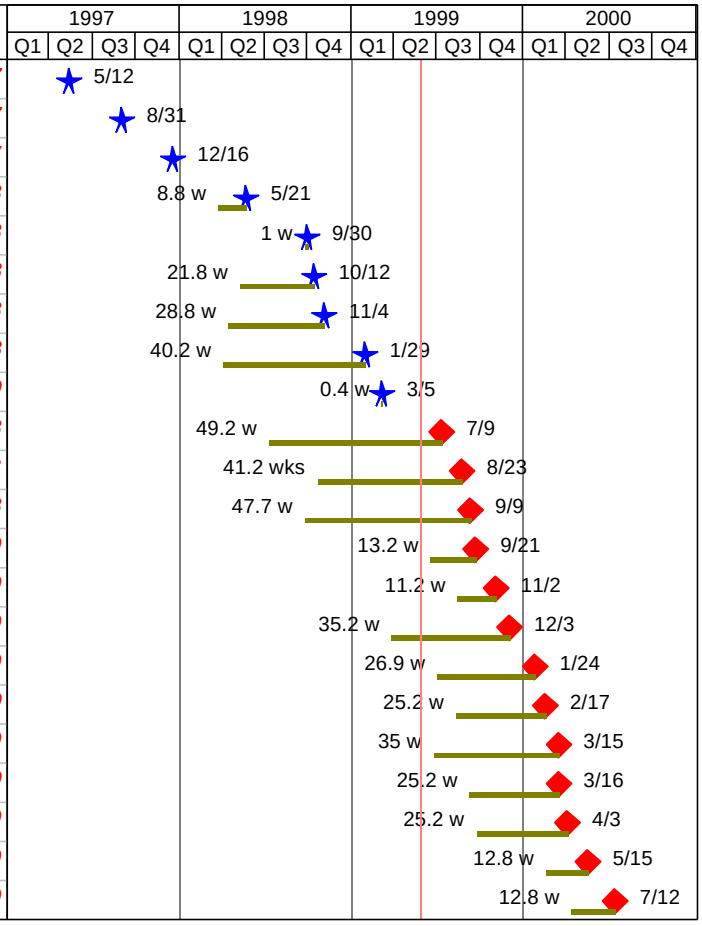
Schedule

- Subsystem status and schedules presented by Harry Weerts
- Schedules (MS Project 98) produced by subsystem managers and maintained by Bill Freeman
- Project tracks major milestones
  - M1 - held by DOE
  - M2 - held by FNAL Directorate
  - M3 - held by Project Managers
  - Others held by Subsystem Managers
- Significant schedule changes approved by PMG
  - present schedule reflects approved change requests

Schedule Milestones

- PMG approved M1 & M2 variances from DOE review 1/98
- Legend: ê complete, ® future

Description	Baseline
M1-Solenoid Delivered to Fermilab	*5/12/97*
M2-VLPC Production 50% Complete	*8/31/97*
M2-Central Preshower Module Fabrication Complete	*12/16/97*
M2-Central Preshower Installed on Solenoid	*3/20/98*
M1-Solenoid Installed and Tested	*9/23/98*
M2-Muon Forward Trigger Counter Assembly 10% Complete	*5/7/98*
M2-Forward Preshower Module Fabrication Begun	*4/13/98*
M2-Muon Forward Tracker MDT Assembly 10% Complete	*4/2/98*
M2 - Assembly design complete	*3/3/99*
M2-First Cylinder Complete	*7/10/98*
M2-First Silicon Tracker Barrel/Disk Module Complete	*10/20/98*
M2-Fiber Tracker Assembly Begun	*9/21/98*
M2-ICD Modules Arrive at Fermilab	*6/17/99*
M2-Muon Electronics Preproduction Installation Complete	*8/13/99*
M2-Calorimeter Preamp System Test Complete	*3/25/99*
M2-Fiber Tracker Assembly Complete	*6/30/99*
M1-Central Silicon Complete	*8/9/99*
M2-Calorimeter BLS Assembly Complete	*6/24/99*
M2-Tracker Installed in Solenoid	*9/7/99*
M2-Muon End Toroids Installed on Platform	*9/23/99*
M1-Ready to Roll-in	*2/15/00*
M1-Detector Rolled-in and Hooked Up	*4/11/00*



DoE Review
June 1999

Schedule Comments

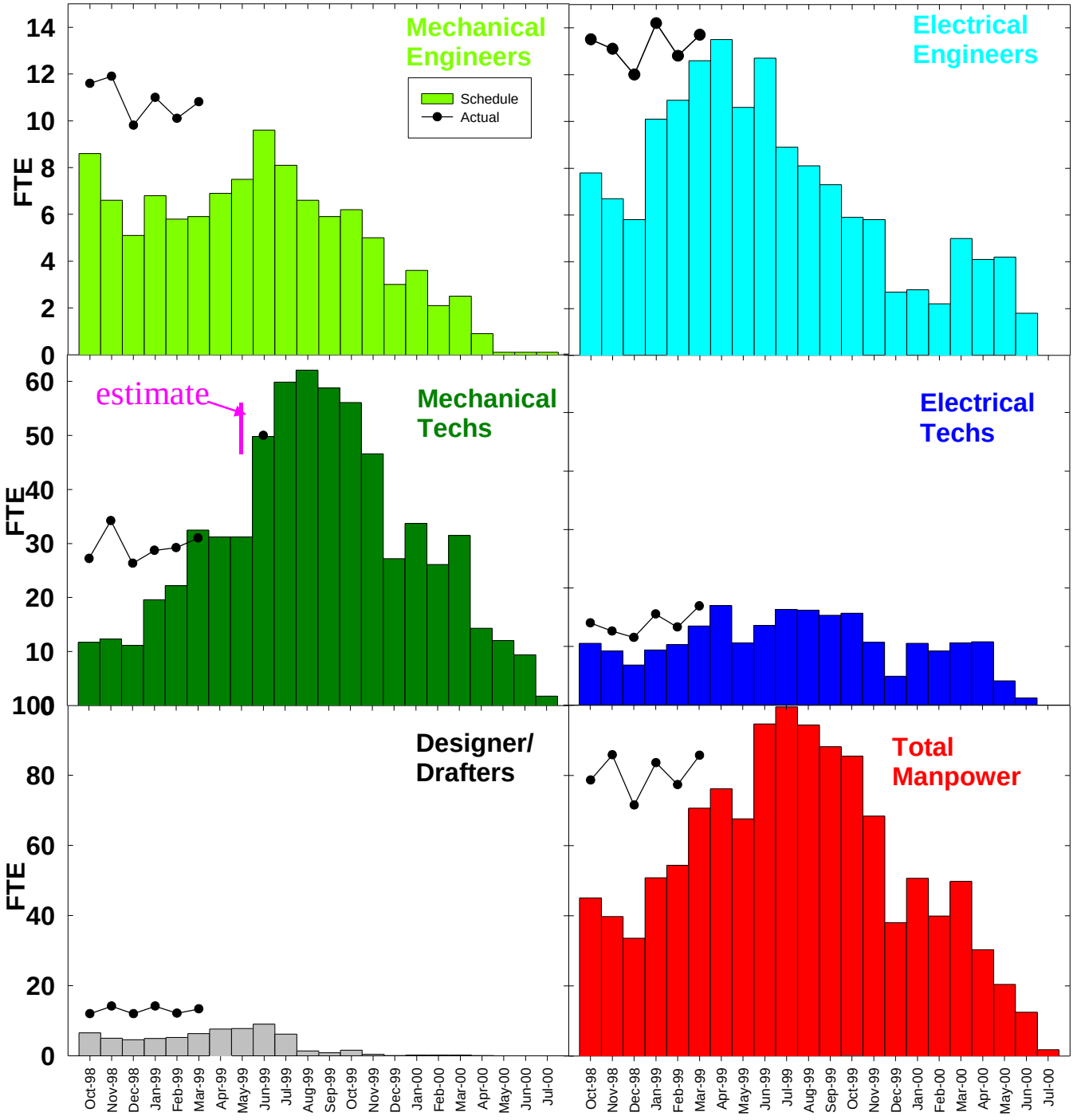
- Harry Weerts addressed individual project schedules
- Critical Paths
  - many systems near critical path
  - focus on those critical to roll-in
    - Silicon - dominated by vendor delays
    - Fibers - new technology Þ new construction techniques to be developed; vendor delays
    - Muons - large production/assembly issues
- Overview
  - ~3 months delay in start of roll-in
  - mitigate some ~6 month delays in many subsystems
    - use of slack
    - improved production techniques
    - reduce commissioning times

Manpower

- Extract manpower profiles from MS Project
  - by type, eg MT, ME, ET, EE
  - by subsystem
- Track actual manpower by effort reporting at WBS level 2 (data available from 1/98)
- Observe actual manpower > schedule manpower
  - work on tasks (R&D) other than in schedule winding down
  - all manpower tasks not fully captured in MS Project

FNAL Technical Manpower Profiles

- FTE by type, add contract labor & overtime



Manpower Plan

- Working closely with Lab to obtain needed manpower, e.g. Mechanical Techs (MT)
  - March: 37 people ~= effort reporting(29) + overtime(2)
  - June: +8 people + 2 overtime + 9 positions being filled + students Þ >19 FTE increment since March
- Present technical manpower tight but ~adequate for now
  - Working on resource leveling of manpower (e.g. mechanical techs)
  - Fall off of manpower during later phase (installation and commissioning) unrealistically fast

Cost Estimate

- Performed new bottoms-up cost estimate in March-April 1999
  - Input from subsystem managers
  - Maintained by Sherie Landrud
- Change control executed for all significant changes
  - >$100k at WBS level 2 reviewed and approved by PMG
  - Smaller changes reviewed and approved by project managers
    - Increasing flexibility for subsystem managers at WBS levels 4 to 6 to re-adjust costs (signature authority to $2,500)
    - Project managers sign for all reqs >$2,500
  - Change control forms filed electronically and on paper
  - All changes recorded in Excel cost spreadsheet in dated notes field

M&S Cost Estimate

- Bottoms-up cost estimate in Spring
  - provided by Level 3 managers
  - M&S only, then year $, no contingency
  - EAC= estimate at completion, ETC = estimate to complete, OTD = obligations to date through May

WBS	System	EAC	ETC	OTD
1.1.1	Silicon Tracker	6,480	1,275	5,205
1.1.2	Fiber Tracker	6,882	573	6,309
1.1.3	Central Preshower	238	0	238
1.1.4	Forward Preshower	554	116	438
1.1.5	Tracking Electronics	3,165	768	2,397
1.2.1	Calorimeter Electronics	4,247	304	3,943
1.2.2	Intercryostat Detector	302	55	247
1.3.1	Cosmic Ray Scintillator	1,223	0	1,223
1.3.2	Central Muon Scint.	908	118	790
1.3.3	Forward Muon Trigger	2,034	379	1,655
1.3.4	Forward Muon Tracking	1,213	269	944
1.3.5	Muon Electronics	4,021	1,367	2,654
1.4.1	Trigger Framework	1,638	0	1,638
1.4.2	Luminosity Monitor	137	51	86
1.4.3	Level 1 Trigger	1,558	448	1,110
1.4.4	Level 2 Trigger	2,085	303	1,782
1.4.5	Level 3 Trigger	1,126	901	225
1.5.1	Online Computing	722	493	229
3.1.1	Solenoid	4,936	122	4,814
	TOTAL	**43,469**	**7,542**	**35,927**

Cost Variance

- Costs in then year $, no contingency
- Variances from Jan98 DOE review

WBS	1/98	6/99	Diff.	Reason
1.1.1	5,205	6,480	1,275	Silicon vendors, cables, interface card
1.1.2	5,957	6,882	925	Flex cables, fixtures, VLPC quantity
1.1.3	323	238	-85	
1.1.4	512	554	42	
1.1.5	3,031	3,165	134	Design finalization
1.2.1	4,032	4,247	215	SCA yields, calibration pulse
1.2.2	304	302	-2	
1.3.1	963	1,223	260	Include foreign contribution
1.3.2	991	908	-83	
1.3.3	1,912	2,034	122	Support structures
1.3.4	1,199	1,213	14	
1.3.5	4,134	4,021	-113	
1.4.1	1,382	1,638	256	Collaborator engineering
1.4.2	139	137	-2	
1.4.3	1,557	1,558	1	
1.4.4	2,026	2,085	59	Design finalization
1.4.5	843	1,126	283	Collaborator engineering, SCL missing
1.5.1	624	722	98	Monitoring system design
3.1.1	4,935	4,936	-1	
Total	40,069	43,469	3,400	

Funding to Collaborators

- Collaborators receive funding for detector construction via MOU's

Institution	*MOU (k$)*
Boston University	298
Brookhaven National Lab	236
Brown University	298
Columbia University	140
Indiana University	110
Institute for HEP (IHEP)	437
ITEP	43
JINR	1,062
Kansas State University	164
Louisiana Tech Univ.	108
Michigan State Univ.	2,086
Moscow State Univ.	238
Northern Illinois Univ.	123
Prague HEP Laboratories	12
SUNY Stony Brook	1,106
University of Arizona	748
UC Davis	163
UC Irvine	49
UC Riverside	144
UIC	214
University of Kansas	16
University of Maryland	221
University of Michigan	207
Univ. of Notre Dame	167
University of Oklahoma	48
University of Texas Arlington	149
University of Washington	51
TOTAL	**8,636**

M&S Cost & Funding

- **Costs (no cont, then yr k$)**

Cost Type	*k$*
M & S	38,532
Solenoid	4,936
TOTAL	**43,469**

- **Funding (Then yr$)**

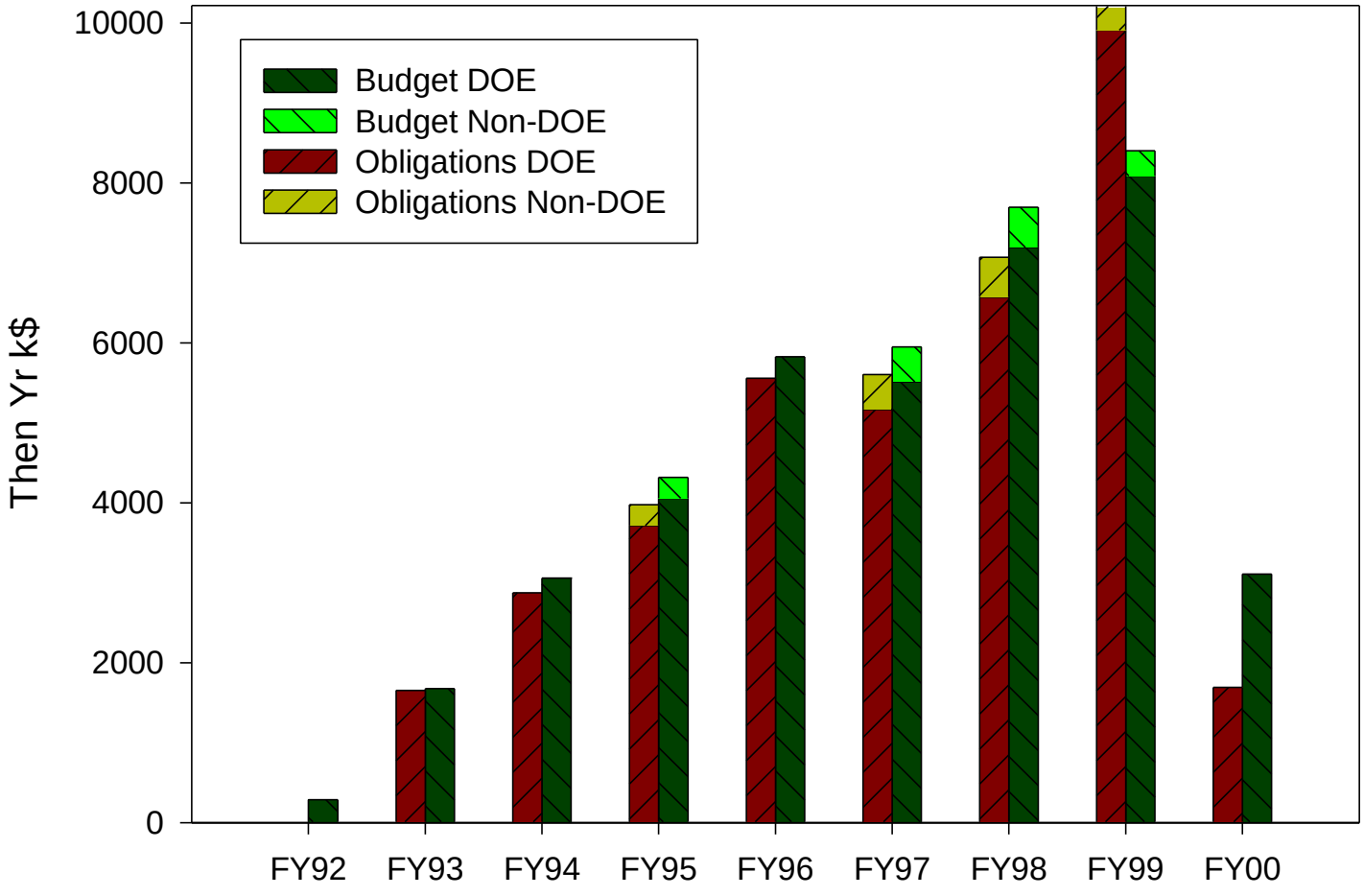
Funding Source	*k$*
DOE M&S	38,798
Solenoid- Plant funds	5,168
Non-DOE (NSF MRI, Foreign collaborators)	1,512
TOTAL	**45,478**

Contingency Analysis

- Remaining Contingency
  - $2,009k (=$45,478k-43,469k)
- Fractional Contingency on
  - Unobligated $ to go: 2,009/ 7,542 = 27 %
- Comments
  - ~$0.5M in possible contingency usage requests under consideration
  - Recent usage of contingency suggests that fraction of unobligated is the ~correct measure
  - 27% is reasonable at this stage
  - Largest R&D uncertainties now behind us - left with production uncertainties (better known)
  - Subsystem managers more comfortable with larger contingency but we believe the contingency is adequate

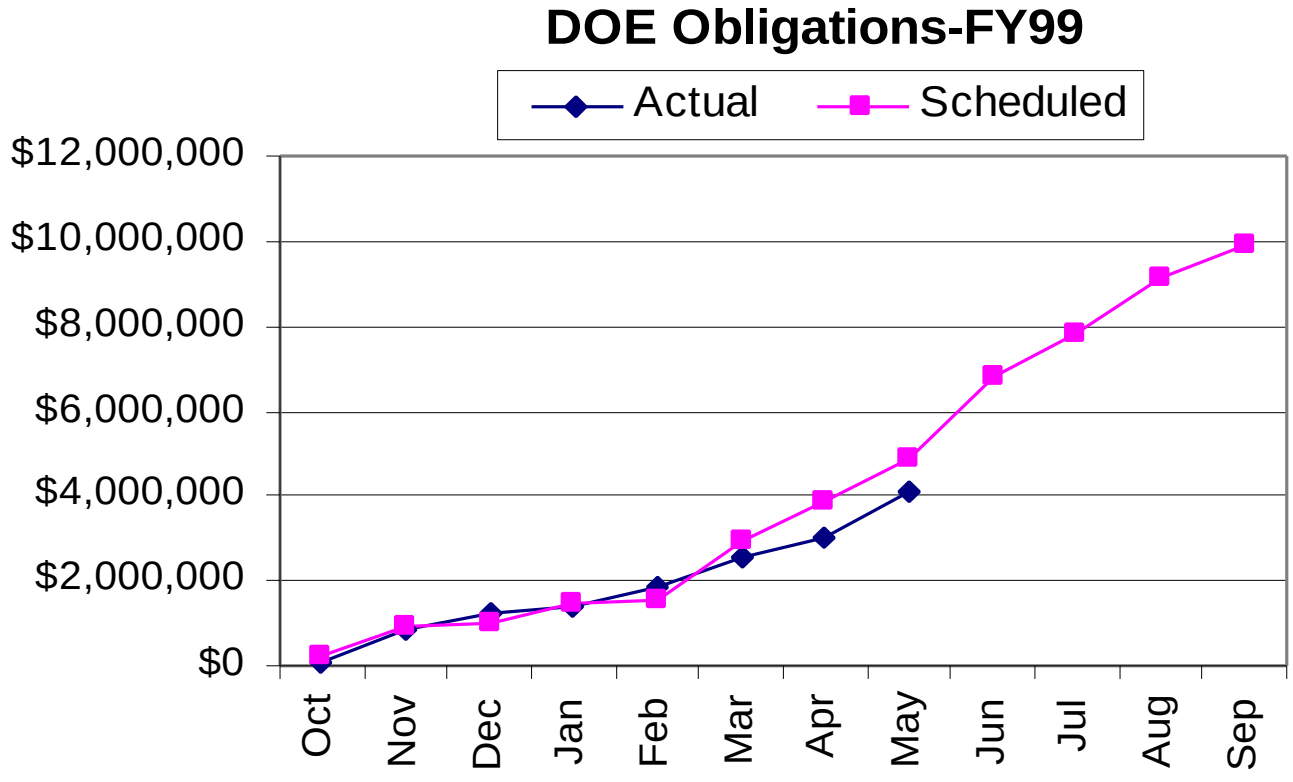
D0 Profile

- Then-yr k$; no solenoid (FY94 plant funds)
- Legend
  - left - D0 obligations for DOE and non-DOE
  - right - Budget authority for DOE (Lab) and non-DOE (foreign funding)



FY99 Obligation Profile

- Integrated scheduled obligations from MS Project
  - aggressive, exceeds BA but can tap forward funding if needed
- Somewhat behind schedule
  - ~$0.8M behind schedule
  - but slope increasing



Conclusions

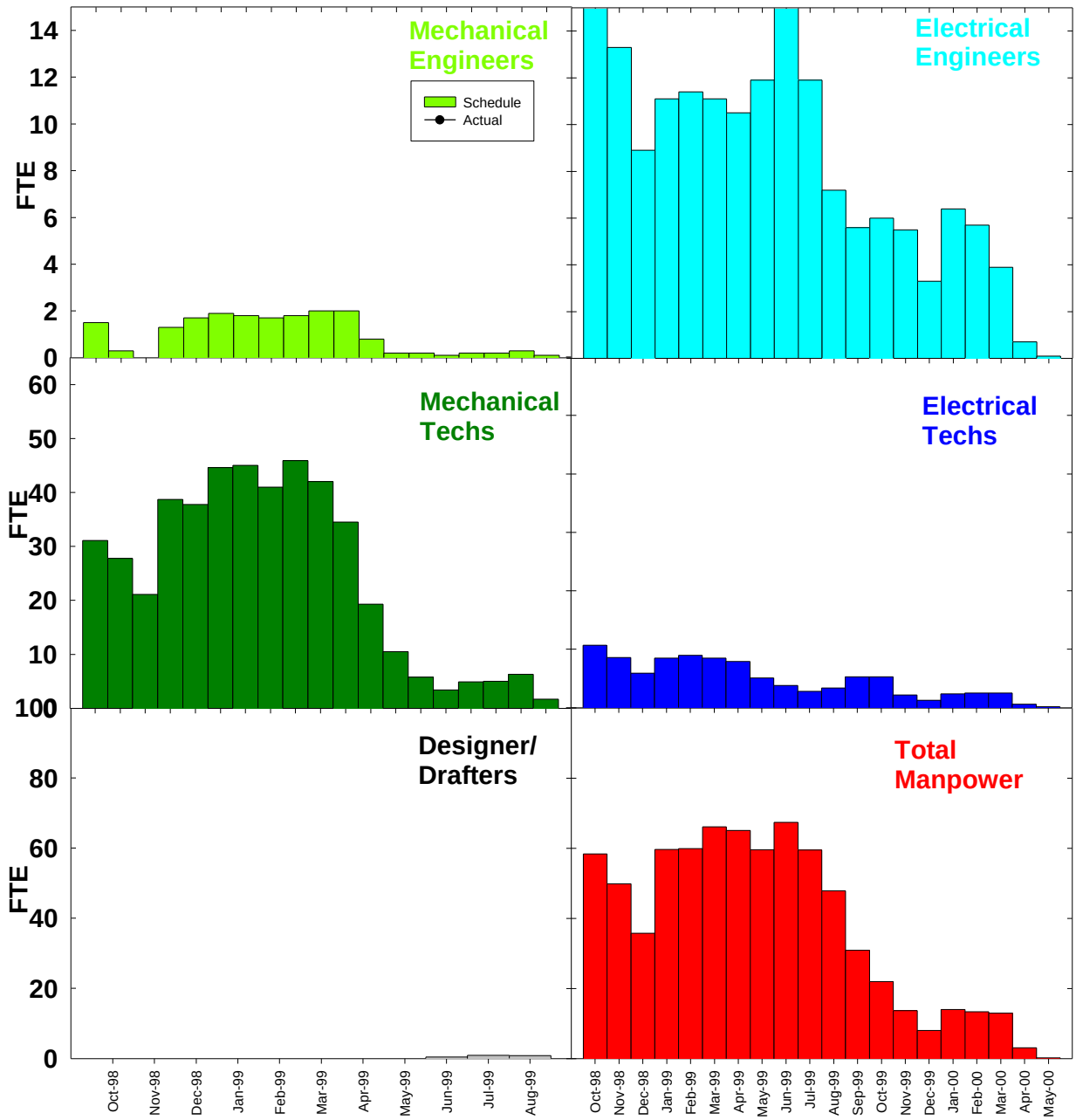
- Schedules and Costs re-evaluated in March-April 1999
- Change control executed
- Schedule is very aggressive but achievable (roll-in start 5/15/00)
- Significant use of contingency applied to project (~$3.4M since 1/98 review)
- Adequate contingency left (~27%) at this stage of the project -- but we continue to monitor this closely

Backup Slides

DoE Review
June 1999

"University" Technical Manpower Profiles

- FTE's by type



Foreign Funding

- FY95
  - Tata $260K
- FY97
  - Tata = $145K
  - IHEP = $260K
  - Moscow = $35K
- FY98
  - NSF / MRI = $502K
- FY99
  - Saclay = $100K
  - IN2P3 = $210K
- $1512 Total

FY00 Obligations

- Based on Schedule, dominant contributions (Then Yr$)
- Essentially electronics which awaits best pricing the later you place the order
  - 1.1 Tracking
    - ~ $397k for tracking electronics
  - 1.4 Trigger
    - ~ $821k for CFT L1 trigger and L3
  - 1.5 Offline
    - ~$382k for computer related items, wait till last moment to optimize

Estimate To Complete - What If Scenario

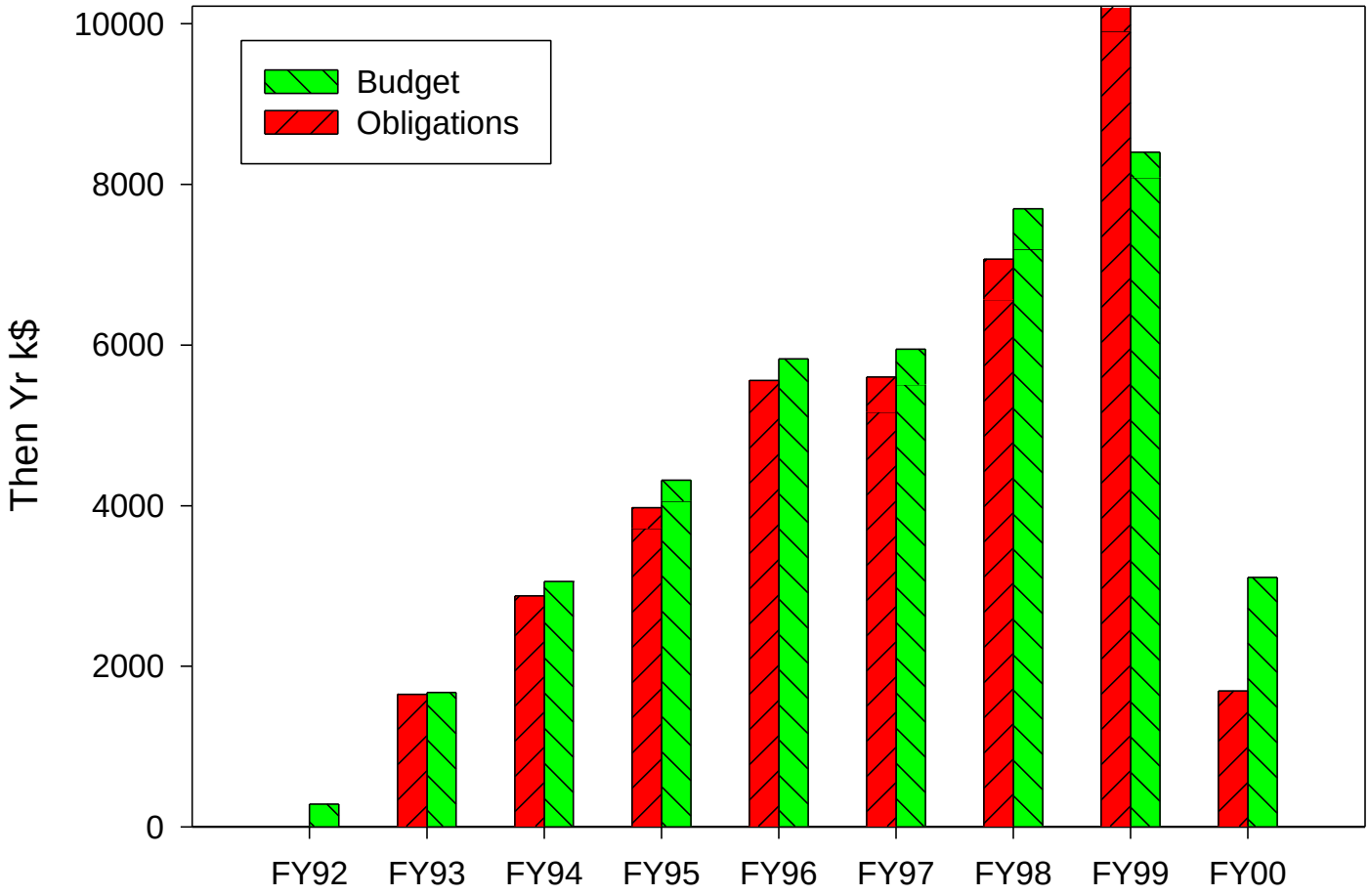
WBS	System	EAC	ETCC	ETCC %	ETC	OBLIG	COMP
1.1.1	Silicon	6,480	240	19%	1,275	5,205	76%
1.1.2	Fiber	6,882	296	52%	573	6,309	87%
1.1.3	CPD	238	1	N/A	0	238	100%
1.1.4	FPD	554	36	31%	116	438	87%
1.1.5	Tracking	3,165	118	15%	768	2,397	77%
1.2.1	Calorimeter	4,247	166	55%	304	3,943	91%
1.2.2	ICD	302	22	40%	55	247	82%
1.3.1	CRS	1,223	0	0	0	1,223	100%
1.3.2	Central Muon Scint	908	21	18%	118	790	94%
1.3.3	Forward Trigger	2,034	56	15%	379	1,655	81%
1.3.4	Forward Tracking	1,213	76	28%	269	944	77%
1.3.5	Electronics	4,021	245	18%	1,367	2,654	59%
1.4.1	Framework	1,638	0	0	0	1,638	100%
1.4.2	Lum Mon	137	7	14%	51	86	62%
1.4.3	Level 1	1,558	121	27%	448	1,110	71%
1.4.4	Level 2	2,085	219	72%	303	1,782	75%
1.4.5	Level 3	1,126	99	11%	901	225	21%
1.5.1	Online	722	55	11%	493	229	32%
	M&S subtotal	***38,533***	***1,778***	***24%***	***7,420***	***31,113***	***78%***
3.1	Solenoid	4,936	232	190%	122	4,814	98%
	TOTAL	***43,469***	***2,010***	***27%***	***7,542***	***35,927***	

FY99 Large Ticket Obligations

- Based on items >$100k in MS Project, after April

WBS	Item	Cost	Date
1.1.1.5.5	High Mass cables	147	June
1.1.1.5.5	High Mass cables	221	July
1.1.1.5.4	Low mass cables	353	Aug
1.1.1.5.8	Interface board	180	Aug
1.1.1.5.6	Transition card	113	Aug
1.1.2.4.1.4	Flex circuits	166	May
1.1.5.3.1.3	FPGA's	105	July
1.3.5.1.2	PDT front-end card	356	June
1.3.5.1.5	PDT control boards	115	June
1.3.5.2.3	MDT dig. Card	160	July
1.3.5.1.2	PDT front end card	240	Sep
1.4.4.4.2	Calorimeter inputs	168	May
1.4.4.2.3.3	Final card	268	Sep

- Then-yr k$; no solenoid (FY94 plant funds)
- Legend
  - left - D0 obligations for DOE and non-DOE
  - right - Budget authority for DOE (Lab) and non-DOE (foreign funding)



June 1999

Lab Profile

D0 Then Year $K	FY92	FY93	FY94	FY95	FY96	FY97	FY98	FY99	FY2000	FY2001	Total	Total 99-01
Equipment M&S	286	1,676	3,057	4,056	5,828	5,510	7,193	8,088	3,104	--	**38,798**	**11,192**
Equipment SWF	392	1,234	2,002	507	925	901	1,774	898	43	--	**8,676**	**941**
G&A	--	--	--	254	847	1,011	2,020	2,214	1,652	--	**7,997**	**3,866**
Equipment Total	678	2,910	5,059	4,817	7,600	7,422	10,987	11,200	**4,799**	--	**55,471**	**15,999**
Operating SWF	--	--	--	--	--	4,227	4,295	2,955	1,064	--	**12,541**	**4,019**
Operating G&A		--	--	--	--	1,691	1,718	1,182	426		**5,016**	**1,608**
Plant Funds (incl. G&A)	--	--	5,168	--	--	--	--	--	--	--	**5,168**	--
Total U.S.	**678**	**2,910**	**10,227**	**4,817**	**7,600**	**13,339**	**17,000**	**15,337**	**6,289**	--	**78,197**	**21,625**
Other Funding Identified	--	--	--	260	--	440	502	310	--	--	1,512	310
Other Funding Total	--	--	--	260	--	440	502	310	--	--	**1,512**	**310**
Total	**678**	**2,910**	**10,227**	**5,077**	**7,600**	**13,779**	**17,502**	**15,647**	**6,289**	--	**79,709**	**21,935**
M&S plus Other		0.00000									38,798	11,192
Escalation Factor	1.082	1.054	1.028	1.000	0.972	0.944	0.916	0.889	0.855	0.830		

D0 Constant FY95 $K	FY92	FY93	FY94	FY95	FY96	FY97	FY98	FY99	FY2000	FY2001	Total	Total 99-01
Equipment M&S	310	1,767	3,143	4,056	5,665	5,201	6,589	7,190	2,654	--	**36,574**	**9,844**
Equipment SWF	424	1,301	2,058	507	899	850	1,625	798	37	--	**8,499**	**835**
G&A	--	--	--	254	823	954	1,850	1,968	1,413	--	**7,262**	**3,380**
Equipment Total	734	3,067	5,201	4,817	7,387	7,006	10,064	9,956	4,103	--	**52,335**	**14,060**
Operating SWF	--	--	--	--	--	3,990	3,934	2,627	910	--	**11,461**	**3,537**
Operating G&A	--	--	--	--	--	1,596	1,574	1,051	364	--	**4,584**	**1,415**
Plant Funds (incl. G&A)	--	--	5,313	--	--	--	--	--	--	--	**5,313**	--
Total U.S.	**734**	**3,067**	**10,513**	**4,817**	**7,387**	**12,592**	**15,572**	**13,634**	**5,377**	--	**73,694**	**19,011**
Other Funding Identified	--	--	--	260	--	415	460	276	--	--	1,411	276
Other Funding Total	--	--	--	260	--	415	460	276	--	--	**1,411**	**276**
Total	**734**	**3,067**	**10,513**	**5,077**	**7,387**	**13,008**	**16,032**	**13,910**	**5,377**	--	**75,104**	**19,287**

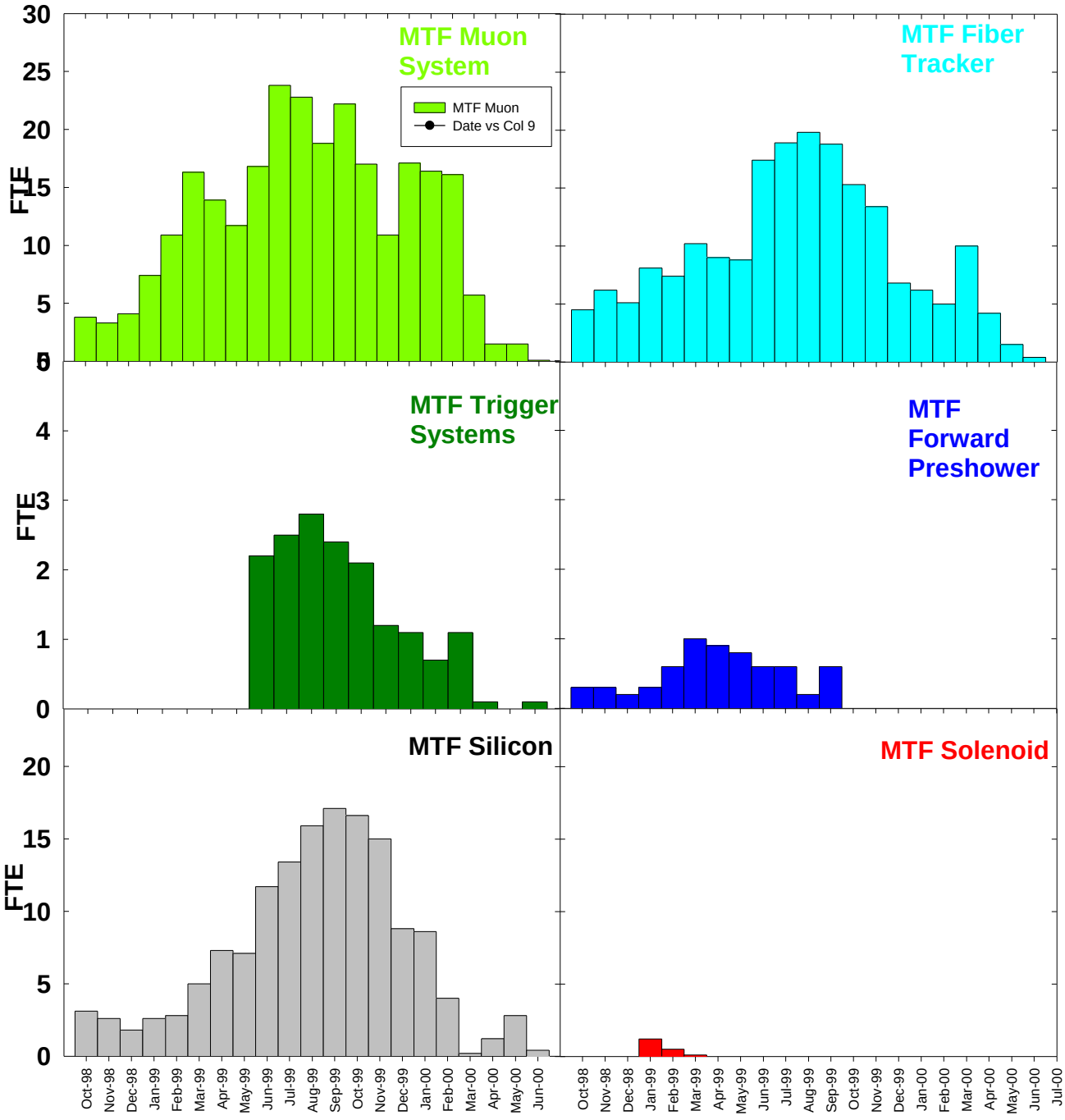
- test

DoE Review
June 1999

Lab Guidance vs. D0 Estimate (Then YR $)

	Lab Guidance	D0 Estimate
Equip M&S	38,798	38,533
Equip SWF	8,676	8,676
G&A	7,997	7,997
Op SWF	12,541	17,602
Op G&A	5,016	7,182
Solenoid	5,168	4,936

- Increase in Operating SWF
  - ~$5M for FY99 + FY00
  - Scale scheduled OpSWF by correction factor from effort reporting data for 10/98-3/99
- Note we do have the FTE's from Lab, so not an issue

Fermilab Mechanical Techs

- Breakdown of FTE for some Mechanical Techs (MT) by subsystem