Project Planning

- Documentation to DOE June 1
- DOE Review ~July 22

Documents

Summary

Project Overview, Summary Resource Loaded Schedule and Luminosity Projection

Performance Models

1. Tevatron Modeling
2. Antiproton Production

Subproject Technical Status and Plans

1. Slip-Stacking Studies
2. Slip-Stacking Beam Loading Compensation
3. Antiproton target Station Upgrade
4. Lithium Lens Upgrade
5. AP2 and Debuncher Acceptance Upgrade
6. Accumulator Stacktail Cooling Upgrade
7. Electron Cooling
8. Rapid Transfers
9. Increased Beam Separation and Active Beam-Beam Compensation in Tevatron

RLS Methodology

WBS at project level 3

1.1	**Protons on Target**
1.1.1	Slip Stacking
1.1.2	Pbar Target and Sweeping
1.1.3	MI Dynamics
1.2	**Pbar Acceptance**
1.2.1	Lithium Lens Upgrades
1.2.2	AP2 and Debuncher Acceptance
1.3	**Pbar Stacking and Cooling**
1.3.1	Stacking and Cooling Integration
1.3.2	Debuncher Cooling
1.3.3	Stacktail Cooling
1.3.4	Recycler Stacking and Cooling
1.3.5	Electron Cooling (excl MI-31)
1.3.6	Rapid Transfers
1.4	**Tevatron High Luminosity**
1.4.1	Tevatron Task Force
1.4.2	Luminosity Studies
1.4.3	Active Beam-Beam Compensation
1.4.4	Increased Beam Separation
1.4.5	Luminosity Leveling
1.4.6	Improved Diagnostics

- Each project leader defines their WBS (at an appropriate level for their planning – typically level 4-6)
- Over 550 tasks
- Estimates M&S costs (document>$200K), task duration and links and assigns resources (named where possible) (study shifts are a resource)
- "Quality of Estimate" assigned to each task

  Interpretation:

  (a)=eng concept or vendor info – 20%

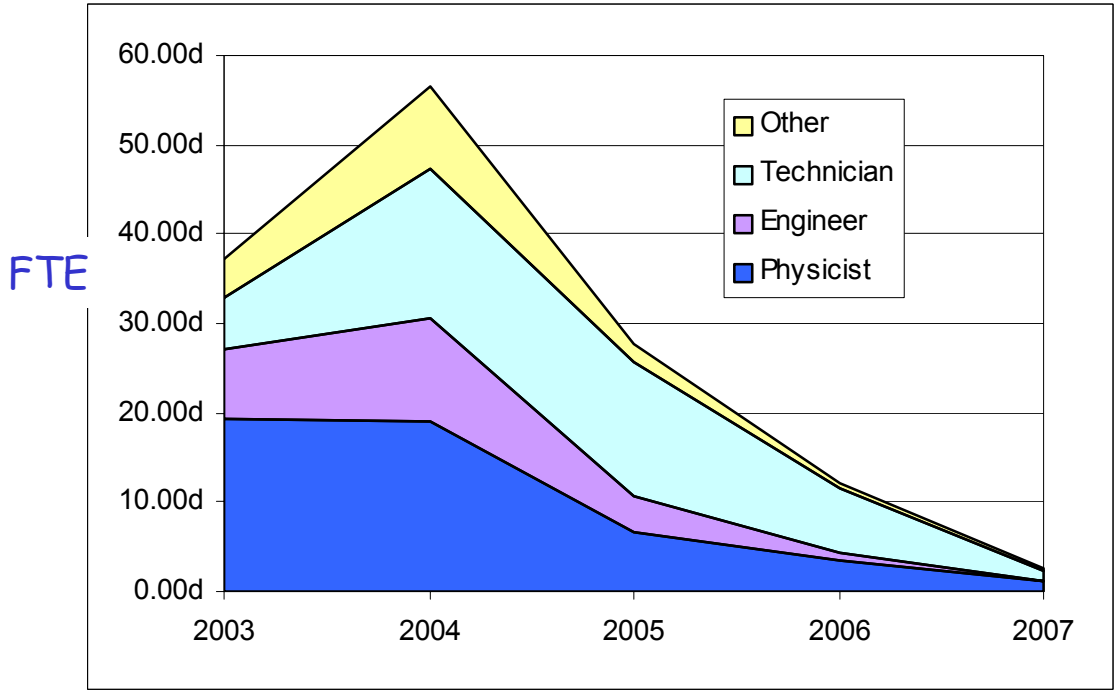
  (b)=initial concept design or done similar before – 40%

  (c)=guess, but we know this sort of thing – 60%

  (d)= scope not yet fully defined → place holder – 100%

RLS Methodology

- Contingency rolled up (45% M&S, 47% Labor) and is assigned by FY with a bias to later years
- No schedule contingency is included
- Labor costs are actual Beams Div SWF by "resource category" corrected to 2004
- Access to tunnels allowed for 1 day jobs, otherwise fit in lab's shutdown schedule



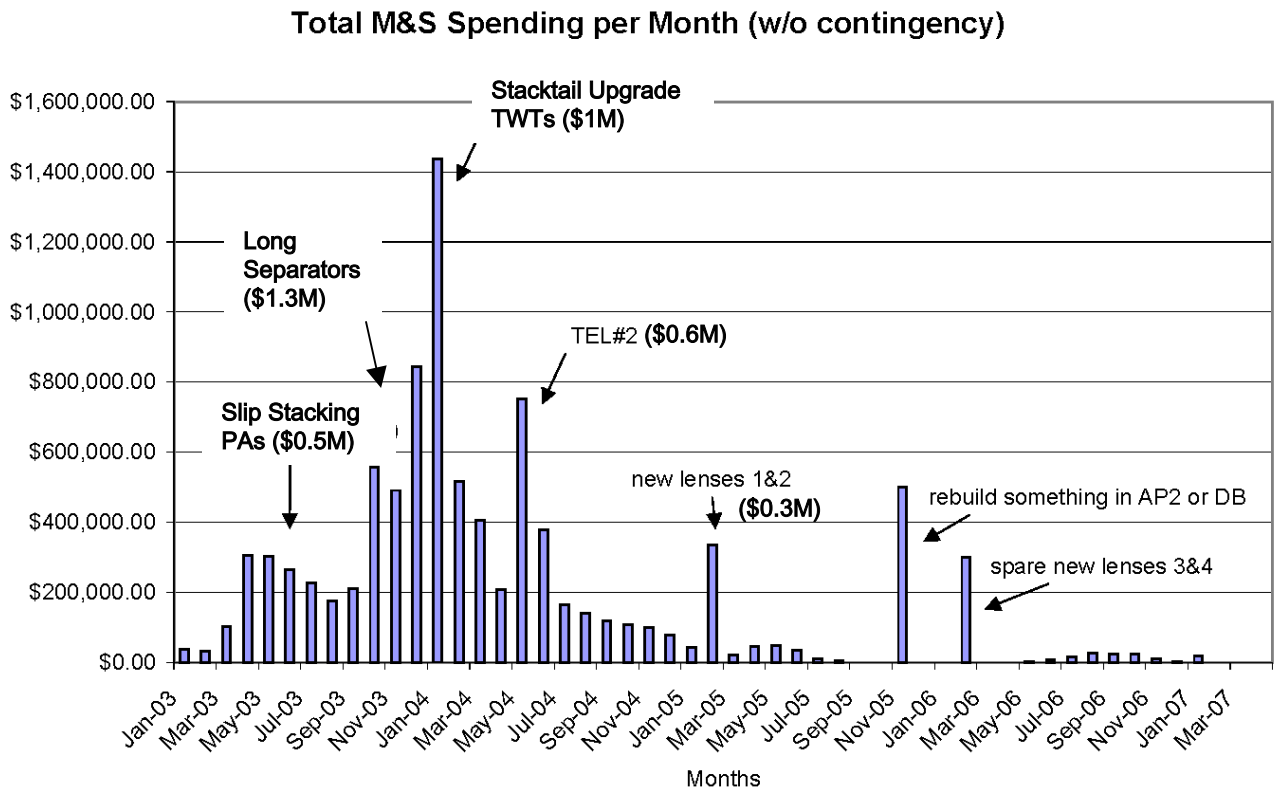
Resources Assigned (named where possible)
computer professional
cryo engineer
cryo tech.
electrical engineer
electrical tech.
ES&H specialist
mechanical engineer
mechanical tech.
operations specialist
physicist
survey crew
study shifts

M&S Cost Estimate

- $9.4M Base + $4.3M Contingency = $13.7M Total
- Cost Drivers…

		M&S Base	M&S Contingency	M&S Total
1	Run II Upgrades	9416500	4263300	13679800
1.1	**Protons on Pbar Target**	**746500**	**266500**	**1013000**
1.1.1	Slip Stacking	650000	230000	880000
1.1.2	Pbar Target and Sweeping	96500	36500	133000
1.2	**Pbar Acceptance**	**2281000**	**1215000**	**3496000**
1.2.1	Lithium Lens Upgrades	918000	268200	1186200
1.2.2	AP2 and Debuncher Acceptance	1363000	946800	2309800
1.3	**Pbar Stacking and Cooling**	**2734000**	**1218800**	**3952800**
1.3.1	Stacking and Cooling Integration	0	0	0
1.3.2	Debuncher Cooling	0	0	0
1.3.3	Stacktail Cooling	1656000	662400	2318400
1.3.5	Electron Cooling	566000	251600	817600
1.3.6	Rapid Transfers	512000	304800	816800
1.4	**Tevatron High Luminosity**	**3655000**	**1563000**	**5218000**
1.4.1	Tevatron Task Force	0	0	0
1.4.2	Beam-beam Limitations	0	0	0
1.4.3	Active Beam-Beam Compensation	1385000	741000	2126000
1.4.4	Increased Helix Separation	1670000	462000	2132000
1.4.5	Luminosity Leveling	0	0	0
1.4.6	Improved Diagnostics	600000	360000	960000
1.6	**Management Oversight**	**0**	**0**	**0**

M&S Cost Drivers



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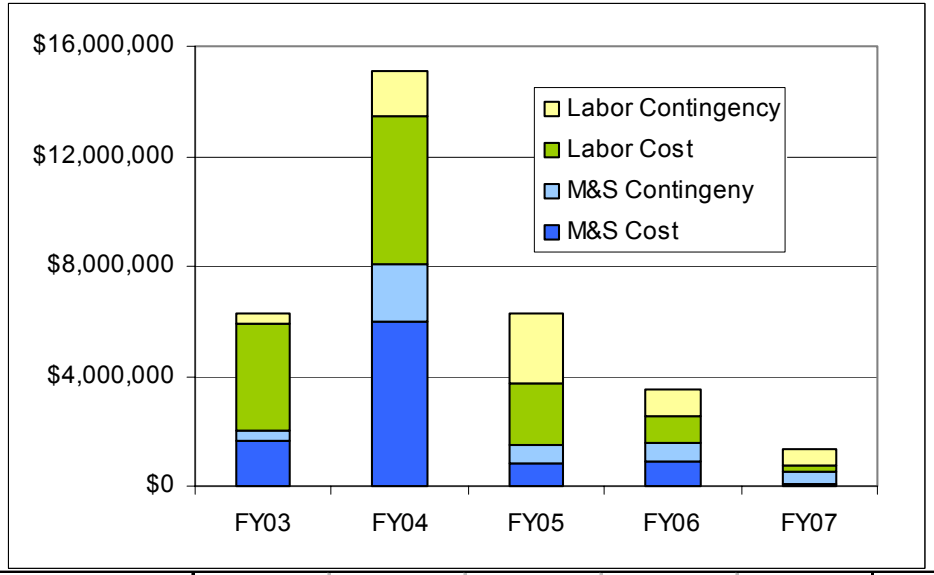
Labor Cost Estimate

- $12.7M Base + $6.1M Contingency = $18.8M Total

		Labor Base	Labor Contingency	Labor Total
1	Run II Upgrades	12755434	6082744	18838178
1.1	**Protons on Pbar Target**	**431312**	**161957**	**593268**
1.1.1	Slip Stacking	318213	112049	430262
1.1.2	Pbar Target and Sweeping	113098	49908	163006
1.2	**Pbar Acceptance**	**2586079**	**1399738**	**3985817**
1.2.1	Lithium Lens Upgrades	595642	259896	855539
1.2.2	AP2 and Debuncher Acceptance	1990437	1139842	3130279
1.3	**Pbar Stacking and Cooling**	**3244376**	**1542979**	**4787355**
1.3.1	Stacking and Cooling Integration	128077	0	128077
1.3.2	Debuncher Cooling	22542	13525	36066
1.3.3	Stacktail Cooling	774225	313356	1087581
1.3.5	Electron Cooling	1009402	490815	1500217
1.3.6	Rapid Transfers	1310131	725283	2035413
1.4	**Tevatron High Luminosity**	**4762143**	**2285460**	**7047603**
1.4.1	Tevatron Task Force	815850	326340	1142190
1.4.2	Beam-beam Limitations	510600	228660	739260
1.4.3	Active Beam-Beam Compensation	1439773	797225	2236998
1.4.4	Increased Helix Separation	926048	292064	1218111
1.4.5	Luminosity Leveling	13149	7138	20287
1.4.6	Improved Diagnostics	1056723	634034	1690757
1.6	**Management Oversight**	**1731525**	**692610**	**2424135**

Cost Profile

- Contingency weighted to later years



$K	FY03	FY04	FY05	FY06	FY07	Total
M&S Cost	1,657	6,008	821	875	55	$9,417
M&S Contingeny	331	2,103	657	700	475	$4,266
Labor Cost	3,915	5,364	2,283	963	229	$12,755
Labor Contingency	392	1,609	2,512	963	602	$6,078
Total	6,295	15,084	6,273	3,501	1,361	$32,515

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Milestones and Operating Phases

- Milestones
  - Interim progress
  - Subproject completion
  - Program phases
  - Program/scope evaluation
  - these are "project milestones", not "reporting milestones"
- Phases
  1. Debuncher upgrade and MI dampers in FY03 plan
  2. Slip-stacking, some Acc (Nov-04)
  3. RR+e-cool and Rapid Transfers (Feb-05)
  4. Upgrade to stacktail cooling (Nov-5)
  5. Final Acc and Tev helix + beam-beam (Apr-07)

WBS	Milestone	Date
Project Management Milestones		
1.6.2.1	Evaluation: Tevatron Upgrade Plan	Sep-03
1.6.2.2	Evaluation: RR & e-cool commissioning plan	Nov-03
1.6.2.3	Evaluation: Phase 2-3 Transition Plan	Apr-04
Subproject Completion Milestones		
1.1.1	Slip Stacking Operational	Nov-04
1.1.2	Target Station	Dec-03
1.2.1	High Gradient Lithium Lens	Jan-05
1.2.2	AP2&DB Aperture Improvements-1	Oct-04
1.2.2	AP2&DB Aperture Improvements-2	Oct-05
1.2.2	AP2&DB Aperture Improvements-3	Feb-07
1.3.3	Stacktail Cooling System	Dec-05
1.3.4	RR Stochastic Commissioned	Apr-04
1.3.5	Electron Cooling Operational	Jan-05
1.3.6	Rapid Transfers Automated	Nov-04
1.4.2	Active BBC: TEL	Jan-06
1.4.3	Increased Helix Separation	Mar-07
Stage Completion Milestones		
1.6.2.4	Start Phase 2	Nov-04
1.6.2.5	Start Phase 3	Feb-05
1.6.2.6	Start Phase 4	Nov-05
1.6.2.7	Start Phase 5	Apr-07

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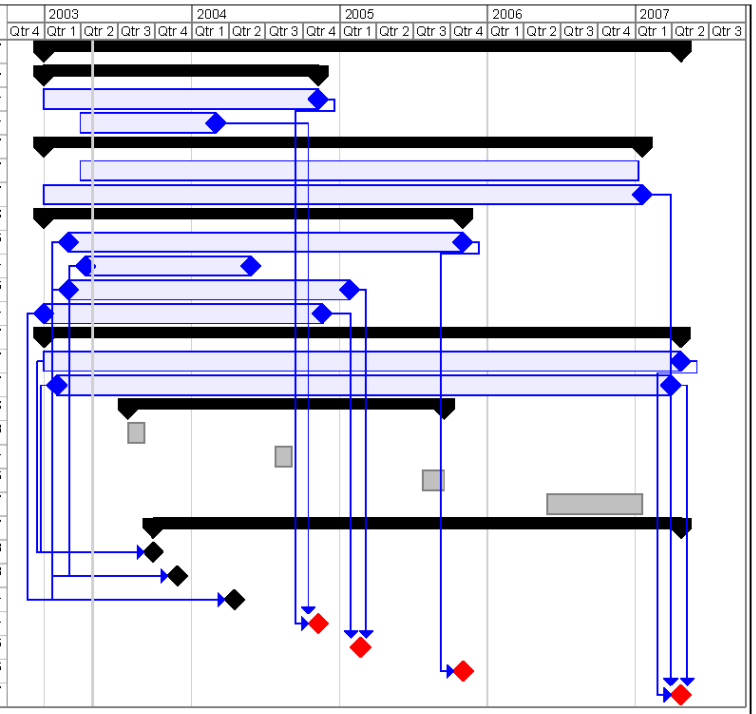
Milestones and Phases

ID	WBS	Task Name	Finish
1	**1**	**Run II Upgrades**	**Tue 4/24/07**
2	**1.1**	**Protons on Pbar Target**	**Mon 11/8/04**
3	1.1.1	Slip Stacking	Mon 11/8/04
4	1.1.2	Pbar Target and Sweeping	Mon 3/1/04
5	**1.2**	**Pbar Acceptance**	**Fri 1/19/07**
6	1.2.1	Lithium Lens Upgrades	Wed 1/10/07
7	1.2.2	AP2 and Debuncher Acceptance	Fri 1/19/07
8	**1.3**	**Pbar Stacking and Cooling**	**Tue 11/1/05**
9	1.3.3	Stacktail Cooling	Tue 11/1/05
10	1.3.4	Recycler Stacking and Cooling	Wed 5/26/04
11	1.3.5	Electron Cooling	Tue 1/25/05
12	1.3.6	Rapid Transfers	Thu 11/18/04
13	**1.4**	**Tevatron High Luminosity**	**Mon 4/23/07**
14	1.4.3	Active Beam-Beam Compensation	Mon 4/23/07
15	1.4.4	Increased Beam-Beam Separation	Fri 3/30/07
16	**1.5**	**Shutdowns**	**Fri 9/16/05**
17	1.5.1	summer 03	Fri 9/5/03
18	1.5.2	summer 04	Fri 9/3/04
19	1.5.3	summer 05	Fri 9/16/05
20	1.5.4	IIb shutdown	Fri 1/19/07
21	**1.6**	**Project Management**	**Tue 4/24/07**
22	1.6.2.1	Evaluation: Tevatron Upgrade Plan	Mon 9/29/03
23	1.6.2.2	Evaluation: RR & e-cool commissioning plan	Wed 11/26/03
24	1.6.2.3	Evaluation: Phase 2-4 Transition Plan	Fri 4/16/04
25	1.6.2.4	Start Phase 2	Mon 11/8/04
26	1.6.2.5	Start Phase 3	Tue 2/22/05
27	1.6.2.6	Start Phase 4	Thu 11/3/05
28	1.6.2.7	Start Phase 5	Tue 4/24/07



Completion milestone for each subproject

Shutdowns ← Fermilab draft long range schedule

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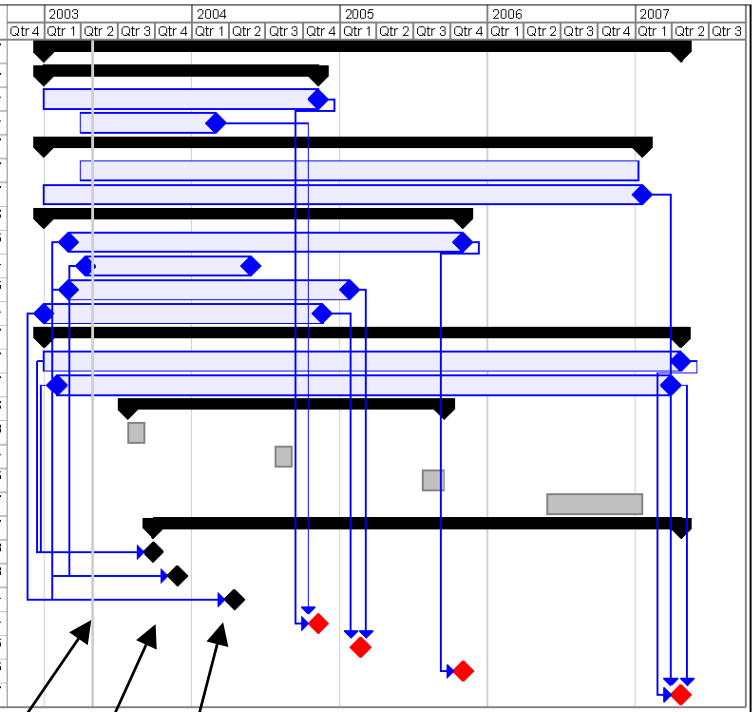

Evaluate Tevatron upgrade plan

Evaluate RR & e-cool commissioning

Evaluate integration plan for RR & e-cool

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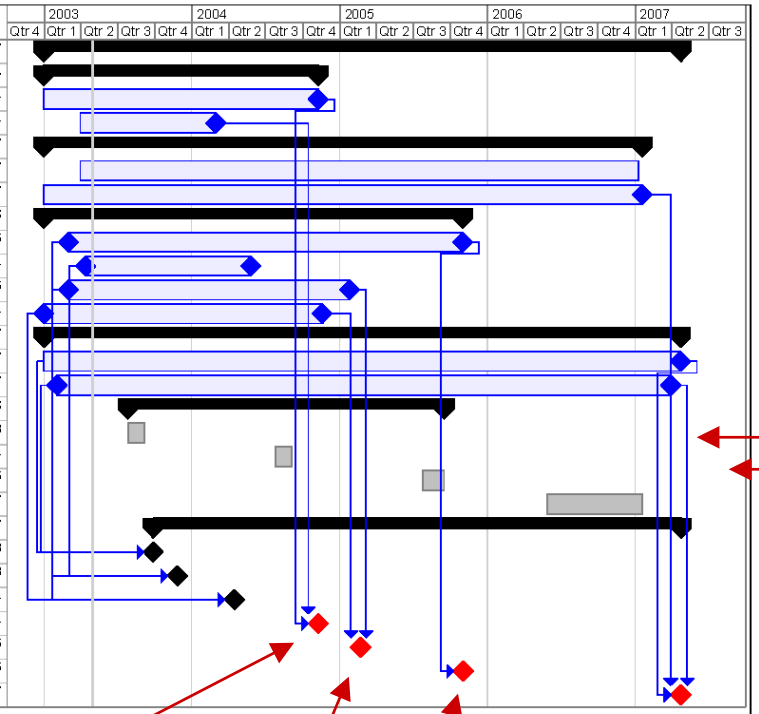

AP2&DB Upgrades

Slip-Stacking
(stack in Accumulator)

RR & e-cool
(stack in RR, but stacktail rate limited)

Stacktail Upgrade

Tevatron Upgrades

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Luminosity Projection (work in progress)

Recipe:

- Combine
  - the parametric modeling (pbar production and Tevatron)
  - the schedule (phase milestones)
  - Add ramp-up following each shutdown and as a learning curve for the start of each phase
- Determine sensitivity to key parameters
  - there are many – so at least a few key ones

Put it together…

Conclusion

- Define(d) scope for the upgrades
- Developed Phased Plan
- Plan reaches peak luminosity of ~$2.9 \times 10^{32} cm^{-2} s^{-1}$ with a stacking rate of 40×10^{10}/hr
- Schedule, cost and luminosity estimates ~bottom up
  - Overall scale of the cost and effort is in line with the Run IIb Plan (Dec 2001)
- Preparing Documentation

- And making good technical progress on the projects!