Project Management for Accelerator Construction
(1-3)

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Brookhaven National Laboratory

IHEP, Beijing
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Versions of This Lecture

- 1st, USPAS talk at Stanford, June 1992
- 2nd, Talk at SSRF Management Workshop,

  Shanghai, June 2004
- 3rd, Talk at NSRRC, Hsin-Chu, Nov. 2006 (for TPS Team)
- 4th, Talk at IHEP, Beijing, and OCPA-AS, Miyun,

  August, 2010

With major updates for this workshop

The Fifth Discipline

There are five disciplines needed for a good organization to thrive in modern world,

1. Personal mastery
2. Mental models
3. Building shared visions
4. Team learning
5. System thinking,

Peter M. Senge, 1990

The Third Discipline

There are three disciplines needed for a successful accelerator construction project,

1. Physics design
2. Engineering design
3. Project management, as an integrating element to assure on time, in budget, and desired performance

Why ME?

- Although you are not an accelerator designer yet, you are here to learn the physics and engineering of the trade, so is project management
- More important yet, everyone in the team has to understand the spirit and method involved in project management to be an effective contributor, no matter what your specialty and position.

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II. Start of a Project ---- Planning

A. Orient Yourself -- Goals, Means, and Environment

B. Conceptual/Preliminary/Detail Design Report

C. Management Plan and Documentation

D. Accounting and Scheduling Tools

E. Organization and Staffing

F. WBS and Work Package

G. Performance, Cost, and Schedule for Project Baseline

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A. Meetings, Reports, and Reviews
B. Communications and Conflict Resolution
C. Use of Outside Experts →
D. Scheduling---Gantt Chart, Pert Chart, Critical Path Network
E. Cost Accounting and Cost Schedule Control System (CSCS)
F. Procurement & Quality Control
G. Signs of Trouble, Technical Contingency, and Rebaseline

IV. Organization and Motivation

A. Functional and Project Management

B. Hierarchical and Matrix Management

C. Elements and Volume of Success

D. Human Motivations

E. Personality Type and Role Playing

V. New Trends and World-wide Long Range Planning

A. New Thinking and New Models

B. Many New Accelerator Construction Projects Need Experienced Managers

C. World-wide Efforts on Long Range Planning

D. Reliability, Availability, Maintainability

E. Management Proverbs

History of Business Management

- 1776, A. Smith, Wealth of Nations, as a result of
  Division of Labor for Efficiency, Exchange Value
- 1901, F. Taylor, Time Management
- 1930, H. Ford, Assembly Line
- 1950, W. E. Demming, Quality Control
- 1960, P. Drucker, Project Management

- 1980 – Quality Circle, Just-in-Time, TQM, HBR,
  Strategic Plan, 5th Discipline, 360, MBA, Down Sizing,
  Out Sourcing, DOE Practices,….

- 1990 – Globalization, Ecology of Manufacturing, …
  Asia Financial Crisis of 1997-1998,
  Rise of the BRICKs,
  Bubble Economy & Global Financial crisis of 2007-2010.
  Budget deficit and sovereign debt problems.

World Accelerator Experiences

A. Friendly Competition (1950-1980)

AGS	PS
SPEAR	DORIS
PEP	PETRA
FNAL	SPS

B. Aggressive Competition (1980-2000)

TEV-2	SppS
SLC	LEP
SSC	LHC
RHIC	LHC (pb)
NLC	ILC

Aiming for similar physics

During the Decade of 1980 to 2000

European H.E. Phys.

More Daring and Willing to Take the Lead(Isr, Scrf, Xfel,..)

More Innovative and FLEXIBLE (Spps, LEP, LHC)

Less Bureaucratic

Keep Up With the Knowledge and Expertise

Involve Industry

Japanese Industry

Focus on Manufacturing and Quality

Sensitive to Consumer's Need and Taste

Less Bureaucratic

Sensitive to New Technology and Strengthen R&D

Also Become More Daring, (KEKB, K2K, J-PARC, 3 Nobel Prize in 2008)

Reasons for a Closer Relationship With Industry

1. Standard Product With Superior Performance: (Computer, Klystron, Electronics,…)
2. Better Equipped to Perform Mass Production With High Quality.
3. Service and Upgrade.
4. Ease of Manpower Build-up and Down.
5. Tighter Budget in National Laboratory.
6. Avoid Excessive Government Regulations.

Definition of Management

The fundamental task of management is to make people capable of joint performance through common goals, common values, the right structure, and the training and development they need to perform and to respond to change any existing organization, whether a business, an university, a labor union, or a hospital, goes down fast if it does not innovate.

Conversely, any new organization, whether a business, a university, a labor union, or a hospital, collapses if it does not manage. Not to innovate is the single largest reason for the decline of existing organizations. Not to know how to manage is the single reason for the failure of new ventures.

Misconceptions about Management

1. It is for people in high positions only.
2. It is nothing, just common sense.
3. It is the only thing.
4. It is for business, not for scientists.
5. It is taken care of by "those people".

Cost of Typical Mistake by Physicist/Engineer, ~ $10-100k
By Managers, ~ $100k – Few Millions, even the Whole Project(ISA, SSC, …)

Project Management as A Discipline

By “discipline”, I do not mean an “enforced order” or “means of punishment”, but a body of theory and technique that must be studied and mastered to be put into practice.

A discipline is a developmental path for acquiring certain skills of competencies, such as mathematics, engineering, medicine, etc., ..

Accelerator Project vs. R&D

R&D	Project
◆Focus on Small Process	◆Focus on Complete System
◆Flexible Schedule	◆Controlled Schedule
◆Flexible Performance	◆Specified Performance
◆Small and Familiar Group	◆Large and Diverse Groups
◆Open-loop Control	◆Closed-loop Control
◆Reactive	◆Proactive

Accelerator Project vs. Industrial Project

Industry

- ◆Flexible Reward Allowed
- ◆Flexible Transfer and Termination
- ◆Component and System Demonstration before Mass Production
- ◆Entrepreneur Risks More in Marketing, Less in Technology

Accelerator

- ◆Structured Reward Practice
- ◆Difficulty in Personnel Transfer or Termination
- ◆Limited Component Prototype and is the Only and First System
- ◆Accelerator Risks More in Technology and System Integration

Project Management vs. Functional Management

Functional

◆Well-defined Steady State Operation

◆Organized Along Discipline and Functional Lines

◆Small and Adiabatic Changes

Project

◆New Activities in Finite Duration of Time

◆Organization Cuts Across Functional Lines

◆New System and New Technology

Management vs. Science

Natural Science

◆Possible to Consider Stable Single Particle and Two-body Interactions

◆Isolate and Repetitive Experimentation Possible

◆Universal Principle and Predictive Theory Possible

◆Interaction and Phenomena Usually are Independent of Expectation

Management

◆Varying Individual and Group Behavior

◆Difficulty to Perform Isolated and Repetitive Experimentation

◆Under/Over-constrained Principles and Theories

◆Behavior Affected by Will and Expectation

Examples of Technical Surprises

- FNAL Main Ring Magnet Coil(6 version), 1972
- NSLS RF Window, 1982
- ISA SC Braid Coil, 1983
- ALS RF Contact Finger, 1994
- ESRF Floor Movement, 1995
- APS Antechamber Deformation, 1997
- KKB Electron Cloud, 2000
- SNS DTL(leak, PM, alignment,..), 2003
- J-PARC RFQ Vacuum and MR e-Cloud, 2009
- LHC SC high resistance cable joint, quench protection, and vacuum interlock failure, 2008 (delay of two years)

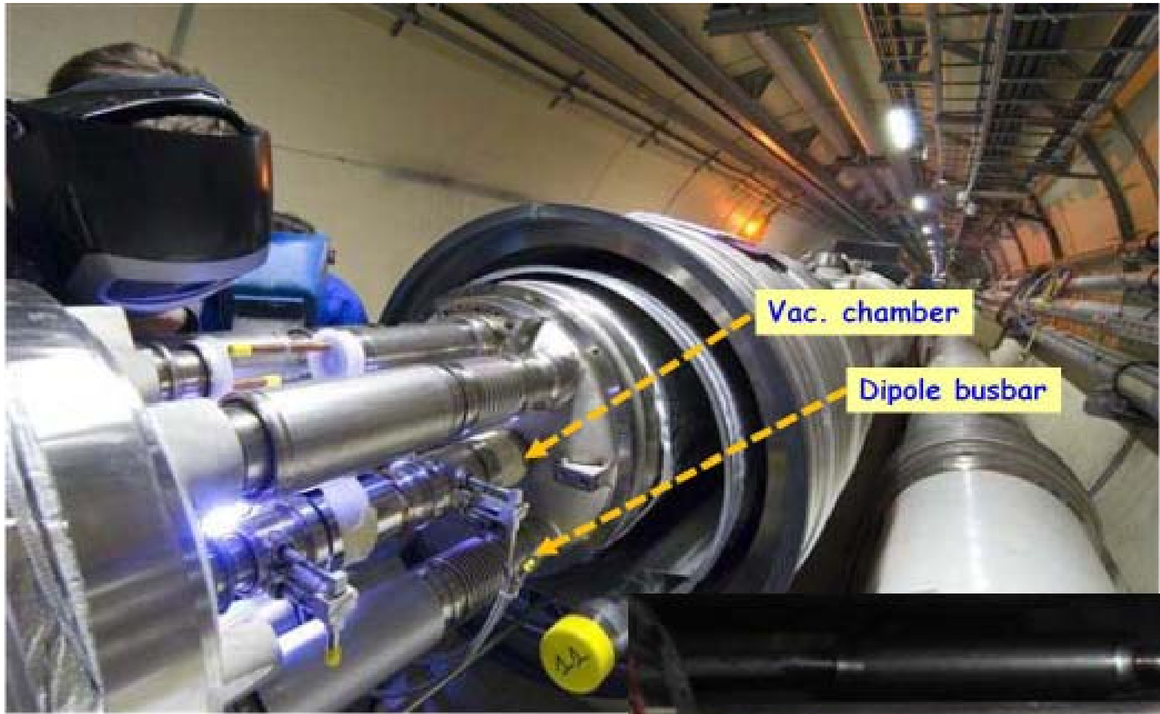
Accident of September 19th 2008

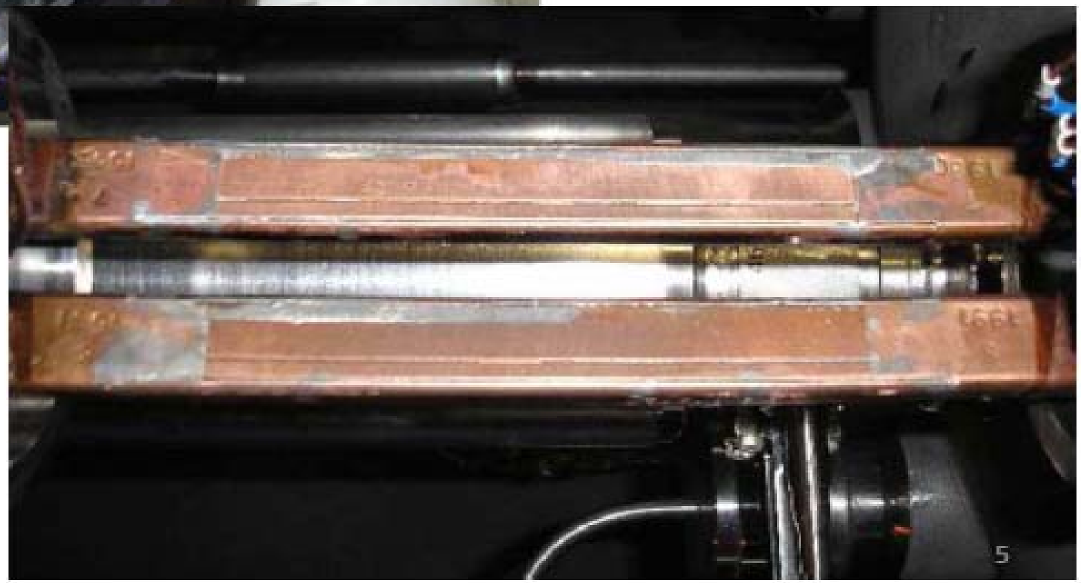
- During a few days period without beam

- Making the last step of dipole circuit in sector 34, to 9.3kA
- At 8.7kA, development of resistive zone in the dipole bus bar splice between Q24 R3 and the neighbouring dipole

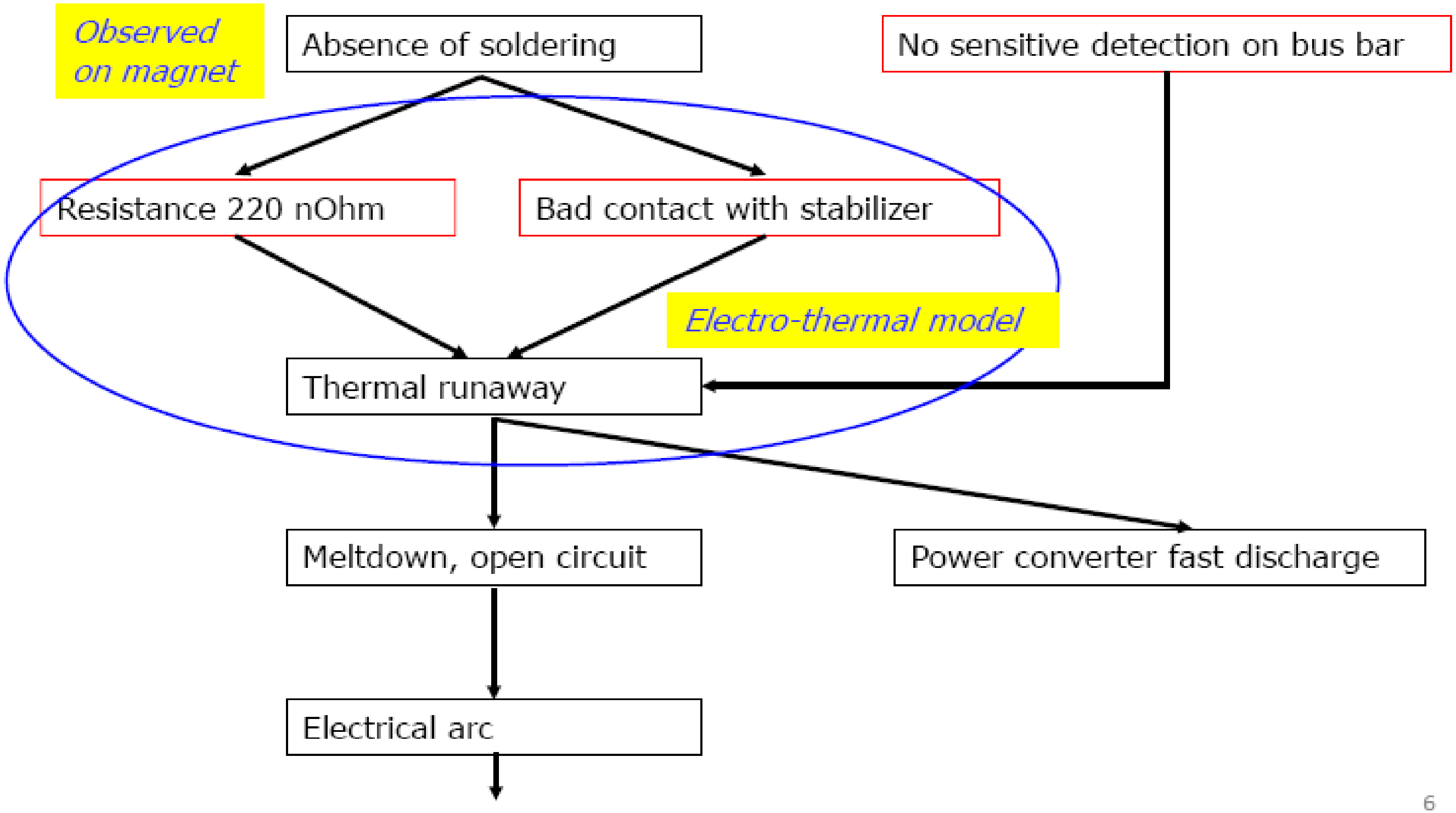
- Electrical arc developed which punctured the helium enclosure

4


Vac. chamber
Dipole busbar



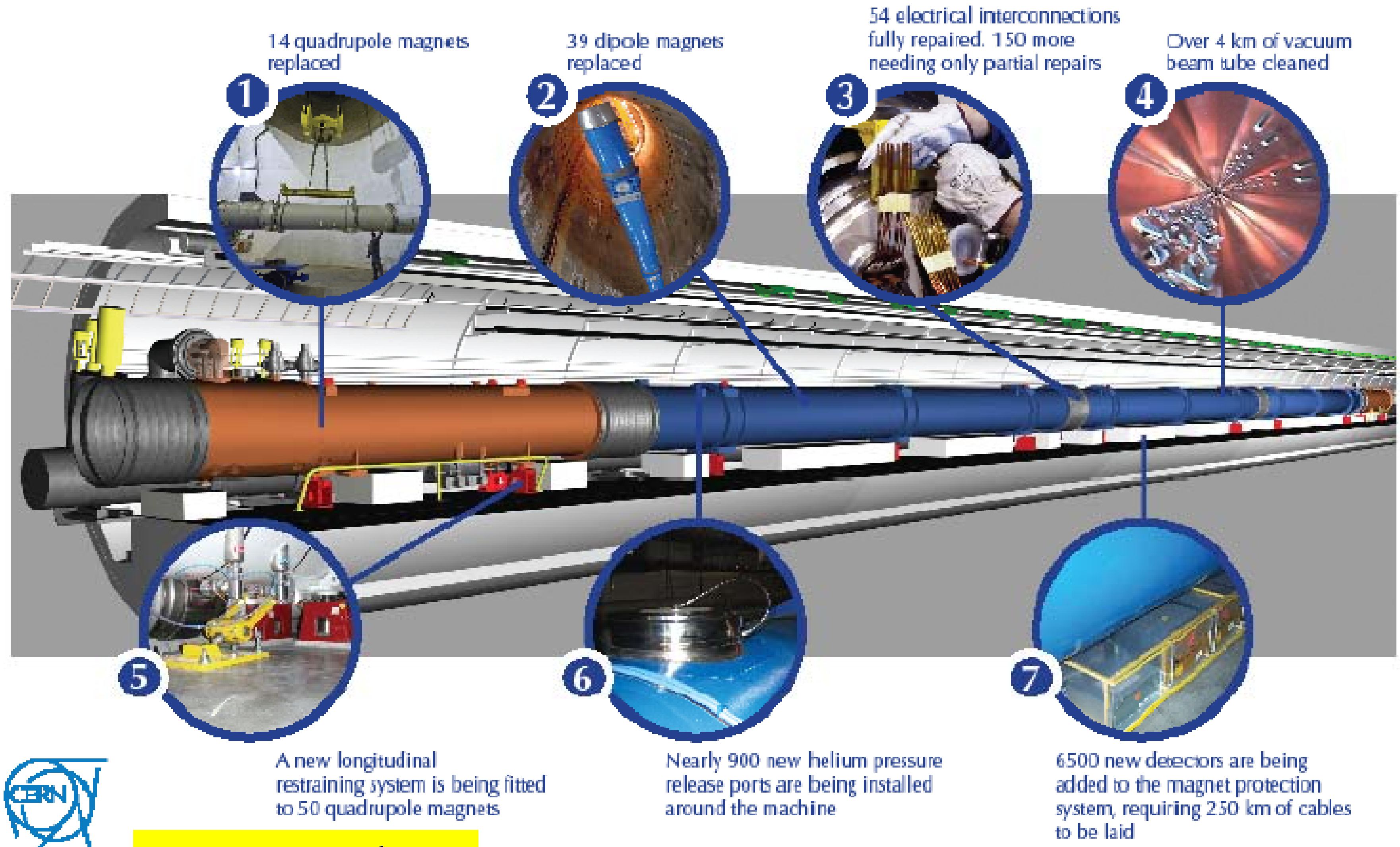
Fault tree [1/3]



Consequences

Phase 1 +2

The LHC repairs in detail

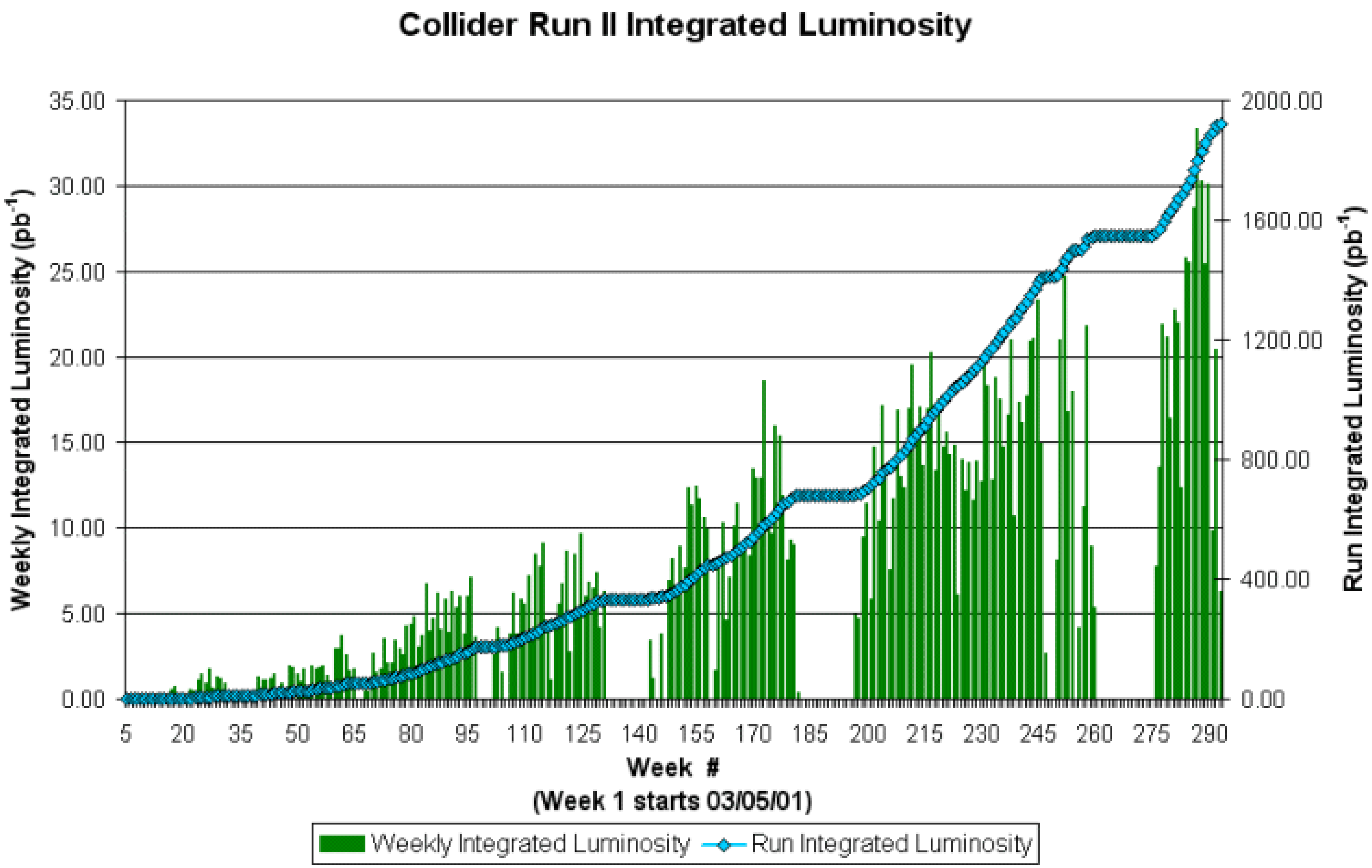


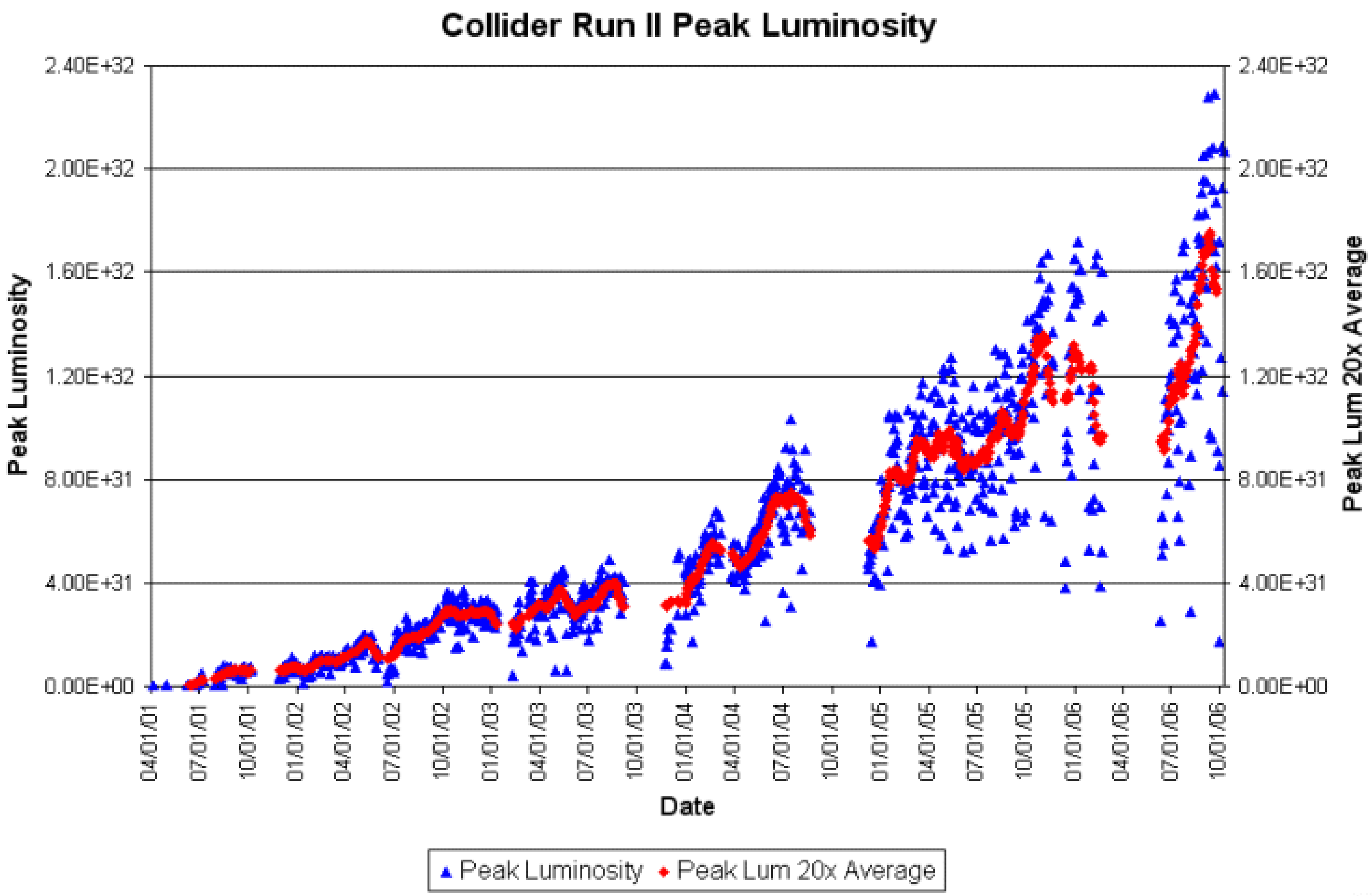
+ 8 cryogenics!

Examples of Performance Surprises

- BNL/ISA, 1983, SC Magnet Failure
- SLAC/SLC, 1992, Reliability & Luminosity
- SSC, 1994, Cost Overrun
- FNAL/Tev-II, 2002, Delayed Performance
- LANL/PSR, 2001, Limited by e-cloud
- CERN/LHC, 2002, Cost Increase of 25%,

  (A typical contingency reserve required in US)
- BP Gulf Oil Platform Explosion, Failure of Emergency Interlock, April, 2010
- Foxconn Incidents (Management/Culture), 2010


Collider Run II Integrated Luminosity
Weekly Integrated Luminosity (pb-1)
Run Integrated Luminosity (pb-1)
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
2000.00
1600.00
1200.00
800.00
400.00
0.00
5 20 35 50 65 80 95 110 125 140 155 170 185 200 215 230 245 260 275 290
Week #
(Week 1 starts 03/05/01)
Weekly Integrated Luminosity
Run Integrated Luminosity



Collider Run II Peak Luminosity
Peak Luminosity
Peak Lum 20x Average
Date
2.40E+32
2.00E+32
1.60E+32
1.20E+32
8.00E+31
4.00E+31
0.00E+00
04/01/01
07/01/01
10/01/01
01/01/02
04/01/02
07/01/02
10/01/02
01/01/03
04/01/03
07/01/03
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04/01/05
07/01/05
10/01/05
01/01/06
04/01/06
07/01/06
10/01/06
Peak Luminosity
Peak Lum 20x Average

Quotation of the Day

"Three outstanding attitudes, obliviousness to the growing disaffection of constituents, primacy of self (aggrandizement), and the illusion of invulnerable status – are persistent aspects of folly".

Barbara Tuchman
The March of Folly

II. Start of a Project---- Planning

A. Orient Yourself -- Goals, Means, and Environment
B. Conceptual/Preliminary/Detail Design Report
C. Management Plan and Documentation
D. Accounting and Scheduling Tools
E. Organization and Staffing
F. WBS and Work Package
G. Performance, Cost, and Schedule for Project Baseline

Definition of a Project

“A project is a single, non-repetitive enterprise.

It is usually undertaken to achieve planned results within a time limit and a cost budget.

Because each project is unique, its outcome can never be predicted with absolute confidence.

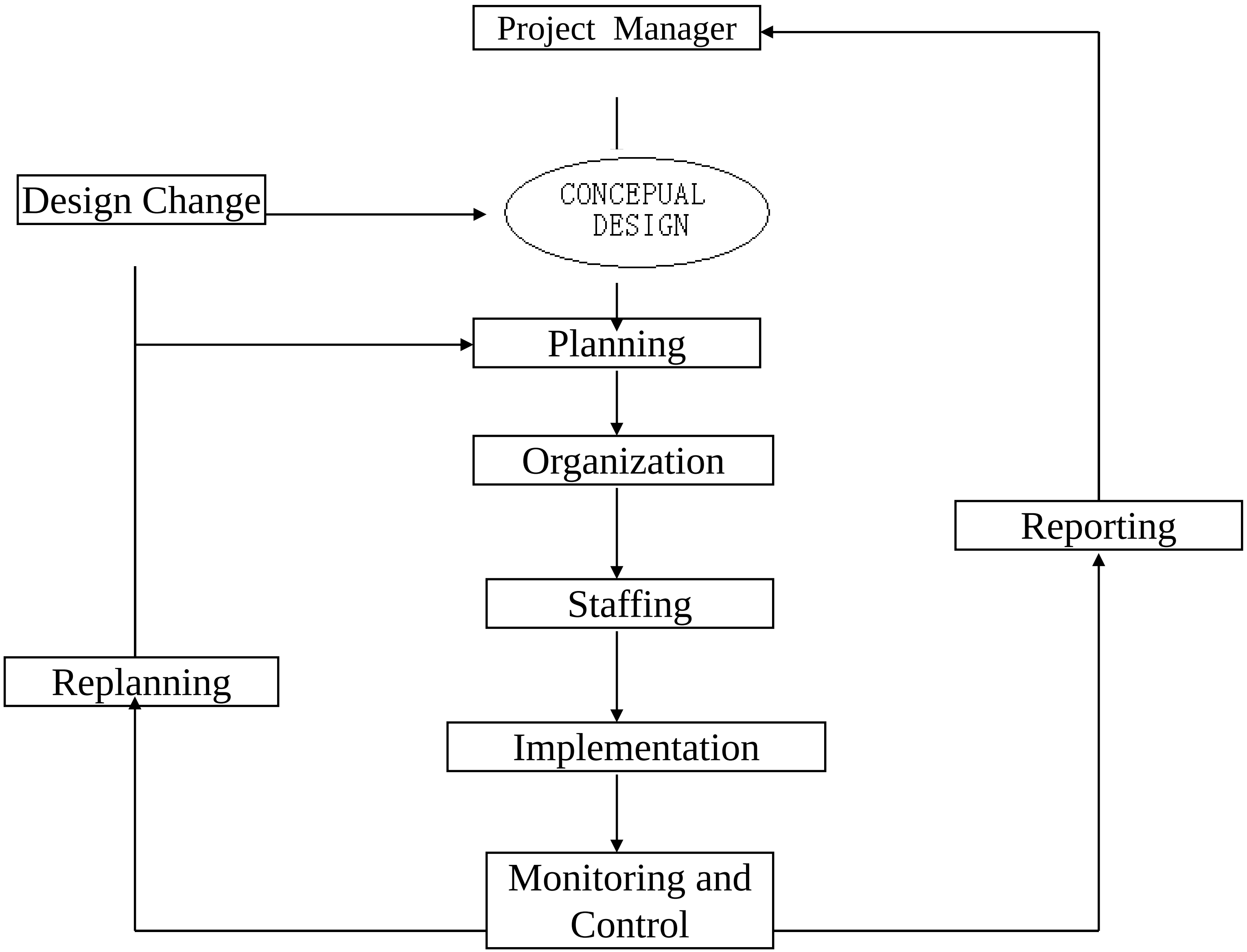
Projects are risky enterprises.

Project management is the business of securing the end objectives in the face of all the risks and problems encountered on the way.

Success depends largely on carrying out the constituent tasks in a sensible sequence and deploying resources to best advantage.”

(Dennis Lock, Project Management, P.11)

Functions of Project Manager



The Project Manager's Role

◆Be accountable for accomplishing the project objective with the available or anticipated resources and within the constraints of time, cost, and performance/technology (PDT).

◆Maintain prime customer liaison and contact.

◆Be responsible for establishing the project organization.

◆Develop and maintain project plans (who does what –for how much-- and when)

The Project Manager's Role

(continued)

- Negotiate and contract with all functional disciplines for accomplishment of the necessary work packages, within time, cost, and performance/technology (sub-PDT).
- Provide technical, financial, and schedule requirements direction.
- Be responsible for change control (PDT).
- Analyze and report project performance.

Phase of Accelerator Project

Proposal	Design	Construction	Commissioning	Operation
Scientific	Detailed	Organization	Machine	Physics Run
Justification	Design	&Staffing	Performance	Upgrade
Feasibility	Prototypes	Engineering	Component	
Study	Cost&	Optimization	Validation	
Conceptual	Schedule	Specification,	Scenario&	
Design	Management	Procurement	Schedule	
Cost&	Plan, Qa/Qc	Assenmbly&	Application	
Schedule		Testing,	Software,	
		Project	Design	
		Control	Validation	
		Installation		

Ingredients of a Successful Project

1. **Good Physics Design – Physicists**
2. **Good Engineering Design – Engineers**
3. **Good Project Management – Managers**
4. **Competent Staff Working Together as a Team**

Everyone Brings His Necessary Contribution
to Make the Whole Sufficient.

Project Management:

The Integrated Planning and Control Process Includes (as a minimum):

- ❖The purpose of the project (Why do it?)
- ❖A clear definition for customer requirements, including quality and reliability standards for the end items.(What level of performance?)
- ❖ An Accountability Matrix (Who will be responsible for What?)
- ❖Definition for the tasks to be performed (How will it be done?)
- ❖Establishment of the timetable (When will it be done?)
- ❖Definition for the resource requirements (How much will it cost?)

W_5H_2(plan)

Establishment of the baseline plan(W_5H_2)
For performance measurement.
Tells W_1ho will do W_2hat, W_3hy, W_4hen, W_5here, H_1ow and H_2ow much

Project & Element Function	General Manager	Engineering Mgr	Project Manager	Marketing Mgr	Contract Admin	Director Mfg	Mfg Co-ordinator
Prepare Proposal	A	D	B	D	D	D	D
Approve Proposal	G	D	G	D	D	D	
Negotiate Contract		B	B		C		
Sign Contract	A	E	E		D		
Plan and Control Project	G	B	B		C		
Design and Develop Prototype	G	B	B				D
Control Product Configuration	G	B	A		D	E	D
Control Product Quality	G	D	A	C	D	E	D
Negotiate Agreements	G		B/G			E	D
Conduct Evaluation Meetings	G	D	B		D		D
Report to Customer	G	E	B	D	E		
Conduct Design Review Meetings	G	C	B		E		E

Relationship code

A General Responsibility

B Operating Responsibility

C Specific Responsibility

D Must Be Consulted

E May Be Consulted

F Must Be Notified

G Must Approve

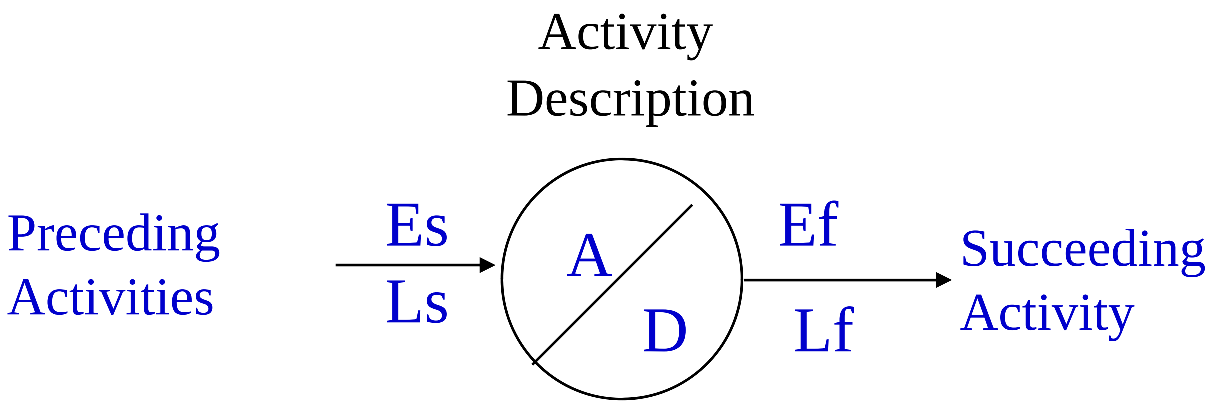
Sample Responsibility Matrix

PMA

What is a Work Package

- o Represents Units of Work Where Performed
- o Distinguishable From Other Work Packages
- o Assigned to a Single Organization, Where Possible, If not, Assign the Primary/Supporting Units.
- o Has a Scheduled Start Date and Completion Date (Including Manpower and Budget)
- o Has Interim Milestones (Monthly if Possible)

Precedence Network



D = Estimated duration of described activity (in project days)

Es = Early start date, earliest that the activity can begin assuming all preceding activities have been completed according to their estimated duration.

Ef = Early finish date, equal to the early start date plus the estimated duration.

Ls = Late start date, latest that the activity can begin without delaying the total project finish date.

Lf = Late finish date, equal to the late start date plus the estimated duration.

A = Activity identification number .(if used)

Procedure for Generating the Precedence Network

Step 1 Determine the Activities Required to Do the Job.

Step 2 Determine the Logical Order for the Work Flow.

Step 3 Assign Activity Numbers to Each Activity (Optional).

Step 4 Estimate the Duration of Work for Each Activity.

Step 5 Develop the Project Calendar.

Step 6 Calculate the Early Start Dates and the Early Finish Dates.

Step 7 Calculate the Late Start Dates and the Late Finish Dates.

Step 8 Determine the Critical Path.

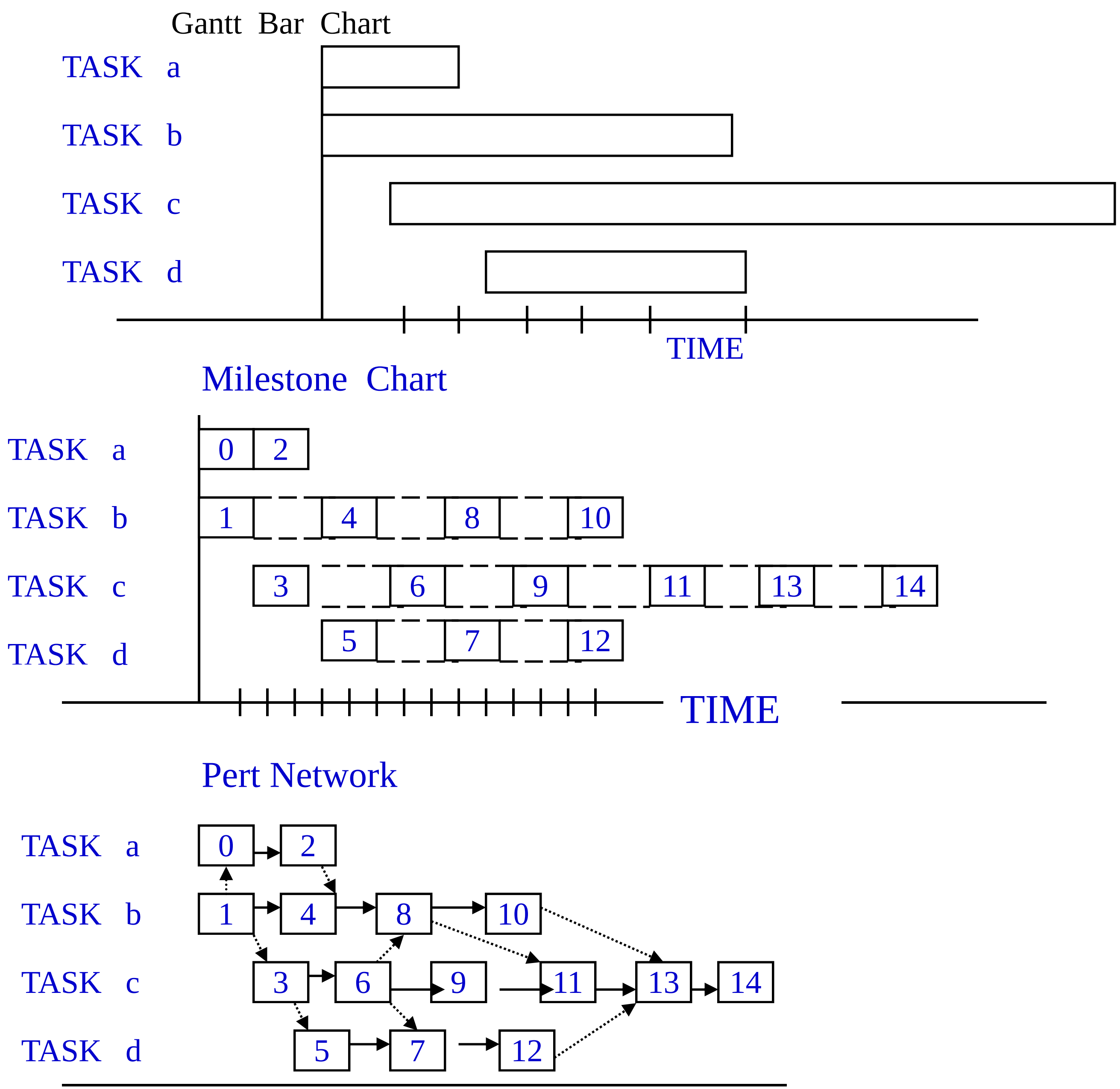
Definitions for the Terms used in PERT Network Planning and Scheduling are :

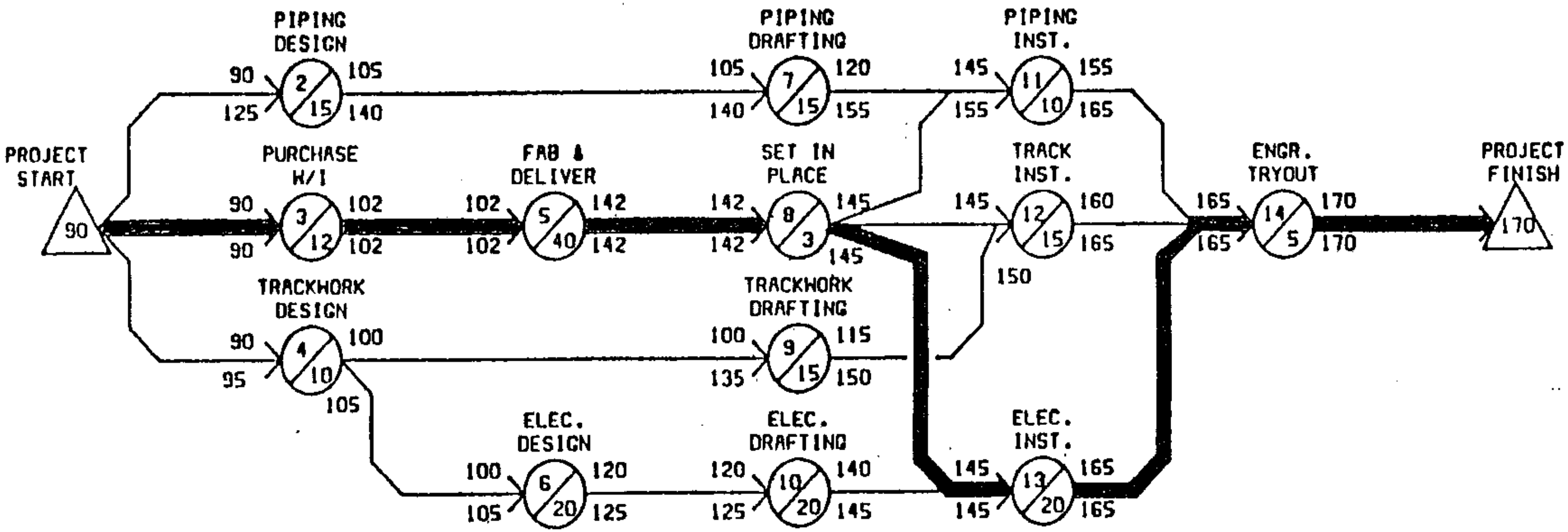
- Event –A specific, definable accomplishment recognizable at a particular instant in time.
- Activity– A unique portion of the project.
- Dummy Activity –An activity that requires no resources or time, used to show logic restraints.
- Duration –The time required to complete the activity.
- Resource –Materials and /or labor required to complete activities.
- Critical path—The particular sequence of activities that comprise the longest time to complete the project.

Definitions for the Terms used in PERT Network Planning and Scheduling Are :(continued)

- Float–The greatest time an activity can be delayed without delaying the completion of the project.
- Early Start—The earliest time an activity can be started.
- Early Finish—The earliest time an activity can be finished.
- Forward Pass—The technique used to determine the early start and early finish of the activities.
- Late Start – The latest an activity can start without delaying the completion of the project.
- Backward Pass– the technique used to determine the late start and late finish of the activities.

Comparison of Scheduling Techniques





WALL IRONER INSTALLATION
EXAMPLE

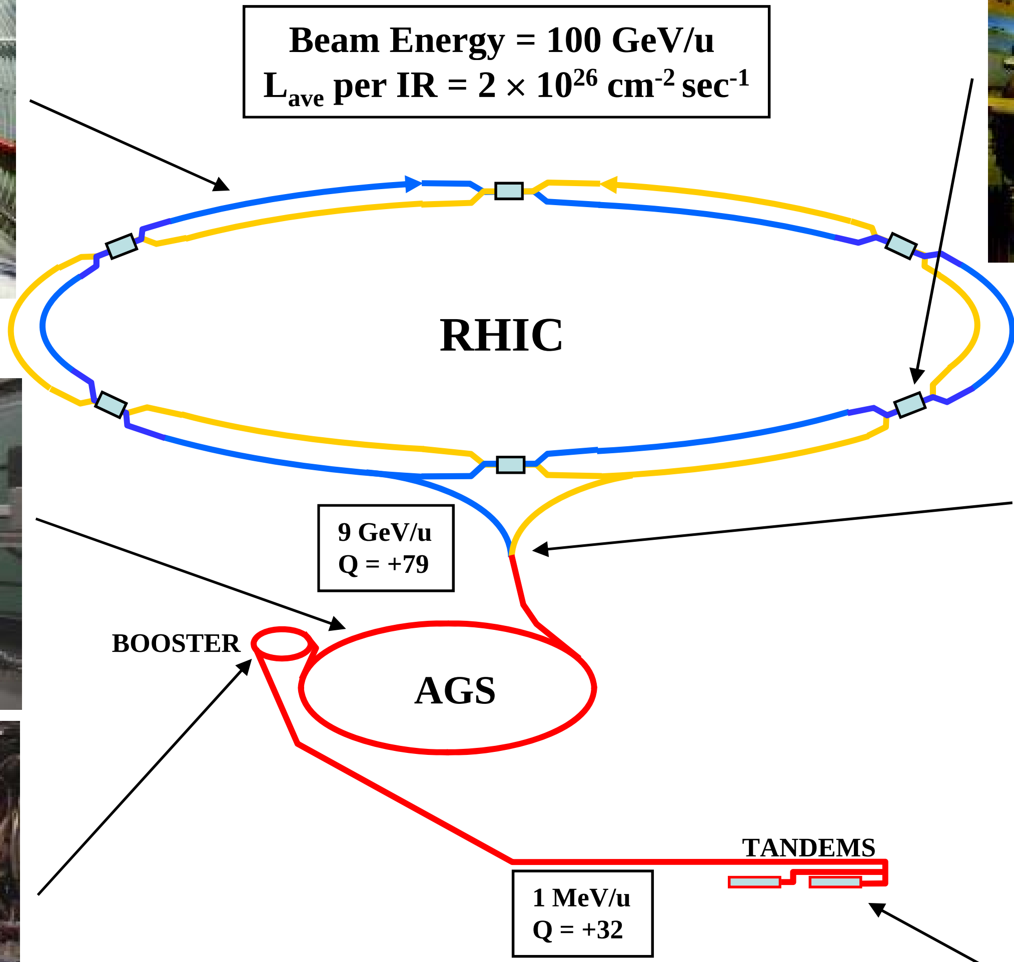
STEP 8 : DETERMINE THE CRITICAL PATH

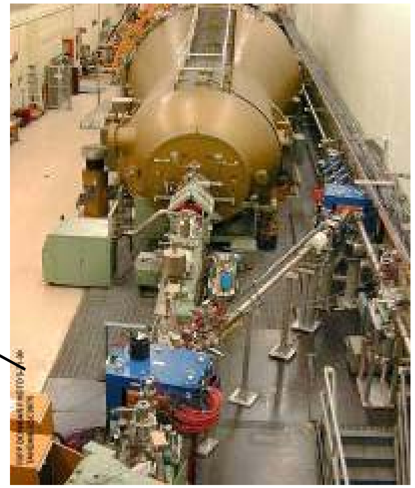
Functions and Purposes of a Project Management System

- Effective Understanding, Planning, Execution, Monitoring, and Intervention of a Project.
- Covers Configuration, Budget, Schedule, Manpower, and Quality.
- Real Time Inputs for Report, Review, Auditing, and Projection.
- CDR, TDR, TDM, PMCS, Constitute the Core of a Project.

PHOBOS
10:00 o'clock
12:00 o'clock
BRAHMS & PP2PP ($\vec{p}$)
2:00 o'clock
RHIC
4:00 o'clock
PHENIX($\vec{p}$)
8:00 o'clock
STAR ($\vec{p}$)
6:00 o'clock
NASA - BAF
μ g-2
HEP/NP(p)
LINAC
BOOSTER
AGS
TANDEMS

Gold Ion Collisions in RHIC





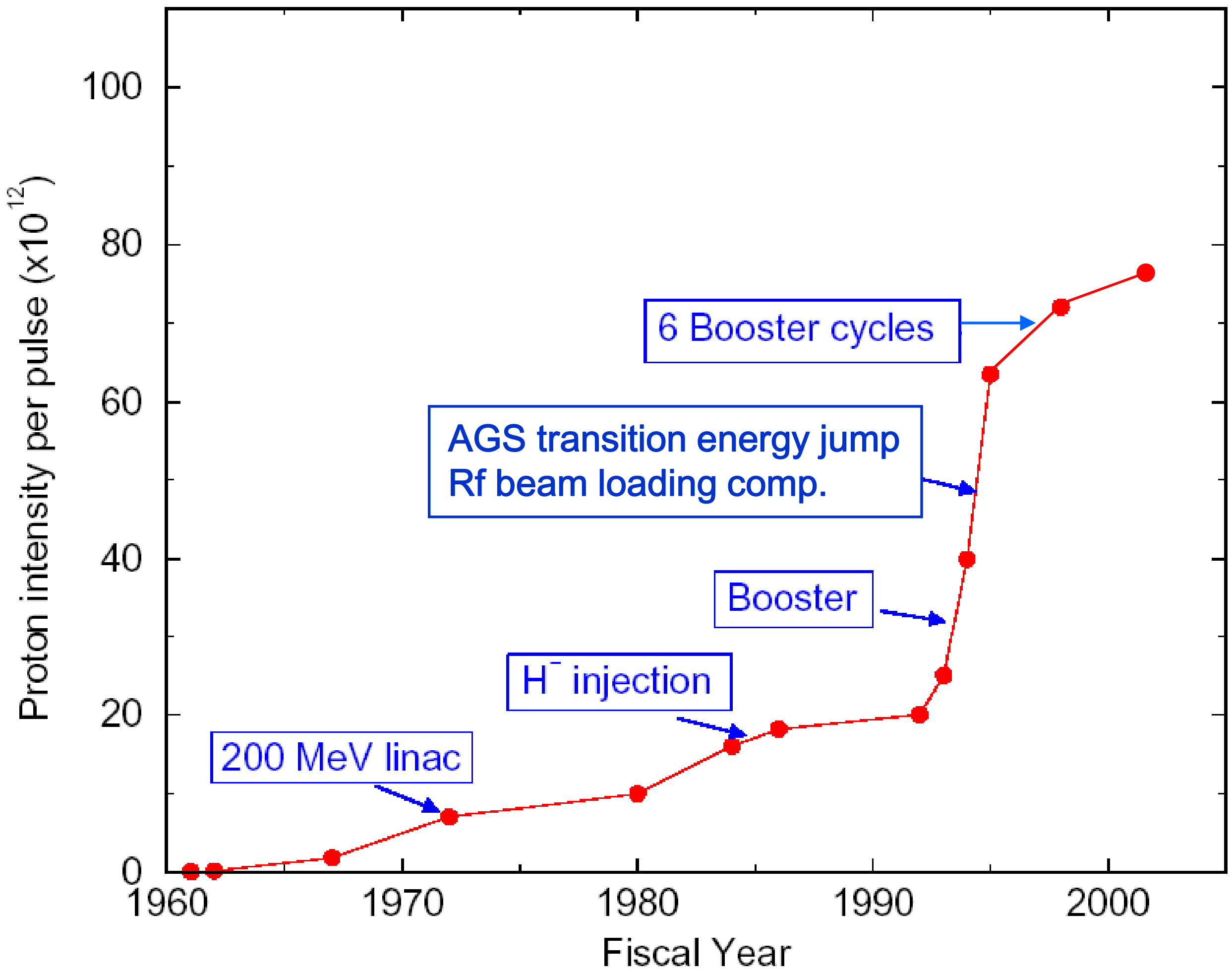
Booster Project and AGS Upgrade

Booster was constructed in 1987 – 1990 to

1. Increase AGS proton intensity(* 5.0)
2. Raise polarized proton intensity in both AGS and RHIC
3. Raise heavy ion mass and intensity in AGS and RHIC

   (from O to U)

AGS Intensity History



Booster Project Work Breakdown Structure

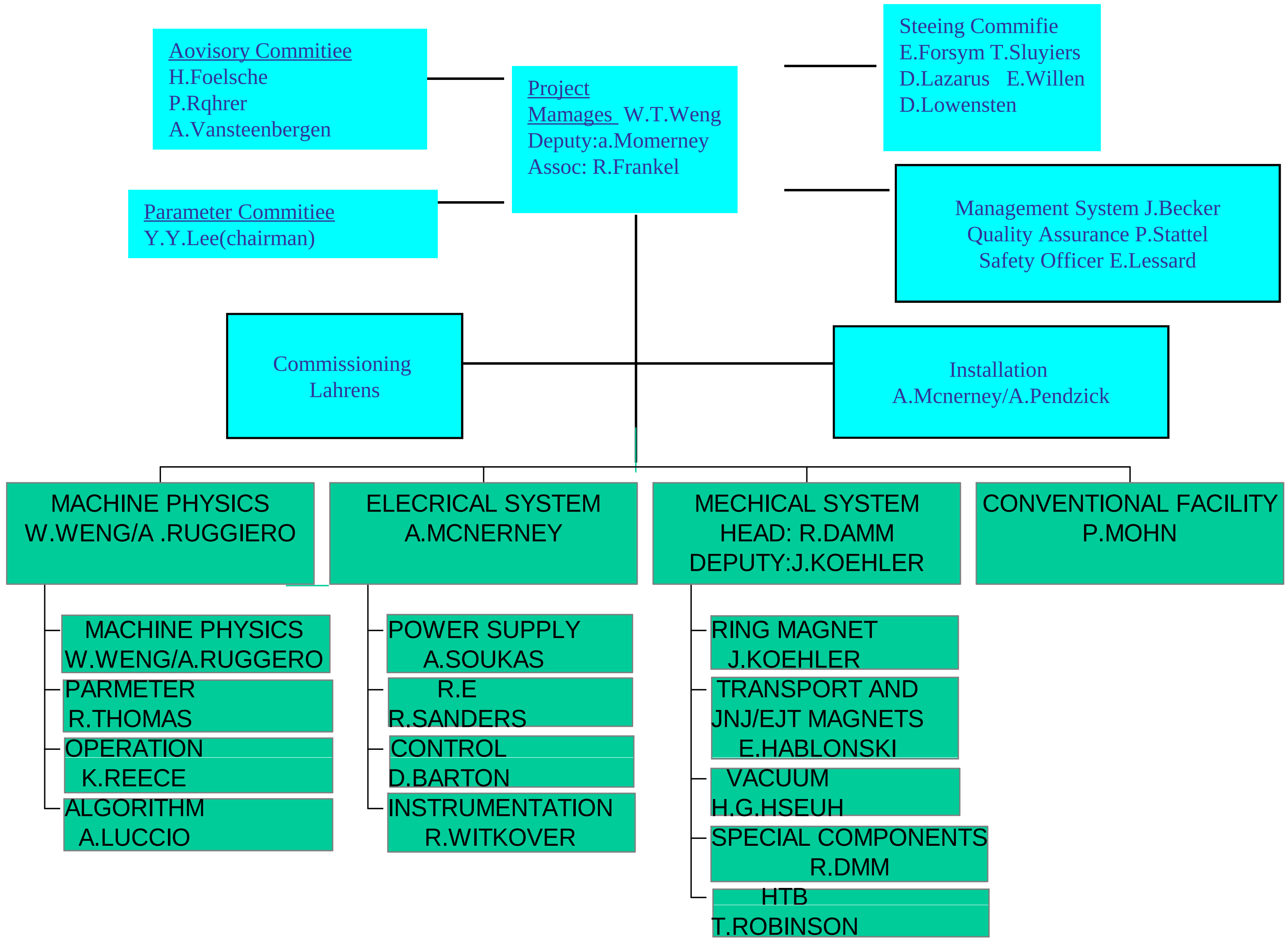
WBS 1 Booster Project

- **1.1 Accelerator Systems**
- **1.2 Conventional Facilities**
- **1.3 Systems Engineering (EDIA)**
- **1.4 Project Management**

Booster Project Work Breakdown Structure
WBS 1 Booster Project

- 1.1 Accelerator Systems
  - 1.1.1 Magnet System
  - 1.1.2 Magnet Power Supplies
  - 1.1.3 Vacuum System
  - 1.1.4 RF System
  - 1.1.5 Beam Instrumentation
  - 1.1.6 Control System
- 1.2 Conventional Facilities
  - 1.2.1 Construction
  - 1.2.2 A/E
- 1.3 Systems Engineering (EDIA)
  - 1.3.1 Magnet System
  - 1.3.2 Magnet Power Supplies
  - 1.3.3 Vacuum System
  - 1.3.4 RF System
  - 1.3.5 Beam Instrumentation
  - 1.3.6 Control System
  - 1.3.7 Accelerator Physics
  - 1.3.8 Construction
- 1.4 Project Management
  - 1.4.1 Management Systems
  - 1.4.2 Quality Assurance
  - 1.4.3 P. M. Administration

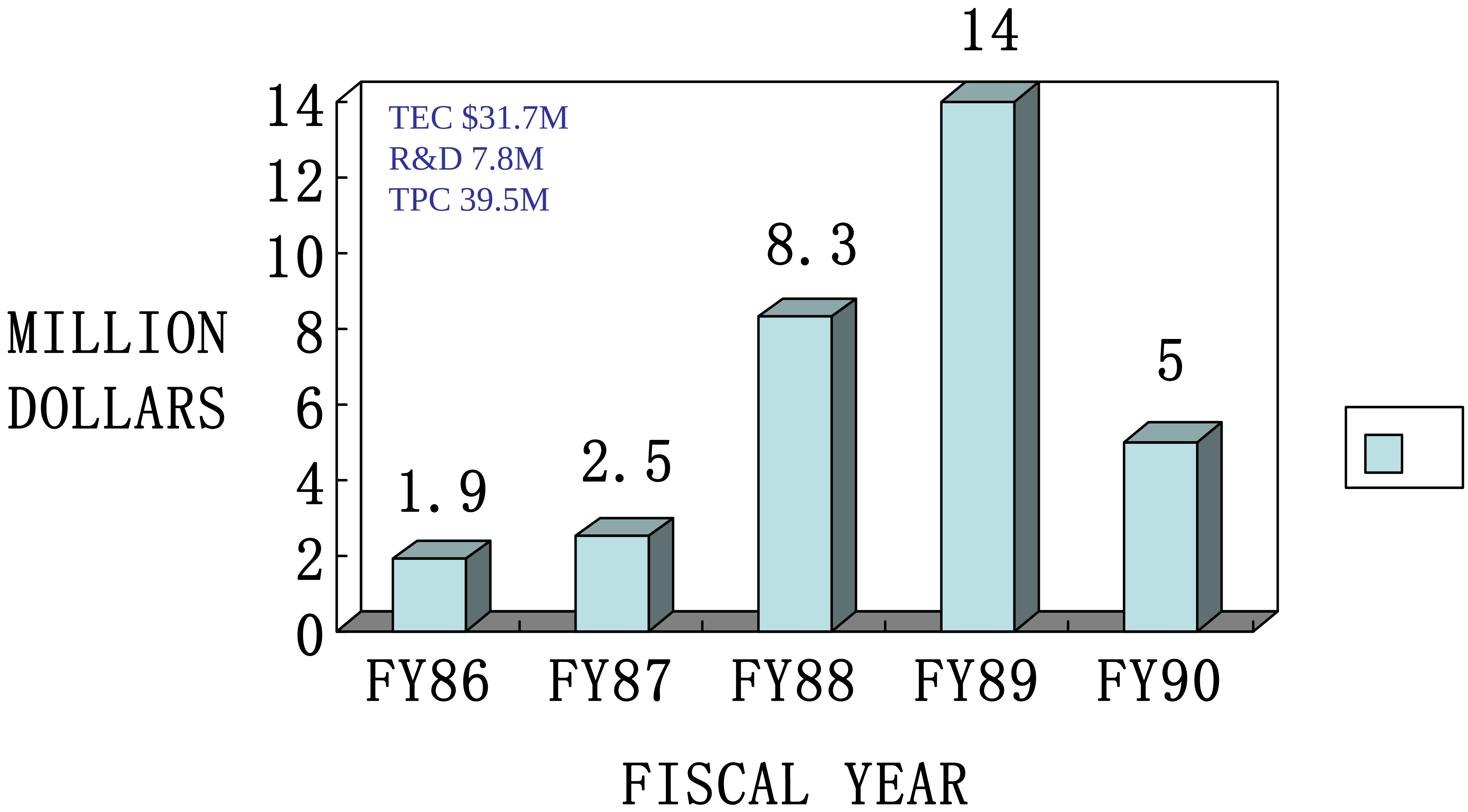
Booster Project



H. Booster Documentation

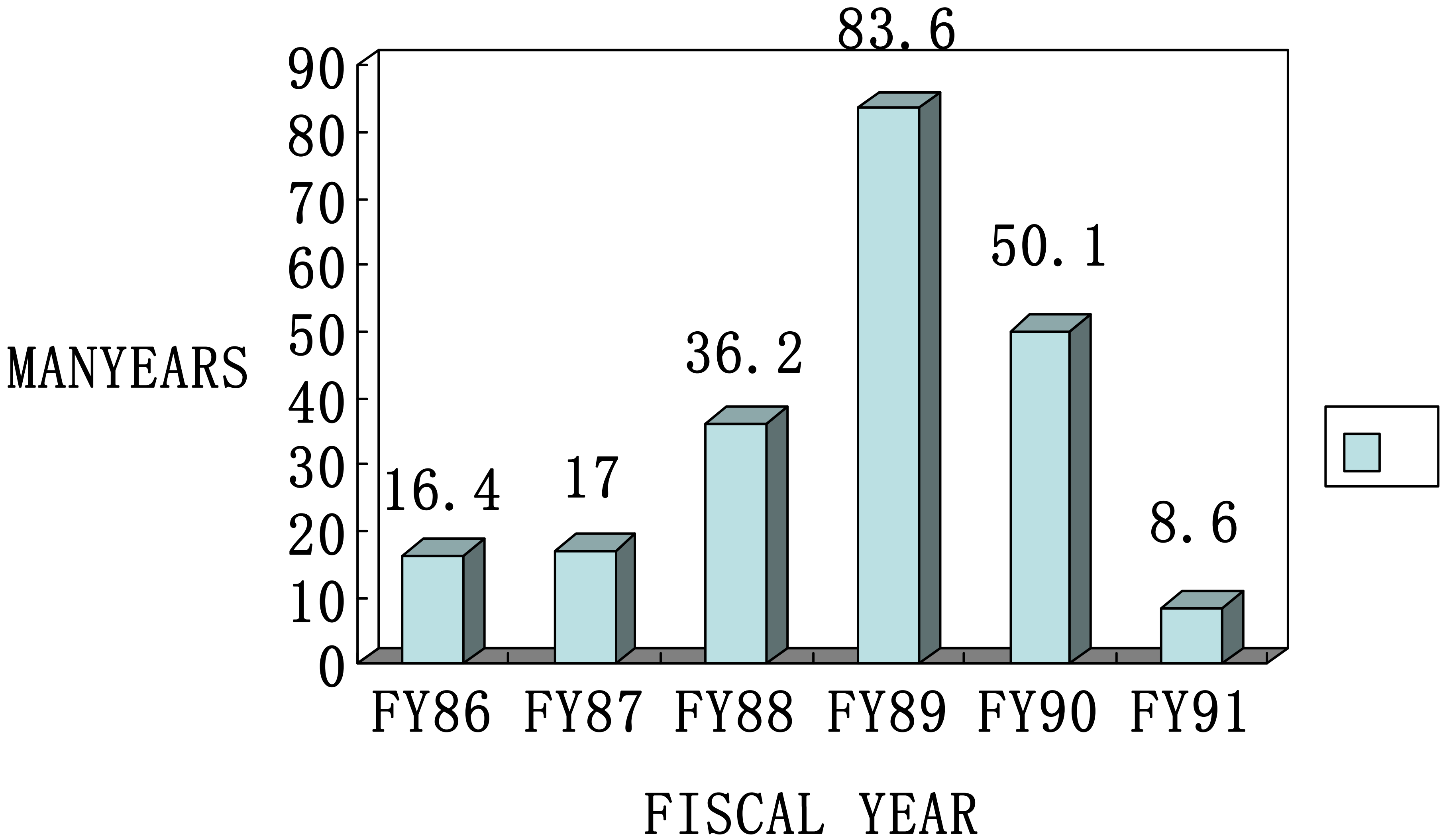
Conceptual Design Rreport (CD-0)	May 1984
Booster Proposal (CD-1)	Oct 1985
TITLE I and II	Jul 1986
DESIGN MANUAL(Preliminary , CD-2)	Oct 1986
Preliminary Safety Analysis Report	Dec 1987
Bars	Jan 1988
Management Plan	Apr 1988
Quality Assurance Manual	Apr 1988
Nepa	Mar 1988
Neshap	Mar 1988
DESIGN MANUAL (Final)	Oct 1988
Occupancy Readiness Review	Sep 1989
Apars Review and Corrective Plan	Apr 1990
Asfety Analysis Report (Sar)	Aug 1990
Operation Manual	Nov 1990
Commissioning Plan (CD-3)	Jan 1991
Operation Procedure	Jan 1991
Accelerarор Readiness Review	Feb 1991
Accaptance Test and Operation (CD-4)	May 1991
Booster Tech. Notes 1-172	

BOOSTER PROJECT FUNDING PROFILE



BOOSTER PROJECT MANPOWER

APR/89



Booster Account Report System (Bars)

1. Work Breakdown Structure Down to Level Seven (Total 1,200 Entries)
2. Cost Estimate & Expense Report (Monthly) Tracked to Each WBS
3. Manpower Estimate & Schedule Tracked to Each WBS
4. Procurement Plan (Monthly) Tied to WBS
5. Sources of Estimate
   - A . Actual
   - S . Similar Part
   - Q . Quotation
   - E. Engineer's Estimate
6. QA Category Assignment to Level 5

Bars is a Home-grown Version of Open Plan & Easy Track for Integrated Project Management System (IPMS) or Performance Measurement.

Source of Estimate Criteria

A - Actual
Q - Quotes
S - Engineering Judgments Based on Similar Parts
E - Estimates – Engineering Judgments on Historical Data

WBS NUMBER	S of E	DESCRIPTION	OCT '89 CWE QTY	OCT '89 CWE UNIT$	OCT '89 CWE TOTAL DOLLARS	ESTIMATE APRIL '89 TOTAL DOLLARS	VARIANCE	ACTUALS THRU SEPT '89	VARIANCE LEVEL 5	VARIANCE LEVEL 4	VARIANCE LEVEL 3	BALANCE AVAILABLE	% OF EST. OBLIG.
1.1.1		Magnet System			7296155	7198029		5740984			98126	1555171	78.7%
		Labor (Direct Only)			1714518	1739245	-24727	1126896				587622	65.7%
		Material (Includes Stores, Travel & Contract Labor)			5581637	5458784	122853	4614088				967549	82.7%
1.1.1.1		Main Ring Magnets			2863989	2805016		2699568		58973		164421	94.3%
1.1.1.1.1		Dipole			1984939	1794402		1980454	190537			4485	99.8%
1.1.1.1.1.1	A	Core	37	24860.00	919820	872490	47330	919820				0	100.0%
1.1.1.1.1.2	A	Coils	37	21300.00	788100	659454	128646	788100				0	100.0%
1.1.1.1.1.3	S	Core/Coil Assy	37	2870.00	106190	110311	-4121	102762				3428	96.8%
1.1.1.1.1.4	A	Tooling	37	3367.00	124579	121054	3525	124570				9	100.0%
1.1.1.1.1.5	A	Fabrication & Assembly	37	1250.00	46250	31093	15157	45202				1048	97.7%
				47									
1.1.1.1.2		Quadrupole			719050	668619		716589	50431			2461	99.7%
1.1.1.1.2.1	A	Core	50	3735.00	186750	173200	13550	186750				0	100.0%
1.1.1.1.2.2	A	Stainless Steel	50	505.00	25250	18619	6631	25250				0	100.0%
1.1.1.1.2.3	A	Steel End Plates	50	2092.68	104634	75720	28914	104634				0	100.0%
1.1.1.1.2.4	A	Coils	50	4388.32	219416	233650	-14234	219416				0	100.0%
1.1.1.1.2.5	S	Misc	50	2860.00	143000	117000	26000	140539				2461	98.3%
1.1.1.1.2.6		Core/Coil Assembly	0	0.00	0	0	0	0				0	0.0%
1.1.1.1.2.7	S	Tooling(Amortized)	50	800.00	40000	50430	-10430	40000				0	100.0%
1.1.1.1.3		Sextupoles				175224		0	-175224			0	0.0%
1.1.1.1.3.1	A	Sextupole Magnets	0	0.00		149149	-149149	0				0	0.0%
1.1.1.1.3.2	E	Sextupole Stands	0	0.00		26075	0	0				0	0.0%
1.1.1.1.4	S	Multipole Corrector	50	3200.00	160000	166771	-6771	2525	-6771			157475	1.6%

WBS NUMBER	S of E	DESCRIPTION	OCT '89 CWE QTY	OCT '89 CWE UNIT$	OCT '89 CWE TOTAL DOLLARS	ESTIMATE APRIL '89 TOTAL DOLLARS	VARIANCE	ACTUALS THRU SEPT '89	VARIANCE LEVEL 5	VARIANCE LEVEL 4	VARIANCE LEVEL 3	BALANCE AVAILABLE	% OF EST. OBLIG.
1.1.5		Beam Instrumentation			1553902	1617583		1003224			-63681	550678	64.6%
		Labor (Direct Only)			75000	104005	-29005	31113				43887	41.5%
		Material (Includes Stores, Travel & Contract Labor)			1478902	1513578	-34676	972111				506791	65.7%
1.1.5.1		Booster Ring			581986	632052		386153		-50066		195833	66.4%
1.1.5.1.1		PUE System			475022	480837		331932	-5815			143090	69.9%
1.1.5.1.1.1	Q	Dectector	47	5658.76	265962	247267	18695	265962				0	100.0%
1.1.5.1.1.2	E	Cable (RF)	147	200.00	29400	29413	-13	0				29400	0.0%
1.1.5.1.1.3	E	Signal Electronics	47	2700.00	126900	149214	-22314	63981				62919	50.4%
1.1.5.1.1.4		Processing Electronics	0	0	0		0	0				0	0.0%
1.1.5.1.1.5		Calibration Electronics	0	0	0		0	0				0	0.0%
1.1.5.1.1.6	E	Data Communication System	47	1000.00	47000	48935	-1935	1989				45011	4.2%
1.1.5.1.1.7	E	Bunch Timing Electronics	1	2000	2000	2086	-86	0				2000	0.0%
1.1.5.1.1.8	E	Bunch Timing Cabling	47	80	3760	3922	-162	0				3760	0.0%
1.1.5.1.2		Intensity Monitors			42084	43244		26401	-1160			15683	62.7%
1.1.5.1.2.1	S	Wall Current Monitor	1	13008.00	13008	13567	-559	0				13008	0.0%
1.1.5.1.2.2	Q	Medium Current Trans	1	4010.00	4010	3000	1010	4010				0	100.0%
1.1.5.1.3.3	Q	DC Current Trans	1	25066.00	25066	26677	-1611	22391				2675	89.3%
1.1.5.1.3		Special PUE Functions			17730	18405		2044	-675			15686	11.5%
1.1.5.1.3.1		Dectectors	0	0	0	0	0	0				0	0.0%
1.1.5.1.3.2		Vacuum Chamber	0	0	0	0	0	0				0	0.0%
1.1.5.1.3.3	E	Cabling	9	170.00	1530	1596	-66	0				1530	0.0%
1.1.5.1.3.4	Q	Electronics	9	1800.00	16200	16809	-609	2044				14156	12.6%

Booster Project

Current Working Estimate

(Fy 90 $ in Thousands)

	PROC	LABOR	CWE TOTAL	PRIOR YEARS	FY'90	FY,91
1.1 Accelerator Sys.	18,859	3,545	22,404	16,269	6,135	
1.2 Conventional Fac.	3,309	77	3,386	3,279	107	
1.3 Systems Eng. (Edia)	635	4,202	4,837	4,434	403	
1.4 Project Management	186	788	974	879	95	
WBS 1 Total	22,989	8,612	31,601	24,861	6,740	
Contingency			29	--	29	
Total Obligation Plan			31,630	24,861	6,769	
Total Expense Plan			31,630	19,046	11,850	
Current Funding Profile*			31,630	26,700	4,930	

*Reflects Gramm-rudman Reduction-

Accelerator Systems

Current Working Estimate

(Fy 90 $ in Thousands)

	PROC	LABOR	CWE TOTAL	PRIOR YEARS	FY'90
1.1.1 Magnet System	6,149	1,581	7,730	5,741	1,989
1.1.2 Magnet Power Supplies	4,284	259	4,543	3,663	880
1.1.3 Vacuum System	2,726	811	3,537	2,423	1,114
1.1.4 Rf System	2,805	503	3,308	2,633	675
1.1.5 Beam Instrumentation	1,555	95	1,650	1,003	647
1.1.6 Control System	1,340	296	1,636	806	830
WBS 1.1 Total	18,859	3,545	22,404	16,269	6,135

Conventional Facilities

Current Working Estimate

(Fy 90 $ in Thousands)

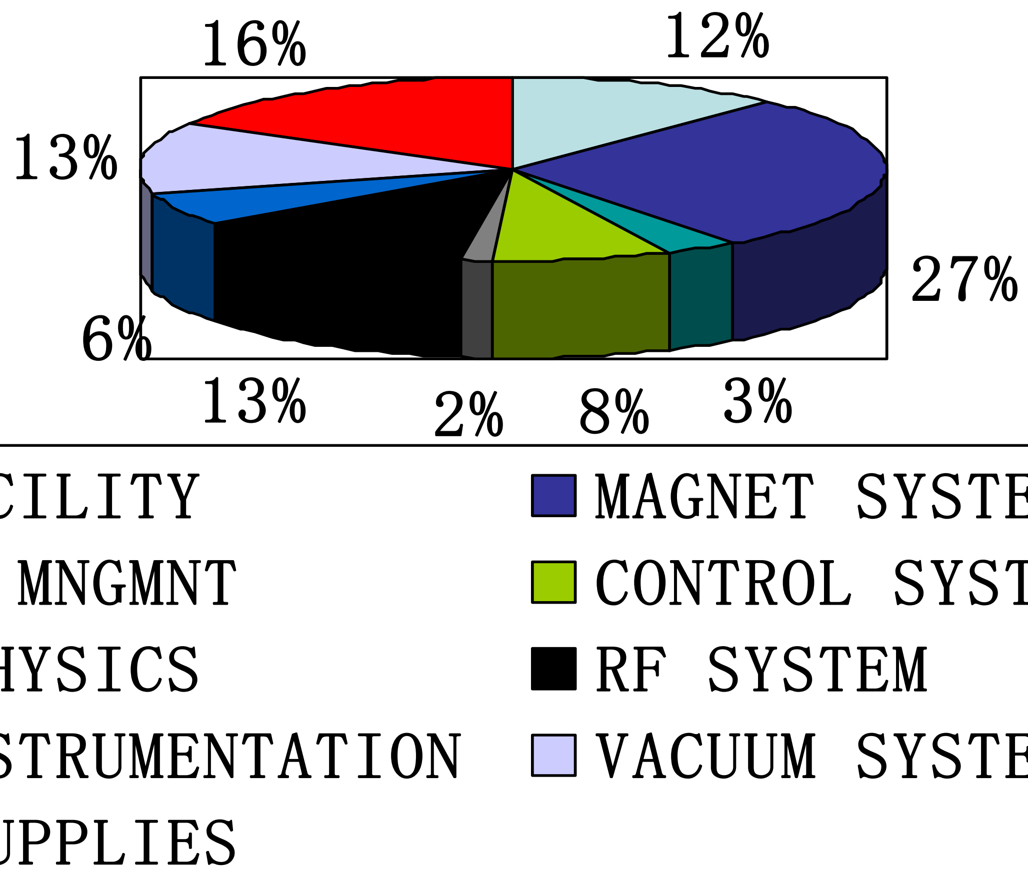
	PROC	LABOR	CWE TOTAL	PRIOR YEARS	FY'90
1.2.1 Construction	3,074	17	3,091	2,984	107
1.2. 2 A/E	235	60	295	295	--
WBS 1.2 Total	3,309	77	3,386	3,279	107

	PROC	LABOR	CWE TOTAL	PRIOR YEARS	FY'90
1.4.1 Management Systems	13	165	178	149	29
1.4.2 Quality Assurance	--	76	76	64	12
1.4.3 Pm Administration	173	547	720	666	54
WBS 1.4 Total	186	788	974	879	95

Systems Engineering (EDIA)
Current Working Estimate
(Fy 90 $ In Thousands)

		PROC	LABOR	CWE TOTAL	PRIOR YEARS	FY'90
1.3.1	Magnet System	306	802	1,108	1,097	11
1.3.2	Magnet Power Supplies	50	634	684	625	59
1.3.3	Vacuum System	116	411	527	527	--
1.3.4	Rf System	19	618	637	550	87
1.3.5	Beam Instrumentation	5	252	257	220	57
1.3.6	Control System	4	803	807	659	148
1.3.7	Accelertor Physics	2	466	468	427	41
1.3.8	Construction	133	216	349	349	--
	WBS 1.3 Total	135	4,202	4,837	4,434	403

CURRENT WORKING ESTIMATE
PERCENTAGE of PROJECT



PRCNT790

INSTALLATION ~10% not included

Computer Models Using “Timeline” Developed and In Use

Mechanical Systems ~~1,000 tasks
Manpower loaded
Maintained by Frankel with input from Damm, Hseuh & Koehler
Controls Engineering ~~ 950 tasks
Manpower loaded
Maintained by Oerter
Instrumentation System~~700 tasks
Manpower loaded
Maintained by Sims
PS Systems ~~ 425 tasks
Manpower loaded –Maintained by Sandberg
RF System ~~400 tasks
Maintained by Frankel with input from Brennan and Sanders
Computer models under development
Controls software :Systems and Application being developed by Culwick
Commissioning being developed by Ahrens

Analysis PS Systems Schedule

Because of the sheer number of elements which must be received, constructed and/or tested, I would estimate the accuracy of this model to be four calendar weeks.

This system is basically on schedule, using the following three dates as goals:

LTB Power Supplies	working	by 15 Jan 91
Ring PS	working	by 15 Feb 91
BTA into AGS	working	by 15 Feb 91

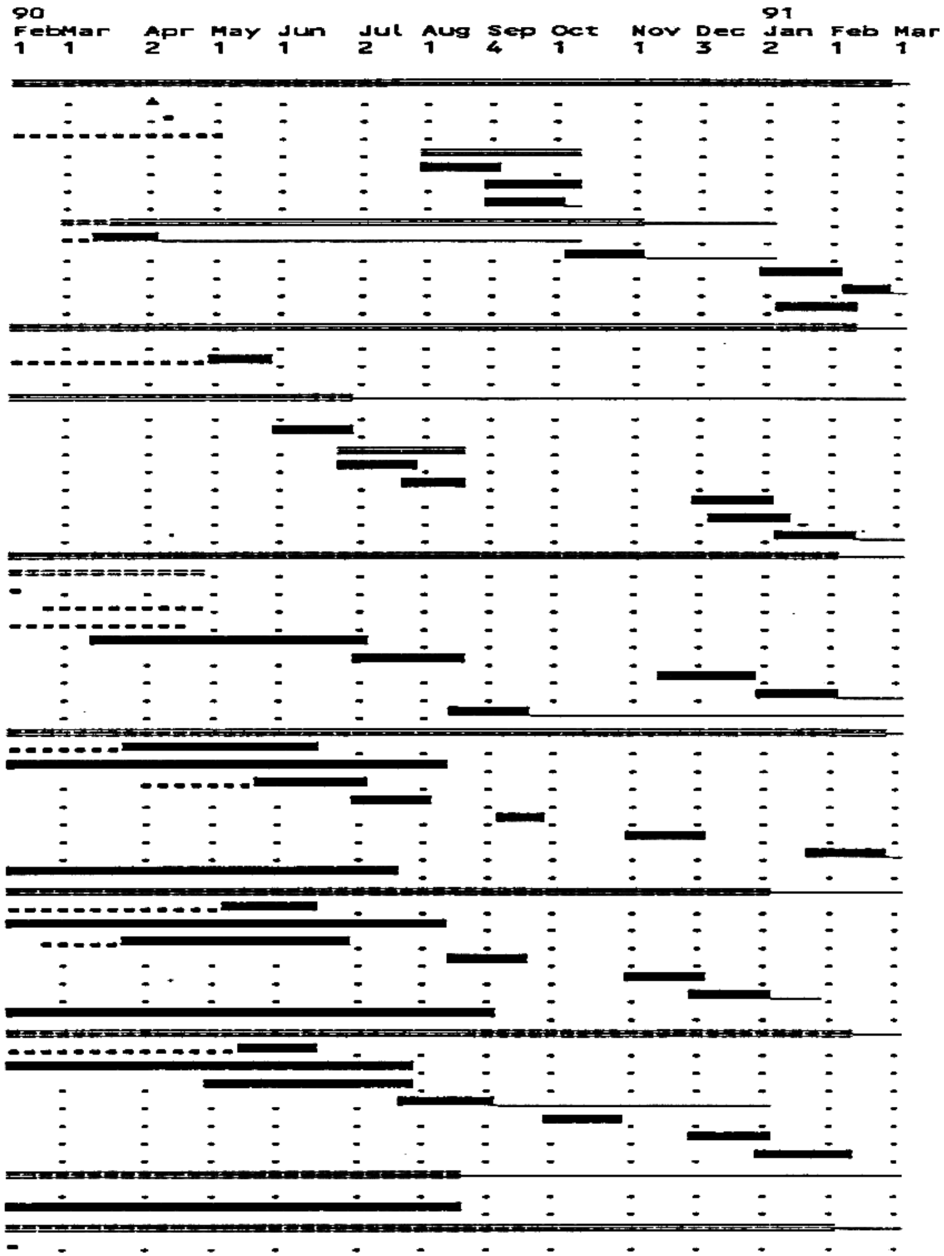
Analysis PS Systems Schedule (continued)

We are close to the critical path in the following places:

Only Four days slack on AA5 Fast Kicker (1)
Only twelve days slack on BF3Kicker (2)
Only four days slack on AL20 Septum (4)
Only seventeen days slack on BF6 Septum (5)
External BLWPS on critical path (6)
Only eleven days slack on Sexupole PS (8)
Only ten days slack on in kickers (9)
Only one days of slack in Quad trim system (13)
Only ten days slack in BLWPS (16)
Corrector PS on critical path (17)
LTB Quad & Dipole PS, ten days slack (19)
Security system, ten days slack (10)
Please remember that a technically a “perfect” project has zero slack. The critical path dates are being constantly monitored and corrections made as needed

Schedule Name : PSGCS1
Responsible : J SANDBERG/F TOLDO/J POST
As-of Date : 4-Jan-88 8:00am Schedule File : C:\TL31\DATA\PS_SHL

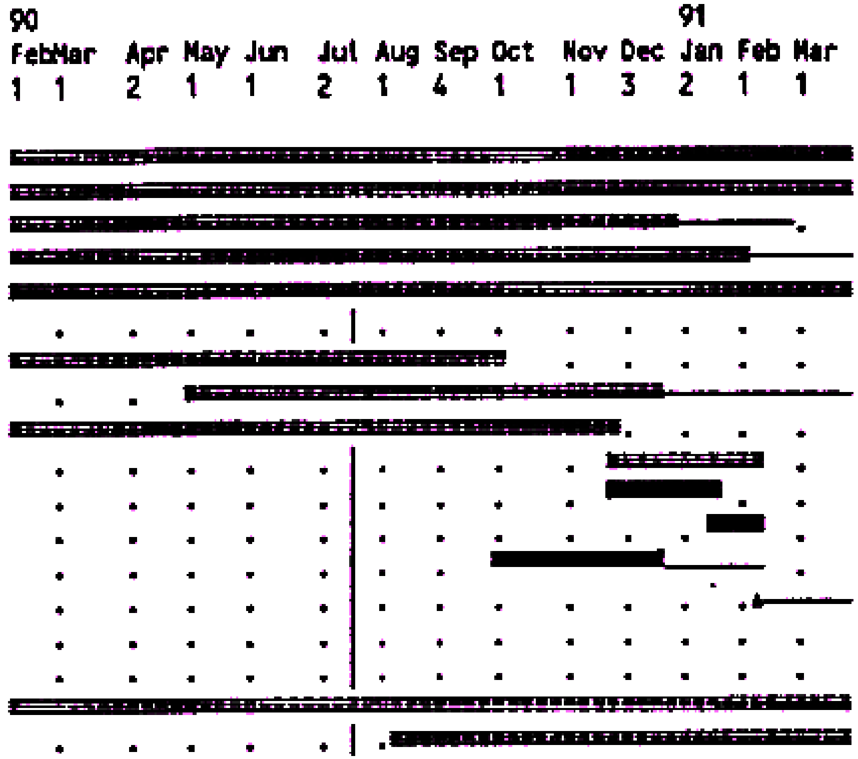
Task Name		End Date	FrSlack (Days)
1. AA5 FAST KICKER	ags	25-Feb-91	6.9
1.1 DESIGN	ags	5-Apr-90	0
1.2 PROCUREMENT	ags	12-Apr-90	0
1.3 PROTOTYPE	ags	30-Apr-90	0
1.4 CONSTRUCTION	ags	3-Oct-90	0
1.4.1 MOD CON A		30-Aug-90	0
1.4.2 MOD CON B	ags	3-Oct-90	0
1.4.3 CONTROLS		28-Sep-90	2.4
1.5 TESTING	ags	5-Nov-90	38
1.5.1 INITIAL		3-Apr-90	127.7
1.5.2 DETAILED	a	5-Nov-90	38
1.6 INSTALLATION	ags	1-Feb-91	0
1.7 SYSTEMS TEST	ags	25-Feb-91	3.7
1.8 DOCUMENTATION	ags	8-Feb-91	0
2. BF3 FAST KICKER	bst	11-Feb-91	15
2.1 DESIGN	bst	30-Oct-89	0
2.2 PROCUREMENT	bst	24-May-90	0
2.3 PROTOTYPE	bst	30-Oct-89	0
2.4 CONSTRUCTION	bst	25-Jun-90	173
2.4.1 CABINET	b	31-Oct-89	0
2.4.2 CONTROLS		25-Jun-90	0
2.5 TESTING	bst	14-Aug-90	0
2.5.1 PHASE 1		30-Jul-90	0
2.5.2 PHASE 2		14-Aug-90	0
2.6 INSTALLATION	bst	3-Jan-91	0
2.8 DOCUMENTATION	bst	10-Jan-91	0
2.7 SYSTEMS TEST	bst	11-Feb-91	11.9
B TUNE METER KICK	bst	5-Feb-91	19
3.1 DESIGN	bst	20-Apr-90	218
3.1.1 INITIAL		2-Feb-90	0
3.1.2 FINAL	b	20-Apr-90	0
3.2 PROCUREMENT	bst	18-Apr-90	0
3.3 CONSTRUCTION	bst	2-Jul-90	0
3.4 TESTING	bst	15-Aug-90	0
3.5 INSTALLATION	bst	27-Dec-90	0
3.6 SYSTEM TEST	bst	5-Feb-91	19
3.7 DRAFTING	bst	17-Sep-90	115
4. AL20 INJ SEPTUM PS	ags	22-Feb-91	7.4
4.1 DESIGN	ags	15-Jun-90	0
4.2 PROCUREMENT	ags	9-Aug-90	0
4.3 CONSTRUCTION	ags	3-Jul-90	0
4.3.2 CONTROLS		3-Aug-90	0
4.4 TESTING	ags	25-Sep-90	0
4.5 INSTALLATION	ags	4-Dec-90	0
4.6 SYSTEM TEST	ags	22-Feb-91	4.2
4.7 DRAFTING	ags	19-Jul-90	0
5. BF6 EXT SEPTUM PS	bst	4-Jan-91	41.6
5.1 DESIGN	bst	15-Jun-90	0
5.2 PROCUREMENT	bst	9-Aug-90	0
5.3 CONSTRUCTION	bst	29-Jun-90	0
5.4 TESTING	bst	12-Sep-90	0
5.5 INSTALLATION	bst	3-Dec-90	0
5.6 SYSTEM TEST	bst	4-Jan-91	17.3
5.7 DRAFTING	bst	30-Aug-90	0
6. BOOSTER EXT BLW PS	bst	6-Feb-91	18.4
6.1 DESIGN	bst	15-Jun-90	0
6.2 PROCUREMENT	bst	26-Jul-90	0
6.3 CONSTRUCTION	bst	27-Jul-90	0
6.3.1 CONTROLS		28-Aug-90	88
6.4 TESTING	bst	31-Oct-90	0
6.5 INSTALLATION	bst	7-Jan-91	0
6.6 SYSTEMS TEST	bst	6-Feb-91	0
6.7 DOCUMENTATION	bst	16-Aug-90	136
6.7.1 MECH DESIGN		18-Dec-89	0
6.7.2 DRAFTING	b	16-Aug-90	0
8. BOOSTER SEXTUPOLE PS	bst	31-Jan-91	22
8.1 DESIGN	bst	1-Feb-90	0



Schedule Name : Booster Project (RF)
Responsible : edited by R. Frankel
As-of Date : 18-Jul-90 Schedule File : C:\TL31\DATA\RF_SHL

Dependencies : test

Task Name	End Date	FrSlack (Days)
RF SYSTEM	30-May-91	0
HIGH LEVEL RF SYSTEM	8-May-91	0
+ CMPONENTS MI BAND	28-Dec-90	37
+ MI BAND A	30-Jan-91	69
+ MI BAND B	8-May-91	0
MI DONE	9-May-91	0
+ BAND III	26-Sep-90	0
+ RF INSTR+INTERL	17-Dec-90	114
+ BEAM CNTL SYSTEM	27-Nov-90	0
LL SYSTEM TEST	7-Feb-91	0
assemble	17-Jan-91	0
test	7-Feb-91	0
PROTON SYSTEM TEST	17-Dec-90	36
READY PROTON BEAM TE	8-Feb-91	78
MI SYSTEM TEST	30-May-91	0
END RF SYSTEM	31-May-91	0
+ INPUT EXTERNALS	30-May-91	0
+ OUTPUT EXTERNALS	24-Apr-91	0



Detail Task — Summary Task — ▲ Milestone
(Started) — (Started) — ▸▸▸ Conflict
(Slack) — (Slack) — .. Resource delay

Scale: 1 week per character

LINE Gantt Chart Report, Strip 1

Comparative Cost Estimate

Building	70~100$/ft^2
Tunnel:	2~4k$/ ft^2
Dipole:	~60k/ Unit
Quadrupole:	~15k/Unit
DC Power Supply:	300$/kw (< 100 Amp)
	700 (< 500 Amp)
	1500 (> 1000 AmP)
BPM:	3k/Unit Mech
	1.5k/Channel Electronic
RF Station	1.2M/station
	~600k, Cavity
	400k PA
	200k LL Control
Manpower	~30% of TEC
Installation	~10% of TEC
Instrumentation and Control	~10% of TEC

Typical Cost Elements

- Manpower

  Salary(1 + Delta)
  Benefit, 27%
  Dept OH, 15%
  Travel/Equip 10 K$
  Lab OH, 15 ~ 35%
  Contingency, 25%
  Escalation, 3%/year

  Delta = 1

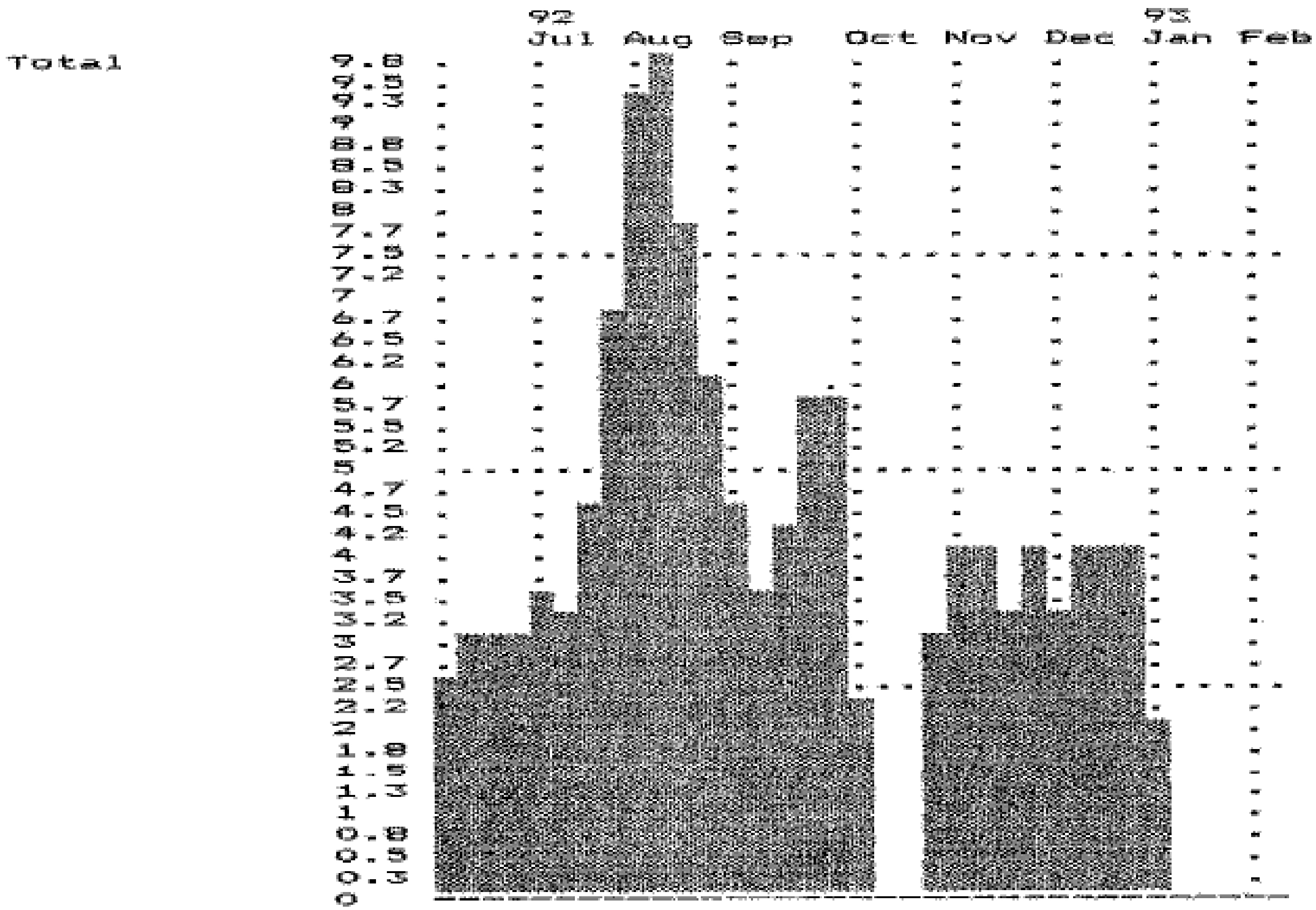
- Material

  Cost (1 + Delta)
  Handling, 6 %
  Dept OH, 5%

  Delta = 0.1

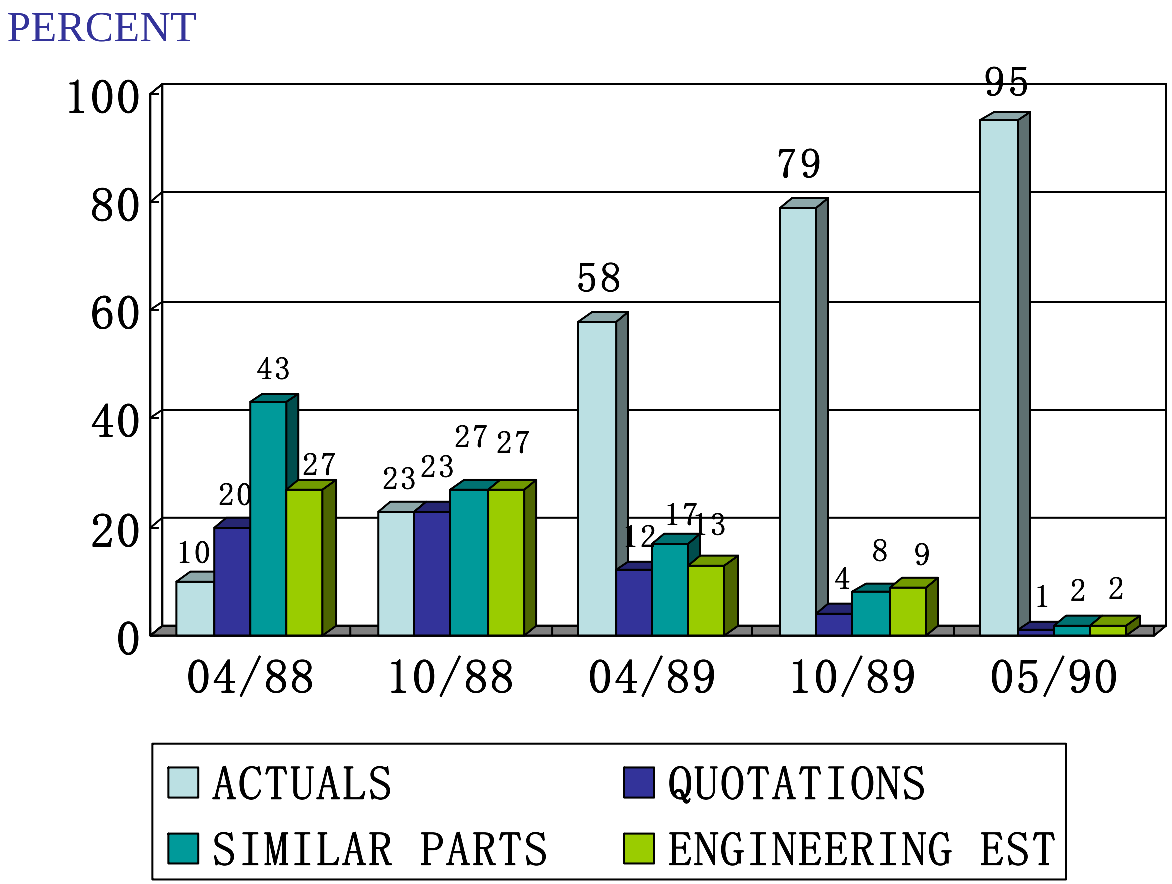
Schedule Name : AGS MMPS SCR UPGRADE
Responsible : JON SANDBERG
As-of Date : 13-May-92 11:00am Schedule File : D:\TL3.1\DATA\UP_1

Select filter : et

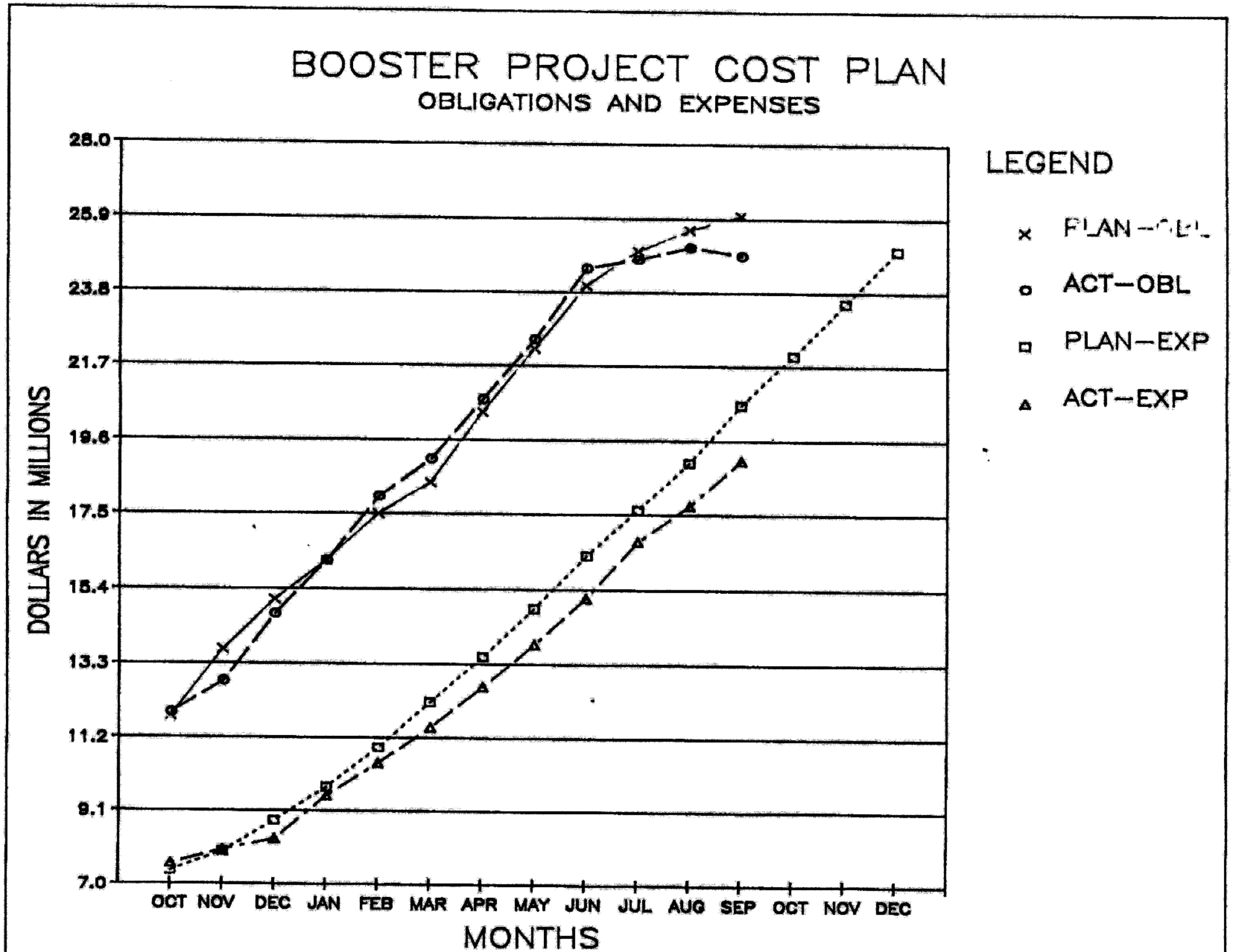


TIME LINE Histogram Report showing Total ManWeeks, Strip 1, Page 7

Accelerator Systems
Source of Estimate Analysis

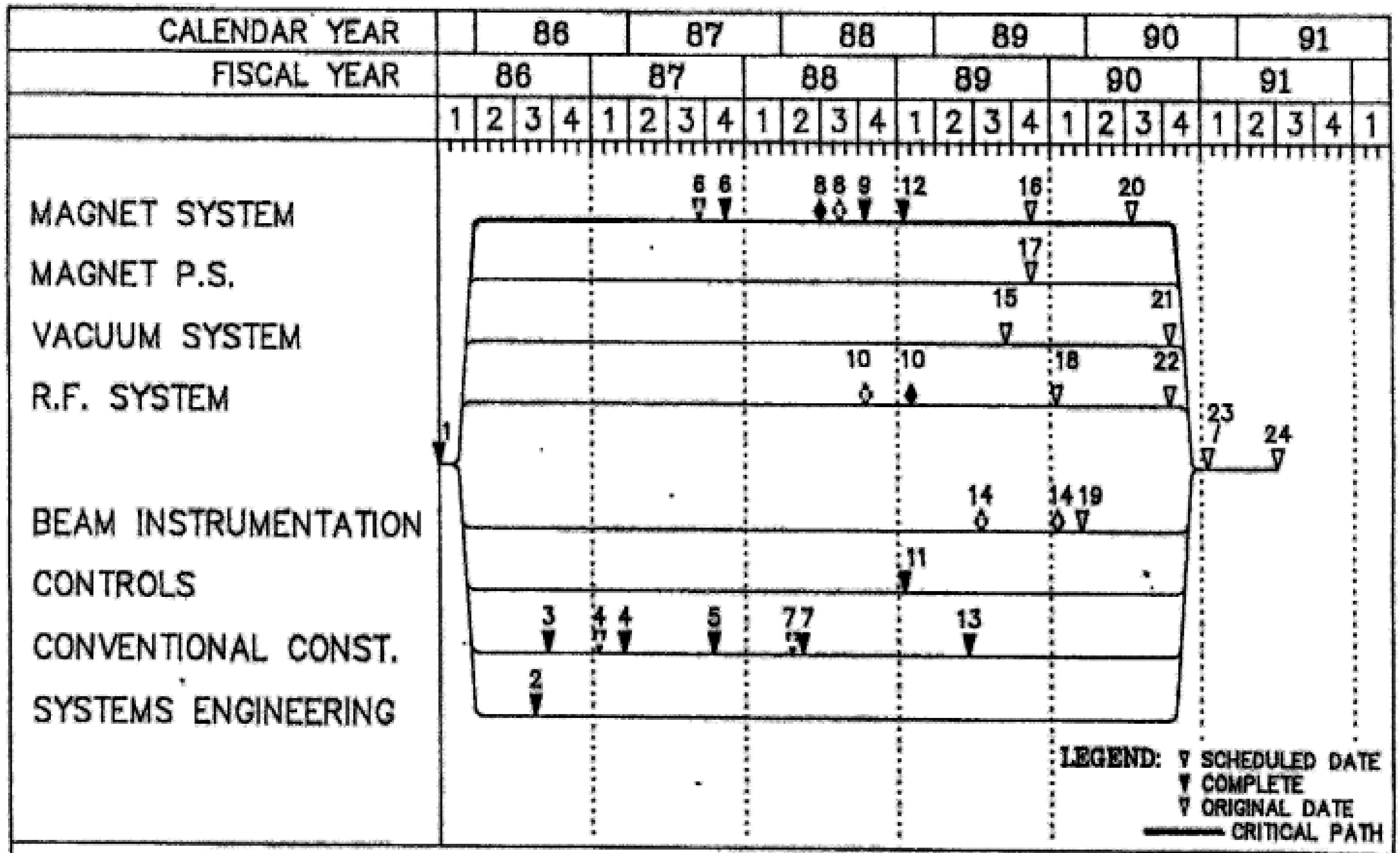


Fiscal Year



CUMULATIVE COST THRU SEP 1989

BOOSTER PROJECT BASELINE MILESTONES



1. PROJECT START
2. DESIGN MANUAL COMPLETE
3. TITLE I COMPLETED
4. TITLE II STARTED
5. TITLE II COMPLETED
6. DIPOLE STAMPING STARTED
7. CONVENTIONAL CONSTRUCTION STARTED
8. HALF CELL PROTOTYPE COMPLETE
9. DIPOLE PREPRODUCTION TESTED
10. RF POWER AMPLIFIER AND CAVITY PROTOTYPE COMPLETE
11. CONTROL SYSTEM COMPUTER ORDER PLACED
12. CORRECTION MAGNET PROTOTYPE COMPLETE
13. TUNNEL BENEFICIAL OCCUPANCY
14. PROFILE MONITOR DESIGN COMPLETE
15. VACUUM CHAMBER PROCUREMENT COMPLETE
16. DIPOLE PRODUCTION 50% COMPLETE
17. MAIN RING DIPOLE AND QUAD P.S. COMPONENTS PROCURED (50% COMPLETE)
18. FERRITE TEST COMPLETE
19. PUE SYSTEM COMPLETE
20. RING MAGNET INSTALLATION COMPLETE
21. VACUUM INSTALLATION COMPLETE
22. RF INSTALLATION COMPLETE
23. SYSTEM TEST START
24. PROJECT COMPLETION/START BOOSTER COMMISSIONING

∇ CONSTRUCTION MILESTONE	◊ RESEARCH AND DEVELOPMENT MILESTONE	4/15/89

Quotations of the Day

"If you know the enemy and know yourself, you need not fear the result of a hundred battles.
If you know yourself but not the enemy, for every victory gained you will also suffer a defeat.
If you know neither the enemy nor yourself , you will succumb in every battle."

Sun Tzu
The Art of War

"Bring me problems while they're still acorns----don't wait until they're oak trees."

John Henry Sununu

III. Execution ---- Monitoring and Control

A. Meetings, Reports, and Reviews

B. Communications and Conflict Resolution

C. Use of Outside Experts ⟶

D. Scheduling---Gantt Chart, Pert Chart, Critical Path Network

E. Cost Accounting and Cost Schedule Control System (CSCS)

F. Procurement & Quality Control

G. Signs of Trouble, Technical Contingency, and Rebaseline

Booster Project
Project Management (continued)

2. Project Control

—

A. Meeting and Report

Weekly or Bi-weekly Meeting

-- Project Office

-- Technical System (6)

-- Design Discussion

Monthly Meeting

-- Project Management

-- Department Office

-- Project Monthly Report

Quarterly

--Project Quarterly Report

6 Month

-- Semi—annual Doe Review

Project System Technical Review (Expert)

Design Expert Review

Booster Design Review (Proposal)	**May 1984**
Booster Design Review (Approval)	**Jul 1985**
Review of Dipole Assembly	**Dec 1986**
Review of Rf System	**May 1987**
Review of Power Supply System	**May 1987**
Review of Beam Position Monitor System	**Oct 1987**
Review of Vacuum System	**Oct 1987**
Commissioning Review (I)	**Sep 1989**
Review of Llrf System	**Sep 1989**
Coherent Instabilities	**Apr 1990**
Damping System	**Apr 1991**
Damping System	**Jun 1992**

Reasons for Expert Review

A. You May Learn Something.

B. They May Pick up Something.

C. Encourage Exchange.

D. Facilitate Consensus.

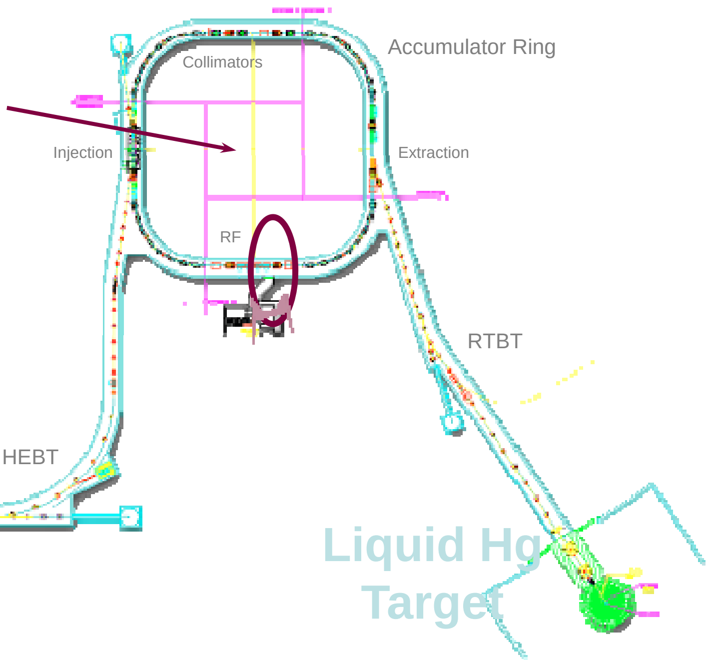
- The SNS is a short-pulse neutron source, driven by a 1.4 MW proton accelerator
- SNS will be the world's leading facility for neutron scattering research with peak neutron flux ~20–100x ILL, Grenoble
- SNS is funded through DOE-BES at a cost of 1.4 B$
- The Project is a collaboration of six USDOE laboratories
- SNS will be 8x ISIS, the world's leading pulsed source
- Stepping stone to other high power facilities

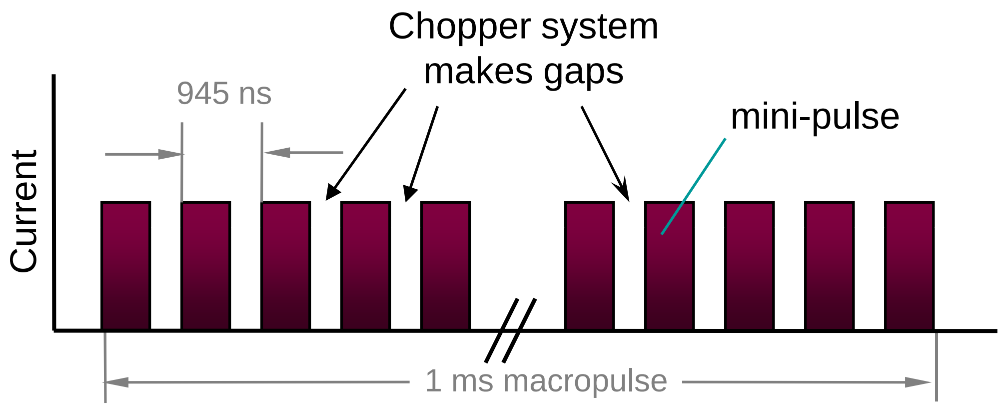
SNS Accelerator Complex

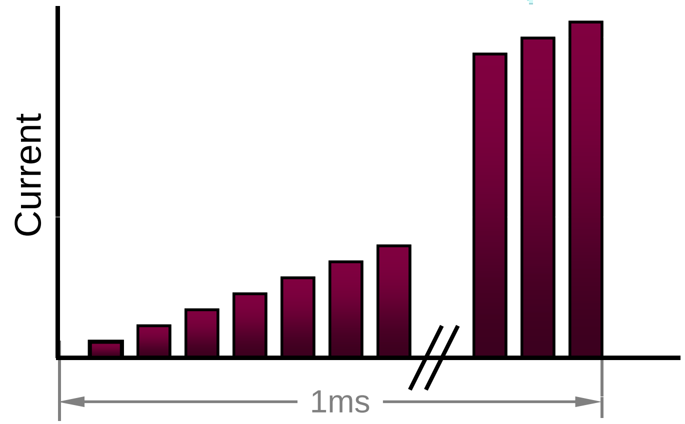
Front-End:
Produce a 1-msec long, chopped, H- beam

1 GeV LINAC

Accumulator Ring: Compress 1 msec long pulse to 700 nsec



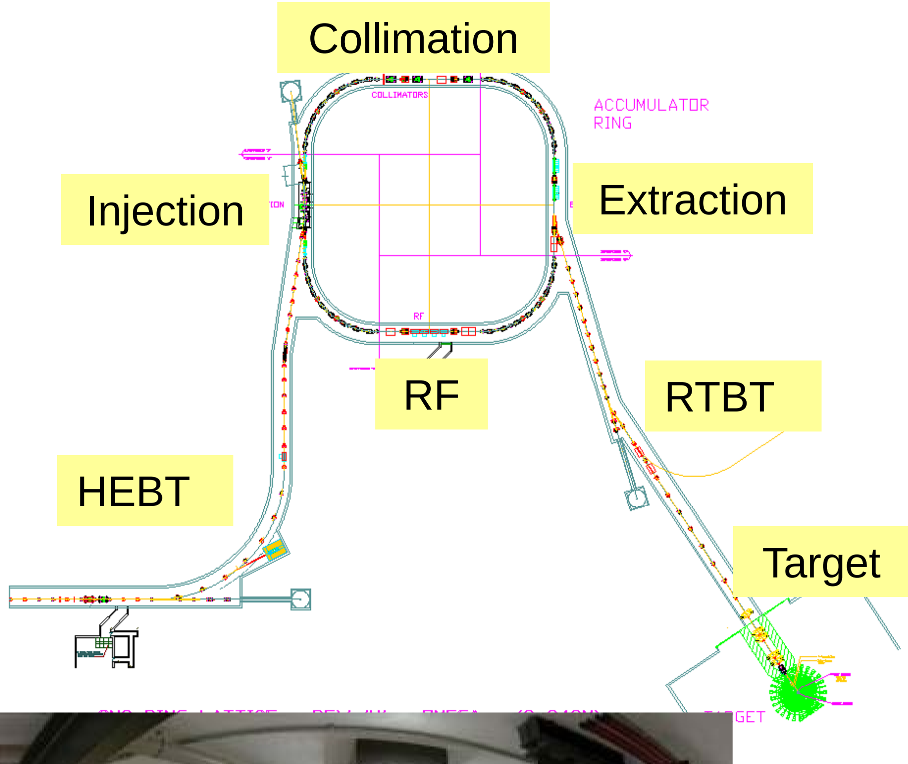


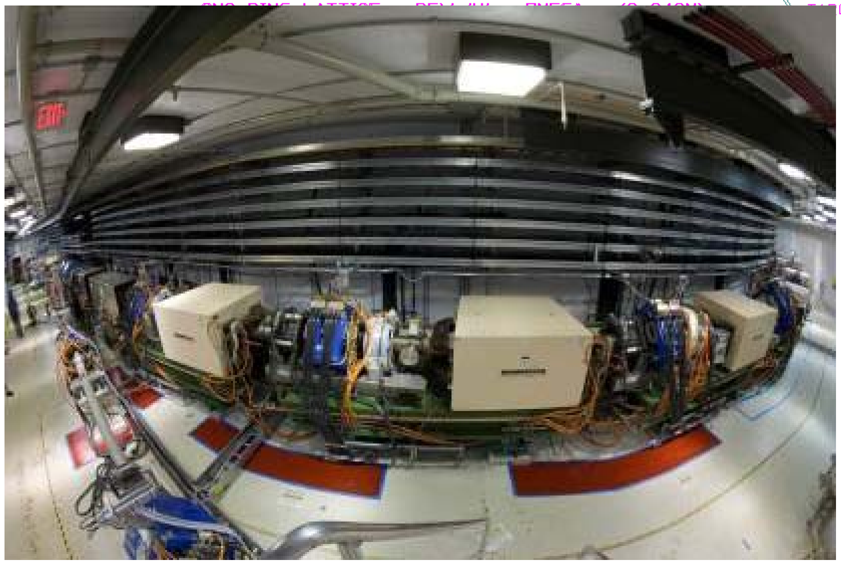


AR and TL

- **Designed and built by Brookhaven National Lab**
- **Accumulates 1-msec long beam pulse by multi-turn charge exchange injection**

Circum	248 m
Energy	1 GeV
Accum turns	1060
Final Intensity	1.5×10^{14}
Current	26 A





Cost Baseline

WBS	Description	May Baseline, $M		November Review Baseline*, $M	
1.2	Project Support	75.7		75.7	
1.3	Front End Systems	21.0		21.1	
1.4	Linac Systems	292.1		301.3	
1.5	Ring & Transfer Systems	150.9		147.9	
1.6	Target Systems	101.9		103.2	
1.7	Instrument Systems	63.4		63.3	
1.8	Conventional Facilities	323.6		345.1	
1.9	Integrated Control Systems	59.5		59.6	
	BAC	1,088.1		1,117.2	
	Contingency	104.6	21.6%	75.5	24.2%**
	TEC	1,192.7		1,192.7	
	R&D	101.2		101.2	
	Pre-Operations	117.8		117.8	
	TPC	1,411.7		1,411.7	

*Rev. 365.

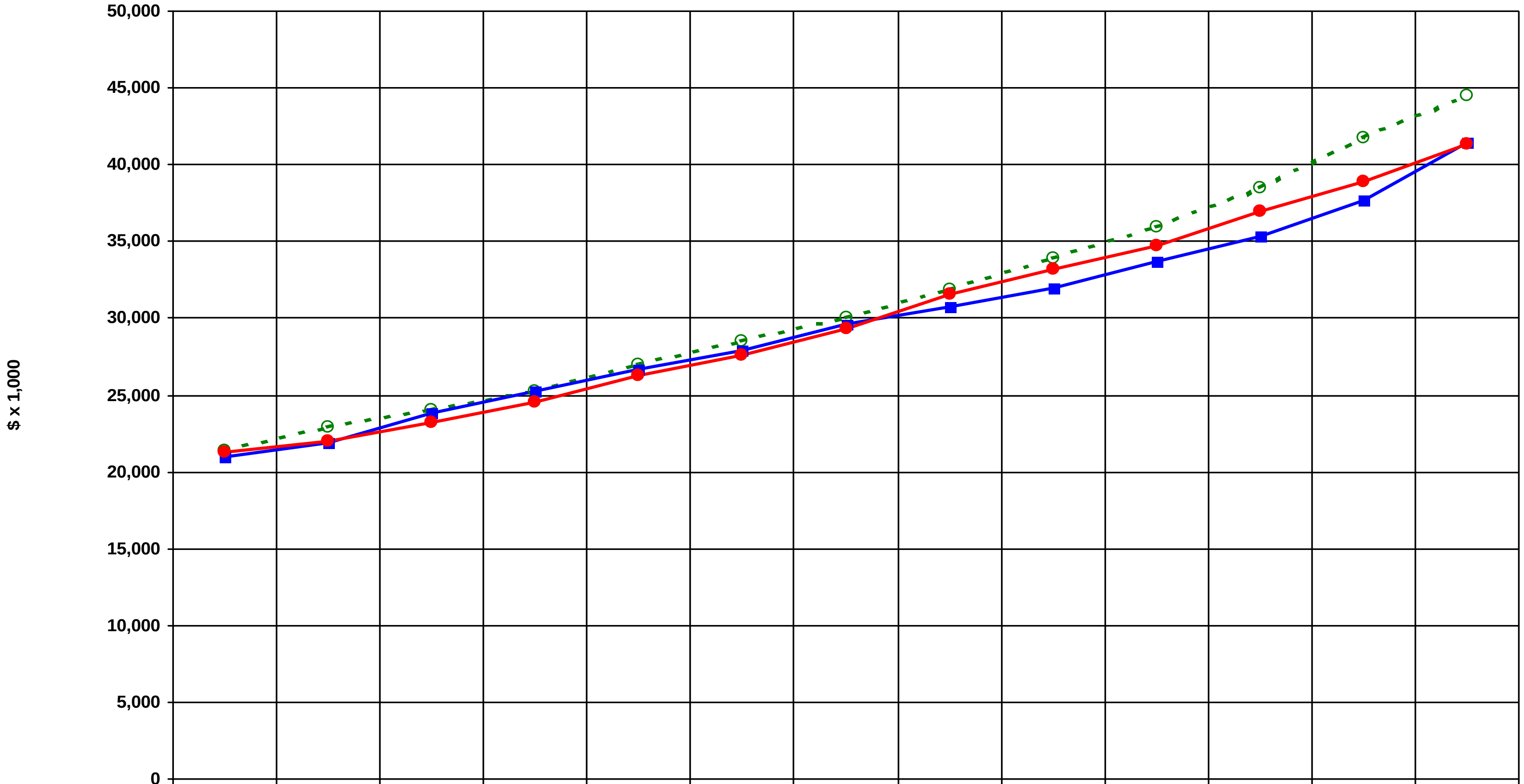
**Reflects 5% reservation for commitments and awards.

Management EAC reflects additional potential changes totaling ~$8 M.

Spallation Neutron Source Project

Cost/Schedule Performance Chart

Ring & Transfer System



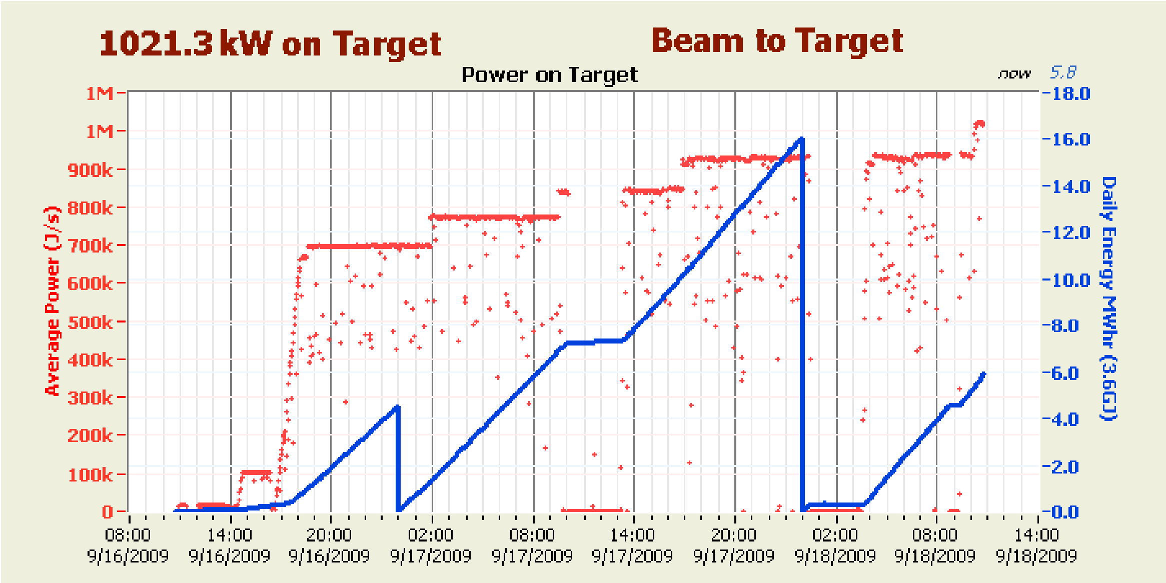
	Prior	Oct 00	Nov 00	Dec 00	Jan 01	Feb 01	Mar 01	Apr 01	May 01	Jun 01	Jul 01	Aug 01	Sep 01
BCWS	21,375	22,943	24,067	25,297	27,014	28,480	30,058	31,894	33,931	35,947	38,447	41,742	44,518
BCWP	20,952	21,867	23,854	25,205	26,691	27,941	29,666	30,764	32,013	33,663	35,337	37,687	41,486
ACWP	21,291	21,980	23,264	24,516	26,239	27,583	29,359	31,615	33,196	34,736	36,991	38,911	41,388

Staffing Plan for AR/BT System

	FY 99	FY 00	FY 01	FY 02	FY 03	FY 04	FY 05
Actual FTE	55	74	90				
Planned FTE	55	85	93	90	82	53	25

NOTE: FY01 Actual FTEs represent the average actual FTE from October 00 through September 01

1 MW Beam Power Achieved!



Dream delivered: SNS pushes past one megawatt

Stuart Henderson said he was ready to get some sleep. Whether he meant for the first time since April 28, 2006, he didn't say. But the director of the Research Accelerator Division was obviously relieved.

The Spallation Neutron Source, which is supported by Stuart's division, on September 18 became the first spallation neutron source to break the one-megawatt barrier. SNS is now the most powerful spallation neutron source in the world, topping the continuous-beam SINQ at the Sherrer Institute in Switzerland, which currently runs at 900 kilowatts.

Much as the day the SNS was first turned on in April 2006, the milestone came with a control-room whoop as the power reading on the instrument panel rolled over to seven figures.

The SNS was ramping up for its latest operational run following a maintenance shutdown that included the installation of a brand new target module to replace the original target, which outlasted most expectations of service life.

"It's been a long time in the making and the dream of a lot of people to make a megawatt-class pulsed spallation neutron source, and today we've finally delivered on that dream," said Stuart just after the deed was done.

(See MEGAWATT, page 5)

Michael Plum (sitting) and Viatcheslav Danilov (standing) react as the SNS beam power readout goes to seven figures.

RHIC Project Management Plan

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Chapter Topic page

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Q. Utility Services…………………………………………………………….…………Q-1

R . Responsibility Matrix…………………………………………………………………R-1

S . Annexes……………………………………………………………………………

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Annex II- Test and Evaluation Plan………………………………………….AXII-1

Annex III- Environment,Safety,and Health Protection
Implementation Plan……………………………………………...AXIII-1

T . Appendix ……………………………………………………………………

Sources of Conflict

- Conflict over project priorities.

- Conflict over administrative procedures and responsibilities.

- Conflict over technical opinions and performance trade-offs.

- The greater the diversity of disciplinary expertise among the participants of a project team, the greater the potential for conflict to develop among the members of the team.

- The greater the agreement on subordinate goals by project team members, the lower the potential for detrimental conflict.

Sources of Conflict (continued)

- The lower the project manager's degree of authority, reward and punishment power over those individuals and organization units supporting his project, the greater the potential for conflict to develop.

- The less the specific objectives of a project (cost, schedule, and technical performance) are understood by the project team members, the more likely conflict is to develop.

- The greater the role ambiguity among the participants of the project team, the more likely conflict is to develop.

Some Guidelines for Conducting More Effective Project Meetings are:

- Learn as much as you can about group process and the psychology of small groups.
- Question the need for the meeting – explore other alternatives.
- Have a specific objective for each meeting.
- Have a detailed agenda with specific time, place, and assigned responsibility for each item.
- Distribute agenda and other relevant material in advance.
- Keep participants to a minimum –attendance by invitation only. Participants must have authority to make commitments.
- Start and end the meeting on time .
- Conduct one piece of business at a time, stay with the agenda, and do not allow petty interruptions.
- Allow each member to contribute in their way; support, counter, or challenge viewpoint differences as being helpful or not.
- Get closure(decision)on each item; test for commitment.

Project Managers Must manage Conflict

The relative intensity of these conflicts can vary over the life cycle of the project. As in negotiating for authority , conflict should be handled at the lowest organizational level of interaction . Higher level authority should be used, if ,and only if , conflict can not be resolved at the lower level.

The following modes can be used for handling conflict:

- ❖Confrontation –Facing the conflict directly and involving a problem-solving approach whereby affected parties work through their disagreements
- ❖Compromising –Bargaining and searching for solutions that bring some degree of satisfaction to each of the parties in a dispute (characterized by a "give and take"attitude)
- ❖Forcing –Exerting one's viewpoint at the potential expense of another (often characterized by competitiveness and win-lose position)
- ❖Withdrawal– Retreating or withdrawing from an actual or potential disagreement
- ❖Smoothing –De-emphasizing or avoiding areas of difference and emphasizing areas of agreement

PDT Objective: First Priority

Impact project PDT objectives must be first priority. One should always first try confrontation, and compromise only if agreement cannot be reached by confrontation. Based on significance of PDT impact, one may have to use higher level authority. If PDT is not significantly impacted, compromise or withdrawal are acceptable solutions

The objectives of an integrated project performance measurement system are to :

- ❖Provide visibility for the integrated PDT, plan and performance standards
- ❖Identify significant problems before they occur, to the extent possible, so they can be avoided or their effects minimized.
- ❖Identify opportunities for schedule acceleration , cost reduction, or technical improvement, and to exploit them before the opportunity is lost.
- ❖Facilitate the comparison of actual performance to the predetermined plans and standards , at successively lower levels within the organization

- ❖Identify significant deviations from the plan
- ❖Assure corrective action when needed by promoting the analysis of significant deviations
- ❖Determine value earned (what are you getting for money and time allocated)
- ❖To provide feedback to management and /or the customer and the performers of the work

Integrated performance measurement is a continuing process throughout the life cycle of the project.It should not be an occasional panic exercise triggered by sudden awareness of crisis.

Advanced Project Control Tools

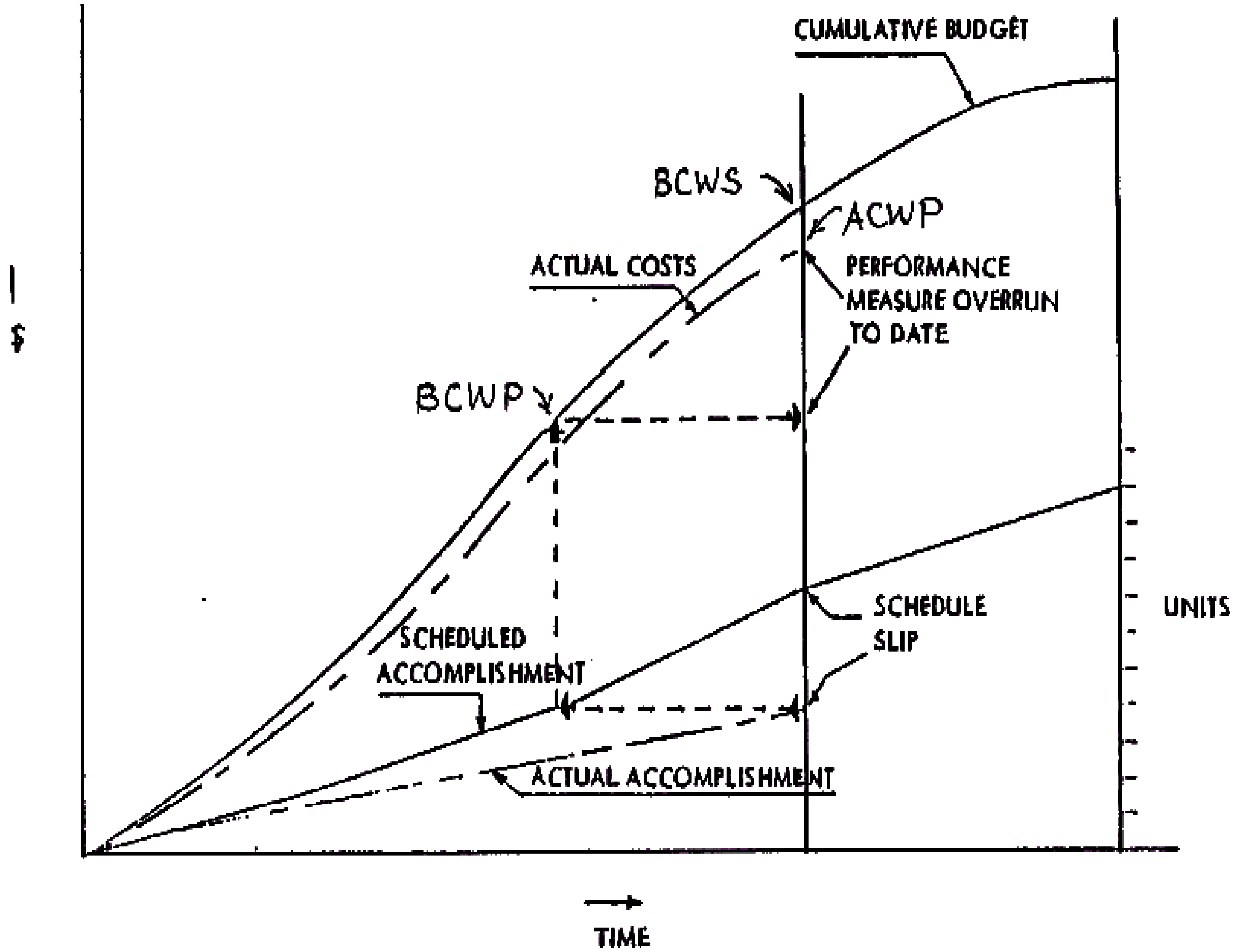

CUMULATIVE BUDGET
BCWS
ACWP
ACTUAL COSTS
PERFORMANCE MEASURE OVERRUN TO DATE
BCWP
$
SCHEDULE SLIP
UNITS
SCHEDULED ACCOMPLISHMENT
ACTUAL ACCOMPLISHMENT
TIME

FIGURE C

PMA

Earned Value Definitions

- **The Budgeted COST for the WORK that is SCHEDULED to be Performed** — **BCWS**
- **The Budgeted COST for the WORK that was PERFORMED** — **BCWP**
- **The ACTUAL COST for the WORK that was PERFORMED** — **ACWP**
- **The Total BUDGET AT the COMPLETION of the Cost Account or Program** — **BAC**

PMA

Earned Value Definitions (Cont'd)

- The VARIANCE in COST from the Plan — **C-VAR**

  (BCWP - ACWP)

- The VARIANCE in SCHEDULE from the Plan — **S-VAR**

  (BCWP – BCWS)

ESTIMATE TO Complete(remaining)

- The ESTIMATE TO COMPLETE The Work Of The Cost Account

Etc

- This Estimate Must Be Done On A Regular Basis In Order To Determine

  The REALISTIC Expected Cost Of The Work At Completion.

- This Estimate Is To Be Done By Reassessing The Cost Account For The Work That Remains To Be Performed

This ESTIMATE Is NOT Done By Subtracting The ACWP From The BAC.

Estimate At Completion (Total)

- **The ESTIMATE of the the amount of money that will be spent AT the COMPLETION of the work**

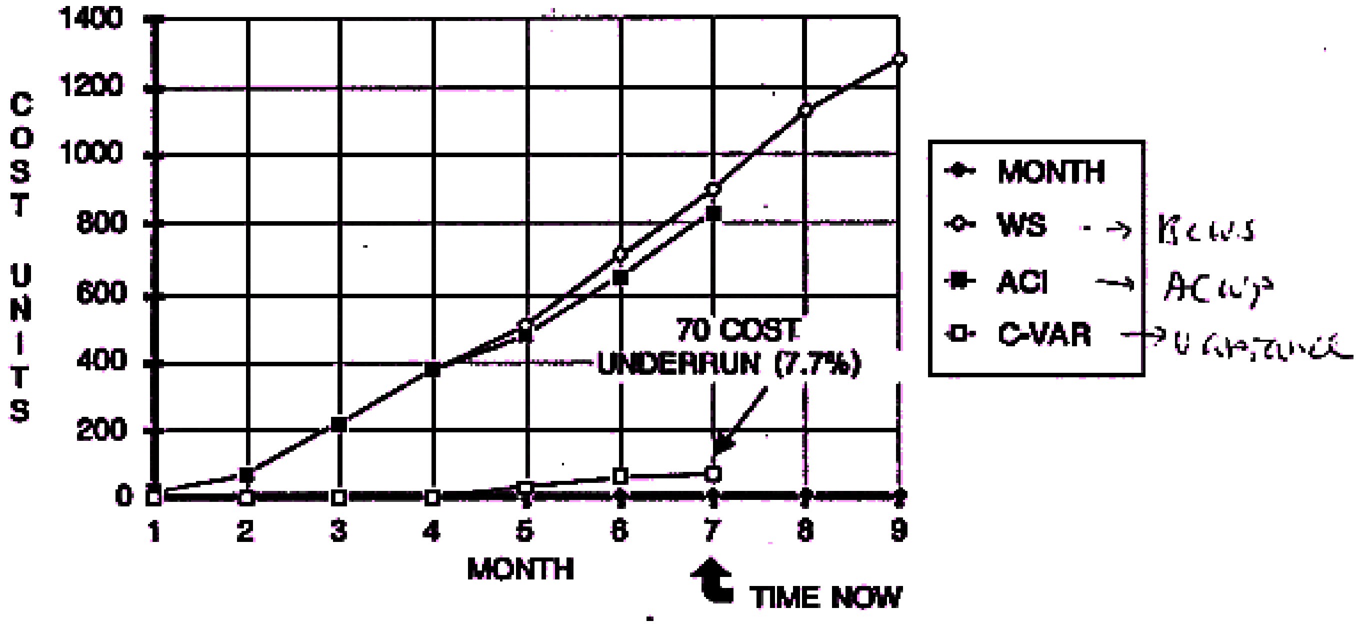
EAC

- **The ESTIMATE TO COMPLETE is added to the ACWP to yield the ESTIMATE AT COMPLETION, (ETC+ACWP)**

- **The Total COST VARIANCE is obtained by subtracting the BUDGET AT COMPLETION from the ESTIMATE AT COMPLETION.**

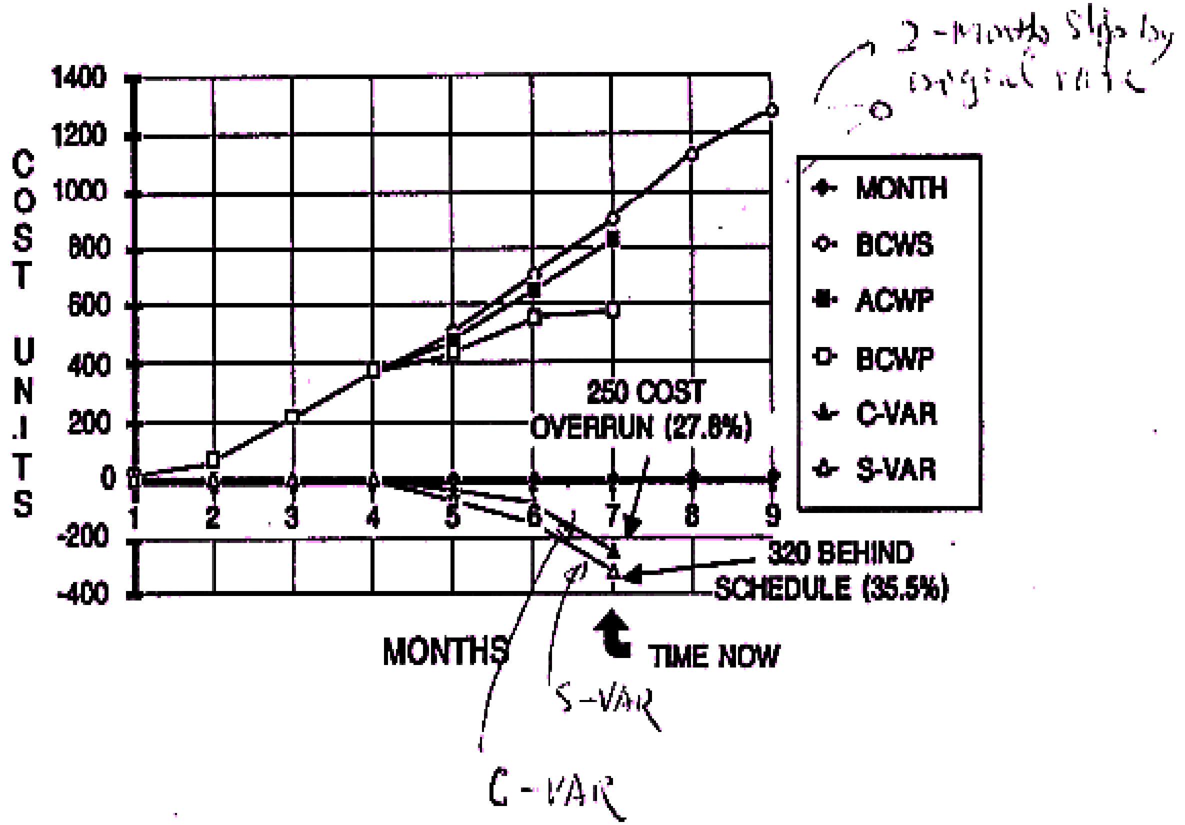
This variance (EAC-BAC) yields the expected UNDERRUN/OVERRUN.

PROGRAM ANALYSIS CHART - ACI

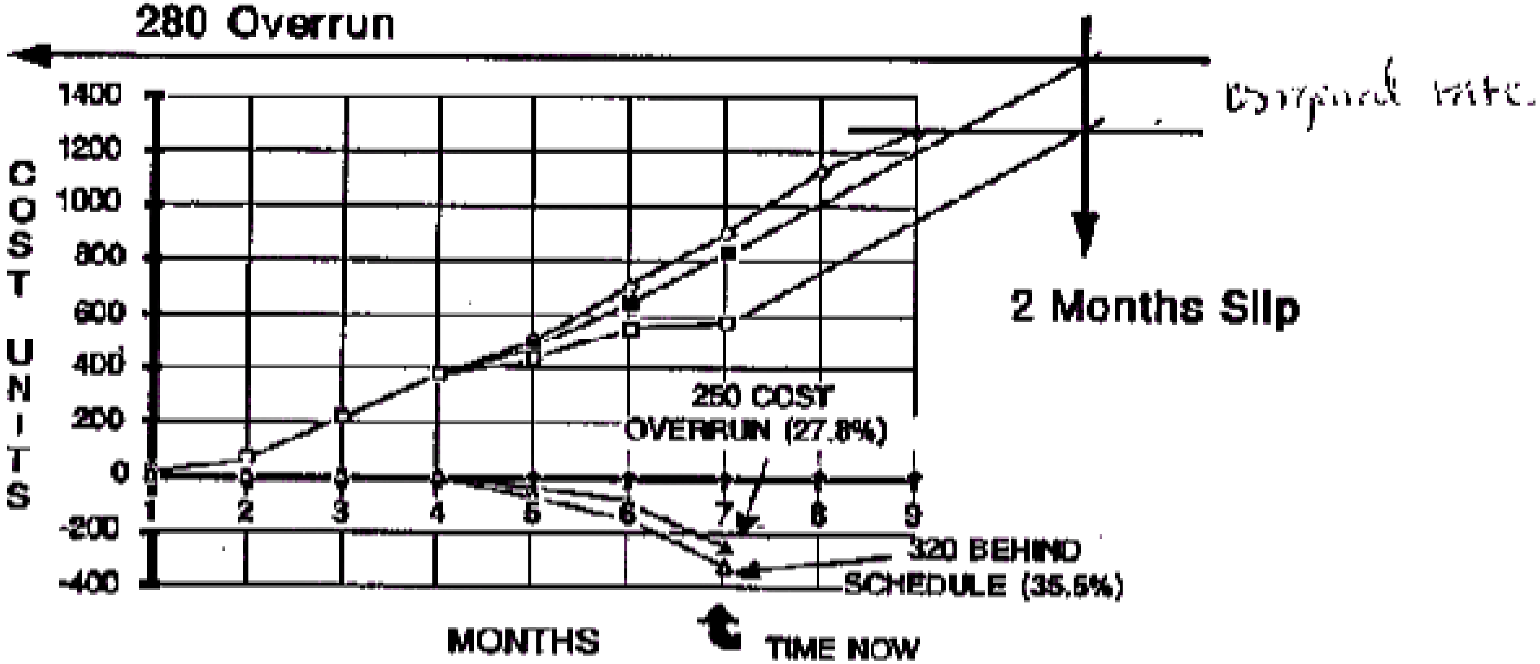


PMA

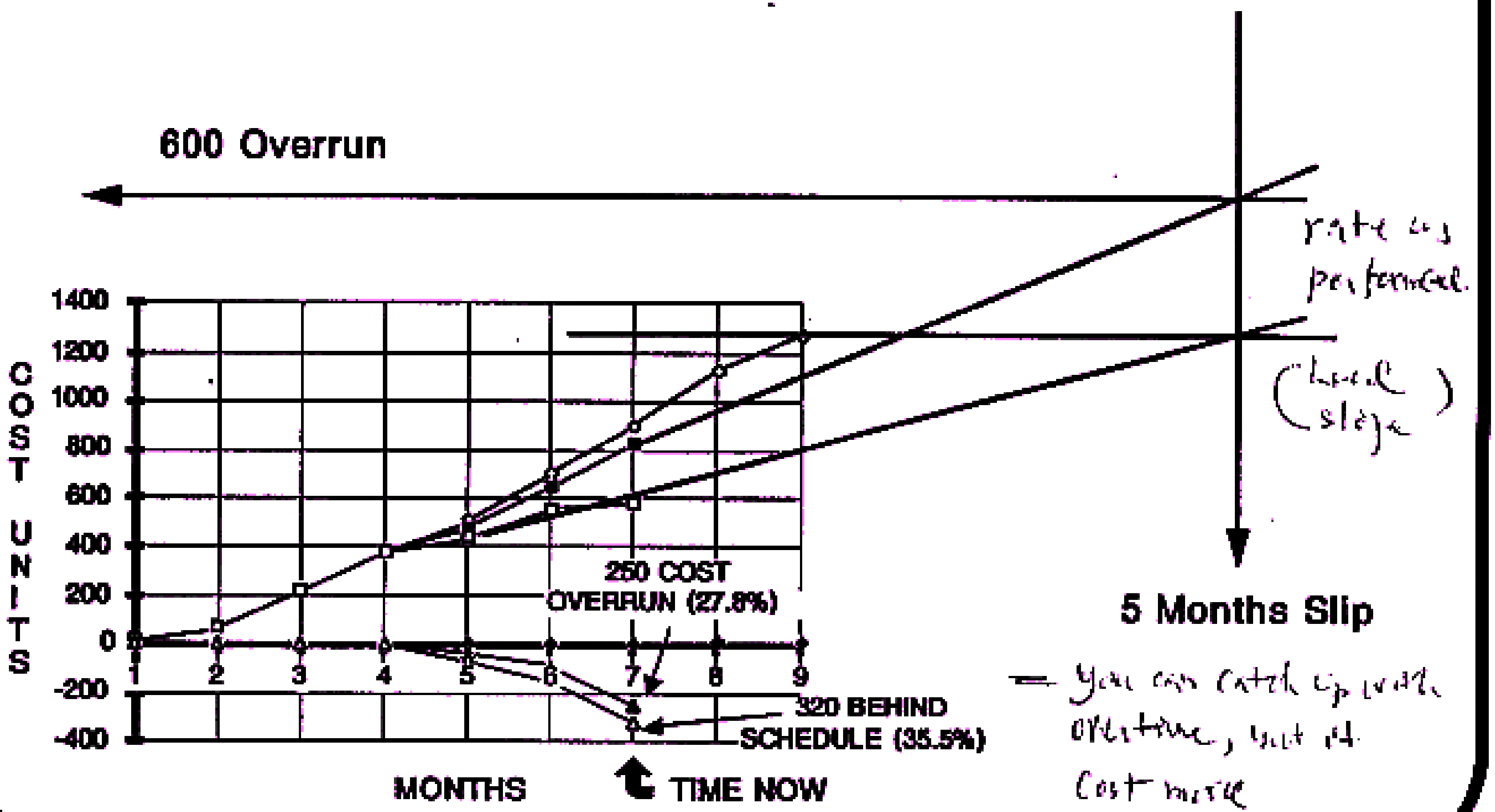
PROGRAM ANALYSIS CHART - WP



PROJECTION OF PROGRAM - BEST CASE



PROJECTION OF PROGRAM - PROBABLE



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Summary Lessons for Management

Adopting the project management concept is a major change. It must be carefully planned and there must be a commitment to go all the way.
One must recognize and deal with the resistance to change the potential authority conflicts.

The key steps in implementing a project management system are:

•**Adopt the right organization structure**—with clear accountability and procedures (rules)
•**Match the right people for the right job** –no system is better than the people who implement it
•**Allow adequate time and effort for planning** –work Breakdown/network planning that clearly defines who will do what, for how much, and when
•**Ensure that work packages are properly sized**—must be manageable, have organizational accountability, and be realistic in terms of effort, time and money
•**Establish and use integrated planning and control systems as a focal point for implementation**—know where you are going, how you are getting there, and when you have arrived
•**Work at assuring realistic information flow (communication)**—information is required for management. Communication pitfall is the greatest contributor to project difficulties
•**Be willing to re-plan** – the best laid plans go astray, change is inevitable
•**Long before project end, plan for their end** –plans must be developed as to disposition of personnel, other resources, and transfer of knowledge.

Project Information System (DOD)
Project Control System (DOE)

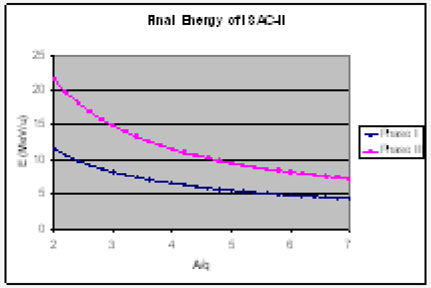
	Software/Vender	Group	Task
RHIC	TRAKKER/DEKKER	8	5000
SSC	OPEN PLAN		5954
CEBAF	OPEN PLAN	8	
APS	PSII	30	
SNS	P3, MPM	45	
NSLS-II			

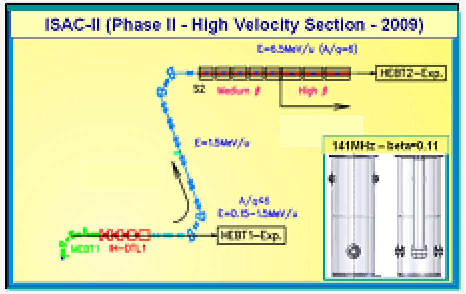
Lessons Learned on Procurement

1. Start Design and Final Specification Early
2. Alert Procurement Office Before Rfq to Start Preparatory Work
3. Rule of Selecting The <u>Lowest Bidder</u>
   Familiarize With Vendors Market
   Pre-qualification
   Site Inspection
   Sole Source
4. Create Leverage Over Vendors by Introducing <u>Incentive and Penalty Clauses</u>
5. Follow Development of the Manufacturing Work at Plant by Constant Contact and Frequent Site Visit
6. Threaten Them or Sweeten the Pot
7. Over-time at BNL to Catch-up on the Schedule

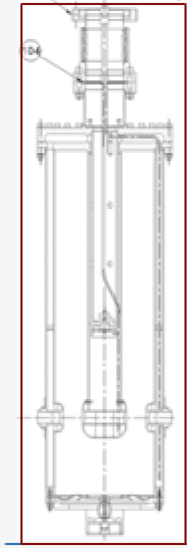
ISAC-II Phase II Linac

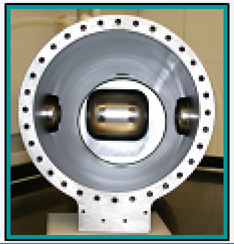
- Goal is to boost the energy of the heavy ions above the Coulomb barrier for all masses
- Total superconducting installation voltage of >40MV





Phase II QWR (Beta=0.11)





Parameter	Units	Value
Frequency	MHz	141.44
E_p/E_a		4.9
B_p/E_a	mT/ (MV/m)	10
β_0		0.11
$G=R_sQ_0$	Ω	26

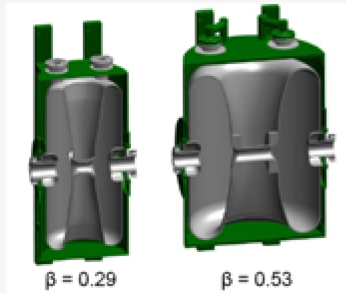
ISAC-II Specification		
P_{cav}	W	7
V_{eff}	MV	1.1
E_a	MV/m	6
E_p	MV/m	30
B_p	mT	60

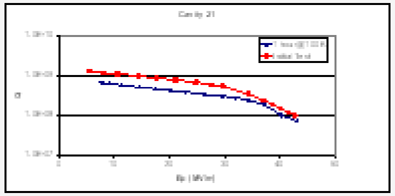
Choose the fabricator

- Write the contract
  - In general the contract will be a technical specification without a performance requirement
    - Not practical since performance based on more than just fabrication and welding (parameters outside contractors control)
      - Performance contract would be expensive
  - Work with the contractor through the mechanical design stage
    - Establish QA procedure early and tweek if required
- Set the schedule
  - Allow time in the schedule for prototyping, analysis of the results and review before proceeding to production

Fabrication - prototyping

- How many prototypes and vendors
  - Depends on resources and size of project
    - 10% of final cavity quantities for each cavity type is reasonable
    - More than one vendor if possible – gives more flexibility during production tender
- Fabrication sequence
  - Work out frequency tuning sequence to arrive at final frequency – build into parts initial sizing
  - Frequency steps should move from coarse to fine to arrive within range of the coarse tuner
- Testing
  - Should plan sufficient testing period to fully characterize all prototype cavities
    - Rf performance, df/dp, Lorentz detuning, Q-disease, microphonics





PAVAC as sole supplier for technology transfer

Two prototype and 20 production cavities were ordered

Cost is $65K/cavity

RF system was installed to be commissioned soon

It also involves in the manufacturing of 1.3 GHz cavity for ILC

TRIUMF

Fabrication - Production

- Keep communication open with vendor
- Frequent site visits
- Depending on vendor may require technical support – pre-weld etching, rf tuning, post production surface treatment
- Work collaboratively to try to stick to schedule
- Follow established QA procedure
- Test cavities as they are produced if possible to look for systematic trends that may feed back on the production process

April 21, 2010 Bob Laxdal, TTC, FNAL 25

Issues and Challenges - 1

- Project Management View: **Scope, Cost and Schedule**
- **Scope**:
  - Need “standard” scope for technical specifications
    - Availability of good sample technical specification important
    - no “bonus points” for originality in specifications
  - Need design standards and guidelines very early in project
    - Difficult with new or inexperienced staff
  - Desirable to have at least 3 bids
    - Can determine scope of major tenders
- **Cost**:
  - Importance of competitive bids
    - Typically factor of two or more in price if 3 or more bids for design-build tenders
    - Restrictive tendering practices will increase cost
  - Frequently used fixed price + incremental rates for most labour contracts
  - Competent installation labour will challenge design team to keep ahead

Issues and Challenges - 2

- **Schedule**:
  - Most design-build contracts arrived late
    - 10 major CLS accelerator contracts
      - 8 deliveries were late by between 5 and 8 months
    - Overall project schedule needs to allow for this possibility
      - CLS targeted all contracted deliveries by end of 2002
    - Approximately ¼ to 1/3 of delay was due to CLS
    - **Delays CAN NOT be used to justify other schedule slippage**
  - Control of scope and design changes essential
    - Need engineering change control
    - New staff often unfamiliar with process
  - Used bonus-penalty contract for two smaller contracts - effective
- **Communications** (Internal and External):
  - Need good tracking of issues raised and their resolution
  - Plan on 3 – 5 face-to-face meetings over contract duration
  - Use weekly teleconference with email of issue-tracking form
  - Difficult to reduce internal delays when contractor questions arise

Summary

A. Good practices for industrial contract

- Start activity early, it always takes longer than you expect
- Good and mature design of systems and components
- Well written specs and contract to minimize change
- Competitive bidding from many qualified firms to reduce cost
- Add bonus/penalty clauses to control schedule
- Frequent and effective communication and site visit
- Cost plus for initial testing units, then fixed price(RHIC approach)

B. Frequently encountered problems

- Design/scope changes
- Personnel changes at industry
- Bad communication and record keeping
- Bankrupts of firm
- Sub-standard product needs rework
- Uncertain/varying foreign exchange rate

Summary

C. Possible reasons of difficulty in US industrial collaboration in accelerator construction

- Decline in industrial base
- Unwillingness of big industry to engage
- Complexity in government regulation
- Insufficient number of accelerator projects

D. Robust industrial participation in long term accelerator R&D in US for future projects

VARIATIONS OF QULITY CONTROL				
	DESIGN	PRODUCTION	INVENTORY	YIELD
NO QA	Prototype No Testing	Mass Production No Check	Quantity	60%
SIMPLE QA	Prototype testing	Mass Production Statistical Check	Quantity	90%
REAL-TIME QA	Prototype CAD-CAM Testing	Real Time Monitoring and Feedback	JIT	~100%

Quotations of the Day

“You will be surprised to find out how much can be achieved , if you do not want the credit.”

F.D.Rossevelt

“…It’s very important to live with fear. One of the things fear tells is that you care about what you are doing.”

Anonymous

US DOE Project Assessment

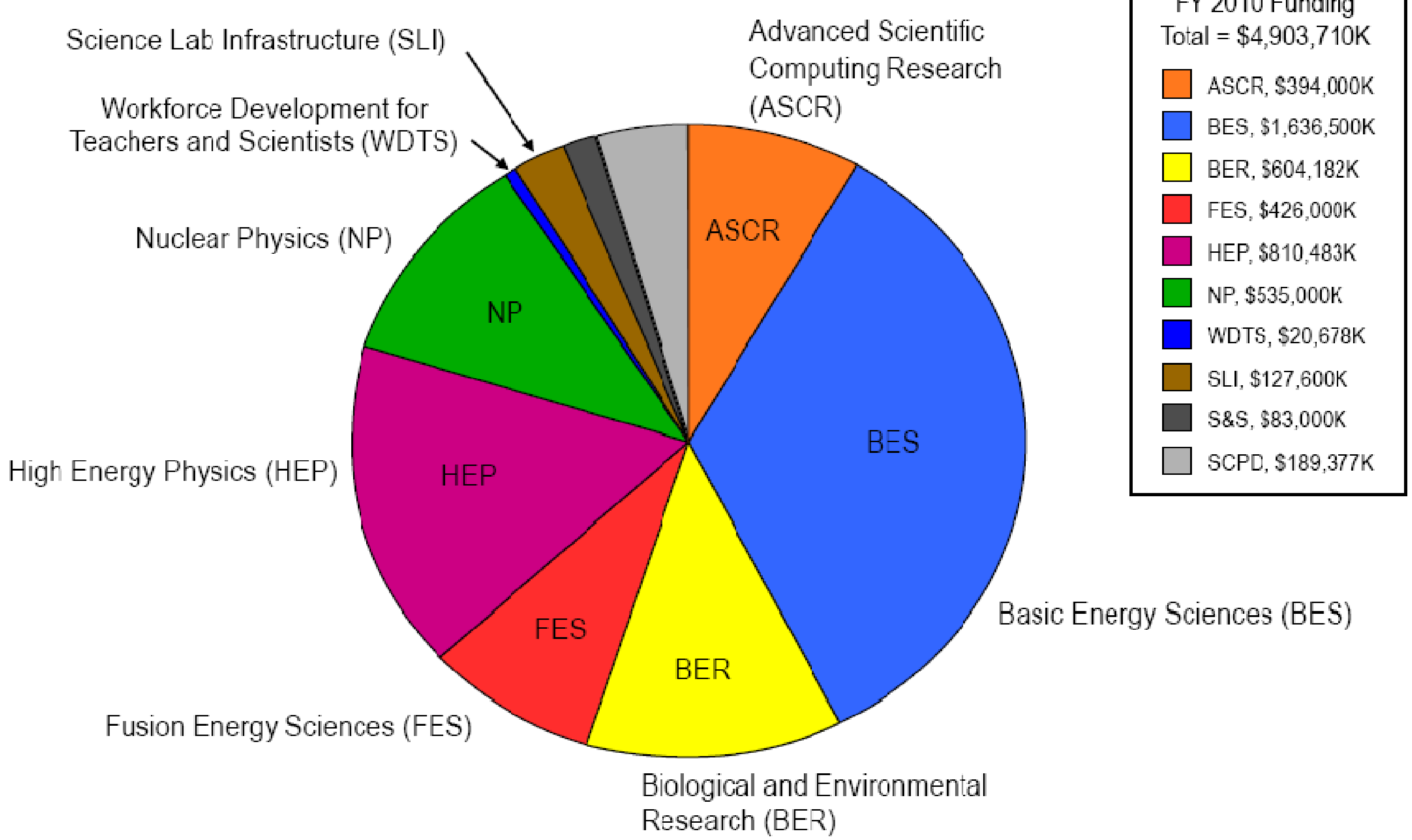
U.S. DEPARTMENT OF ENERGY

Energy R&D Organizations

- **Secretary** – Steven Chu
- **Deputy Secretary** – Daniel B. Poneman
  - **Under Secretary for Energy** – Kristina Johnson
    - Energy Efficiency & Renewable Energy – Cathy Zoi
    - Fossil Energy – James Markowski
    - Nuclear Energy – Pete Miller
    - Electricity Delivery and Energy Reliability – Pat Hoffman (A)
  - **Under Secretary for Science** – Steven E. Koonin
    - **Office of Science** – William Brinkman, Patricia Dehmer
      - Basic Energy Sciences – Harriet Kung
      - High Energy Physics – Dennis Kovar
      - Advanced Scientific Computing Research – Michael Strayer
      - Nuclear Physics – Tim Hallman
      - Biological & Environmental Research – Anna Palmisano
      - Fusion Energy Sciences – Ed Synakowski
      - Workforce Development for Teachers & Scientists – Bill Valdez
  - **Advanced Research Projects Agency – Energy** – Arun Majumdar

Office of Science Programs

FY 2010 Appropriation



U.S. DEPARTMENT OF ENERGY | Office of Science

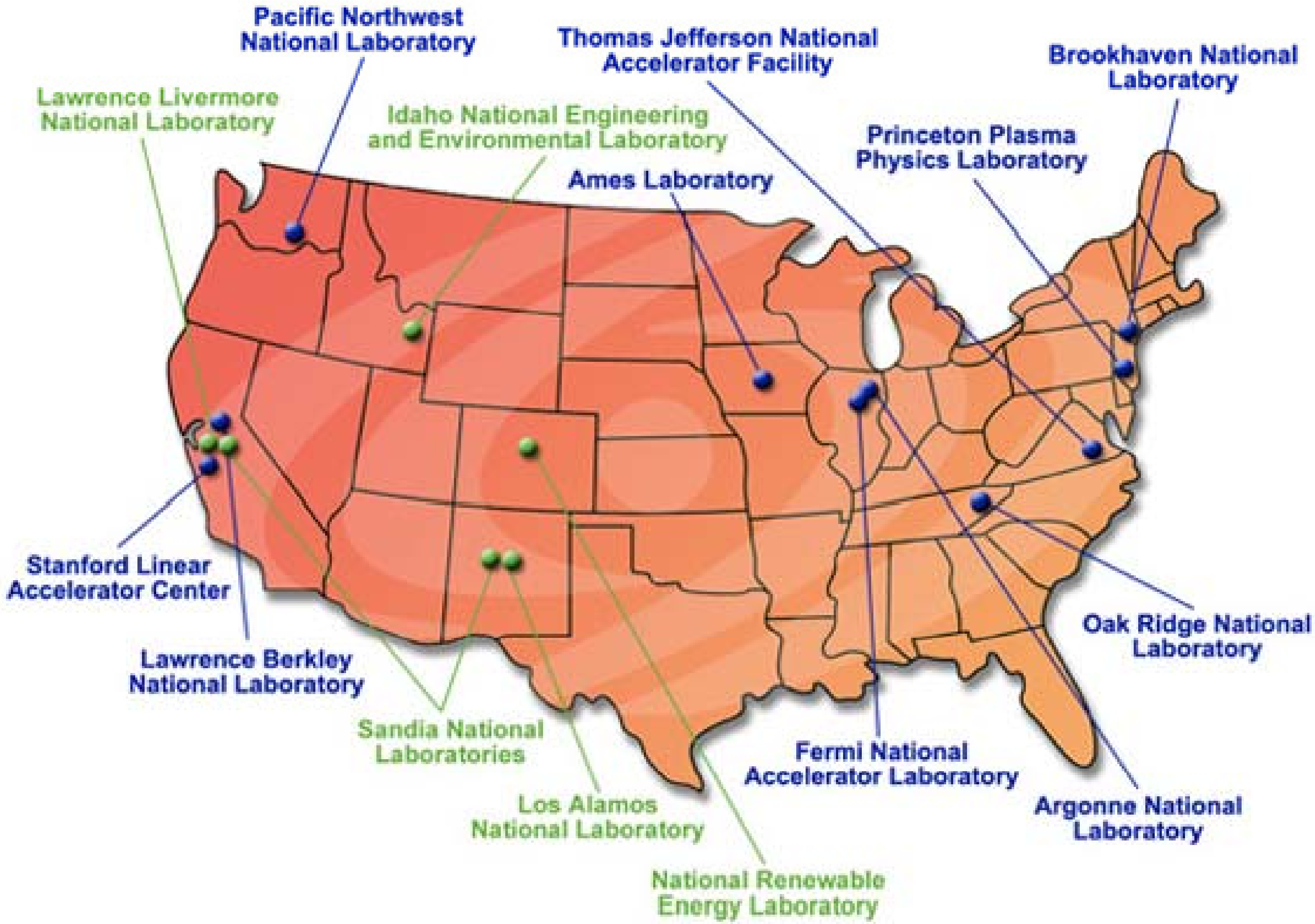
U.S. Department of Energy's Office of Science

Daniel R. Lehman, Director

Office of Project Assessment

December 12, 2005

www.science.doe.gov/opa

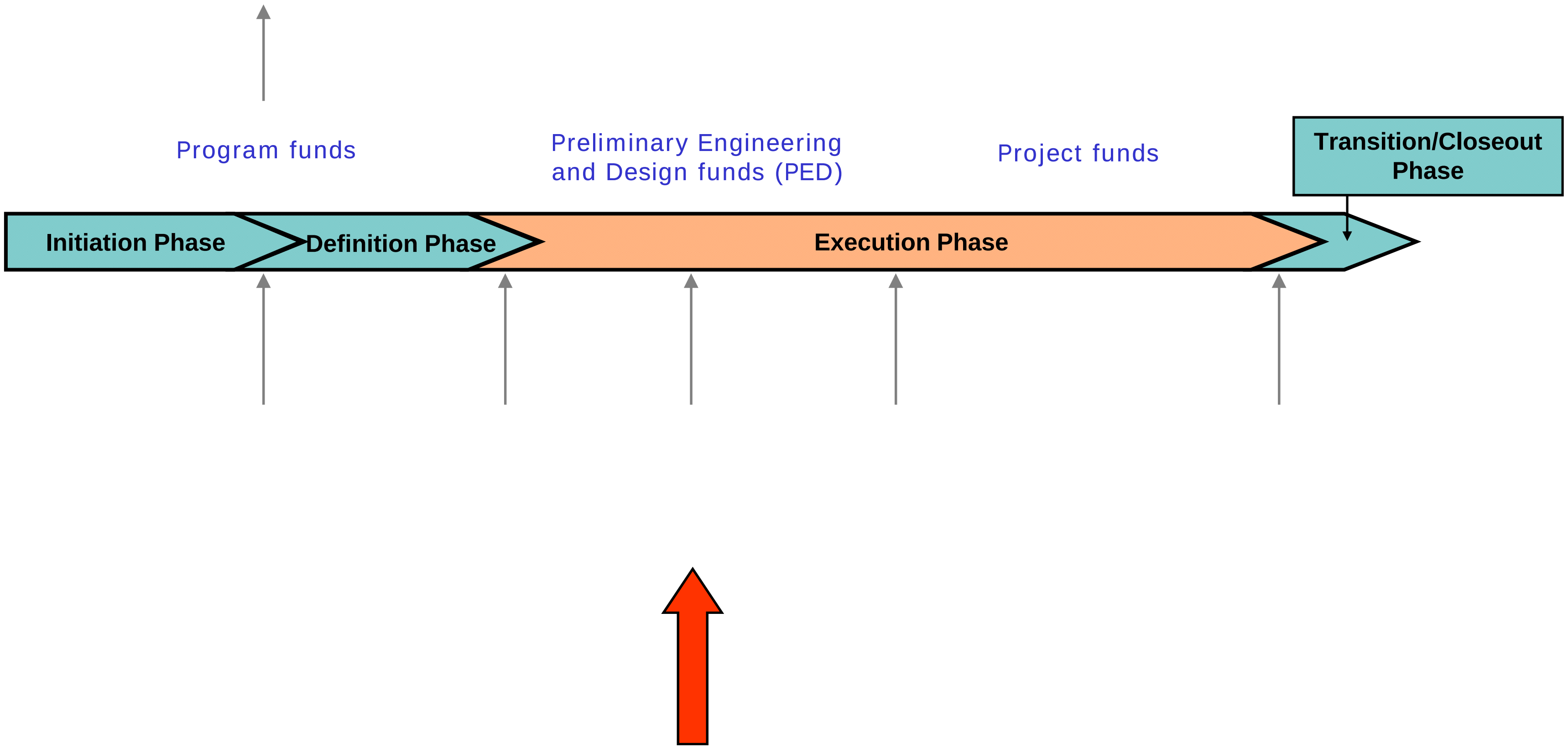


Pacific Northwest
National Laboratory
Thomas Jefferson National
Accelerator Facility
Brookhaven National
Laboratory
Lawrence Livermore
National Laboratory
Idaho National Engineering
and Environmental Laboratory
Princeton Plasma
Physics Laboratory
Ames Laboratory
Stanford Linear
Accelerator Center
Oak Ridge National
Laboratory
Lawrence Berkley
National Laboratory
Sandia National
Laboratories
Fermi National
Accelerator Laboratory
Los Alamos
National Laboratory
Argonne National
Laboratory
National Renewable
Energy Laboratory

Department of Energy’s Portfolio of Projects*

Organization	Total Projects	Total Project Cost
NNSA	64	$ 14.52B
EM	7	$ 7.51B
SC	41	$ 7.75B
NE	5	$ 0.39B
EE	2	$ 0.10B
FE	4	$ 1.07B
LM	1	$ 0.01B
RW	3	$ 10.1B
Sub-Total	127	$ 41.45B
EM - Operating Projects	77	$ 131.26B
Total DOE	204	$ 172.71B

Department of Energy Project Management Process



CD-2 is the watershed event in the DOE project management process

Project Management Elements

Key Elements of Project Management Process	Project Management Phases				
	Project Planning		Project Execution		Operations
Critical Decisions	CD-0 Approve Mission Need	CD-1 Approve Preliminary Baseline Range	CD-2 Approve Performance Baseline	CD-3 Approve Start of Construction	CD-4 Operations or Project Closeout
Fundamental Actions Enabled by Approval of Critical Decision	Begin Conceptual Design and Request PED Funding	Begin Preliminary Design	Establish Baseline for Construction, Request Construction Funds, and Continue Design	Approve Spending of Construction Funds	Allow Start of Operations or Closeout Project
Major Activities	Justifying the Mission Need	Developing Acquisition Strategy and Design	Establishing Technical, Schedule and Cost Baselines	Finalize Design	Develop "End-game" and Transition Plans
Reviews	Internal Project Review	Internal Project Review	**External Independent Review**	Internal Project Review	Operational Readiness Review
Reporting	Begin Monthly Progress Reporting (PARS)	Begin Quarterly Project Performance Reporting (QPPR)	Begin Monthly Earned Value Reporting	Continue QPPR and Earned Value Reporting	N/A
Key Documents	Mission Need Statement	Preliminary Project Execution Plan; Acquisition Strategy	Project Execution Plan	Final Design and Procurement Packages	Project Closeout Report

Project Reporting

Project Reporting Requirements	Frequency	Content	Primary Audience
Federal Project Director's Progress Report	Monthly	Detailed	Project Team; Acquisition Executive; Sponsoring Program Organization
Quarterly Project Performance Review	Quarterly	Summary	Acquisition Executive; Sponsoring Program Organization; Senior SC Line Managers
Independent Project Review Reports	As Needed	Detailed	Sponsoring Program Organization
Project Assessment and Reporting System (PARS)	Monthly	Summary	Deputy Secretary
SC "Watch" List Reporting	Monthly	Detailed	Acquisition Executive
"Top Ten" Briefings	Quarterly	Summary	Under Secretary
OMB Exhibit 300's	Semi-Annually	Detailed	Budget Analysts in DOE and Examiners in OMB
Annual Budget Justifications	Annually	Summary	Congress, OMB

Accomplishment of SC PM Program

Since 1985, it has been shown that for projects > $100M, variation of CD-4 to CD-2

	Time	Tech	Cost
DEO (none SC)	+ 2y	80%	+ 2.0
DOD	+ 3.5y	70%	+4.0
DOE-SC	+ 1y	95%	+1.5

Final Comments

- I would like to thank IHEP for the opportunity to participate in the workshop.
- It is to the credit of the top management of IHEP to initiate this timely workshop. If successful, this could be a model for future scientific projects in China.
- It is a privilege for everyone of you to be part of the project like CSNS. Try to become a team member to support each other and to contribute.
- It is nice to know some management principles and methods. But the challenge is in the application to your particular environment which requires curiosity, willingness to learn through hard work with discipline.

Final Comments-- continued

- Don’t assume anything. When in doubt, ask, check it out, fill in.
- Don’t just complain. It is only half of the job. Try to come up with constructive solution, and sell it to your colleagues.
- In the end, you will realize that the success of the whole project is more meaningful than your own ego. And if you really feel this way, you have arrived.
- Remember that we start by saying the success of a new project of any kind in the end is measured by a changed person, organization, or a nation in its outlook, inter-personal relationship, laws, institutions, and a more humane and rewarding type of life.

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