Fermilab **BENERGY** Office of Science



121.2, 121.3.1, 121.3.2: Project Management, Linac Project Management, Accelerator Physics

Project Management Breakout

Steve Holmes

PIP-II Director's Review

10-12 October 2017

In partnership with:

India Institutes Fermilab Collaboration Istituto Nazionale di Fisica Nucleare Science and Technology Facilities Council



Outline

- Scope & Requirements
- Deliverables
- Organization/Interfaces
- Progress to Date
- Risk
- Cost
- Schedule
- Summary

Project Management Plan (Draft): PIP-II-doc-172





Charge #1

Scope and Requirements

- Project Management (WBS 121.2)
 - Responsible for executing and managing the PIP-II Project to the approved scope, cost, and schedule
 - Conform with requirements of DOE413.3b
 - Provide a safe working environment for all project participants and minimize environmental impacts
 - Coordinate with external stakeholders
- Linac Project Management (WBS 121.3.1)
 - Coordinate Level 3 linac activities
- Accelerator Physics (WBS 121.3.2)
 - Establish and control the configuration of the PIP-II accelerators
- L3 Management (WBS 121.3.X.2)
 - Note: All L3 activites have a management and coordination task assigned at L4



Project Management Deliverables

- Project Management (WBS 121.2)
 - KPPs
 - Project Office
 - Coordination of L2, L3, and CAMs
 - Resource planning
 - Configuration control
 - Systems engineering/integration
 - ESH and QA coordination
 - Risk Management
 - Monthly Reporting
 - Primary interface to DOE/HEP and Fermilab management
 - Coordination with external collaborators
- Linac Project Management (WBS 121.3.1)
 - Installed & commissioned accelerator
- Accelerator Physics (WBS 121.3.2)
 - Design Reports (conceptual, technical)
 - Complete set of Functional Requirements Specifications
 - Accelerator configuration management
 - Technical Board

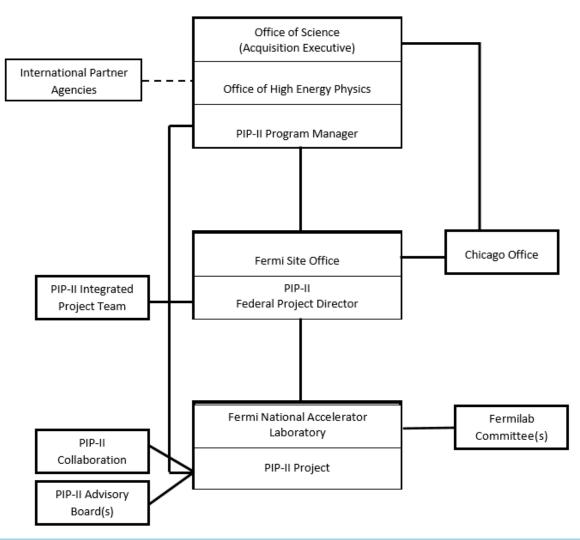


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Organization and Interfaces

PIP-II Project Management Organization

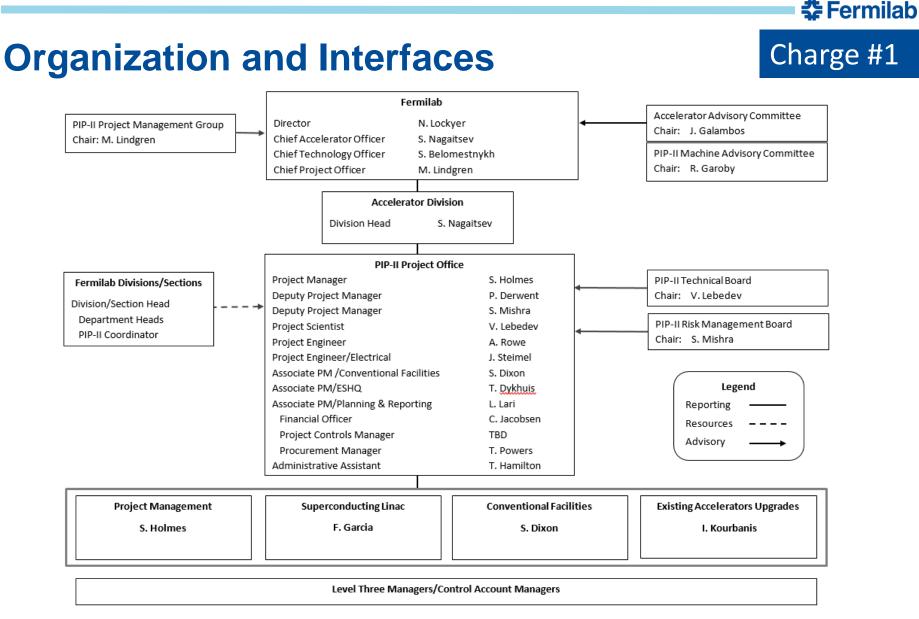


Charge #1

PIP-II: DOE/SC Project

- HEP responsible for funding and oversight
- Fermilab responsible for execution
- IPT responsible for coordination





PIP-II-doc#172



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Charge #1

Progress to date

- Organization provides high-level oversight of all key project aspects:
 - Project Scientist
 - Project Engineer(s)
 - Associate PMs for
 - Conventional Facilities
 - ESH&Q
 - Planning and Reporting
- High level positions filled with the exception of Project Controls Manager
- Team has successfully:
 - Transitioned from R&D to R&D + project activities
 - Completed the Analysis of Alternatives report and developed a Conceptual Design Report based on the preferred alternative
 - Organized and developed CD-1 deliverables
 - Managed the India Institutions and Fermilab Collaboration (IIFC)
 - Engaged INFN, STFC, and CEA
 - Coordinated interactions with national partner institutions
- CD-1 cost estimate based on the current organization chart
 - We expect to modify the organization post-CD-1 in order provide more effective alignment with project goals (see Holmes/Plenary)



Design Review Plan

Charge #3

- PIP-II Machine Advisory Committee (P2MAC)
 - Chartered to provide advice to the Directorate on PIP-II technical design and development activities
 - Meets annually and reports to the Fermilab Director through the Chief Accelerator Officer
 - CAO provides the charge for each meeting
 - Project Scientist develops the meeting agenda
 - Closeout followed by written report
 - April 2017 meeting reviewed the Conceptual Design suitability for CD-1: "As it stands, the conceptual design is supported by convincing results of studies and experimental tests that provide a sound technical basis for CD-1."
 - Full report at PIP-II-doc-605
- Engineering reviews
 - Engineering design reviews are the responsibility of the Project Engineer(s)
 - The requirements are outlined in the Fermilab Engineering Manual

 $\text{FRS/TRS} \rightarrow \text{PDR} \rightarrow \text{FDR} \rightarrow \text{PRR} \rightarrow \text{ORC}$

Requirements are applied to international partners



ESH&Q

- Responsibility of the Associate Project Manager for ESH&Q
 - ESH&Q professional with more than a decade of experience at Fermilab
 - Expertise in NEPA
 - All CD-1 requirements met
 - NEPA strategy in place
 - Preparing for CD-2
 - More details in T. Dykhuis presentation





Risk: PIP-II Enterprise Risk

Top Five Enterprise Risks

- Increase in Laboratory Overhead Rate Large Procurements
- Delay in access to SRF testing and fabrication infrastructure
- Failure of SRF cavity processing equipment
- Cryogenic plant Failure
- Major Accident/Incident on Fermilab Site

Title	Probability	Score	(ks)		- Score - Cost	Impact Score - Schedul	Risk Rank
Increase in Laboratory Overhead Rate - Large Procurements	75.00%	5 (VH)	4,050	0.0	3 (H)	0(N)	3 (High)
Delay in access to SRF testing and fabrication infrastructure	50.00%	4 (H)	317	3.8	2 (M)	3 (H)	3 (High)
Failure of SRF cavity processing equipment	10.00%	2 (L)	20	0.4	2 (M)	2 (M)	2 (Medium)
Cryoplant Failure	15.00%	2 (L)	94	0.9	2 (M)	2 (M)	2 (Medium)
Major Accident/Incident on Fermilab Site	10.00%	2 (L)	0	0.1	0 (N)	1 (L)	1 (Low)





Risk: Project Management

Top five Project Management risks:

- Insufficient Scientific, engineering and technical human resources including T&M
- Delay in Transition from R&D to Operations Funding
- Assumed R&D funding profile not achieved
- NEPA approval is delayed
- Effect of US Continuing Resolution

Title 🔽	Probability	Score —	P * Impact (k\$)		Impact Score - Cost	Impact Score - Schedul	Risk Rank
Insufficient Scientific, engineering and technical human resources including T&M	50.00%	4 (H)	1,500	4.8	2 (M)	3 (H)	3 (High)
Delay in Transition from R&D to Operations Funding	50.00%	4 (H)	1,500	3.5	2 (M)	3 (H)	3 (High)
Assumed R&D funding profile not achieved	50.00%	4 (H)	0	8.0	0(N)	3 (H)	3 (High)
NEPA approval is delayed	50.00%	4 (H)	50	3.0	1 (L)	2 (M)	3 (High)
Effect of US Continuing Resolution	50.00%	4 (H)	0	2.0	0(N)	2 (M)	3 (High)

BOE Summary



WBS Number	Title	Docdb #
121.2	Project Management	229
121.3.1.2	Linac Project Management	1019
121.3.2.2	AP PM & Coord	887
121.3.2.3-7	AP Support for PIP-II	890



Cost Summary





Cost estimate based on org chart displayed on slide 6 Labor activity is all level-of-effort (LOE) Covers period Q1FY18 to Q3FY26 (8.5 years) • Project Management (121.2): 133 FTE-years • Linac Project Management (121.3.1): 8 FTE-years 11 FTE-years Accelerator Physics (121.3.2): M&S is dominated by travel and import duties Conference travel \$0.4M 10 domestic and 6 foreign conferences/year International collaboration travel \$0.3M 5 trips/year up to CD-2, 8 trips/year after (Note: This is for collaboration meetings only. Additional int'l travel is found in individual L3s) International short-term visitor support \$0.5M _ 2 short term visitors continuously over project duration Import duties on international contributions \$2.2M 2.6% x \$86M (estimated value of int'l deliverables) **Environmental Assessment** \$0.2M



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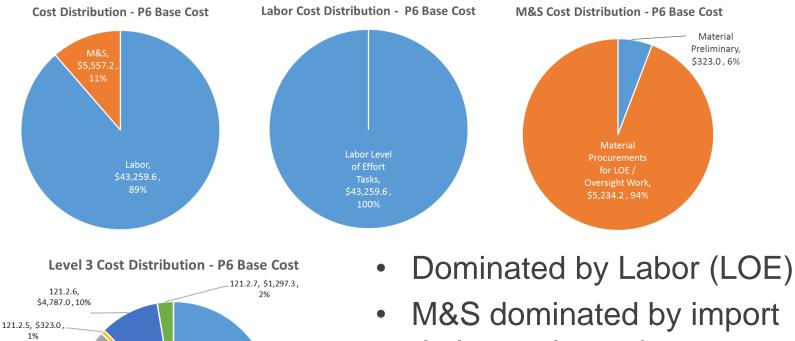
Cost Summary/Project Management

WBS Element	Hours	La	bor (\$000)	Ν	l&S (\$000)	Es	t. Uncerta	nity (\$000)		
121.2 - PIP-II - Project Management	P6 Hours	P6	Base Cost	Pe	i Base Cost		Total	% of Base	Total C Incl. Un	
121.2.2 - PM - Fermilab & USA Coordination (Fermi&USACoord)	83,317	\$	15,379.8	\$	729.8	\$	73.0	0.5%	\$ 16,1	82.6
121.2.3 - PM - International Coordination (IntCoord)	7,381	\$	2,029.3	\$	4,229.1	\$	1,251.7	20.0%	\$7,5	10.2
121.2.4 - PM - Business Office (BO)	107,337	\$	19,766.1	\$	275.2	\$	1,978.7	9.9%	\$ 22,0	20.0
121.2.5 - PM - Environmental Safety, Health & Quality (ESH&Q)	7,514	\$	-	\$	323.0	\$	96.9	30.0%	\$ 4	20.0
121.2.6 - PM - System Engineering & Electrical and Mechanical Integration (SE&EMI)	22,011	\$	4,787.0	\$	-	\$	957.4	20.0%	\$ 5,7	44.4
121.2.7 - PM - Conventional Facilities Management (CF)	6,011	\$	1,297.3	\$	-	\$	-	0.0%	\$ 1,2	97.3
Grand Total	233,571	\$	43,259.6	\$	5,557.2	\$	4,357.7	8.9%	\$ 53,1	74.4
Note: P6 base cost = BOE + overheads and escalation										

- Costs generated from resource loaded schedule
- Overall contingency is small (9%) because this activity is dominated by LOE and can be managed to a nearly fixed budget.



Cost Drivers and Estimate Maturity

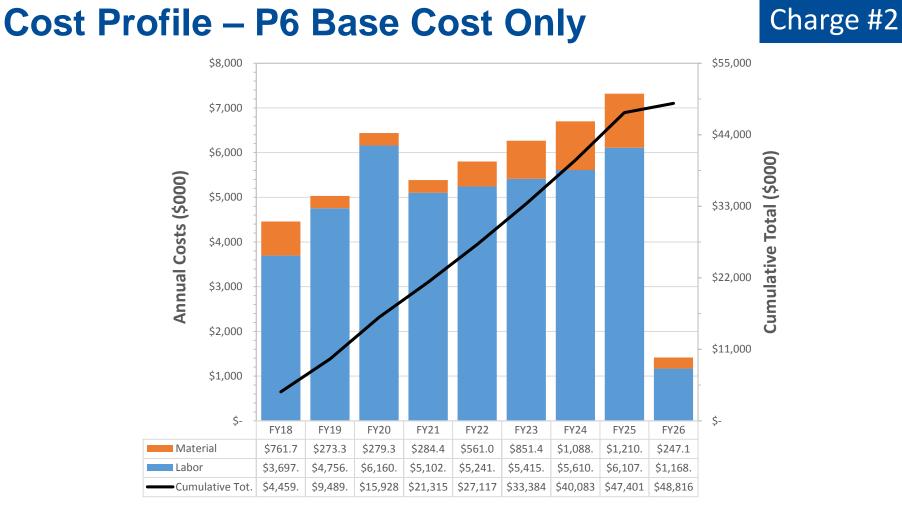


- M&S dominated by duties and travel
 20% estimate un
 - 20% estimate uncertainty assigned to import duties
 - 10% estimate uncertainty assigned to travel



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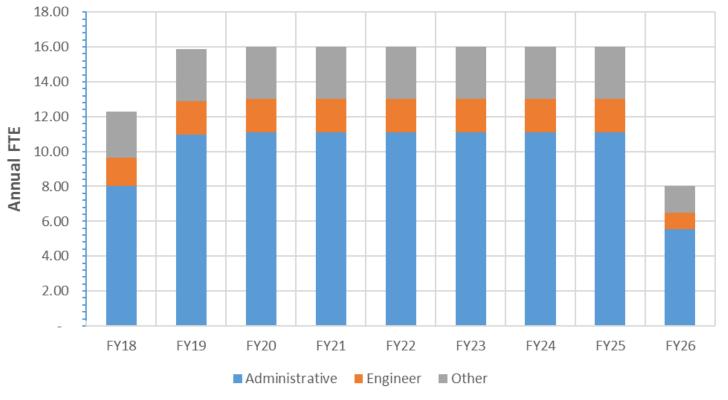
- Note: Assumes project completion in 2026
 - Standing army associated with theses tasks is ~16 FTE



2.00

- FY18 FY19 FY21 FY22 FY23 FY25 FY20 FY24 FY26 Administrative Engineer Other
- Essentially all required labor for FY18 is currently on-board
- Modest build-up required in FY19-20
 - Primarily project controls staff

Labor Profile – P6 Hours/FTE







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Cost Summary/Linac Proj Man



WBS Element	Hours	Labor (\$000)		M&S (\$000)		Est. Uncertanity (\$000)				
121.3.1 - Linac - Project Management									Т	otal Cost
(PM)	P6 Hours	P6	Base Cost	P6	Base Cost		Total	% of Base	Inc	l. Uncrty.
121.3.1.2 - Linac - PM - Project Management & Coordination	14,940	\$	3,321.2	\$	51.6	\$	337.3	10.0%	\$	3,710.1
Grand Total	14,940	\$	3,321.2	\$	51.6	\$	337.3	10.0%	\$	3,710.1
Note: P6 base cost = BOE + overheads and										



Cost Drivers and Estimate Maturity



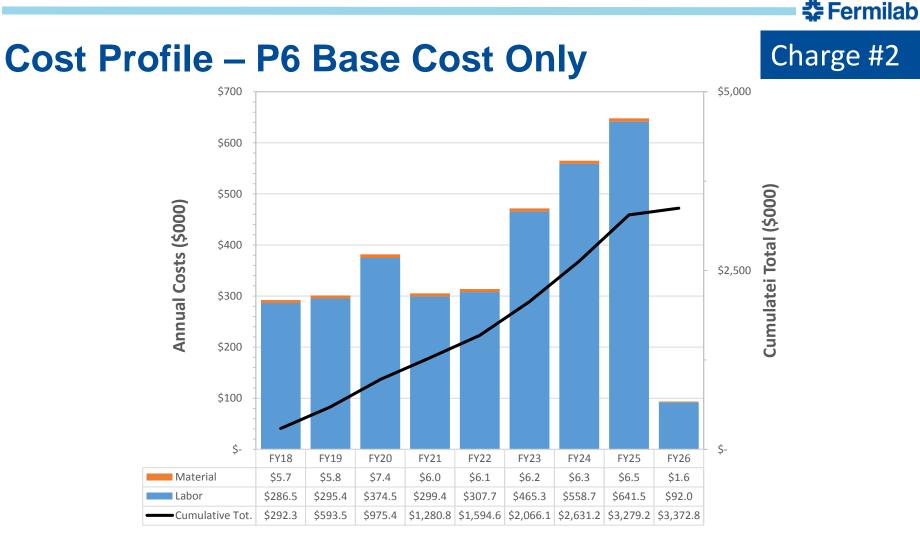
P6 Base Costs = BOE + Overheads + Escalation

Essentially all LOE





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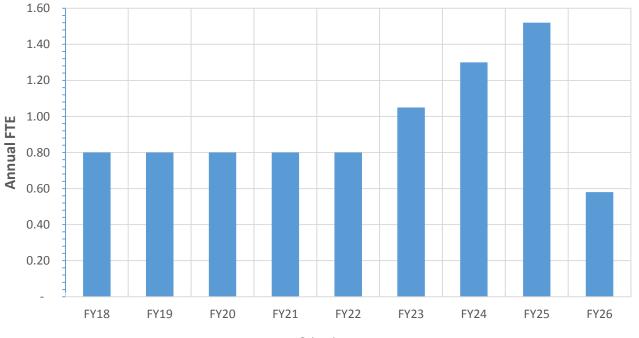


P6 Base Costs = BOE + Overheads + Escalation

Build up is preparation and coordination of commissioning



Labor Profile – P6 Hours/FTE



Scientist



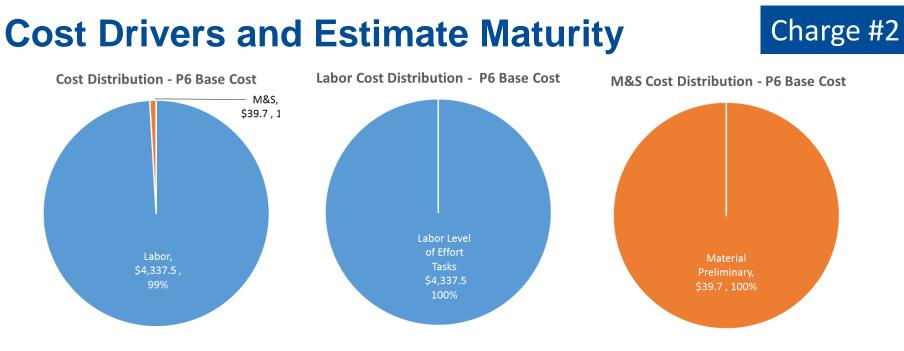


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Cost Summary/Accelerator Physics

WBS Element	Hours	Lab	or (\$000)	Μ	&S (\$000)	Es	t. Uncerta	nity (\$000)		
121.3.2 - Linac - Accelerator Physics (AP)	P6 Hours	P6 Base Cost		P6 Base Cost		Total		% of Base		otal Cost I. Uncrty.
121.3.2.2 - Linac - AP - Project Management & Coordination	7,514	\$	1,648.3	\$	19.4	\$	168.7	10.1%	\$	1,836.4
121.3.2.3 - Linac - AP - Accelerator Physics Studies for CD-1 documentation	442	\$	89.6	\$	-	\$	17.9	20.0%	\$	107.5
121.3.2.4 - Linac - AP - Accelerator Physics Studies for TDR and CD-2 documentation	884	\$	179.8	\$	-	\$	36.0	20.0%	\$	215.7
121.3.2.5 - Linac - AP - Beam Physics Studies at PIP2IT	2,652	\$	553.3	\$	7.0	\$	112.1	20.0%	\$	672.4
121.3.2.6 - Linac - AP - High Level Software Development	5,304	\$	1,217.4	\$	13.2	\$	246.1	20.0%	\$	1,476.7
121.3.2.7 - Linac - AP - Beam Physics Support to Beam Commissioning	2,652	<u>\$</u>	649.3	\$		<u>\$</u>	129.9	<u>20.0</u> %	<u>\$</u>	779.1
121.3.2.7 - Linac - AP - Beam Physics Support to Beam Commissioning	19,448	\$	4,337.5	\$	39.7	\$	710.6	16.2%	\$	5,087.8

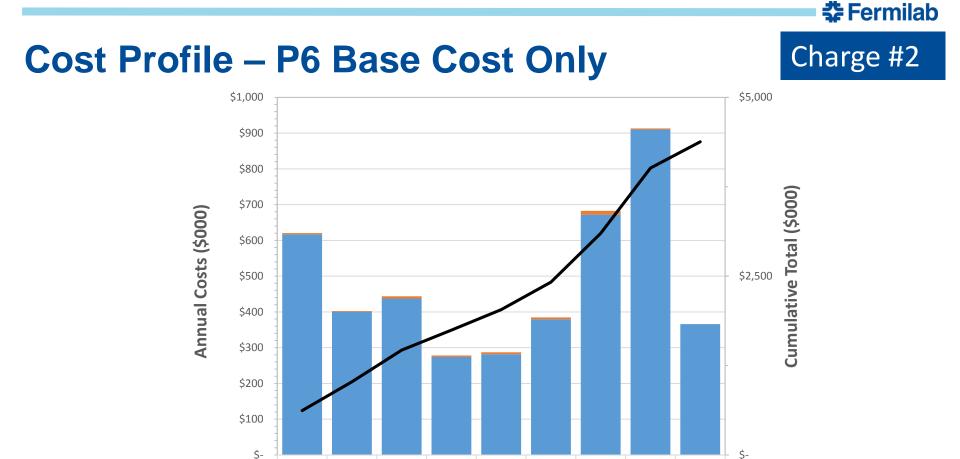




P6 Base Costs = BOE + Overheads + Escalation



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FY24

\$10.5

\$671.9

\$3,098.

FY25

\$2.9

\$910.0

\$4,011.

FY26

\$-

\$365.9

\$4,377.

P6 Base Costs = BOE + Overheads + Escalation

FY18

\$3.4

\$616.8

\$620.2

Material

Cumulative Tot.

Labor

FY19

\$1.9

\$400.3

\$1,022.

FY20

\$6.3

\$437.5

\$1,466.

FY21

\$4.2

\$274.0

\$1,744.

FY22

\$5.1

\$281.8

\$2,031.

FY23

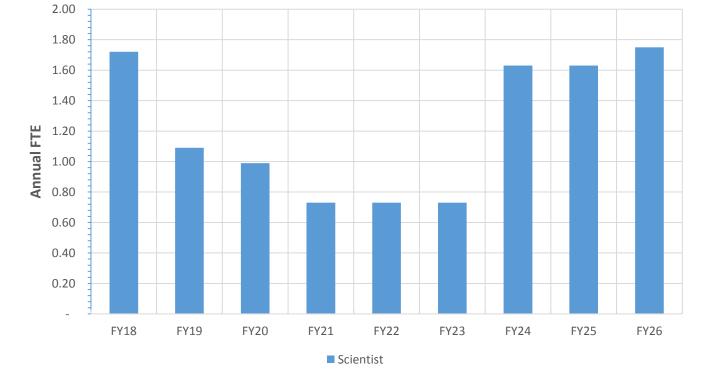
\$5.3

\$379.2

\$2,416.



Labor Profile – P6 Hours/FTE

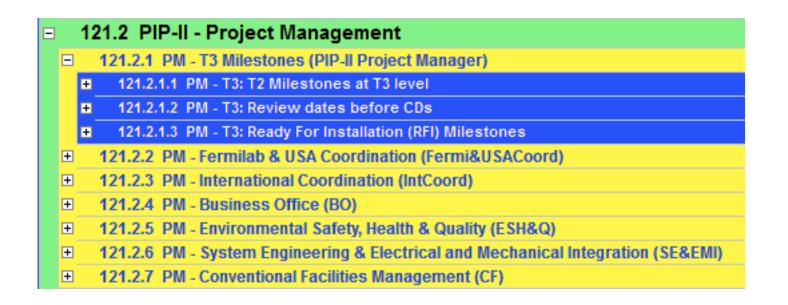


End buildup is preparation for commissioning





Schedule – PIP-II Project Management



- T3 Milestones belong to Project Manager
 - Reside in 121.2.1
 - Three flavors



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121.2.1 PM - T3 Milestones (PIP-II Project Manager)

Activity ID

Activity Name

121.2 PIP-II - Project Management

	stones (PIP-II Project Manager)	 					
121.2.1.1 PM - T3: T	72 Milestones at T3 level						
A17240	PM - BO - R&DPh: T3 MS - CD-1 Review Date	•					
A17250	PM - ESH&Q - R&DPh: T3 MS - Environmental Assessment submited to DOE	•					
A17260	PM - IntCoord - ConstrPh: T3 MS - Construction Agreement Signed (other international partners)	•					
A17270	PM - IntCoord - ConstrPh: T3 MS - Construction Agreement Signed (India) for the CryoPlant	•					
A17280	PM - IntCoord - ConstrPh: T3 MS - Construction Agr. Signed (India) for all contrib. but CryoPlant	•					
A17370	Linac - AP - R&DPh: T3 MS - Technical Design Report (TDR) released						
A17766740	Linac - SSR1 - 1stCM - STRING - ASSEM - R&DPh: T3 MS - SSR1 CM1 String assembled in Lab 2	•					
A17380	Linac - CRYO - PIP2ITCDS - CavTL - R&DPh: T3 MS - CDS installation completed in PIP2IT	•					
A17390	PM - BO - R&DPh: T3 MS - CD-2 Review Date	•					
A17400	PM - BO - R&DPh: T3 MS - CD-3a Review Date	•					
A17766700	Linac - HWR - INT - CMComp - R&DPh: T3 MS - HWR CM Delivered @ Fermilab	•					
A17410	CF - SitePrep - DD&FD - ConstrPh: T3 MS - Initiate Site Preparation works						
A17766680	Linac - WFE - MEBT - forCMcomm - R&DPh: T3 MS - WFE Commissioned with Beam to meet CDR parameters in PIP2/T		•				
A17766760	Linac - SSR1 - 1stCM - RFTest - R&DPh: T3 MS - SSR1 CM1 RF Tested in PIP2/IT / Ready For Installation MS						
A17766880	Linac - RF - PIP2IT - SSR1/325MHz - R&DPh: T3 MS - SSR1 7kW RF System tested completed in PIP2IT						
A17766710	Linac HWR - CM - RFTest - R&DPh: T3 MS - HWR CM RF Tested in PIP2IT / Ready For Installation MS						
A17420	PM - BO - R&OPh: T3 MS - CD-3 Review Date						
A17766830	Line - HB650 - 1stCH - STRING - ASSEM - R&DPh: T3 MS - HB650 CM1 String assembled in Lab 2						
A17766890	Linac - RF - TI - CMTS/650MHz - R&DPh: T3 MS - CMTS 40kW RF System tested						
A17766810	Linac - HB650 - 1stCM - RFTest - R&DPh: T3 MS - HB650 CM1 Tested in CMTS / Ready For Installation MS			• • • • • • • • • • • • • • • • • • • •			
A17766940	Linac - CRYO - PIP-IICrvoP - InstCONTR - ConstrPh: T3 MS - Issue PO / Contract awarded / End Procurement Cvcle	 **********			****************	*****	
A17766850	Linac - SSR1 - 2ndCM - STRING - ASSEM - ConstrPh: T3 MS - SSR1 CM2 String assembled in Lab 2						
A17766790	Linac - RF-INT - LLRF - TI - R&DPh: T3 MS - CMTS LLRF System Commissioned						
A17430	CF - CRYOBIdo - CoS - ConstrPh: T3 MS - Beneficial Occupancy Cryogenics Building						
A17430 A17762540	CF - UtilityBldg - CdS - ConstrPh: T3 MS - Beneficial Occupancy Utility Building to support 800 MeV SRF Linac (KPP #4)						
A17762540 A17440	CF - UtilityBlog - CoS - ConstrPh: 13 MS - Beneficial Occupancy Utility Building to support dou MeV SRF Linac (RPP #4) CF - HighBay - CoS - ConstrPh: T3 MS - Beneficial Occupancy High Bay Building						
A17440 A17450							
A17450 A17766860	CF - LTunnel - CoS - ConstrPh: T3 MS - Beneficial Occupancy Linac Tunnel to support 1 GeV SRF Linac (KPP #4)					₹	
	Linac - SSR2 - 1stCM - STRING - ASSEM - ConstrPh: T3 MS - SSR2 CM1 String assembled in Lab 2					••••••	
A17766900	Linac - RF - PIP2IT - SSR2/325MHz - ConstrPh: T3 MS - SSR2 20kW RF System tested in PIP2IT					• • • • • • • • • • • • • • • • • • •	
A17460	Linac - CRYO - PIP-IICDS - ConstrPh: T3 MS - PIP-II CDS Ready For Installation in PIP-II Tunnel						
A17470	CF - LGallery - CoS - ConstrPh: T3 MS - Beneficial Occupancy Linac Gallery to support 800 MeV SRF Linac (KPP #4)						
A17762550	CF - BTL - CoS - ConstrPh: T3 MS - Beam Transfer Line ready to support 800 MeV SRF Linac (KPP #4)					• • • • • • • • • • • • • • • • • • • •	
A17767360	Linac - CRYO - PIP-IICryoP - ConstrPh: T3 MS - CryoPlant commissioned					•	
A17762520	RingsUpgrade - Booster - 800MeVInjSyst - Test/Assem - ConstrPh: T3 MS - Inst. Complete & Ready for Beam Comm. (KPP #2)						
A17762530	RingsUpgrade - Booster - 20HzUpgrade - Test/Assem - ConstrPh: T3 MS - Inst. Complete & Ready for Beam Comm. (KPP #2)						
A17700000	Linac - PM - ConstPh: T3 MS - Accelerator Readiness Review before starting Beam Commissioning						•
A17480	Linac - IIC - Comm - SCL/BTL/BAL - ConstrPh: T3 MS - Cryoplant &CDS Ready to supp. CW RF oper: & operated to 2K (KPP #3)						•
A17762470	Linac - IIC - Comm - SCL/BTL/BAL - ConstrPh: T3 MS - Linac Beam Injected and circulating in the Booster (KPP #2)						
A17762510	Linac - IIC - Comm - SCL/BTL/BAL - ConstrPh: T3 MS - 800 MeV beam delivered to Booster injection region (KPP #1)						
A17490	PM - ConstrPh: T3 MS - CD-4 Review Date						

2017

2019

2020

2021

2022

2023

2018

Schedule – T2 MS @ T3 Level



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2025

2026

Charge #2

2024

121.2 PIP-II - Project Management 121.2.1 P

Schedule – T3 Review Date before CDs

2017

121.2.1.2 PM	T3: Review dates before CDs
A17520	PM - BO - R&DPh: T3 MS - Independent Project Review (IPR) before CD-1
A17535	PM - BO - R&DPh: T3 MS - Independent Cost Review (ICR) before CD-1
A17550	PM - BO - R&DPh: T3 MS - Director Review before CD-2
A17560	PM - BO - R&DPh: T3 MS - Director Review before CD-3a
A17570	PM - BO - R&DPh: T3 MS - Independent Project Review (IPR) before CD-2
A17580	PM - BO - R&DPh: T3 MS - Independent Project Review (IPR) before CD-3a
A17530	PM - BO - R&DPh: T3 MS - Independent Cost Review (ICR) before CD-2
A17540	PM - BO - R&DPh: T3 MS - Independent Cost Review (ICR) before CD-3a
A17590	PM - BO - R&DPh: T3 MS - Director Review before CD-3
A17600	PM - BO - R&DPh: T3 MS - Independent Project Review (IPR) before CD-3
A17605	PM - BO - ConstrPh: T3 MS - Independent Project Review (IPR) before CD-4

Activity Name

Activity ID

r-n - Froject Management							 	 	
PM - T3 Milestones (PIP-II Project I	Manager)							 	
1.1 PM - T3: T2 Milestones at T3 leve	el la								
1.2 PM - T3: Review dates before CI	ls							 	
7520 PM - BO - R&DPh: T3 MS - Ind	ependent Project Review (IPR) before CD-1	 +							
7535 PM - BO - R&DPh: T3 MS - Ind	ependent Cost Review (ICR) before CD-1	•							
2550 PM - BO - R&DPh: T3 MS - Dir		•••••							
7560 PM - BO - R&DPh: T3 MS - Dir		 	*			 	 		
	ependent Project Review (IPR) before CD-2	•							
	ependent Project Review (IPR) before CD-3a ependent Cost Review (ICR) before CD-2	The second se							
	ependent Cost Review (ICR) before CD-2								
590 PM - BO - R&DPh: T3 MS - Dir				•					
7600 PM - BO - R&DPh: T3 MS - Ind	ependent Project Review (IPR) before CD-3				•				
7605 PM - BO - ConstrPh: T3 MS - I	ndependent Project Review (IPR) before CD-4								•

2018

2019

2020

2021

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2022

2023

28 Holmes | Project Management | Project Management Breakout 10/10/2017



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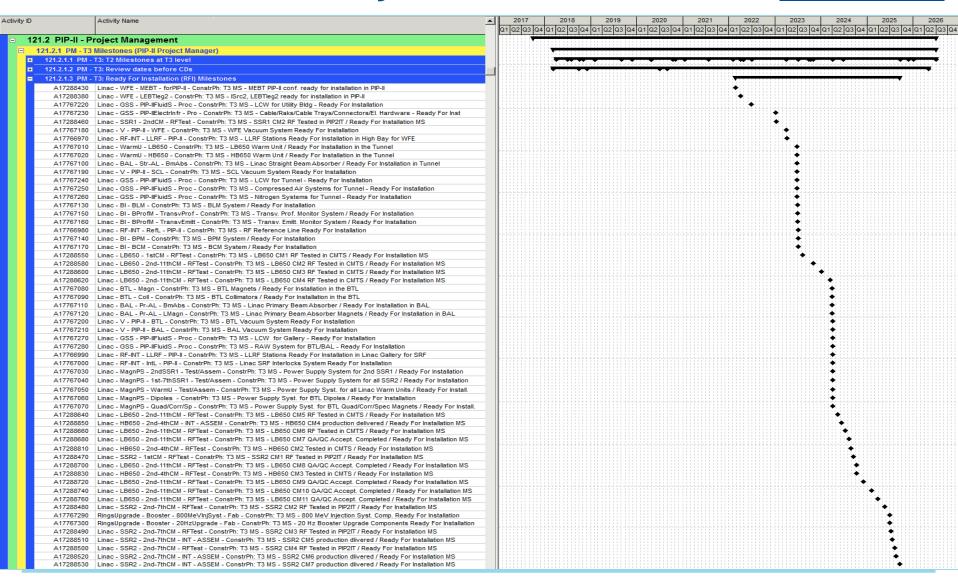
2025

2026

Charge #2

2024

Schedule – T3 Ready For Installation





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Schedule – Linac PM and Accelerator Physics

Activity ID)	Activity Name
□ 1	21.3 PIP-II - I	Linac
	121.3.1 Linac	- Project Management (PM)
- C	121.3.1.1 Lin	ac - PM - T4 Milestones
	A17698	Linac - PM - ConstPh: T4 MS - Early Accelerator Readiness Review before starting Beam Commissioning
	121.3.2 Linac	- Accelerator Physics (AP)
E	121.3.2.1 Lin	ac - AP - T4 Milestones
	A1720240	Linac - AP - R&DPh: T4 MS - Early Technical Design Report (TDR) released

2017 2	018	2019	2020	2021	2022	2023	2024	2025	2026
Q1 Q2 Q3 Q4 Q1 Q2	2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4	Q1 Q2 Q3 Q4
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	₩1.1.1.1.1								
	▼::::::								
	▲:::::::								
	▼ ::::::								





Summary

- Project Management tasks are well-defined
 - Based on (current) project organization chart
 - Nearly all positions filled
 - Modest adjustments to org chart & WBS anticipated after CD-1
- Project Team is well-qualified to deliver this project
 - Many years experience in accelerator development, operations, and projects
- Groundwork is being laid for CD-2 and we are ready to move forward following CD-1





Thank you for your attention

