



Conventional Facilities (WBS 121.06)

Steve Dixon

Basis of Estimate Review

08 March 2019

In partnership with:

India/DAE

Italy/INFN

UK/STFC

France/CEA/Irfu, CNRS/IN2P3

Outline

- Charge Questions
- Key Performance Parameters
- Scope/Deliverables
- Basis of Estimate Format
- List of Basis of Estimates
- Summary



Charge Questions

For each Level 3 sub-system, please:

1. Assess if the scope is necessary and sufficient to meet the objective KPP goals. *(no KPPs associated with conventional facilities)*
2. Assess if the estimated resources, cost, and schedule are reasonable and credible.
3. Assess if the bases of estimates credible.
4. Assess if uncertainties and risks have been captured comprehensively.
5. Identify cost reduction opportunities
6. Identify Value Engineering opportunities.

Key Performance Parameters

#	Scope	Threshold KPP	Objective KPP
1	SRF <u>Linac</u> Beam Energy	600 MeV	800 MeV
2	<u>Linac</u> Beam	Beam delivered to the Beamline Dump	5.4E12 particles per pulse (H-) at 20 Hz beam delivered to the Beamline Dump
3	Booster/Recycler/Main Injector upgrades	Booster injection region, Recycler RF upgrades, and Main Injector RF upgrades, hardware installed and tested without beam in respective machines.	<u>Linac</u> beam injected and circulated in the Booster

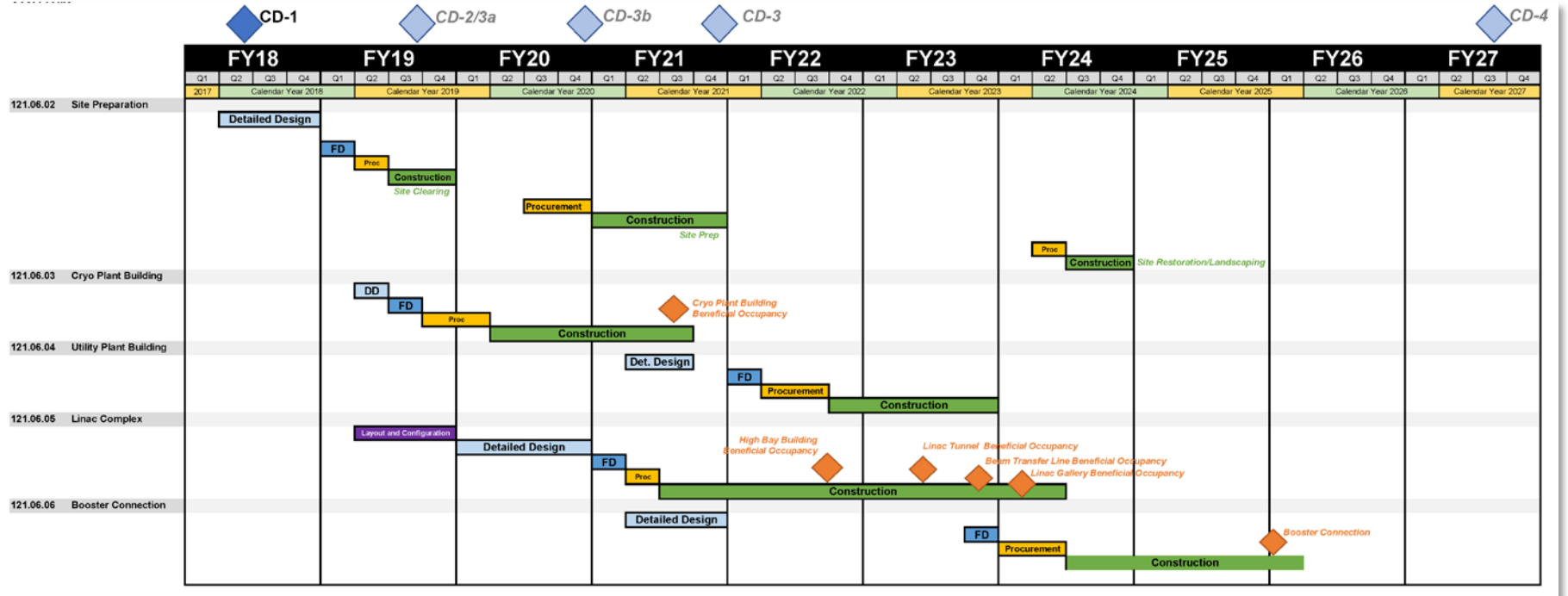
- Conventional Facilities includes the design, procurement and construction of the utilities, roads, structures, enclosures and buildings to support the installation, assembly and operation of the technical components. ^[1]
- WBS
 - 121.06.01 – Project Management and Coordination
 - 121.06.02 – Site Preparation
 - 121.06.03 – Cryogenics Plant Building (23,245 square feet)
 - 121.06.04 – Utility Plant Building (21,275 square feet)
 - 121.06.05 – Linac Complex (88,550 square feet)
 - 121.06.06 – Booster Connection (7,750 square feet)

[1] See WBS Dictionary in PIP-II-doc-599 for complete description

Scope and Deliverables



Schedule



Basis of Estimate

<p align="center">PIP-II BASIS of ESTIMATE (BoE) for 121.06.05.03 CnvF - Cmplx - Construction on Site</p>		Date of Estimate: December 27, 2018
		Prepared by: S. Dixon Contributing Authors: _____ Reviewed by: _____
		Docdb #: 2124
WBS number: 121.06.05.03	Control Account: 121.06.05.03	WBS Title: CnvF - Cmplx - Construction on Site
WBS Dictionary Definition: This WBS entry covers procurement and management for all contracted labor, materials, tools, equipment, and services needed for the construction of the Linac Complex work scope. It describes the labor resources, materials and services necessary organization, planning, oversight and engineering, design, inspection and administration (EDIA) of the construction work on the Fermilab site.		
Supporting Documents (including but not limited to): <ul style="list-style-type: none"> • PIP-II-doc-144 for PIP-II Project Assumptions Document; • PIP-II-doc-345 Contingency Rules for Basis of Estimates; • PIP-II-doc-328 PIP-II Fermilab Interface Document; • PIP-II-doc-327 EDIA Calculation; • PIP-II-doc-318 for A/E Tasking Duration Assumptions; • PIP-II-doc-321 for Construction Subcontract Procurement Duration Assumptions; • PIP-II-doc-333 Construction Package Cost Estimate; • PIP-II-doc-581 Construction Package Schedule Estimate; 		
Assumptions: <ul style="list-style-type: none"> • This Basis of Estimate covers activities after September 1, 2018; • This WBS does not include any extraordinary technology requirements; • Costs listed are in 2018 dollars and do not include escalation; • Costs listed do not include Indirect multipliers; • One (1) full time equivalent (FTE) is based on 1,768 hours worked per year; • FESS/Engineering hourly rate is based on \$111.00/hour per FY19 Provisional Labor, Indirect and Shop Rates • The PIP-II Fermilab Memorandum of understanding is in place; • Construction Phase is assumed to begin after CD-3 is issued and be complete when Final Acceptance is achieved for the installed work; • The construction subcontract is anticipated to be specified as a multi-year, phased funded procurement; • This construction portion of this WBS will require coordination with an accelerator shutdown. 		

WBS Dictionary Description (PIP-II-doc-599)

Supporting Documents

Assumptions

Details of the Base Estimate

Description

This work consists of the procurement and construction phases for the Linac Complex construction package. The construction package will include the following components:

- **High Bay Building** that includes the construction package includes the below grade and above grade structures, mechanical, electrical, conveying systems and related support systems to house the PIP2IT components and related infrastructure;

Basis of Estimate

- **Linac Tunnel** that includes the work required to install the below grade beamline enclosure to accommodate the beamline components and related support infrastructure;
- **Linac Gallery** that includes the above grade service building and associated infrastructure to support the technical equipment for the beamline components;
- **Beam Transfer Line** that includes the work required to install the below grade beamline enclosure to accommodate the beamline components, beam dump and related support infrastructure.

The Procurement phase of the work includes the activities required to support the selection of a construction subcontractor and construct the work package scope. For cost tracking purposes, this effort is included in the Construction phase calculations.

The Construction phase of the work will procure, fabricate, construct, install and deliver the work associated with the Linac Complex work package.

Deliverables

The Construction Phase deliverables will include the installation of the Linac Complex work scope and supporting close out documentation typical for construction projects including shop drawings, operations and maintenance manuals and warranty information.

Calculation

\$56,624,561	Estimated Construction Package Base Cost				
	<i>See PIP-II-doc-333 for construction cost estimate</i>				
-\$2,198,000	Scope Adjustments (see description below)				
\$54,426,561	Total				

Construction Package Cost Estimate
(PIP-II-doc-333)

Engineering Design, Inspection and Administration Multipliers

7.9%	Construction Phase A/E Construction Administration				
3.1%	Construction Phase A/E Construction Coordination				
2.0%	Construction Phase ED&I In-House				

See PIP-II-doc-327 for basis of EDI and A description and analysis of multipliers by phase

EDIA Multipliers Rates
(PIP-II-doc-327)

Cost Breakdown

	M&S				Labor		
	A/E		FESS/E		Construction	FTE	Hours
	CA Support	CC Support	\$	Hours			
Construction Phase Support	7.9%	3.1%	2.0%				
	\$4,473,000	\$1,755,000	\$1,132,000	10,198		3.15	5,570
Construction					\$54,426,561		
Totals	\$4,473,000	\$1,755,000	\$1,132,000	10,198	\$54,426,561	3.15	5,570

Cost Estimate Breakdown
By Category

Materials and Supplies (M&S) Notes:

The M&S costs will consist of the following:

- Scope Adjustments from the Estimated Construction Package Base Cost include the following:
 - \$1,157,000 for removing precast concrete shield block from the base estimate;
 - \$1,041,000 for reducing the width of the Linac Gallery by five (5) feet.
- "CA Support" is the A/E construction administration cost to support the project during the construction phase.
- "CC Support" is the A/E construction coordination cost to provide field representatives during the construction phase.
- Architect/Engineering (A/E) firm(s) to provide CA and CC services. This will be done utilizing task order agreements from a previously selected A/E firm(s);

Scope Adjustment Descriptions
(PIP-II-doc-1025)

Basis of Estimate

- FESS/Engineering will provide support during the construction phases;
- Emil Huedem of FESS/Engineering is assumed to be available at an approximate full-time level based on his level of mechanical expertise, history of project management knowledge and PIP-II conceptual design.
- It is anticipated that the construction subcontract will be specified as a multi-year, phased funded procurement.

Labor Notes:

The Labor for this WBS includes a portion of the annual labor cost for the Conventional Facilities (L2-CF) management efforts.

Uncertainty/Contingency Rules

The estimate uncertainty for this WBS is based on the standard PIP-II guidance (PIP-II-doc-345) and is assumed to be:

Labor L4	Preliminary	Based on direct experience with similar work. Development of activities, resource requirements, and schedule constraints are defined at a preliminary (beyond conceptual) design level. Technical requirements are achievable and with some precedent.	25%-40%	37.5%	Based on level of design maturity
M&S M4	Preliminary	Items that can be readily estimated from a reasonably detailed but not completed design; items adapted from existing designs but with moderate modifications, which have documented costs from past projects. A recent vendor survey (e.g., budgetary quote, vendor RFI response) based on a preliminary design belongs here.	20%-40%	30%	For A/E and FESS/E support. Based on preliminary estimate from A/E - See PIP-II-doc-327
M&S M5	Conceptual	Items with a documented conceptual level of design; items adapted from existing designs but with extensive modifications, which have documented costs from past projects	40%-60%	30%	For the Construction on Site work. Based on current state of the design. Does not include risk-based contingency

Estimate Uncertainty
(PIP-II-doc-345)

Durations

Listed below are the basis of the durations for this work scope:

	Work Days	Reference
Construction		
Procurement	191	See PIP-II-doc-321
Construction Phase	544	Based on 04MAY18 A/E Estimate

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Duration Estimates

- Construction Procurement (PIP-II-doc-321)
- Construction Work (PIP-II-doc-581)

Basis of Estimate

Notice To Proceed (NTP)	0	
Start Construction	43	After NTP
Beneficial Occupancy	783	After NTP
Final Acceptance	544	After NTP

Duration Notes:

- Planning packages are based on previous similar work scope.
- Construction durations are assumed to have a range of -10% to +20% based on the results of the 19MAY17 cost/schedule estimate.
- Duration estimates will be updated upon receipt of task order agreement from A/E firms and Construction Subcontractor.

Relationships

Listed below are associated WBS items:

- WBS 121.06.05.01 – Linac Complex Project Management and Coordination (PIP-II-doc-2127)
- WBS 121.06.05.02 – Linac Complex Building Detailed and Final Design (PIP-II-doc-2130)

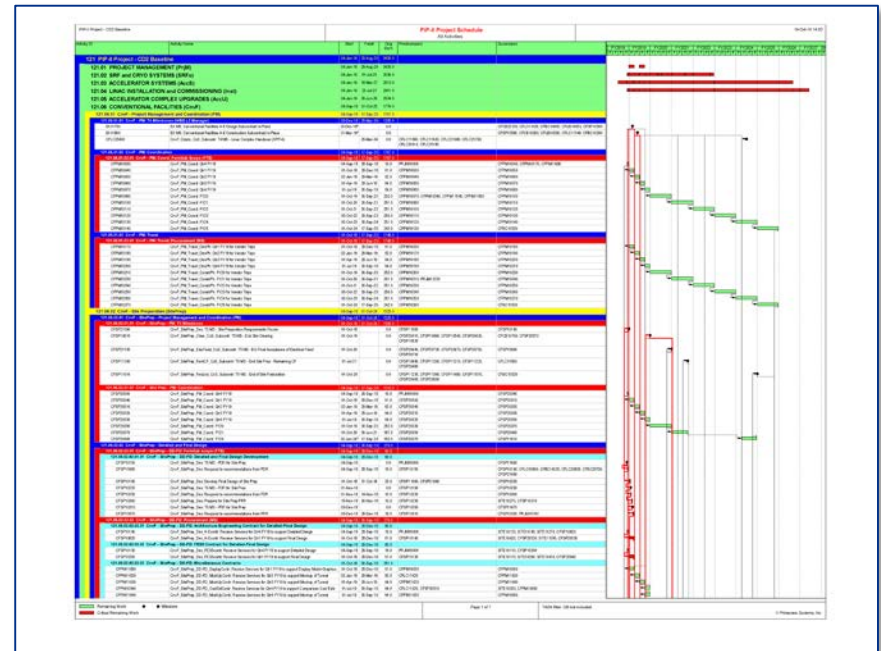
Change Log

Revision No.	Description of Change	Change Date	Modified By:
Rev. 0	Revised format based on new WBS organization	12/27/18	S. Dixon

Approval of the Revision Change of the BOE is by electronic approval in PIP-II DocDB by the Level 2 Manager responsible for this WBS work scope.

{end of document}

Construction Duration Estimates Based on Gensler/Turner Schedule



Basis of Estimates

		Basis of Estimate
WBS	Identification	DocDb ID
121.06.01	CF Project Management and Coordination	PIP-II-doc-2079
121.06.02	Site Preparation	
121.06.02.01	SP PM&C	PIP-II-doc-2082
121.06.02.02	SP Detailed and Final Design	PIP-II-doc-2085
121.06.02.03	SP - Site Clearing	PIP-II-doc-2088
121.06.02.04	SP - Site Work	PIP-II-doc-2091
121.06.02.05	SP - Site Restoration and Landscaping	PIP-II-doc-2094
121.06.02.06	SP - Electrical Feed	PIP-II-doc-2097
121.06.03	Cryo Plant Building	
121.06.03.01	CPB PM&C	PIP-II-doc-2100
121.06.03.02	CPB Detailed and Final Design	PIP-II-doc-2103
121.06.03.03	CPB Construction on Site	PIP-II-doc-2106
121.06.04	Utility Plant Building	
121.06.04.01	UPB PM&C	PIP-II-doc-2109
121.06.04.02	UPB Detailed and Final Design	PIP-II-doc-2112
121.06.04.03	UPB Construction on Site	PIP-II-doc-2115
121.06.05	Linac Complex	
121.06.05.01	LC PM&C	PIP-II-doc-2118
121.06.05.02	LC Detailed and Final Design	PIP-II-doc-2121
121.06.05.03	LC Construction on Site	PIP-II-doc-2124
121.06.06	Booster Connection	
121.06.06.01	BC PM&C	PIP-II-doc-2127
121.06.06.02	BC Detailed and Final Design	PIP-II-doc-2130
121.06.06.03	BC Construction on Site	PIP-II-doc-2133

Supporting Documentation

- AE Tasking Duration Memo – PIP-II-doc-318
- Subcontract Procurement Durations Memo – PIP-II-doc-321
- Construction Package Cost Estimate – PIP-II-doc-333
- Construction Package Schedule Estimate – PIP-II-doc-581
- EDIA Estimate Calculation – PIP-II-doc-327
- Scope Adjustment Memo – PIP-II-doc-1025
- PIP-II Interface Document – PIP-II-doc-528
- PIP-II Project Assumptions Document – PIP-II-doc-144
- PIP-II Cost Estimating Uncertainty – PIP-II-doc-345
- PIP-II WBS Dictionary – PIP-II-doc-599

Summary

- Thank you for your participation and we look forward to your feedback

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