



# Cost Estimate Methodology (WBS 121.06)

## Breakout Session

Steve Dixon

PIP-II IPR

4-6 December 2018

In partnership with:

India/DAE

Italy/INFN

UK/STFC

France/CEA/Irfu, CNRS/IN2P3

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# Charge Questions Addressed

1. Is the project making adequate technical progress to ensure that the completed project will perform as planned and meet the key performance parameters?
2. Will execution of PIP II design plans and planned R&D program activities ensure most major technical risks will be appropriately mitigated or retired prior to CD-3?
3. Has the project made adequate progress on its resource-loaded schedule to complete it by the time of CD-2?
4. Are preparations for defining, documenting, and managing the international in-kind contributions suitable to ensure their timely delivery and technical fidelity?
5. Is the proposed CD-2 timeline reasonable and consistent with the current project status?
6. Is ESH&Q being handled appropriately?
7. Are the proposed risk mitigation strategies reasonable and are the proposed contingencies acceptable?
8. Has the project satisfactorily responded to the recommendations from previous reviews?
9. Are there any other significant issues that require HEP or project's attention?

# Outline

- Cost Estimate History
- Plans Moving Forward
- Summary

## About Me:

- PIP-II Level 2 Manager for Conventional Facilities
- Relevant Experience
  - Licensed Architect;
  - Project Management Professional (PMP);
  - LEED Accredited Professional;
  - 26+ years at Fermilab;
  - NOvA Project L2 Manager for Site and Buildings;
    - 2014 CD-4
    - 2015 U.S. DOE Secretary's Award for Excellence
  - General Plant Project Manager for 15+ years
    - Short Baseline Neutrino (SBN) Near Detector Building;
    - Short Baseline Neutrino (SBN) Far Detector Building;
    - Experimental Operations Center;

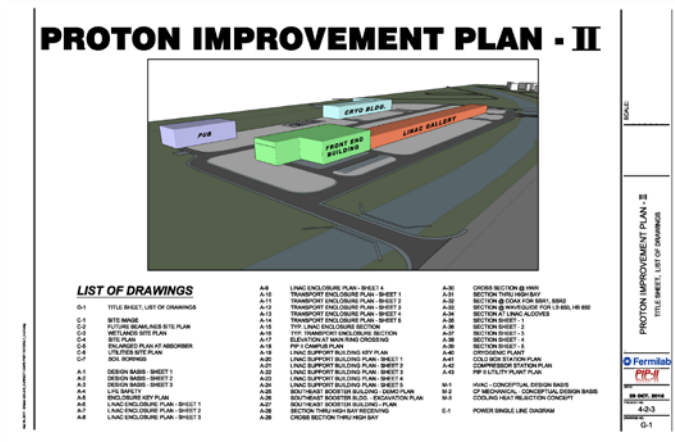
# Cost Estimate History

- CD-0
  - Cost estimate was based on parametric scaling from previous schemes (Project X, Proton Driver);
  - Done internally within Fermilab
- CD-1 - 2017
  - Based on conceptual design and an Estimate Assumptions document developed by Fermilab;
  - Cost/Schedule estimate was done by an outside construction firm (Turner Construction) that was not involved with the design;
- Preparation for CD-2 - 2018
  - Estimate was updated based on Value Engineering, Construction Packaging and market conditions



# CD-1 Cost Estimate Tasking

Drawings from PIP-II-doc-1155



## Initial Tasking for A/E Team



Conceptual Design drawings and Estimate Assumptions developed with input from stakeholders

**Estimate Assumptions**  
For  
**The PIP II Conventional Construction**  
WBS 121.06  
Conceptual Design  
March 1, 2017  
Version 0.0  
Doc. XXX

This document agrees the design information provided by the Conceptual Design drawings dated 28 October 2016.

Managed by the Fermi Research Alliance, LLC for the U.S. Department of Energy Office of Science

*the construction cost estimate should be prepared in accordance with DOE's Cost Estimating Guide (G413.3-21) and GAO Cost Estimating and Assessment Guide (GOA-09-3SP) as well as current industry best practices. For the purposes of this tasking the preliminary cost estimate should assume a 10%-40% project definition based on the conceptual design documentation and therefore a Class 3 estimate classification as defined by DOE G 413.3-21*

Documentation can be found at PIP-II-doc-333

# CD-1 Cost Estimate Summary

## Fermilab PIP II

Estimate Level (Concept - Priced at 2nd Q1R 2017 - 1000 Index) 12/9  
May 19, 2017

SYSTEM SUMMARY	TOTAL		121.6.2 - Site Preparation		121.6.3 - Cryo Plant Building		121.6.4 - Utility Plant Building (PUB)		121.6.8 - Linac Tunnel		121.6.7 - Linac Gallery		121.6.6 - High Bay Building		121.6.9 - Beam Transfer Lns		121.6.9 - Booster Connection		
	Total	GSF	Total	Cost/RSF	Total	Cost/RSF	Total	Cost/RSF	Total	Cost/RSF	Total	Cost/RSF	Total	Cost/RSF	Total	Cost/RSF	Total	Cost/RSF	
<b>A-Substructure</b>	<b>\$17,462,973</b>	<b>\$134.57</b>	\$0	\$0.00	\$1,217,062	\$52.39	\$355,201	\$45.39	\$4,429,566	\$222.20	\$1,716,070	\$52.16	\$3,757,250	\$175.00	\$3,406,734	\$241.46	\$2,193,661	\$283.04	
A1-Foundations	\$12,645,034	\$97.57	\$0	\$0.00	\$1,050,866	\$47.39	\$313,684	\$42.39	\$2,285,252	\$116.43	\$1,290,821	\$48.39	\$2,197,238	\$148.40	\$1,385,210	\$123.91	\$1,256,124	\$220.03	
A2-Excavation/Construction	\$4,718,939	\$37.00	\$0	\$0.00	\$166,197	\$5.55	\$19,518	\$2.41	\$1,470,213	\$73.75	\$155,249	\$3.81	\$559,952	\$29.20	\$1,340,434	\$103.57	\$869,427	\$92.01	
<b>B-Shell</b>	<b>\$20,721,228</b>	<b>\$162.47</b>	\$0	\$0.00	\$4,728,330	\$203.33	\$1,693,498	\$214.62	\$2,262,024	\$115.40	\$5,747,566	\$174.67	\$4,554,907	\$217.62	\$4,047,569	\$265.64	\$4,609,293	\$596.26	
B10-Superstructure	\$11,120,899	\$87.20	\$0	\$0.00	\$2,191,206	\$92.34	\$629,035	\$79.68	\$2,329,699	\$120.78	\$2,229,862	\$61.77	\$2,376,340	\$129.80	\$2,789,995	\$54.73	\$595,791	\$89.13	
B20-Exterior Enclosure	\$7,605,999	\$59.64	\$0	\$0.00	\$2,102,207	\$90.45	\$879,912	\$109.95	\$115,868	\$5.82	\$2,753,006	\$83.67	\$1,438,874	\$70.45	\$135,706	\$9.40	\$121,026	\$15.62	
B30-Flooring	\$1,994,330	\$15.64	\$0	\$0.00	\$470,700	\$20.34	\$135,523	\$17.20	\$157,250	\$7.89	\$764,500	\$23.24	\$379,770	\$17.05	\$21,660	\$1.51	\$12,475	\$1.61	
<b>C-Interiors</b>	<b>\$2,960,901</b>	<b>\$22.36</b>	\$0	\$0.00	\$408,730	\$17.69	\$256,526	\$31.96	\$278,946	\$13.06	\$379,160	\$11.62	\$1,114,011	\$52.36	\$190,029	\$13.72	\$216,640	\$27.94	
C10-Interior Construction	\$1,054,176	\$8.27	\$0	\$0.00	\$127,027	\$5.47	\$124,769	\$15.61	\$31,517	\$1.58	\$69,204	\$2.12	\$394,001	\$28.51	\$24,500	\$1.70	\$112,200	\$14.22	
C20-Stairs	\$487,657	\$3.43	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$104,200	\$5.20	\$20,700	\$0.63	\$168,667	\$7.92	\$62,800	\$5.74	\$41,400	\$5.34	
C30-Interior Finishes	\$1,329,126	\$10.44	\$0	\$0.00	\$281,703	\$12.12	\$130,756	\$16.35	\$123,229	\$6.18	\$289,696	\$8.77	\$381,453	\$17.83	\$90,724	\$6.79	\$42,637	\$5.48	
<b>D-Services</b>	<b>\$21,219,200</b>	<b>\$166.37</b>	\$0	\$0.00	\$4,312,895	\$186.64	\$2,981,201	\$370.38	\$1,325,379	\$66.48	\$7,821,172	\$231.61	\$2,508,195	\$117.89	\$1,588,741	\$110.82	\$890,661	\$114.92	
D10-Conveying	\$265,000	\$1.96	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$126,000	\$6.88	\$125,000	\$6.88	\$0	\$0.00	\$0	\$0.00	
D20-Pneumatics	\$968,130	\$7.59	\$0	\$0.00	\$149,269	\$6.43	\$41,354	\$5.17	\$136,359	\$6.64	\$154,754	\$4.73	\$314,376	\$14.78	\$119,171	\$8.76	\$52,748	\$6.81	
D30-HVAC	\$5460,124	\$42.61	\$0	\$0.00	\$1,022,000	\$44.00	\$1,333,220	\$220.92	\$540,383	\$26.05	\$922,356	\$28.05	\$300,429	\$37.76	\$234,556	\$17.04	\$306,213	\$39.49	
D40-Fire Protection	\$549,398	\$4.24	\$0	\$0.00	\$87,160	\$3.75	\$29,981	\$3.76	\$129,334	\$3.75	\$79,781	\$3.75	\$179,781	\$3.75	\$0	\$0.00	\$29,203	\$3.76	
D50-Electrical	\$14,191,590	\$111.27	\$0	\$0.00	\$3,053,468	\$131.36	\$1,329,666	\$133.54	\$646,637	\$42.57	\$6,295,159	\$191.31	\$1,193,558	\$55.75	\$1,246,214	\$89.33	\$502,836	\$64.88	
<b>E-Equipment &amp; Furnishings</b>	<b>\$790,900</b>	<b>\$6.20</b>	\$0	\$0.00	\$502,400	\$21.61	\$0	\$0.00	\$0	\$0.00	\$40,000	\$1.22	\$248,500	\$11.68	\$0	\$0.00	\$0	\$0.00	
E10-Equipment	\$790,900	\$6.20	\$0	\$0.00	\$502,400	\$21.61	\$0	\$0.00	\$0	\$0.00	\$40,000	\$1.22	\$248,500	\$11.68	\$0	\$0.00	\$0	\$0.00	
E20-Furnishings	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	
<b>F-Special Construction &amp; Demolition</b>	<b>\$172,056</b>	<b>\$1.36</b>	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$64,000	\$4.48	\$107,295	\$13.94	
F10-Special Construction	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	
F20-Selective Building Demolition	\$172,056	\$1.36	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$64,000	\$4.48	\$107,295	\$13.94	
<b>G-Building Sitework</b>	<b>\$23,700,100</b>	<b>\$186.20</b>	<b>\$17,000,007</b>	<b>\$12.27</b>	<b>\$311,425</b>	<b>\$13.40</b>	<b>\$226,255</b>	<b>\$27.62</b>	<b>\$104,251</b>	<b>\$5.25</b>	<b>\$19,643</b>	<b>\$27.74</b>	<b>\$157,010</b>	<b>\$7.70</b>	<b>\$1,506,000</b>	<b>\$104.32</b>	<b>\$3,407,514</b>	<b>\$446.00</b>	
G10-Site Preparation	\$306,932	\$2.41	\$1,902,694	\$1.39	\$20,198	\$8.65	\$12,073	\$21.82	\$30,331	\$2.23	\$32,283	\$12.72	\$131,956	\$4.78	\$22,299	\$6.99	\$19,796	\$14.16	
G20-Site Impervement	\$6,568,821	\$51.08	\$889,844	\$3.71	\$11,412	\$3.38	\$22,349	\$2.78	\$0	\$0.00	\$46,670	\$14.12	\$47,919	\$2.24	\$1,413,568	\$97.93	\$3,378,158	\$435.09	
G30-Site Mechanical Utilities	\$5,548,036	\$43.81	\$5,456,309	\$3.95	\$12,426	\$5.32	\$25,022	\$3.22	\$0	\$0.00	\$16,449	\$5.32	\$7,141	\$3.35	\$0	\$0.00	\$0	\$0.00	
G40-Site Electrical Utilities	\$8,757,430	\$68.64	\$8,692,573	\$6.22	\$26,220	\$11.13	\$0	\$0.00	\$0	\$0.00	\$19,680	\$2.39	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	
G93-Other Site Construction	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	
<b>DESIGN CONTINGENCY</b>	<b>0.00%</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0.00</b>	<b>\$0</b>	<b>\$0.00</b>	<b>\$0</b>	<b>\$0.00</b>	<b>\$0</b>	<b>\$0.00</b>	<b>\$0</b>	<b>\$0.00</b>	<b>\$0</b>	<b>\$0.00</b>	<b>\$0</b>	<b>\$0.00</b>	<b>\$0</b>	<b>\$0.00</b>	
<b>ESCALATION</b>	<b>\$0</b>	<b>\$0.00</b>	<b>\$0</b>	<b>\$0.00</b>	<b>\$0</b>	<b>\$0.00</b>	<b>\$0</b>	<b>\$0.00</b>	<b>\$0</b>	<b>\$0.00</b>	<b>\$0</b>	<b>\$0.00</b>	<b>\$0</b>	<b>\$0.00</b>	<b>\$0</b>	<b>\$0.00</b>	<b>\$0</b>	<b>\$0.00</b>	
<b>BONDS / SDI</b>	<b>1.15%</b>	<b>\$996,791</b>	<b>\$7.82</b>	<b>\$1,96,191</b>	<b>\$10.14</b>	<b>\$132,016</b>	<b>\$5.68</b>	<b>\$83,181</b>	<b>\$7.90</b>	<b>\$97,983</b>	<b>\$4.82</b>	<b>\$188,791</b>	<b>\$5.74</b>	<b>\$141,909</b>	<b>\$8.67</b>	<b>\$89,720</b>	<b>\$6.22</b>	<b>\$87,000</b>	<b>\$11.23</b>
<b>SUBTOTAL DIRECT COST</b>	<b>\$87,674,267</b>	<b>\$687.43</b>	<b>\$17,256,248</b>	<b>\$12.41</b>	<b>\$11,611,648</b>	<b>\$499.63</b>	<b>\$5,557,161</b>	<b>\$695.09</b>	<b>\$8,818,228</b>	<b>\$432.32</b>	<b>\$16,608,411</b>	<b>\$504.65</b>	<b>\$12,497,857</b>	<b>\$585.89</b>	<b>\$7,097,461</b>	<b>\$568.89</b>	<b>\$7,662,253</b>	<b>\$987.30</b>	
GC's / INS. / STAFF / FEE	9.45%	\$8,684,118	\$68.00	\$1,709,228	\$1.23	\$1,150,132	\$49.48	\$550,426	\$68.85	\$853,654	\$42.82	\$1,644,763	\$49.99	\$1,236,326	\$88.11	\$781,648	\$64.15	\$757,954	\$97.90
GC / STAFFING PREMIUM	2.40%	\$2,104,182	\$16.50	\$414,150	\$0.30	\$278,680	\$11.99	\$133,372	\$16.68	\$206,837	\$10.26	\$336,533	\$12.11	\$236,505	\$14.08	\$188,395	\$13.12	\$188,654	\$23.70
PAVEMENT & RESURFACING	0.28%	\$714,646	\$5.61	\$142,349	\$0.11	\$102,515	\$4.41	\$40,952	\$5.14	\$10,987	\$0.52	\$18,603	\$0.66	\$60,671	\$4.62	\$97,559	\$9.72	\$0	\$0.00
BUILDERS RISK INSURANCE	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	
CONSTRUCTION CONTINGENCY	0.00%	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	
<b>TOTAL CONSTRUCTION COST</b>	<b>\$99,239,600</b>	<b>\$778.00</b>	<b>\$19,631,976</b>	<b>\$14.06</b>	<b>\$13,142,975</b>	<b>\$566.41</b>	<b>\$6,230,000</b>	<b>\$786.74</b>	<b>\$9,764,766</b>	<b>\$483.33</b>	<b>\$18,796,307</b>	<b>\$571.20</b>	<b>\$14,127,946</b>	<b>\$664.00</b>	<b>\$8,332,174</b>	<b>\$618.78</b>	<b>\$8,661,421</b>	<b>\$1,117.00</b>	

Alternates	ADD:		DEDUCT:															
1. Furnish and install CIV mode Mechanical System	ADD:	\$5,707,000																
2. Demolish SE Booster Building in lieu of Base Design	DEDUCT:	-\$930,000																
3. Withdr Linac Tunnel by 2' - 2"	ADD:	\$840,000																
Start Year	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017
Escalation % by Year	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

- Estimate completed in May 2017;
- Broken down by work package;
- Costs in FY17 dollars, de-escalated to FY16 dollars for overall project consistency;

Documentation can be found at PIP-II-doc-333



12/04/2018

# 2018 Cost Estimate Summary

## Fermilab PIP II - Entire Project

Estimate Level (Concept - Priced at 2nd QTR 2017 - May 18, 2017 - TCDD Index: 1.29)  
 April 25, 2017

SYSTEM SUMMARY	TOTAL		121.62 - Site Preparation		121.65.02 - G-yo Plant Building		121.65.04 - Utility Plant Building (PUB)		121.65.02.02 - Linac Tunnel		121.65.05.02 - Linac Gallery		121.65.05.01 - High Bay Building		121.65.05.04 - Beam Transfer Line		121.65.05 - Booster Connection		
	127,840	GSF	1,300,860	Sq. SF	22,246	GSF	7,968	GSF	19,905	GSF	32,906	GSF	21,275	GSF	14,458	GSF	7,760	GSF	
	Total	Cost/CSF	Total	Cost/CSF	Total	Cost/CSF	Total	Cost/CSF	Total	Cost/CSF	Total	Cost/CSF	Total	Cost/CSF	Total	Cost/CSF	Total	Cost/CSF	
<b>A Infrastructure</b>	\$17,162,973	\$134.87	\$0	\$0.00	\$1,217,882	\$62.39	\$262,921	\$48.39	\$4,429,960	\$222.20	\$1,716,073	\$52.18	\$2,797,200	\$176.60	\$3,408,734	\$241.48	\$2,193,601	\$283.04	
A10 Foundations	\$1,244,054	\$67.07	\$0	\$0.00	\$1,363,486	\$47.04	\$34,684	\$12.90	\$2,695,352	\$149.45	\$1,167,801	\$48.35	\$1,167,269	\$149.45	\$1,746,130	\$129.57	\$1,544,124	\$209.53	
A20 Basement Construction	\$4,710,029	\$237.96	\$0	\$0.00	\$1,747,147	\$75.75	\$19,223	\$2.41	\$1,747,213	\$75.75	\$155,359	\$3.31	\$109,362	\$26.20	\$1,746,424	\$129.57	\$1,339,437	\$122.51	
<b>B Steel</b>	\$25,120,659	\$192.87	\$0	\$0.00	\$4,706,200	\$203.20	\$160,469	\$219.82	\$2,292,024	\$119.89	\$6,747,999	\$174.81	\$4,944,987	\$274.19	\$9,647,969	\$689.84	\$4,909,293	\$636.24	
B10 Reproduction	\$11,230,659	\$67.32	\$0	\$0.00	\$2,149,206	\$103.64	\$23,029	\$2.98	\$2,229,062	\$112.77	\$2,374,349	\$105.00	\$789,199	\$55.73	\$789,199	\$55.73	\$1,036,731	\$133.13	
B20 External Enclosure	\$1,705,989	\$79.84	\$0	\$0.00	\$2,142,507	\$100.45	\$679,912	\$119.89	\$1,705,989	\$85.42	\$1,488,374	\$70.45	\$1,025,706	\$73.07	\$1,025,706	\$73.07	\$1,217,208	\$155.87	
B30 Roofing	\$1,984,370	\$154.84	\$0	\$0.00	\$472,789	\$20.34	\$195,523	\$27.23	\$192,368	\$7.94	\$784,469	\$23.34	\$178,773	\$12.95	\$25,889	\$1.91	\$17,476	\$1.91	
<b>C Interiors</b>	\$2,820,391	\$222.20	\$0	\$0.00	\$408,700	\$17.28	\$225,025	\$29.86	\$278,946	\$13.99	\$279,180	\$11.82	\$1,114,011	\$62.26	\$108,029	\$10.70	\$218,540	\$27.84	
C10 Interir Construction	\$1,054,176	\$67.27	\$0	\$0.00	\$1,272,957	\$57.47	\$124,789	\$16.61	\$124,789	\$16.61	\$89,834	\$1.12	\$94,201	\$36.11	\$34,578	\$1.73	\$112,530	\$14.52	
C20 Bars	\$437,657	\$3.43	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0.00	\$188,567	\$8.83	\$22,600	\$4.74	\$41,409	\$5.34		
C30 Interior Finishes	\$1,359,120	\$106.96	\$0	\$0.00	\$281,973	\$12.12	\$103,750	\$16.35	\$122,229	\$6.10	\$283,656	\$8.77	\$80,724	\$4.29	\$22,037	\$8.89	\$22,037	\$8.89	
<b>D Services</b>	\$21,219,202	\$166.27	\$0	\$0.00	\$4,212,868	\$188.84	\$2,961,201	\$270.38	\$1,328,979	\$66.49	\$7,621,172	\$221.61	\$2,809,186	\$177.89	\$1,699,741	\$110.82	\$990,661	\$114.82	
D10 Covering	\$260,000	\$1.86	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$125,000	\$3.33	\$125,000	\$5.58	\$0	\$0.00	\$0	\$0.00	
D20 Plumbing	\$868,120	\$7.59	\$0	\$0.00	\$148,359	\$6.43	\$41,354	\$5.17	\$136,359	\$6.64	\$154,704	\$4.73	\$74,376	\$14.70	\$119,171	\$8.29	\$32,748	\$8.83	
D30 HVAC	\$5,860,124	\$43.91	\$0	\$0.00	\$1,322,844	\$44.00	\$1,830,220	\$228.92	\$346,283	\$17.07	\$1,022,956	\$29.25	\$983,429	\$17.76	\$224,256	\$14.24	\$326,073	\$17.49	
D40 Fire Protection	\$249,300	\$2.74	\$0	\$0.00	\$87,749	\$3.75	\$23,901	\$3.75	\$0	\$0.00	\$122,394	\$3.75	\$79,731	\$3.75	\$0	\$0.00	\$29,063	\$3.75	
D50 Electrical	\$14,191,590	\$111.27	\$0	\$0.00	\$3,353,489	\$139.38	\$1,094,645	\$137.34	\$486,632	\$42.07	\$6,295,159	\$191.37	\$1,165,268	\$75.72	\$1,246,214	\$96.33	\$902,038	\$84.88	
<b>E Equipment &amp; Furnishings</b>	\$796,900	\$6.20	\$0	\$0.00	\$902,400	\$21.81	\$0	\$0.00	\$0	\$0.00	\$46,000	\$1.22	\$248,600	\$11.08	\$0	\$0.00	\$0	\$0.00	
E10 Equipment	\$796,900	\$6.20	\$0	\$0.00	\$902,400	\$21.81	\$0	\$0.00	\$0	\$0.00	\$46,000	\$1.22	\$248,600	\$11.08	\$0	\$0.00	\$0	\$0.00	
E20 Furnishings	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	
<b>F Special Construction &amp; Demolition</b>	\$172,000	\$1.20	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$64,200	\$4.49	\$107,250	\$10.84	
F10 Special Construction	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	
F20 Selective Building Demolition	\$172,000	\$1.20	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$64,200	\$4.49	\$107,250	\$10.84	
<b>G Building Sitework</b>	\$23,760,108	\$186.20	\$17,040,007	\$12.27	\$31,142.5	\$13.40	\$228,859	\$27.42	\$194,201	\$5.23	\$912,643	\$27.74	\$1,975,016	\$7.26	\$1,605,988	\$104.32	\$2,487,814	\$300.05	
G10 Site Preparation	\$3,096,812	\$24.95	\$1,832,474	\$1.39	\$1,232,168	\$88.85	\$172,073	\$7.52	\$184,331	\$5.23	\$782,863	\$19.72	\$82,218	\$3.39	\$82,218	\$3.39	\$138,796	\$14.16	
G20 Site Improvement	\$8,398,621	\$65.86	\$0	\$0.00	\$22,444	\$8.71	\$22,243	\$2.79	\$0	\$0.00	\$484,670	\$11.12	\$47,819	\$2.25	\$1,413,980	\$107.93	\$1,378,168	\$145.09	
G30 Site Mechanical/Utilities	\$5,548,656	\$43.51	\$5,406,289	\$3.85	\$20,532	\$3.32	\$20,532	\$3.32	\$15,449	\$5.53	\$1,141	\$0.34	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	
G40 Site Electrical/Utilities	\$8,747,450	\$68.96	\$8,642,570	\$6.22	\$76,720	\$1.13	\$0	\$0.00	\$19,680	\$7.39	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	
G50 Other Site Construction	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	
<b>DESIGN CONTINGENCY</b>	0.00%	\$0	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	
<b>ESCALATION (May 2017 to September 2018 @ 1.25% per QTR)</b>	6.97%	\$6,044,972	\$47.82	\$1,189,798	\$5.26	\$890,001	\$24.44	\$283,166	\$47.82	\$894,210	\$29.81	\$1,144,911	\$34.79	\$899,600	\$40.48	\$844,101	\$70.69	\$827,608	\$88.08
<b>BONDING / BDI</b>	1.15%	\$1,068,308	\$8.26	\$269,873	\$1.16	\$141,223	\$6.08	\$67,087	\$8.45	\$104,816	\$5.26	\$201,395	\$6.14	\$191,806	\$7.14	\$55,977	\$6.65	\$83,068	\$12.61
<b>SUBTOTAL DIRECT COST</b>	<b>\$93,769,749</b>	<b>\$738.27</b>	<b>\$19,489,719</b>	<b>\$13.28</b>	<b>\$12,421,456</b>	<b>\$54.27</b>	<b>\$6,944,712</b>	<b>\$74.83</b>	<b>\$5,219,272</b>	<b>\$462.47</b>	<b>\$17,763,439</b>	<b>\$529.84</b>	<b>\$10,262,265</b>	<b>\$627.81</b>	<b>\$8,441,319</b>	<b>\$504.82</b>	<b>\$6,195,929</b>	<b>\$1,096.25</b>	
CON / INS / STAFF / FEE	9.45%	\$8,293,757	\$72.04	\$1,829,431	\$1.21	\$1,200,340	\$52.02	\$582,220	\$70.65	\$913,167	\$45.01	\$1,753,473	\$50.47	\$1,322,548	\$62.16	\$856,151	\$57.00	\$913,816	\$104.02
GC / STAFFING PREMIUM	2.40%	\$2,250,300	\$17.62	\$443,030	\$0.32	\$296,115	\$12.82	\$142,873	\$17.62	\$221,243	\$11.10	\$426,324	\$12.96	\$202,834	\$14.04	\$136,462	\$25.35	\$136,462	\$25.35
PAVIMENT & PROF. BOUND	0.16%	\$970,308	\$7.60	\$167,940	\$0.12	\$139,885	\$5.87	\$51,243	\$6.46	\$81,764	\$4.09	\$156,268	\$4.77	\$117,693	\$5.64	\$14,293	\$1.16	\$17,271	\$18.23
BUILDERS RISK INSURANCE	0.00%	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0.00	
CONSTRUCTION CONTINGENCY	0.00%	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0.00	
<b>TOTAL CONSTRUCTION COST</b>	<b>\$104,157,493</b>	<b>\$802.20</b>	<b>\$20,894,150</b>	<b>\$15.63</b>	<b>\$14,029,979</b>	<b>\$64.84</b>	<b>\$7,728,892</b>	<b>\$84.81</b>	<b>\$10,430,690</b>	<b>\$523.84</b>	<b>\$20,106,111</b>	<b>\$611.84</b>	<b>\$11,113,240</b>	<b>\$719.28</b>	<b>\$9,955,113</b>	<b>\$609.14</b>	<b>\$8,285,477</b>	<b>\$1,195.05</b>	

ITEMS	ADD	DEDUCT	ADO	ADD	DEDUCT	ADO	ADD	DEDUCT	ADO	ADD	DEDUCT	ADO	ADD	DEDUCT	ADO	ADD	DEDUCT	ADO
1. Furnish and install CVT mode Mechanical System	\$6,105,000	\$0	\$0	\$2,336,000	\$0	\$0	\$2,377,000	\$0	\$0	\$65,000	\$0	\$1,230,000	\$0	\$0	\$0	\$0	\$0	\$0
2. Demolition SE Booster Building in lieu of Base Design	\$1,000,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$1,030,000
3. Widen Linac Tunnel by 2'-2"	\$925,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$685,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0

Start Year	May 2017 to September 2018 @ 1.25% per QTR	May 2017 to September 2018 @ 1.25% per QTR	May 2017 to September 2018 @ 1.25% per QTR	May 2017 to September 2018 @ 1.25% per QTR	May 2017 to September 2018 @ 1.25% per QTR	May 2017 to September 2018 @ 1.25% per QTR	May 2017 to September 2018 @ 1.25% per QTR	May 2017 to September 2018 @ 1.25% per QTR	May 2017 to September 2018 @ 1.25% per QTR
Escalation % by Area	6.97%	6.97%	6.97%	6.97%	6.97%	6.97%	6.97%	6.97%	6.97%

- Estimate completed in April 2018;
- Broken down by work package;
- Costs in FY18 dollars;

Documentation can be found at PIP-II-doc-333



# 2018 Cost Estimate Summary

## Fermilab PIP II - Linac Complex

Estimate Level (Concept - Priced at 2nd QTR 2017 - May 18, 2017 - TCCO Index: 1.29)  
April 25, 2017

SYSTEM SUMMARY	121.06.05 - Linac Complex		121.06.05.02 - Linac Tunnel		121.06.05.03 - Linac Gallery		121.06.05.01 - High Bay Building		121.06.05.04 - Beam Transfer Line		
	88,550	GSF	19,935	GSF	32,905	GSF	21,275	GSF	14,435	GSF	
	Total	Cost/SF	Total	Cost/SF	Total	Cost/SF	Total	Cost/SF	Total	Cost/SF	
<b>A-Substructure</b>	<b>\$13,388,619</b>	<b>\$151.20</b>	<b>\$4,429,565</b>	<b>\$222.20</b>	<b>\$1,716,070</b>	<b>\$52.15</b>	<b>\$3,757,250</b>	<b>\$176.60</b>	<b>\$3,485,734</b>	<b>\$241.48</b>	
A10-Foundations	\$8,452,781	\$106.75	\$2,959,362	\$148.45	\$1,590,801	\$48.35	\$3,157,298	\$148.40	\$1,745,310	\$120.91	
A20-Basement Construction	\$3,935,838	\$44.45	\$1,470,213	\$73.75	\$125,269	\$3.91	\$599,952	\$28.20	\$1,740,424	\$120.67	
<b>B-Shell</b>	<b>\$13,632,136</b>	<b>\$153.95</b>	<b>\$2,382,024</b>	<b>\$119.49</b>	<b>\$5,747,556</b>	<b>\$174.67</b>	<b>\$4,554,987</b>	<b>\$214.10</b>	<b>\$947,569</b>	<b>\$65.84</b>	
B10-Superstructure	\$7,804,997	\$89.14	\$2,108,699	\$106.78	\$2,229,962	\$67.77	\$2,676,340	\$125.80	\$789,906	\$54.73	
B20-Exterior Enclosure	\$4,503,554	\$50.86	\$115,968	\$5.82	\$2,753,008	\$83.67	\$1,498,874	\$70.45	\$135,708	\$9.40	
B30-Roofing	\$1,323,585	\$14.85	\$157,368	\$7.89	\$764,688	\$23.24	\$379,773	\$17.85	\$21,888	\$1.51	
<b>C-Interiors</b>	<b>\$1,970,166</b>	<b>\$22.25</b>	<b>\$278,946</b>	<b>\$13.99</b>	<b>\$379,180</b>	<b>\$11.52</b>	<b>\$1,114,011</b>	<b>\$52.36</b>	<b>\$198,029</b>	<b>\$13.72</b>	
C10-Interior Construction	\$689,846	\$7.79	\$31,517	\$1.58	\$89,824	\$2.12	\$564,001	\$26.51	\$24,505	\$1.70	
C20-Stairs	\$396,257	\$4.47	\$124,200	\$6.23	\$20,700	\$0.63	\$168,657	\$7.92	\$82,800	\$5.74	
C30-Interior Finishes	\$894,063	\$9.98	\$123,229	\$6.18	\$288,666	\$8.77	\$381,453	\$17.93	\$90,724	\$6.29	
<b>D-Services</b>	<b>\$13,054,476</b>	<b>\$147.42</b>	<b>\$1,325,379</b>	<b>\$66.49</b>	<b>\$7,621,172</b>	<b>\$231.61</b>	<b>\$2,508,185</b>	<b>\$117.89</b>	<b>\$1,593,741</b>	<b>\$110.82</b>	
D10-Conveying	\$250,000	\$2.82	\$0	\$0.00	\$125,000	\$3.80	\$125,000	\$5.89	\$0	\$0.00	
D20-Plumbing	\$724,670	\$8.18	\$156,959	\$6.84	\$154,784	\$4.70	\$314,376	\$14.78	\$119,171	\$8.25	
D30-HVAC	\$2,301,024	\$26.09	\$340,393	\$17.07	\$922,956	\$28.05	\$803,429	\$37.76	\$284,356	\$19.24	
D40-Fire Protection	\$203,175	\$2.29	\$0	\$0.00	\$123,394	\$3.75	\$79,781	\$3.75	\$0	\$0.00	
D60-Electrical	\$8,676,607	\$108.14	\$848,637	\$42.57	\$6,296,159	\$191.31	\$1,186,698	\$56.73	\$1,246,214	\$86.33	
<b>E-Equipment &amp; Furnishings</b>	<b>\$288,500</b>	<b>\$3.26</b>	<b>\$0</b>	<b>\$0.00</b>	<b>\$0</b>	<b>\$0.00</b>	<b>\$248,500</b>	<b>\$11.68</b>	<b>\$0</b>	<b>\$0.00</b>	
E10-Equipment	\$288,500	\$3.26	\$0	\$0.00	\$40,000	\$1.22	\$248,500	\$11.68	\$0	\$0.00	
E20-Furnishings	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	
<b>F-Special Construction &amp; Demolition</b>	<b>\$64,800</b>	<b>\$0.73</b>	<b>\$0</b>	<b>\$0.00</b>	<b>\$0</b>	<b>\$0.00</b>	<b>\$0</b>	<b>\$0.00</b>	<b>\$64,800</b>	<b>\$4.49</b>	
F10-Special Construction	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	
F20-Selective Building Demolition	\$64,800	\$0.73	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$64,800	\$4.49	
<b>G-Building Sitework</b>	<b>\$2,679,857</b>	<b>\$30.26</b>	<b>\$104,331</b>	<b>\$5.23</b>	<b>\$912,643</b>	<b>\$27.74</b>	<b>\$157,016</b>	<b>\$7.38</b>	<b>\$1,505,868</b>	<b>\$104.32</b>	
G10-Site Preparation	\$651,450	\$7.36	\$104,331	\$5.23	\$352,883	\$10.72	\$101,956	\$4.79	\$92,298	\$6.38	
G20-Site Improvement	\$1,926,157	\$21.75	\$0	\$0.00	\$484,670	\$14.12	\$47,919	\$2.25	\$1,413,568	\$97.93	
G30-Site Mechanical Utilities	\$23,690	\$0.27	\$0	\$0.00	\$16,449	\$0.50	\$7,141	\$0.34	\$0	\$0.00	
G40-Site Electrical Utilities	\$79,660	\$0.89	\$0	\$0.00	\$79,660	\$2.38	\$0	\$0.00	\$0	\$0.00	
G60-Other Site Construction	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	
DESIGN CONTINGENCY	0.00%	\$0	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	
ESCALATION (May 2017 to September 2018 @ 1.23% per QTR)	6.97%	\$3,143,823	\$35.50	\$594,210	\$29.81	\$1,144,911	\$34.79	\$860,600	\$40.45	\$544,101	\$37.69
BONDING / SDI	1.15%	\$554,557	\$6.26	\$104,816	\$5.26	\$201,958	\$6.14	\$151,806	\$7.14	\$95,977	\$6.65
<b>SUBTOTAL DIRECT COST</b>	<b>\$48,776,934</b>	<b>\$550.84</b>	<b>\$9,219,272</b>	<b>\$462.47</b>	<b>\$17,763,489</b>	<b>\$539.84</b>	<b>\$13,352,355</b>	<b>\$627.61</b>	<b>\$8,441,819</b>	<b>\$584.82</b>	
GC'S / INS. / STAFF / FEE	9.45%	\$4,631,346	\$54.56	\$913,167	\$45.81	\$1,759,470	\$53.47	\$1,322,548	\$62.16	\$835,161	\$57.93
GC / STAFFING PREMIUM	2.40%	\$1,170,846	\$13.22	\$221,293	\$11.10	\$426,324	\$12.96	\$320,457	\$15.65	\$202,004	\$14.04
PAYMENT & PERF. BOND	0.78%	\$430,635	\$4.86	\$81,394	\$4.05	\$156,828	\$4.77	\$117,883	\$5.54	\$74,530	\$5.16
BUILDERS RISK INSURANCE	0.00%	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00
CONSTRUCTION CONTINGENCY	0.00%	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00	\$0	\$0.00
<b>TOTAL CONSTRUCTION COST</b>	<b>\$55,209,561</b>	<b>\$623.48</b>	<b>\$10,435,095</b>	<b>\$523.46</b>	<b>\$20,106,111</b>	<b>\$611.04</b>	<b>\$15,113,243</b>	<b>\$710.38</b>	<b>\$9,555,113</b>	<b>\$661.94</b>	

Example

Start Year:	May 2017 to September 2018 @ 1.23% per QTR	May 2017 to September 2018 @ 1.23% per QTR	May 2017 to September 2018 @ 1.23% per QTR	May 2017 to September 2018 @ 1.23% per QTR
Escalation % by Area :	6.97%	6.97%	6.97%	6.97%

Documentation can be found at PIP-II-doc-333

# Basis of Estimate Example

**\$55,209,561** Construction Estimate  
 \$1,415,000 Add CW Cooling Equipment  
 -\$1,157,000 Remove Shielding Blocks  
 -\$1,041,000 Reduce Linac Gallery Width by 5'  


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**\$54,426,561** Total

\$53,926,564  
 + \$500,000  
 -----  
**\$54,426,561**

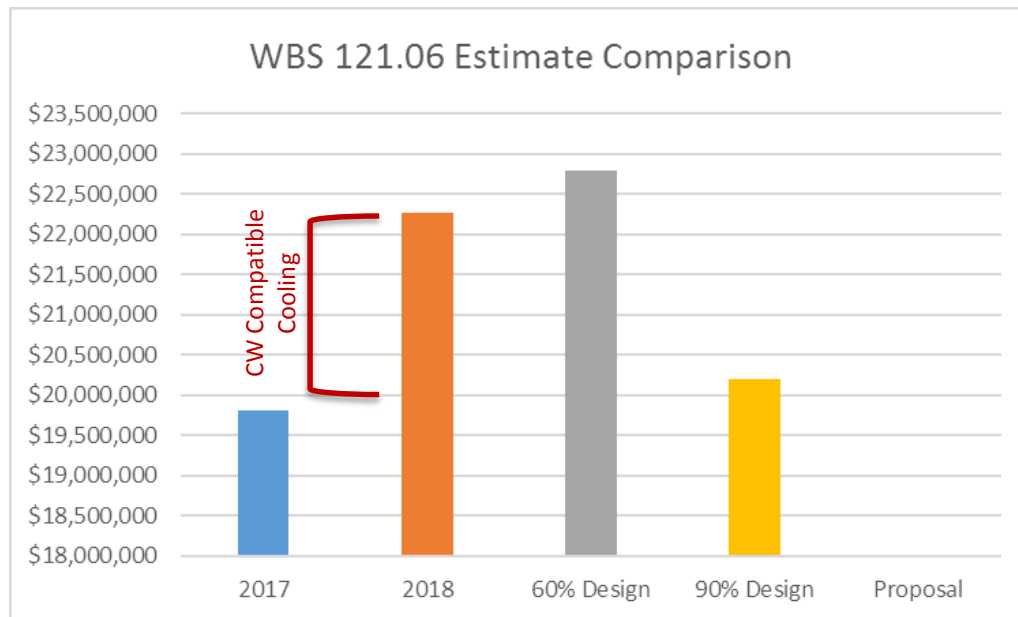
Conventional Facilities (>500K) Base FY16	Conventional Facilities (>500K) Base FY18	M&S Conv Facilities Complex Procurement Rate FY16 (1st 500k)	M&S Conv Facilities Complex Procurement Rate FY18 (1st 500k)
12382336	53926564	500000	500000
12382336	53926564	500000	500000
12382336	53926564	500000	500000
0	0	0	0
0	0	0	0

Activity ID	Activity Name	Start	Finish	Orig Durn	Input M&S In Whole Dollars	Select Est. Year	Cost for P6 - DO NOT EDIT CELL	Resource Type - Labor, M&S or CF	Select Labor Functional Role 2nd ->	Conventional facilities (>500K) Base FY16	Conventional Facilities (>500K) Base FY18	M&S Conv Facilities Complex Procurement Rate FY16 (1st 500k)	M&S Conv Facilities Complex Procurement Rate FY18 (1st 500k)	M&S Standard with Base Year FY16	M&S Standard with Base Year FY18	CFS Design Engineer
121.06 - CONVENTIONAL FACILITIES (CnvF)										12382336	53926564	500000	500000	3329002	7360000	5570
121.06.05 - CnvF - Linac Complex (Cmplx)										12382336	53926564	500000	500000	3329002	7360000	5570
121.06.05.03 - CnvF - Cmplx - Construction on Site										12382336	53926564	500000	500000	3329002	7360000	5570
121.06.05.03.01 - CnvF - Cmplx - CoS: Fermilab scope (FTE)										0	0	0	0	0	0	126
121.06.05.03.01.01 - CnvF - Cmplx - CoS: Procurement support to Linac Complex Construction Subcontract										0	0	0	0	0	0	126

Basis of Estimate can be found at [PIP-II-doc-2124](#)

# Plan Moving Forward

- Cost Estimate Updates
  - Included in A/E tasking for design packages;
  - Deliverable at the 60% and 90% design stage
- Track Estimates Over Time
  - Site Preparation (121.06.02)

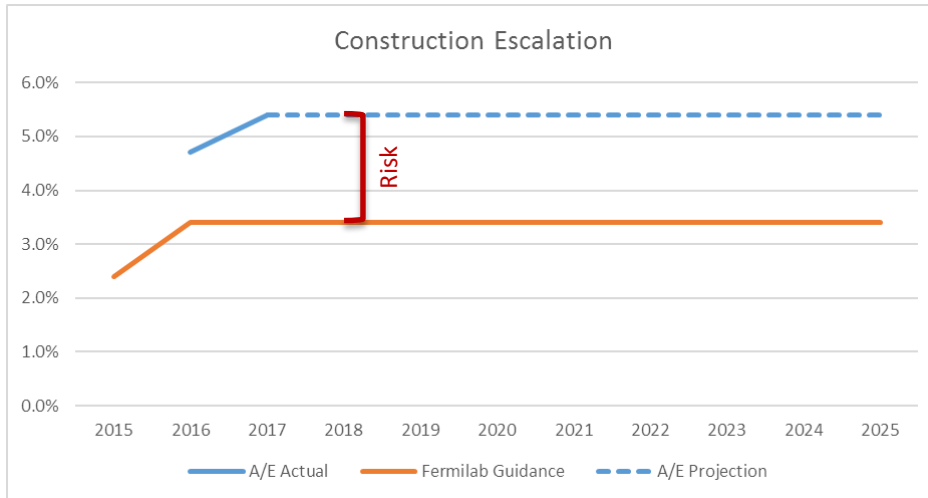



# Plan Moving Forward

- Gather Data
  - Address the unique Fermilab bidding environment;
    - Contractor pool;
    - Market conditions;
    - Two different counties;
  - Site Clearing package;
    - Out for proposals now;
    - Provides a data point for the estimate
- Adjust Approach
  - Smaller/larger package size;
  - Bid alternates;
  - Attract a wider contractor pool

# Plan Moving Forward - Escalation

- Utilize Fermilab guidance
  - Base rate (3.4%);
  - Difference between base rate and actual is accounted for a project level risk.
- Track market conditions
  - Based on Turner Construction input;
  - Update on a yearly basis;
  - Adjust as necessary.





Fermilab National Accelerator Laboratory

## Memorandum

**Date:** December 21, 2017

**To:** Project File

**From:** S. Dixon

**Re:** Conventional Facilities Construction Escalation  
Proton Improvement Plan II (PIP-II)  
PIP-II-doc-1299

Steven Dixon  
APM Conventional Facilities  
AD/PIP-II  
P.O. Box 500, MS 312  
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Batavia, Illinois 60510-5011  
USA  
Office: 630.840.8501  
[sdixon@fnal.gov](mailto:sdixon@fnal.gov)

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Escalation for conventional facilities construction often does not track with escalation rates for non-construction projects. This memo describes the strategy used to determine the appropriate escalation rates for the conventional facilities for the PIP-II project.

**Background**

The Fermilab Office of Project Support Services (OPSS) has historically tracked construction and non-construction escalation rates. The current "base" escalation rate for conventional facilities construction is 3.4% per year based on an analysis created for the LBNF project in 2013 and updated yearly by the LBNF team. This information is contained within the scheduling and cost processing software available for projects throughout the Laboratory and provides a consistent means of calculating project costs.

While reasonable for long term projections, it is recognized that the standard base escalation rate may not adequately account for estimate inaccuracies, different project approaches and volatility in the local construction market. To account for this variance, the LBNF project includes a risk (RT-131-CFNS-20) that is adjusted periodically to account for the difference between the base escalation rate and the current escalation projections.

**PIP-II Strategy**

A strategy similar to LBNF will be utilized for the conventional facilities portion of PIP-II. The base rate of 3.4% will be applied to the conventional facilities construction projects and a PIP-II risk (RT-121-05-001) will be updated periodically to reflect the latest information provided by the PIP-II architect engineer (Genesler). The Genesler team includes Turner Construction, a large national construction firm that can provide escalation data based on current trends and conditions in the Chicago area.

**Escalation Determination**

In May 2017, the Genesler team estimated that the escalation rates for conventional facilities were approximately 1% per quarter in 2017. In December 2017, they indicated that the escalation rate for the last four quarters was 4.7% and that a rate of 5.4% was indicated for future work.

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# Summary

- The basis of estimates in the RLS are based on construction estimates developed by outside construction contractors;
- The conventional facilities plan includes construction cost estimates as the 60% and 90% design completion stages for each construction package;
- The construction cost estimates are tracked and managed;
- The construction escalation assumptions are based on input from construction contractors and Fermilab guidance.
- Thanks for your time.

**END**