

Memorandum

Date: March 6, 2019
To: Project File
From: S. Dixon
Re: **EDIA Estimate Calculations**
Proton Improvement Plan II (PIP-II)
PIP-II-doc-327

Steven Dixon
Conventional Facilities

PIP-II Division
P.O. Box 500, MS 312
Kirk Road and Pine Street
Batavia, Illinois 60510-5011
USA
Office: 630.840.8501
steveo@fnal.gov

This memo describes the historical data and assumptions used to estimate the engineering, design, inspection (ED&I) and administration (A) costs for the conventional facilities portion of the PIP-II project.

Background

Engineering Design and Inspection (ED&I) activities include the engineering and design activities in Preliminary Design and Final Design as well as the inspection activities associated with Construction Phase of the project. These descriptions are based on DOE Directive G413.3-21, Chapter 6.

DOE Directive G413.3-21, Section 5.4.3 was used as guidance in estimating the ED&I cost for this project. That section states "Total design percentages are usually 15-25 percent of estimated construction costs for DOE projects. Non-traditional, first of a kind projects may be higher, while simple construction such as buildings will be lower than this range (on the order of 6 percent), the more safety and regulatory intervention is involved, the higher the percentage."

Administration activities include those defined by DOE Directive G413.3-21, Section 5.4.3 as Project Management (PM) and Construction Management (CM). DOE Directive G413.3-21, Section 5.4.3 states that "Project management costs range from 5 to 15 percent of the other estimated costs for most DOE projects, depending upon the nature of the project and the scope of what is covered under project management."

Historic Data

Eight (8) projects were reviewed to understand the historic estimates for ED&I for the conventional facilities. These projects included line item projects, general plant projects as well as science laboratory infrastructure projects managed by Fermilab. The ED&I estimates at CD-1 were used for comparison to the current PIP-II project stage. The information was broken down by category and as a percentage of the base construction subcontract value. Listed below is a summary chart of those projects.

Project Name	Project Stage	Construction Base Cost	Total EDI		Engineering, Design and Inspection			
					Design Phase		Construction Phase	
			%	\$	A/E	In-House	A/E	In-House
NOVA Site Prep Package	CD-1 Review	\$8,868,437	15%	\$1,344,832	3%	1%	10%	2%
NOVA Far Detector Building	CD-1 Review	\$26,978,612	26%	\$7,018,202	10%	1%	12%	2%
SBN Far Detector Building	CDR	\$5,746,000	18%	\$1,025,661	9%	3%	1%	5%
SBN Near Detector Building	CDR	\$4,317,000	18%	\$770,585	9%	3%	1%	5%
Mu2e Service Building and Hall	CDR	\$14,046,094	23%	\$3,230,602	8%	4%	1%	10%
MC-1 Building	CD-1 Review	\$5,720,000	15%	\$846,903	7%	1%	1%	6%
Utilities Upgrade Project	CD-1 Review	\$22,500,000	22%	\$4,952,000	8%	8%	2%	4%
IERC	CD-1 Review	\$58,000,000	16%	\$11,600,000	7%	2%	2%	4%
Average			19%		7.6%	2.8%	3.8%	4.8%
Average Over \$10m			22%		8.4%	3.8%	4.3%	5.1%

The data indicated that there is a breakpoint in the ED&I costs for projects over \$10m from an average of 19% to 22% reflecting the complexity of the design and the likely use of additional outside consultants.

Architect/Engineer Input

In May 2017, the A/E firm selected for the preliminary design portion of the PIP-II conventional facilities provided a preliminary range of expected fees for the project. Those estimated fees, shown below, indicate a range of 10% to 15% for design and construction phase support based on the May 2017 construction cost of \$105m in FY17 dollars. Initially, the upper end of this range (15%) was used in developing the ED&I estimates for the PIP-II conventional facilities.

Company	Responsibility	Design through DD (60% CDs assume to be completed for all buildings/phases at one time)		Final CDs assume to be completed for each building/phase separately		Construction Administration assume to be completed for each building/phase separately		Subtotal	
		low range	high range	low range	high range	low range	high range	low range	high range
Gensler	Project Management	\$ 170,000	\$ 190,000	\$ 175,000	\$ 240,000	\$ 250,000	\$ 400,000	\$ 595,000	\$ 830,000
Gensler	Architecture	\$ 650,000	\$ 850,000	\$ 400,000	\$ 700,000	\$ 600,000	\$ 850,000	\$ 1,650,000	\$ 2,400,000
TGRWA	Structural Engineering	\$ 200,000	\$ 300,000	\$ 200,000	\$ 300,000	\$ 100,000	\$ 150,000	\$ 500,000	\$ 750,000
CMT	Civil Engineering	\$ 1,000,000	\$ 1,250,000	\$ 800,000	\$ 1,000,000	\$ 650,000	\$ 1,000,000	\$ 2,450,000	\$ 3,250,000
Hoerr Schaudt	Landscape Design	\$ 250,000	\$ 300,000	\$ 330,000	\$ 380,000	\$ 230,000	\$ 270,000	\$ 810,000	\$ 950,000
KJWW	MEFP Engineering	\$ 780,000	\$ 860,000	\$ 210,000	\$ 235,999	\$ 330,000	\$ 365,000	\$ 1,320,000	\$ 1,460,999
Jensen Hughes	Life Safety	\$ 12,000	\$ 15,000	\$ 6,000	\$ 9,000	\$ 17,000	\$ 25,000	\$ 35,000	\$ 49,000
Subtotal		\$ 3,062,000	\$ 3,765,000	\$ 2,121,000	\$ 2,864,999	\$ 2,177,000	\$ 3,060,000	\$ 7,360,000	\$ 9,689,999
Syska Hennessey	Commissioning Agent	\$ 45,000	\$ 75,000	\$ 45,000	\$ 75,000	\$ 300,000	\$ 900,000	\$ 390,000	\$ 1,050,000
Turner Construction	CM/Estimating/ Scheduling	\$ 90,000	\$ 130,000	\$ 90,000	\$ 130,000	\$ 3,000,000	\$ 4,300,000	\$ 3,180,000	\$ 4,560,000
TOTAL		\$ 3,197,000	\$ 3,970,000	\$ 2,256,000	\$ 3,069,999	\$ 5,477,000	\$ 8,260,000	\$ 10,930,000	\$ 15,299,999

Based on discussions and recommendations from the DOE Independent Project Review in December 2017, the A/E support during the Construction Phase was increased from 8% to 11% to accommodate additional support anticipated for a project of this scope. This resulted in an overall increase in the A/E from 15% to 18%.

In-House Support

The in-house support portion of the ED&I assumes chargebacks from FESS/Engineering. Historic data shows that this supports ranges from 1%-4% with an average of 2.6% for the design phase support. Given the scope of the project, 2% was used for the PIP-II conventional facilities.

In-house construction phase support has historically been between 2% and 10% with an average of 4.5%. This is driven primarily by construction coordination support from FESS/Engineering. For PIP-II, construction coordination personnel will primarily be provided by the A/E team. In house FESS/Engineering support will still be required to coordinate Fermilab interfaces and assist in the review of submittals. This in-house support is estimated at 2% of the construction cost.

Administration Costs

Administration costs are primarily management and oversight activities during the design and construction phases. For the PIP-II conventional facilities, the administration costs are assumed to consist of one (1) full time equivalent (FTE) for the Level 2 Manager for Conventional Facilities from FY18 until the end of the project. An additional FTE for a design coordinator position will be required and is assumed to begin in FY19 coinciding with CD-2/3a and extends until the end of the project.

PIP-II ED&I Summary

The PIP-II conventional facilities ED&I estimates were developed based on the historic ED&I data for typical conventional facilities and preliminary discussions with the A/E firm selected for the preliminary design portion. The ED&I assumptions for each construction package of the work breakdown structure is listed below.

WBS	Construction Package	Base Cost (FY18\$)	Total EDI		Engineering, Design and Inspection				
					Design Phase		Construction Phase		
					A/E	In-House	Construction Administration A/E	Construction Coordination A/E	In-House
121.06.02	Site Preparation	\$14,270,155	22%	\$3,138,000	7.0%	2.0%	7.9%	3.1%	2.0%
					\$999,000	\$285,000	\$1,127,000	\$442,000	\$285,000
121.06.03	Cryo Plant Building	\$14,923,579	22%	\$3,283,000	7.0%	2.0%	7.9%	3.1%	2.0%
					\$1,045,000	\$298,000	\$1,179,000	\$463,000	\$298,000
121.06.04	Utility Plant Building	\$8,841,692	22%	\$1,946,000	7.0%	2.0%	7.9%	3.1%	2.0%
					\$620,000	\$177,000	\$698,000	\$274,000	\$177,000
121.06.05	Linac Complex	\$63,114,561	22%	\$13,885,000	7.0%	2.0%	7.9%	3.1%	2.0%
					\$4,418,000	\$1,262,000	\$4,986,000	\$1,957,000	\$1,262,000
121.06.06	Booster Connection	\$5,646,477	22%	\$1,242,000	7.0%	2.0%	7.9%	3.1%	2.0%
					\$395,000	\$113,000	\$446,000	\$175,000	\$113,000
	Total	\$106,796,464	22%	\$23,494,000	\$7,477,000	\$2,135,000	\$8,436,000	\$3,311,000	\$2,135,000

These ED&I values fall within the 15%-25%% range recommendations for combined ED&I contained within DOE Directive G413.3-21, Section 5.4.3.

Summary

This memo describes the basis for the ED&I and A estimates for the conventional facilities portions of the PIP-II project. These assumptions will be revisited as necessary in subsequent design phases to validate the assumptions.

Update History

December 2017 after the DOE Independent Project Review

May 2018 with costs in FY18 dollars and revised WBS

March 2019 with updated construction costs based on room data sheet validation

Cc: L. Meringa, PIP-II
M. Kaducak, PIP-II
L. Lari, PIP-II
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