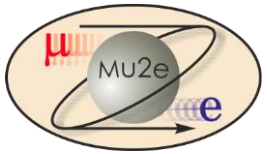
Fermilab

Mu2e Conventional Construction WBS 3.0



T. Lackowski

L2 Manager

10/21/2014

Conventional Construction Fermi Team

- Tom Lackowski- L2 Manager
  - 36 years experience; 30 years at Fermilab, State of Illinois Licensed Architect, State of Illinois Licensed Structural Engineer, Project Management Professional (PMP).

	Field of Expertise	Years @ Fermi
• Ron Jedziniak	Design Coordination	42/18
• Chuck Federowicz*	Civil/Environmental	38/30
• Steve Dixon*	Architect	31/23
• Tom Lackowski*	Structural	38/30
• Emil Huedem*	Mechanical	29/23
• Randy Wielgos*	Electrical	28/5
• Jim Niehoff	Fire Protection / Detection	25/22
• Tim Trout*	Construction Coordinator	37/12

- * Denotes Professional License

Current Status

- Following the CD-1 recommendations:
  - Preliminary and final design has been completed.
    - AE (Architect/Engineering) team continuity maintained by minimizing the duration between preliminary and final design.
  - Taking advantage of the recent aggressive construction market conditions, the Mu2e Conventional Facilities package has:
    - Issued RFP (Request For Proposal);
    - Eight proposals received (apparent successful proposer 4% under engineers estimate)
    - Evaluation board made subcontractor selection based on technical (60%) and price (40%).
    - Prepared to start construction once authorization is received.
- CD-3b is needed to keep building off the critical path.

Integration and Interfaces

- Conventional construction has coordinated the internal interfaces between conventional disciplines.
- There are external interfaces with all of the other subprojects.
- Internal and external interfaces identified and described in Conventional Construction Interface document (approved); available on review site Mu2e-doc-1537.
- Subprojects participated in weekly conventional design development meetings.
- Participation in bi-weekly integration meetings.
- Weekly Tech Board meetings.
- Formal sign-off between owners of all external interfaces.
- Interfaces understood and under control.

Requirements and Interfaces

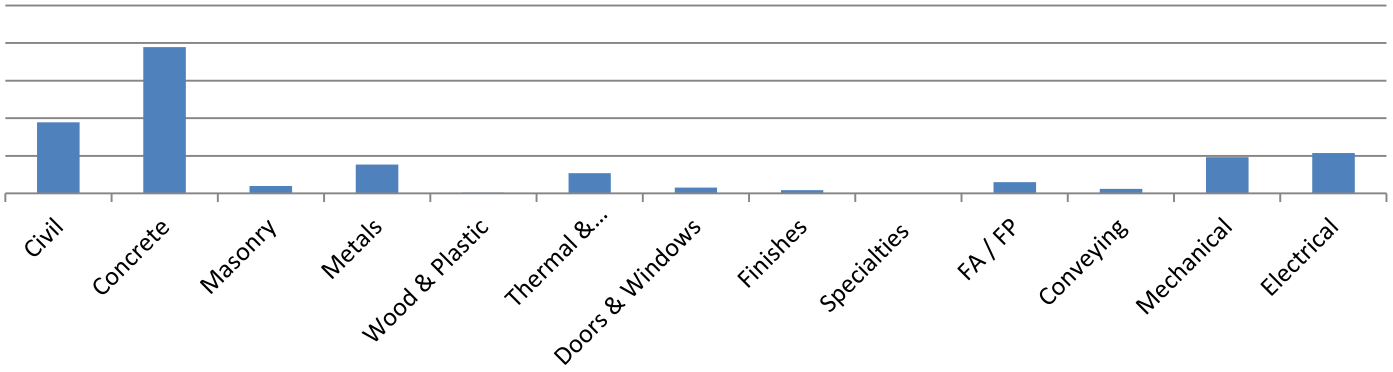
- The Conventional Construction will produce a facility that satisfies the physical and environmental needs of the other sub-projects.
  - The requirements and interfaces were developed via a series of meetings that included stakeholders from the other sub-projects.
  - The requirements were translated into drawings which formed the basis for the A&E, Middough Inc., to produce the contract documents.
  - The project team reviewed drawings at 30%, 60%, 90% and 100%. The 90% review was also issued as a Lab Wide Comment and Compliance Review.
- Conform to applicable environmental and organizational standards.
  - Life safety code (NFPA 101), IBC Building Code, DOE Guiding Principles, Fermi standards and requirements.
- Requirements document Mu2e-doc-1088, approved.

Requirements translate to:

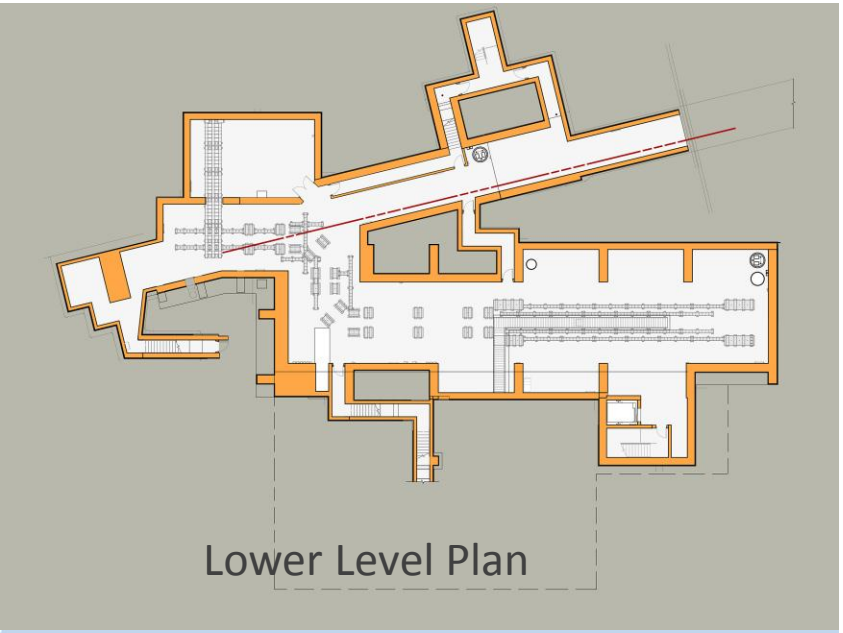
- Space Requirements
  - Mu2e Conventional Facilities Square Footages:
    - Grade Level 12,600 Square Feet
      - Grade level divided into a high bay with two 30 ton cranes and a side bay to house support equipment.
    - Detector Level 9,640 Square Feet
    - Building square footage increased 27% since CD-1 (from 17,500 SF to 22,240 SF).
- Mechanical
  - HVAC ~300KW HVAC load (about 50% process load) ~88KW CHW for detector cooling, vacuum pump, and electronic racks. (30% margin on CHW to building)
  - ODH Ventilation: 7000 cfm each for the PS and DS areas & 6300 cfm for solenoid power supply room.

Requirements translate to:

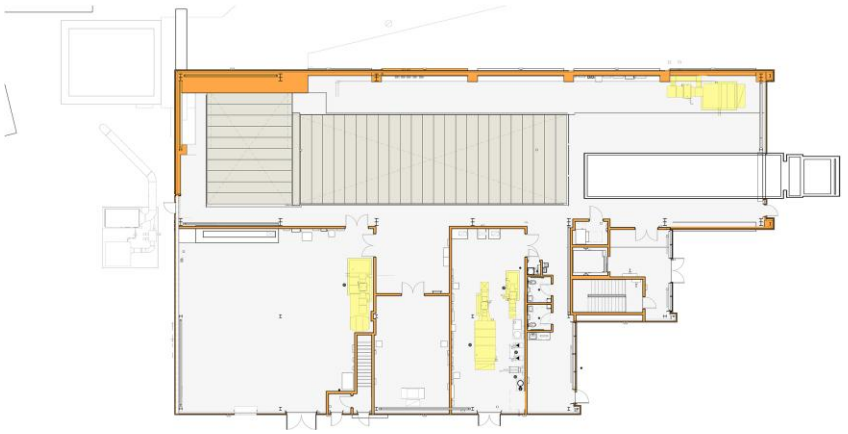
- Electrical
  - Mu2e Conventional Facilities
    - 1,500 KVA for solenoid and beam line power supplies (20% margin)
    - 750 KVA house power (10% margin, upgradable to 1500KVA)
  - The Delivery Rings Upgrade(AP-30)
    - Beamline power supplies located in AP-30 require a new 1200 Amp. distribution panel with new secondary from the primary transformer.
- Cost Distribution by Trade



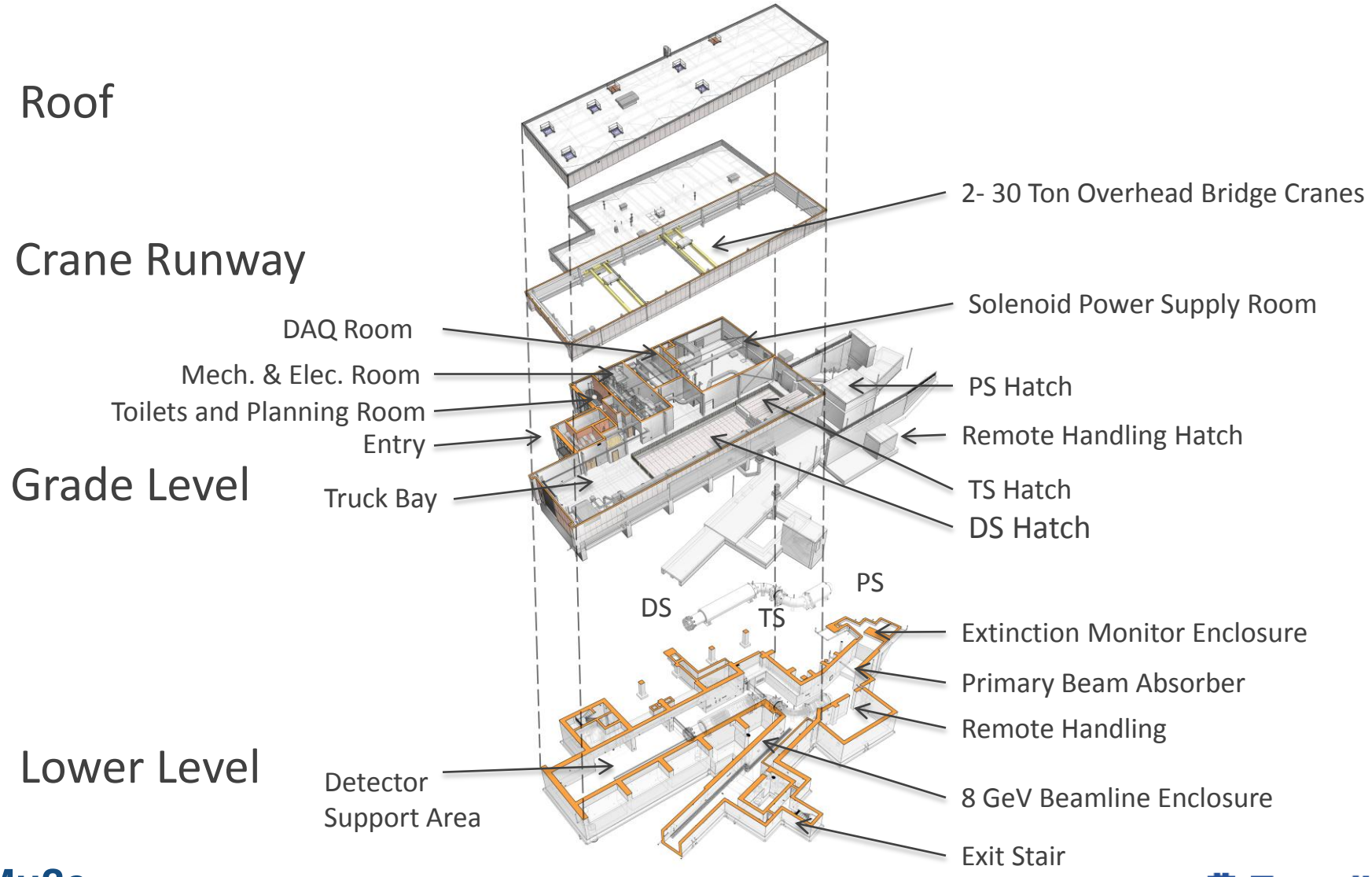
Design - Mu2e Conventional Facilities



Grade Level Plan



Design- Mu2e Conventional Facilities



Improvements since CD-1

- Requirements and the interfaces between the Conventional and other subprojects have matured.
  - Received final beam lattice; Solenoid installation and support requirements defined; Cooling and power loads are well established.
  - Physical space requirements analyzed and adjusted for each phase of technical equipment installation and operation.
  - Project Manager has put the Conventional Construction under change control.
- Independent Cost Estimate (ICE) completed, .4% delta on work to go.
- A&E selected, final contract drawings developed, issued for RFP, proposals received and evaluated; contracts drafted and are under review.

Value Engineering since CD-1

- Held Feb 14th and 15th, 2014
- Based on U.S. Army Corp of Engineers Methodology
  - 20 participants including the A&E discipline leads.
  - Speculation list contained 62 items; 20 have been accepted.
- Items with major value impact
  - Eliminated Kautz Rd bypass
  - Reduced number of stairs tower
  - Increased crane hook height

SPECULATION LIST

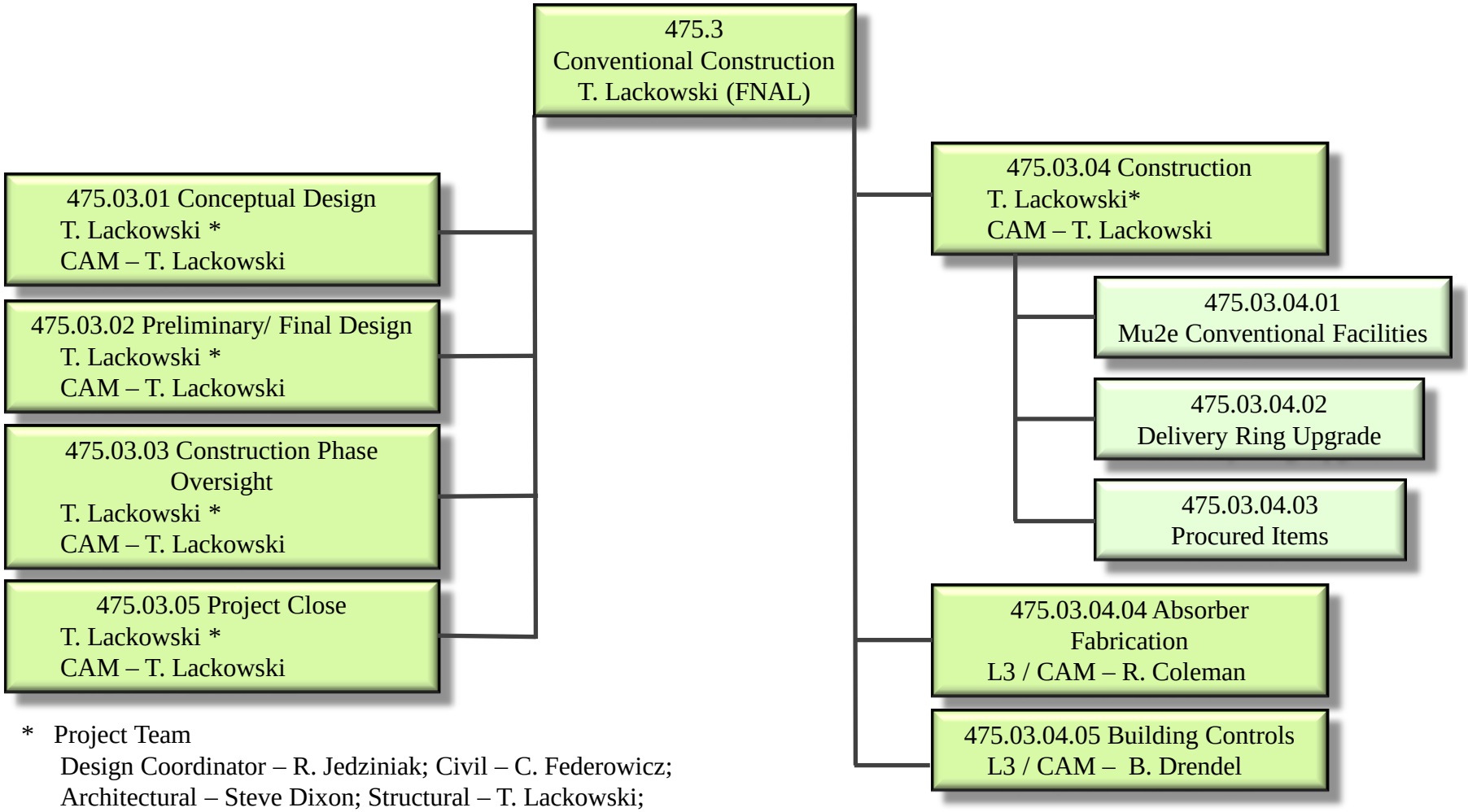
Speculation List

Item Number	Color legend (DRAFT Feb. 14-15, 2013)	Proposed Action
	(Gut-Feel) may not result to large savings	
	(Gut-Feel) may result to savings. Will be evaluated? (potential cost savings TBD)	
	Obvious Cost Savings	
	Warranted Increase in Performance to be evaluated	
	Will be evaluated By Others, not CFS, whether high cost savings impact or not	
	(not shaded) = Items that I'm Not Sure	
43	use Indian Ck road as part of the truck turnaround, take out new turnaround	Accepted
44	interrupt Kautz Rd tertiary power feed	
45	shorten gas routing that follows Kautz Rd	Accepted
24	make generator natural gas	Accepted
50	remove EG from containment area	Accepted
12	relocate stair 4 to west corridor from stair 3	Accepted
13	relocate stair 2 corridor from stair 1	Rejected due to Shielding
23	eliminate Kautz road bypass and straighten east route	Accepted
27	look at location of dump resistor	Checking
28	reduce parking spaces	Rejected
29	use MC1 parking with walkway over berm	Rejected
47	re-contour parts of stockpile to lessen dirt removal	Accepted
48	closer stockpile... south of bldg	Accepted
49	simplify underground structure at column B1	
51	dry type transformers adjacent to bldg.	
52	ballast issues, remote limitations	
59	two smaller transformers	Rejected
26	reduce mech room space	
57	provide infrastructure for rental HVAC for installation phase	Accepted
58	conduct model reviews	Will evaluate With A&E
10	replace shielding blocks with cast in place where possible	Accepted
14	examine penetration material	
22	flip elec/mech room to eliminate utility congestion	Accepted
30	benefit of raising low bay	Rejected
32	Mezzanine over portion of low bay	Rejected
37	stack toilet and mech space to reduce low bay area	Rejected
53	unforeseen conditions clause policy	
1	Waterproof or control water inflow in the PS region	Accepted
2	Provide for Collection of process water in enclosure especially around PS / trench gutter along walls	Accepted
11	building over PS hatch Weather protection while open	Not Accepted
21	turn west crane catwalk 180degrees	Accepted
41	hardstand for PS hatch	Accepted
36	integrate future clean space system with civil HVAC system	If criteria is provided we will accept
55	provide sealed combustion gas appliances	
17	procure shielding blocks with later funding	Defer to PM
54	TS hall , imbed transfer lines into wall, increase highbay 2 feet	Accepted
60	make room for tornado shelter in stair 1, enhance room for controlled access entry	Stairs 1 and 2 will be the shelter areas, accept breaking interlock if needed.
3	secondary containment for raw skid	Secondary Containment will be builti into the skid.
7	verify hook height on crane	Accepted
9	look at length of loading dock wrt to closing OH door with truck inside	A temporary bridge will be fashioned by adding additional support under the
18	verify crane coverage with shield blocks	Accepted
62	Verify OHD size	
61	Raw skid shielding possibilities	
31	will minimum shielding allow for beam intensity increases in future	

Performance

- High Performance Sustainable Building Compliance; DOE Guiding Principles.
- Meet all applicable building codes and material standards.
- Meet Fermilab Design Standards.
- Addendum A / Exhibit A defines the sub-contractor's performance expectation for ES&H, Quality, training, communication, schedule and acceptance.
- The Technical Specifications define the performance requirements for each material and product incorporated into the design.

Organization



* Project Team
Design Coordinator – R. Jedziniak; Civil – C. Federowicz;
Architectural – Steve Dixon; Structural – T. Lackowski;
Mechanical - E. Huedem; Electical – R. Wielgos;
Construction Coordinator. - R. Foutch; Construction Safety Consultant – Environmental Resource Management
Consulting A&E - Middough Inc.; Consulting Life Safety Eng.- AON; Commissioning - Primera

Quality Assurance

- Quality Assurance Program for the Mu2e Project, Mu2e Doc 677.
- FNAL Engineering Manual
- FESS Engineering Policies and Procedures
  - FESS Engineering Design Guides
  - FESS Engineering Cad Standards Manual
  - Document Review Procedures
  - AE Handbook
- Addendum A and Exhibit A define requirements for Subcontractor's QC program.
- Middough Inc. Quality Control Plan
  - Technical specifications define quality of installed products.
- Construction Coordinator is the first line of QA during Construction.
- L2 / Construction Manager has overall responsibility for QA.

ES&H

- Construction safety expectations are communicated in the Exhibit A.
  - flows down the essence of the applicable chapters of FESHM.
  - requires conformance to OSHA 1926.
  - requires Hazard Analysis approach.
- The Addendum to Exhibit A
  - Defines subcontractor's oversight requirements.
    - On site Project Manager, Site Superintendent and Safety Representative.
    - Requires the corporate safety person be involved during preparatory meetings, make bi-monthly walk through and assist in any investigations.
  - Defines Fermilab specific training requirements.
- Fermilab will use a consultant ES&H professional to augment its Construction Coordinator.

ES&H

- NEPA approved, and CX issued at beginning of CD-1.
  - Mu2e is included in the Muon Campus IEPA SWPPP, approved.
  - Domestic Water Permit to Construct is approved, Application for Operating Permit will be completed prior to placing new piping into service.
  - Sanitary Sewer Permit is not required.

- The project's goal is to have a safe work place with zero incidences. This will be achieved by aggressive compliance to the existing, robust, integrated safety management (ISM) systems for construction that exist at Fermilab.

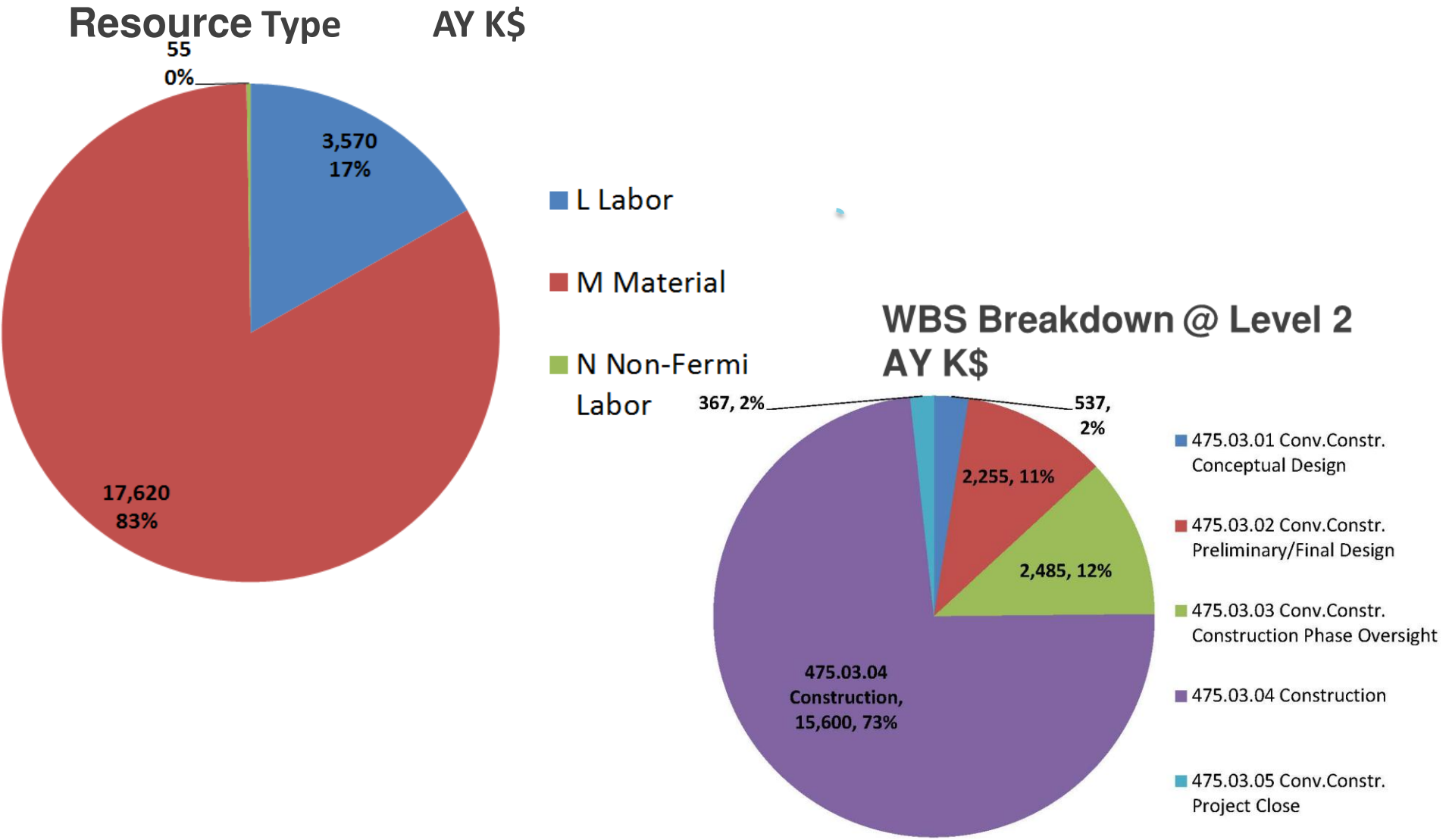
Risks

- Project level risks; One opportunity and three threats risks have been mitigated.
  - The two construction cost risks have been retired or accepted with receipt of proposals.
  - “Significant injury or death associated with Mu2e construction/assembly” transferred to Project Manager; but Conventional Construction maintains a significant ownership in this risk.
  - Need for a parallel electrical feeder from Master Sub Station to campus, transferred to Muon Campus.
- Of the 35 lower level subproject risks;
  - 14 are Accepted
  - 17 have been retired
  - 4 transferred

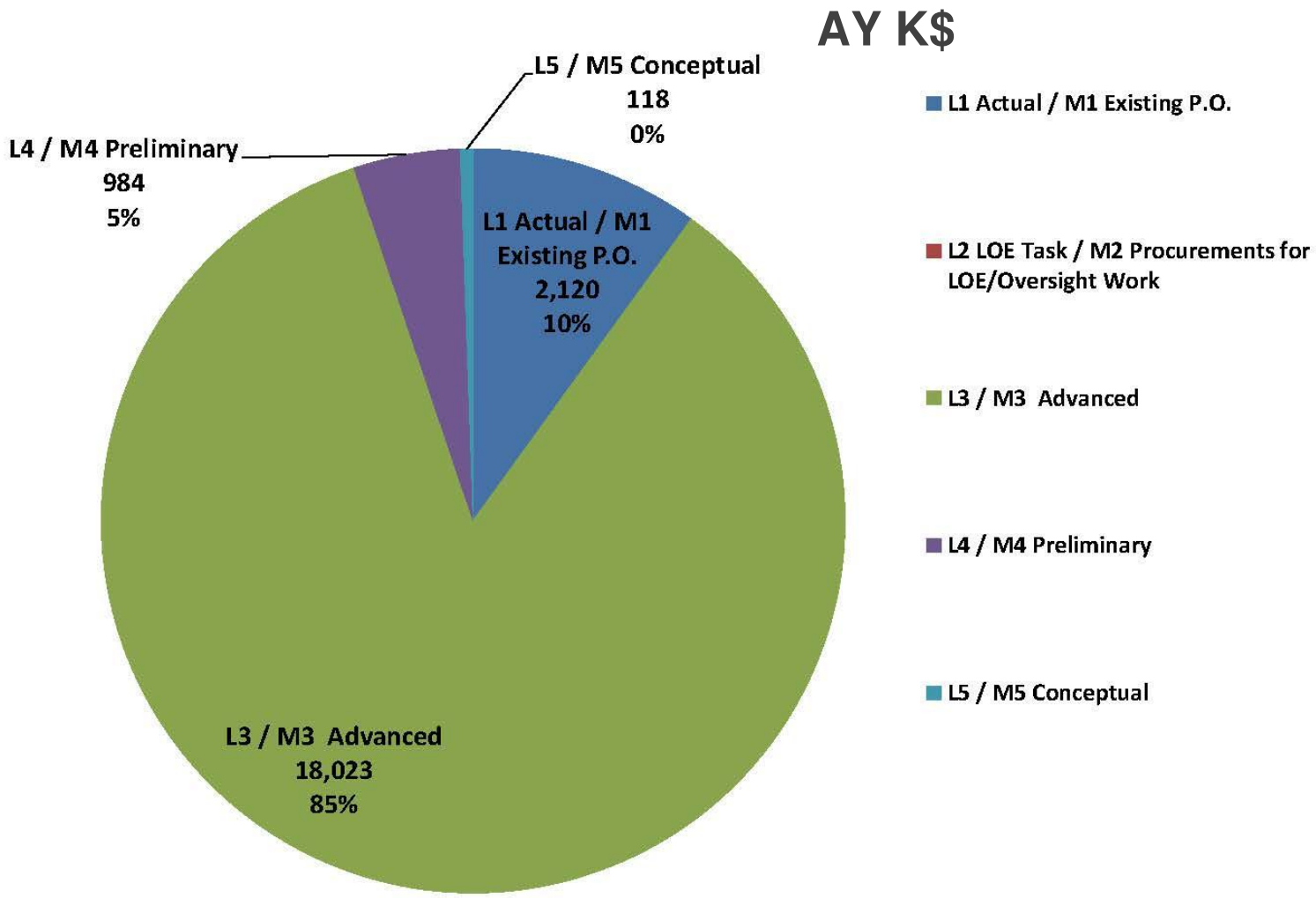
Cost Table

	Base Cost (AY K$)					
	M&S	Labor	Total	Estimate Uncertainty (on remaining budget)	% Contingency on (on remaining budget)	Total Cost
475.03.01 Conv.Constr. Conceptual Design	221	316	537		100%	537
475.03.02 Conv.Constr. Preliminary/Final Design	1,413	842	2,255	114	76%	2,370
475.03.03 Conv.Constr. Construction Phase Oversight	517	1,968	2,485	505	20%	2,990
475.03.04 Construction	15,369	232	15,600	2,769	18%	18,369
475.03.05 Conv.Constr. Project Close	156	212	367	73	20%	441
475.03.99 Risk Based Contingency				-637	-	-637
Grand Total	**17,675**	**3,570**	**21,245**	**2,825**	**15%**	**24,070**

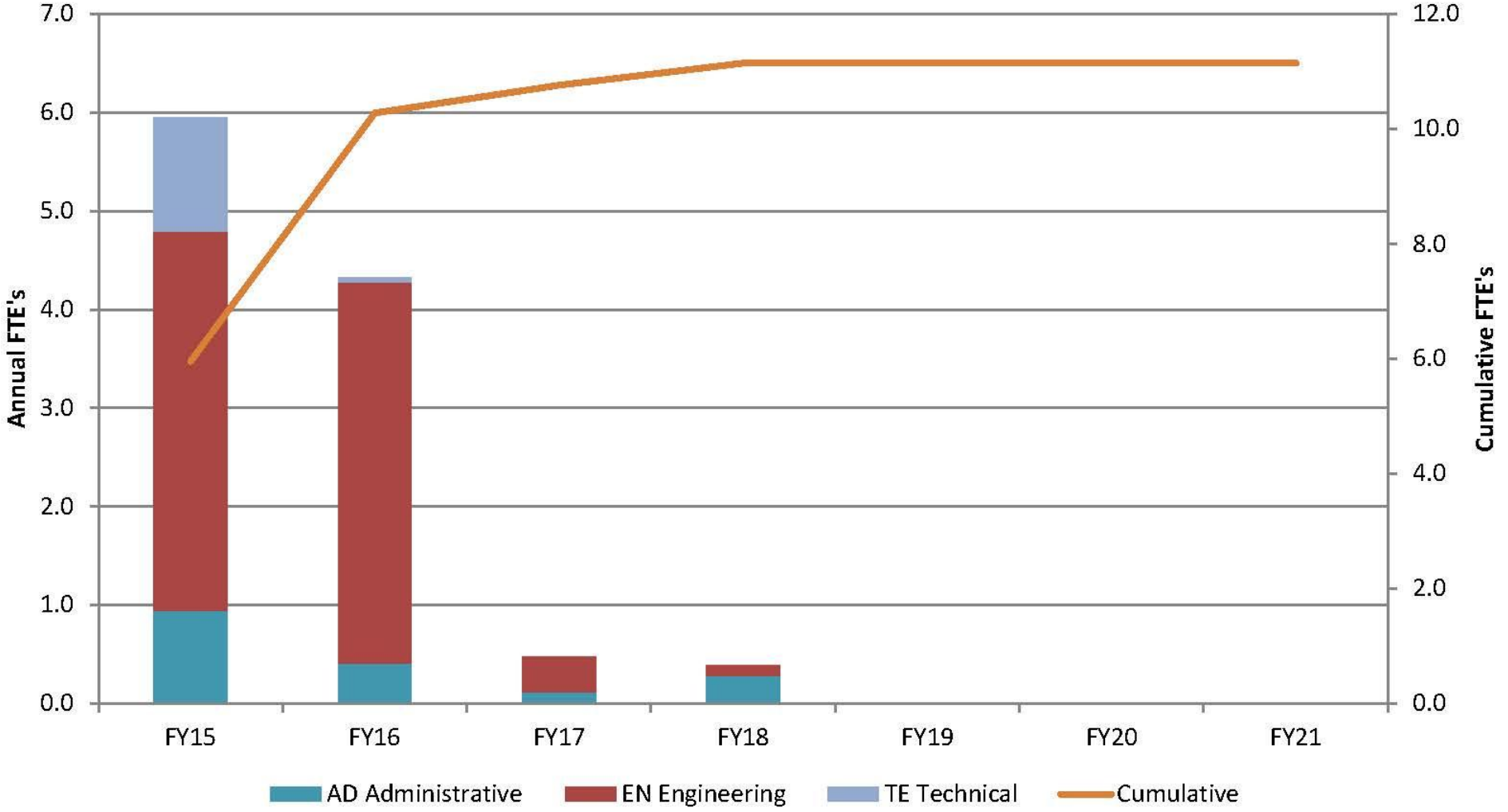
Cost Breakdown



Quality of Estimate

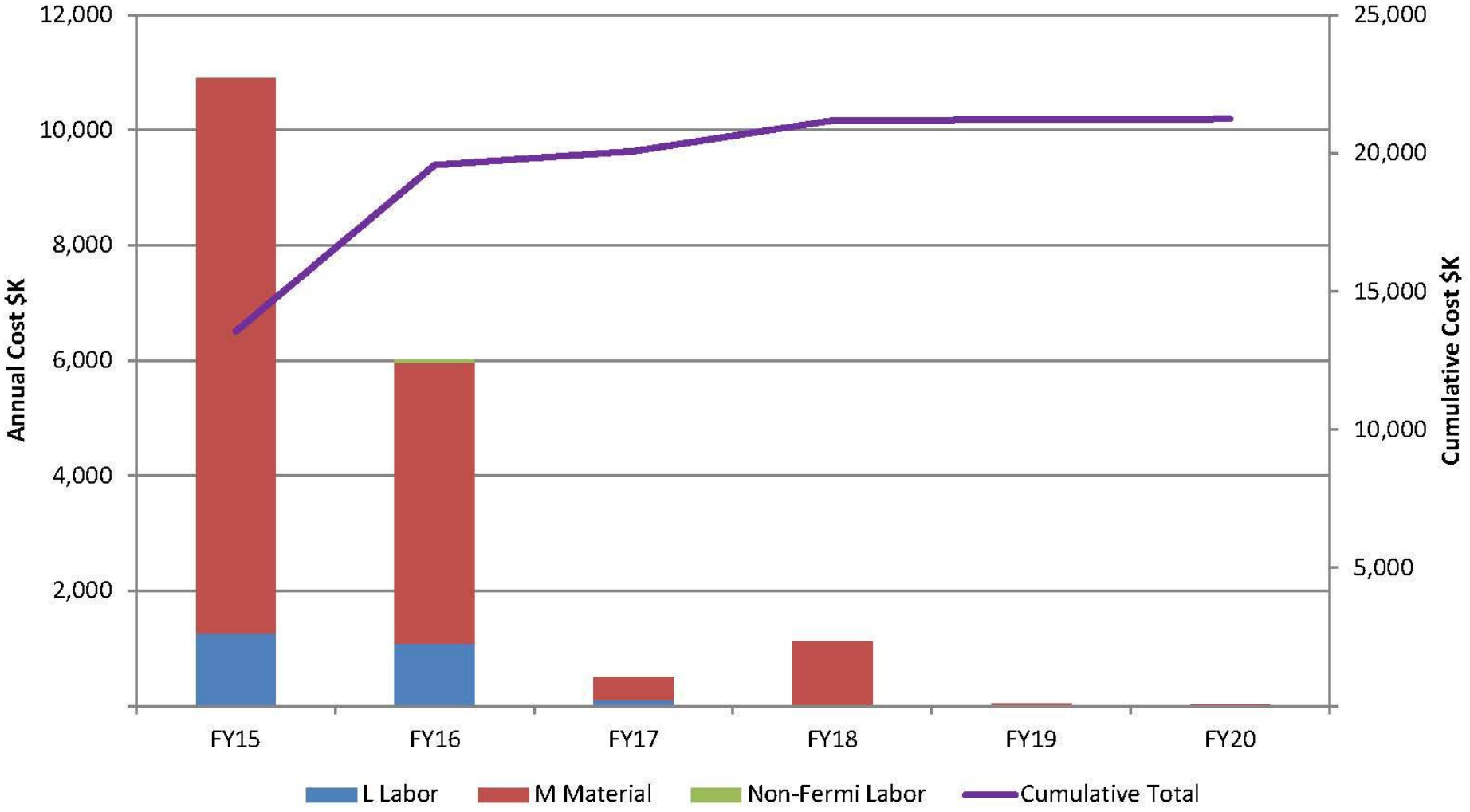


Labor Resources by FY



FESS Engineering provides the Construction Management and Coordination with in-house personnel.

Labor and M&S by FY

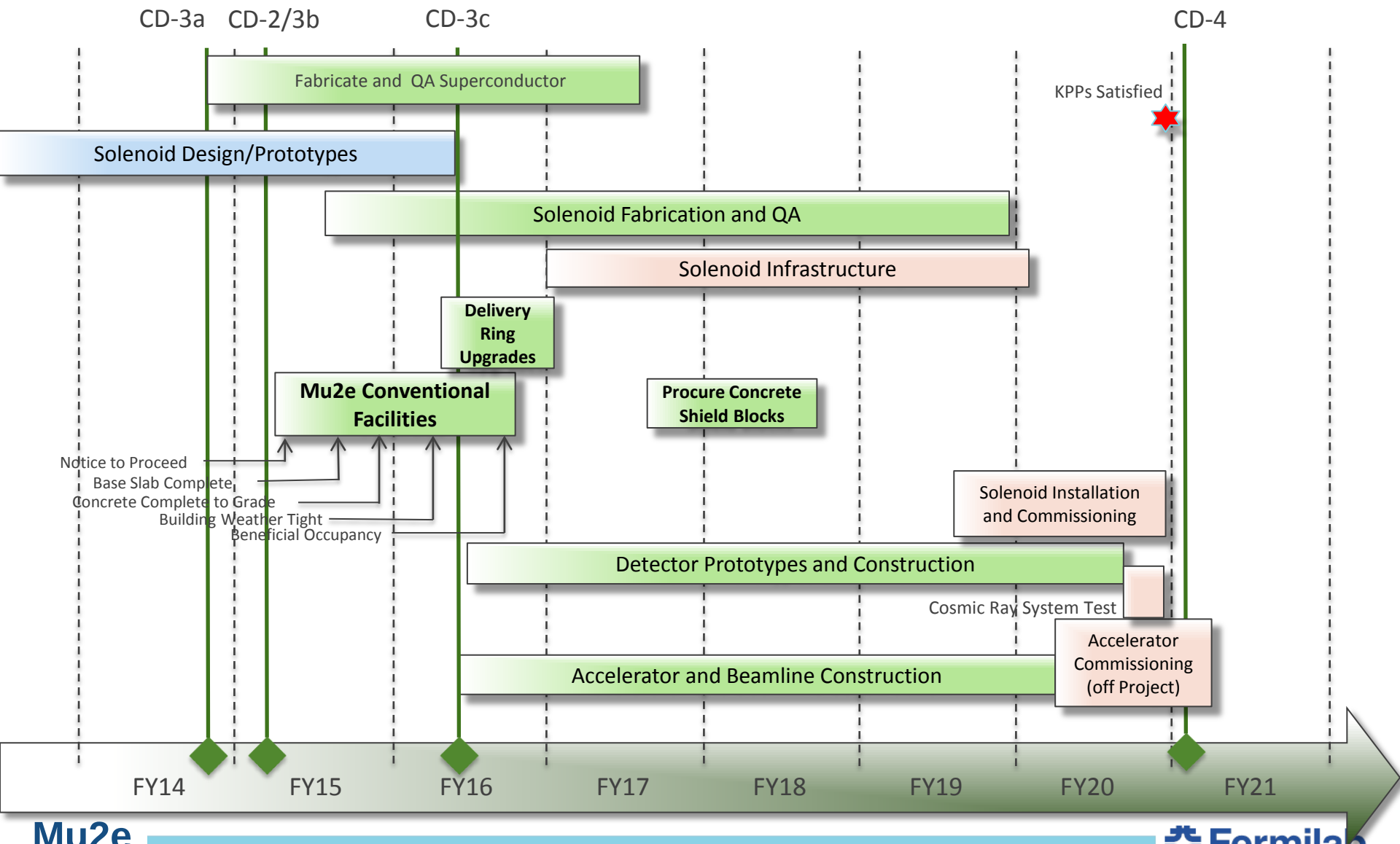


Major Milestones

47503.02.02.1090	T4 - Requirements and design development ready for A&E	1/25/2013
47503.02.02.1255	T3 - Lab Wide Review Complete	9/20/2013
47503.02.05.1030	T4 - Advanced Acquisition plan for Mu2e Conventional Facilities Complete	4/14/2014
47503.03.03.01.1060	T5 - PO issued for Mu2e Conventional Construction General Sub-Contract	1/20/2015
47503.03.03.01.1061	T4 - PO issued for Mu2e Conventional Construction General Sub-Contract	2/20/2015
47503.03.03.01.1062	T3 - PO issued for Mu2e Conventional Construction General Sub-Contract	3/20/2015
47503.03.03.01.1063	T2 - PO issued for Mu2e Conventional Construction General Sub-Contract	6/22/2015
47503.04.01.1260	T5 - MS-10 Issue Beneficial Occupancy	2/26/2016
47503.04.01.1261	T4 - MS-10 Issue Beneficial Occupancy	4/26/2016
47503.04.01.1262	T3 - MS-10 Issue Beneficial Occupancy	5/26/2016
47503.04.01.1263	T2 - MS-10 Issue Beneficial Occupancy	8/26/2016
47503.05.02.1000	T5 - Implementation Tasks Complete	4/25/2018

Tier 0 Milestone - DOE Acquisition Executive
Tier 1 - DOE Program
Tier 2 - DOE Federal Project Director
Tier 3 - Fermilab Directorate
Tier 4 - Project Manager
Tier 5 - Sub-project Manager

Schedule


CD-3a
CD-2/3b
CD-3c
CD-4
Fabricate and QA Superconductor
KPPs Satisfied
Solenoid Design/Prototypes
Solenoid Fabrication and QA
Solenoid Infrastructure
Delivery Ring Upgrades
Mu2e Conventional Facilities
Procure Concrete Shield Blocks
Notice to Proceed
Base Slab Complete
Concrete Complete to Grade
Building Weather Tight
Beneficial Occupancy
Solenoid Installation and Commissioning
Detector Prototypes and Construction
Cosmic Ray System Test
Accelerator Commissioning (off Project)
Accelerator and Beamline Construction
FY14
FY15
FY16
FY17
FY18
FY19
FY20
FY21

Summary

- We have a final design that fully satisfies the requirements.
- Costs, scope, and schedule through CD-4 are understood.
  - ICE was within .4% of engineers estimate for remaining work.
  - The Mu2e Conventional Facilities subcontract has proposals in hand at 4% below engineers estimate.
  - The remaining construction packages have substantially complete contract documents.
- Interfaces are identified and defined.
- Resource needs understood and individuals identified.
- ES&H embedded into all aspects of the Project.
- Responded to all recommendations from previous reviews.
- **Conventional Construction is ready for CD-2 and CD-3b.**