



U.S. DEPARTMENT OF  
**ENERGY**

Office of  
Science

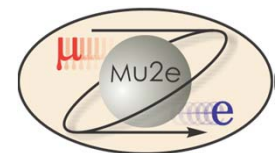
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# Mu2e Conventional Construction WBS 3.0

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Conventional Construction L2

7/8/2014 Draft 7/1/2014



# Status

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- CD-1 Recommendations
  - Consider reducing the duration between preliminary design completion and final design start to support AE team continuity.
    - An Advanced Conceptual Design was prepared in-house and issued to the A&E to prepare the final contract documents.
      - The contract documents for the Mu2e Conventional Construction Facilities, are complete.
      - The contract document for the Delivery Ring Upgrade will be complete by the DOE CD-2/3 Review.
  - Consider accelerating the start of civil construction to take advantage of the recent aggressive construction market conditions
    - The Mu2e Conventional Facilities package has been issued for RFP, with proposals due prior the DOE Review.
- WBS 3.0 is seeking CD-2/3 approval for its entire scope.

# Requirements

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- The Conventional Construction prime requirement is to construct a facility that satisfies the physical and environmental needs of the other sub-projects.
  - The requirements were developed via a series of meeting that included representative from the other sub-projects along with a series of focused meeting to develop the detailed requirements. (weekly Conventional Construction meetings, bi-weekly Integration Meetings, weekly Tech Board meetings)
  - The requirements were translated into a physical design that addressed the major elements. This Advanced Conceptual Design formed the bases for the A&E, Middough Inc., to produce a final design. Weekly meetings were held with the A&E to review progress and refine the design.
  - The project reviewed drawings at 30%, 60% 90% and 100%. A separate integration model was generated by the project that combined the technical components with the building drawings at each stage in order to verify compliance with the needs of the technical equipment. The 90% review was issued as a Lab Wide Comment and Compliance Review.

# Summary Requirements

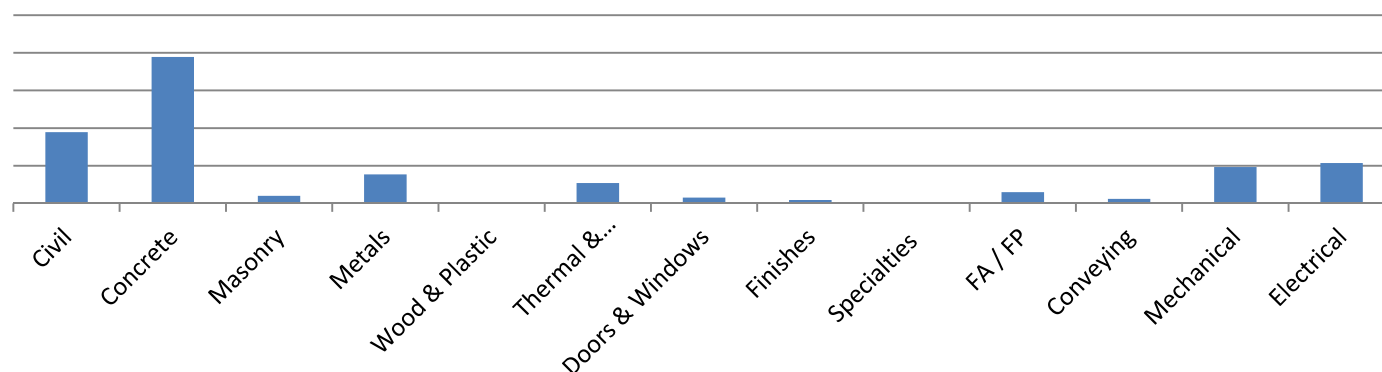
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- Space Requirements
  - Mu2e Conventional Facilities Square Footages:
    - Grade Level 12,600 SF (10,000 SF @ CD-1)
    - Detector Level 9,640 SF (7,500 SF @ CD-1)
      - surface building divided into a high bay with two 30 ton cranes and a side bay to house support equipment.
- Mechanical
  - HVAC ~300KW CHW for HVAC (about 50% process load)  
~88KW CHW for detector cooling, vacuum pump, and other future user equip  
~12 KW CHW AP50
  - ODH Ventilation: 7000 CFM each for the two lower area & 6300cfm for solenoid power supply room
  - LCW is in WBS 2.0 (Accelerator)

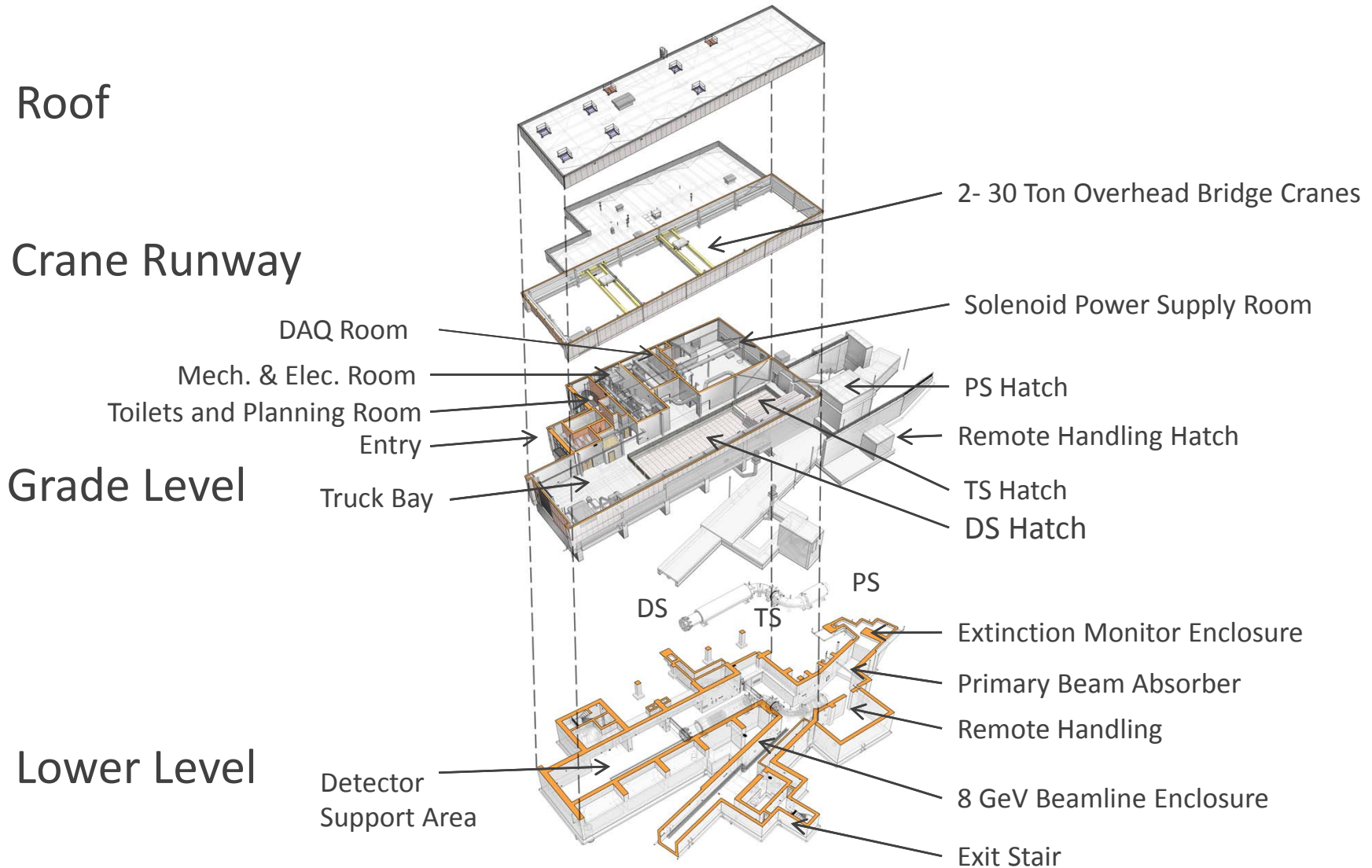
# Summary Requirements / Design

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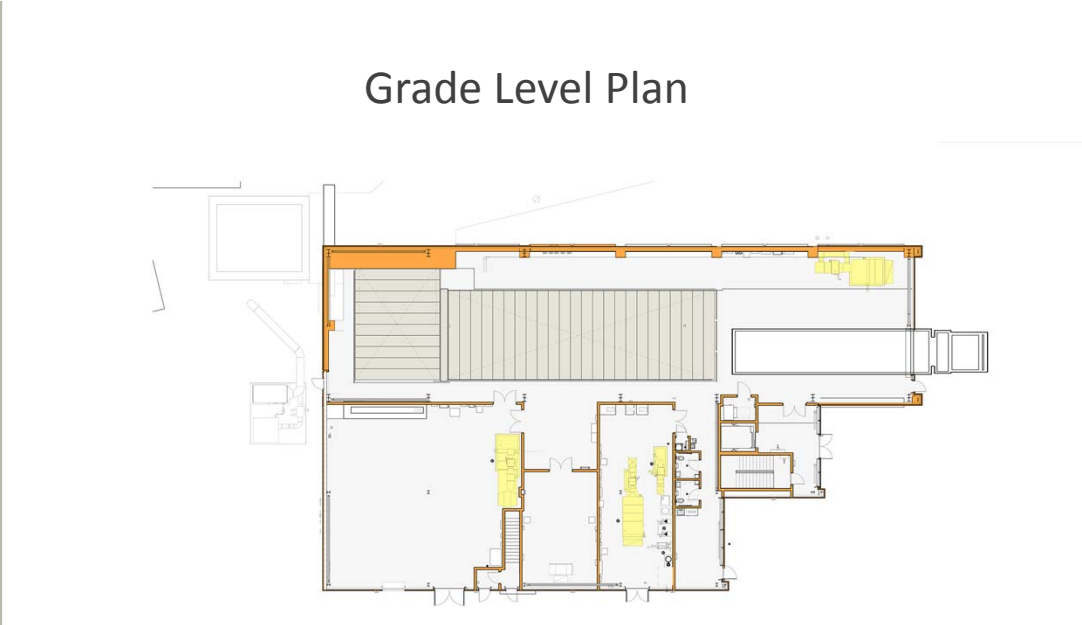
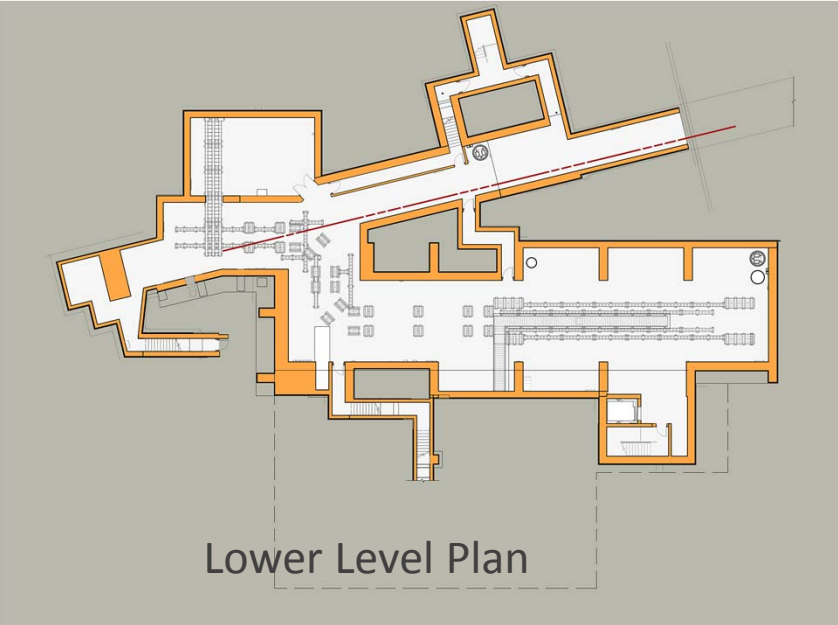
- Electrical
  - Mu2e Conventional Facilities
    - 1,500 KVA for solenoid and beam line power supplies
    - 750 KVA house Power
  - The Delivery Rings Upgrade(AP-30)
    - Beamline power supplies require new secondary feeds from the primary transformer to an additional distribution panel
- Cost Distribution by Trade
  - Civil and Concrete dominate.



# Design- Mu2e Conventional Facilities



# Design



# Changes since CD-1

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- The major change between CD-1 and now is that the CD-1 requirements were preliminary and general. The current design documents are based on mature design requirements.
  - Complete beam lattice.
  - Solenoid installation and structural support requirements defined and verified.
  - Physical space requirements during each phase of technical equipment installation has been analyzed and discussed.
  - Mature Cooling and power loads
- Building square footage has increased 27% from 17,500 SF to 22,240 SF.
  - High Bay – Room for beamline PS; crane coverage over TS
  - Side Bay - move DAQ away from stray magnetic field; enlarge Mech.
  - Below Grade – Enlarged Remote Handling, add SF under truck dock



# Value Engineering since CD-1

- Feb 14<sup>th</sup> and 15<sup>th</sup>, 2014
- Based on US 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

Color Legend: 10/04/17 Feb. 10-15, 2013

Item Number	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 main CK road as part of the truck turnaround, take out new turnaround	Accepted
44 interrupt Kautz Rd tertiary power feed	Accepted
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	
51 470 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 built 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 OH size	
61 Raw skid shielding possibilities	
31 will minimum shielding allow for beam intensity increases in future	

# Performance

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

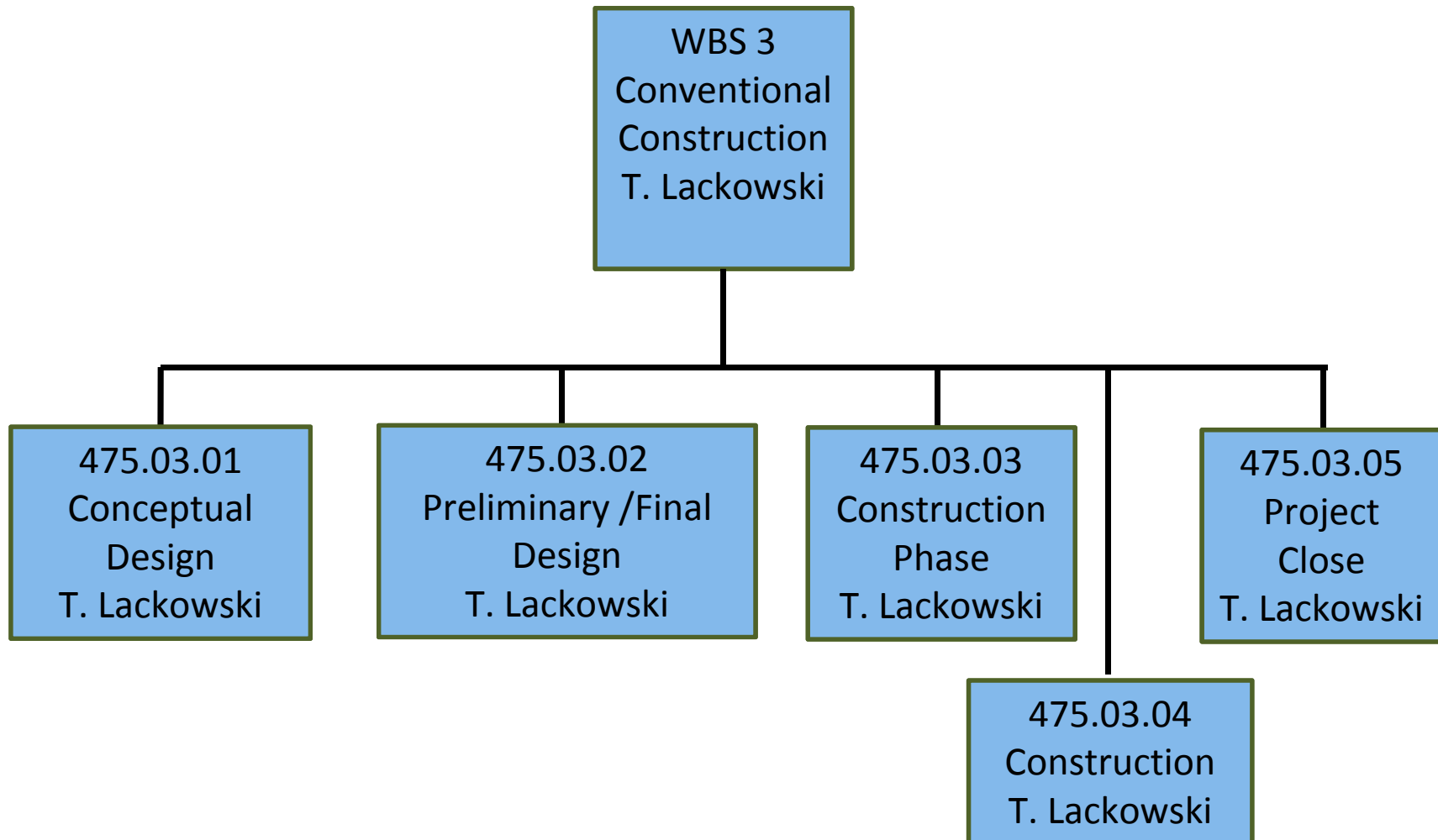
# Remaining work before CD-3

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- WBS 3.0, Conventional Facilities is ready for CD-3.
  - Mu2e Conventional Facilities design documents are complete and have been issued for RFP.
  - The design documents for the Delivery Ring upgrade will be 100% by the DOE CD-2/3 review.
  - Crane Specifications are complete ready for Lab Wide Review.
  - Most of the direct procured items are Fermilab standards with existing designs and specifications. The exception are the shielding blocks that are not standard sizes.

# Organizational Breakdown

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# Quality Assurance

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- 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 subcontractor QC required program
- Middough Inc. Quality Control Plan
  - Technical specifications define Quality Control
  - Construction Coordinator is first line of QA during Construction
  - L2 / Construction Manager has overall responsibility for QA.

# Risks

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- Conventional construction bids are lower than estimated cost.
- Conventional construction bids exceed estimated cost.
  - Proposals will be received prior to the DOE CD2/3 review, one risk will be retired and one accepted.
- Unforeseen/undocumented subsurface conditions discovered during excavation for conventional construction.
  - Performed soil exploration to help characterize site
- Significant injury or death associated with Mu2e construction/assembly. (this risk is listed under PM but Conventional Construction has significant ownership)
- Severe Weather impacts civil construction.
- Civil contractor cannot complete work satisfactorily or defaults on contract.

# ES&H

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- Construction activities contain hazards, Exhibit A.
  - flows down essence of the applicable chapters of FESHM
  - requires conformance to OSHA 1926.
  - requires Hazard analysis approach.
- The Addendum to Exhibit A
  - requires Fermilab site specific training
    - Subcontractor Orientation
    - GERT or Radiological Worker training based on the work activity.
    - Superintendent can serve as day to day Safety Representative
  - Requires a corporate safety representative during preparatory meetings, to make bi-monthly walk through and assist in any investigations.
- Fermilab will use a consultant ES&H professional to augment its staff weekly or more frequently if needed.

# ES&H

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- NEPA issues were addressed during CD-1 with a CX issued just after CD-1.
  - Mu2e will be Phase 2 of the Current IEPA SWPPP which covers the 10 plus acres of the Muon Campus.
  - Domestic Water Permit to Construct is approved, Application for Operating Permit will be complete prior to placing new piping into service.
  - Sanitary Sewer Permit is not required.
- The project's goal is to have safe work place with zero incidences. This will be achieved by aggressive compliance to the existing, robust, integrated safety management systems for construction that exist at Fermilab.



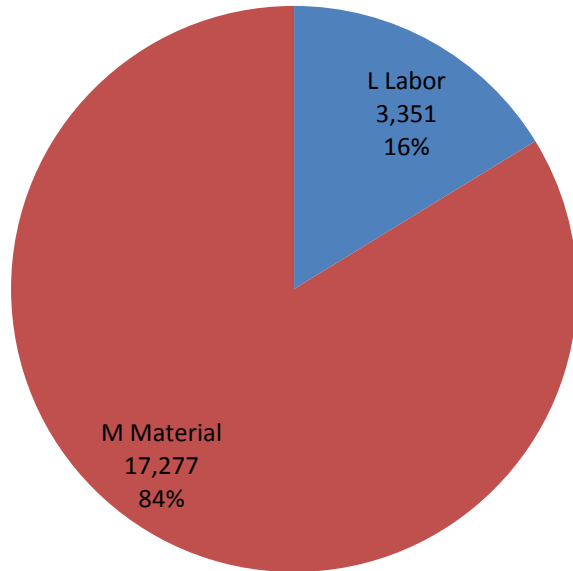
# Cost Table

	M&S	Labor	Base Cost	Estimate Uncertainty	% Contingency on ETC	Total
475.03.01 Conceptual Design	190	347	537	0	0%	537
475.03.02 Preliminary/Final Design	1,228	1,033	2,260	116	22%	2,376
475.03.03 Construction Phase Oversight	420	2,066	2,486	505	20%	2,991
475.03.04 Construction	14,095	882	14,977	2,999	20%	17,976
475.03.05 Project Close	125	243	368	74	20%	441
Risk Based Contingency				-510		
Total	16,057	4,571	20,628	3,183	17%	23,811

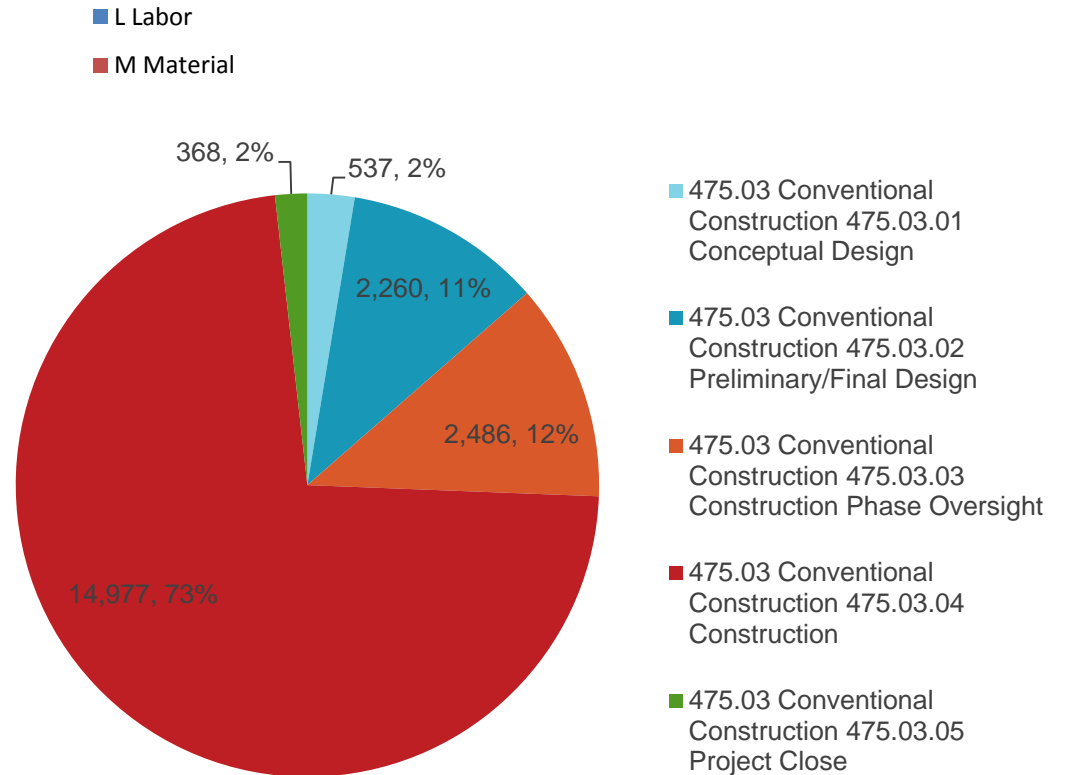
AY k\$

# Cost Breakdown

Resource Type AY K\$

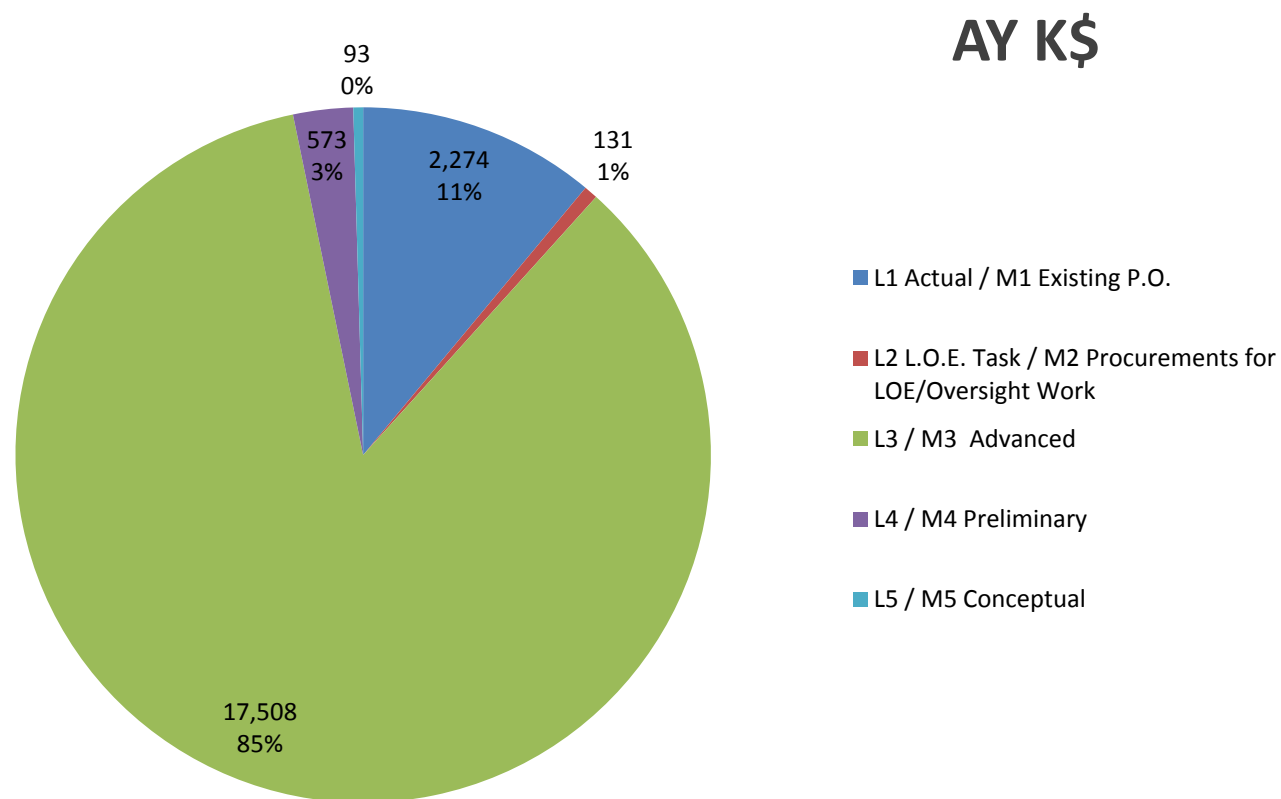


WBS Breakdown @ Level 2  
AY K\$

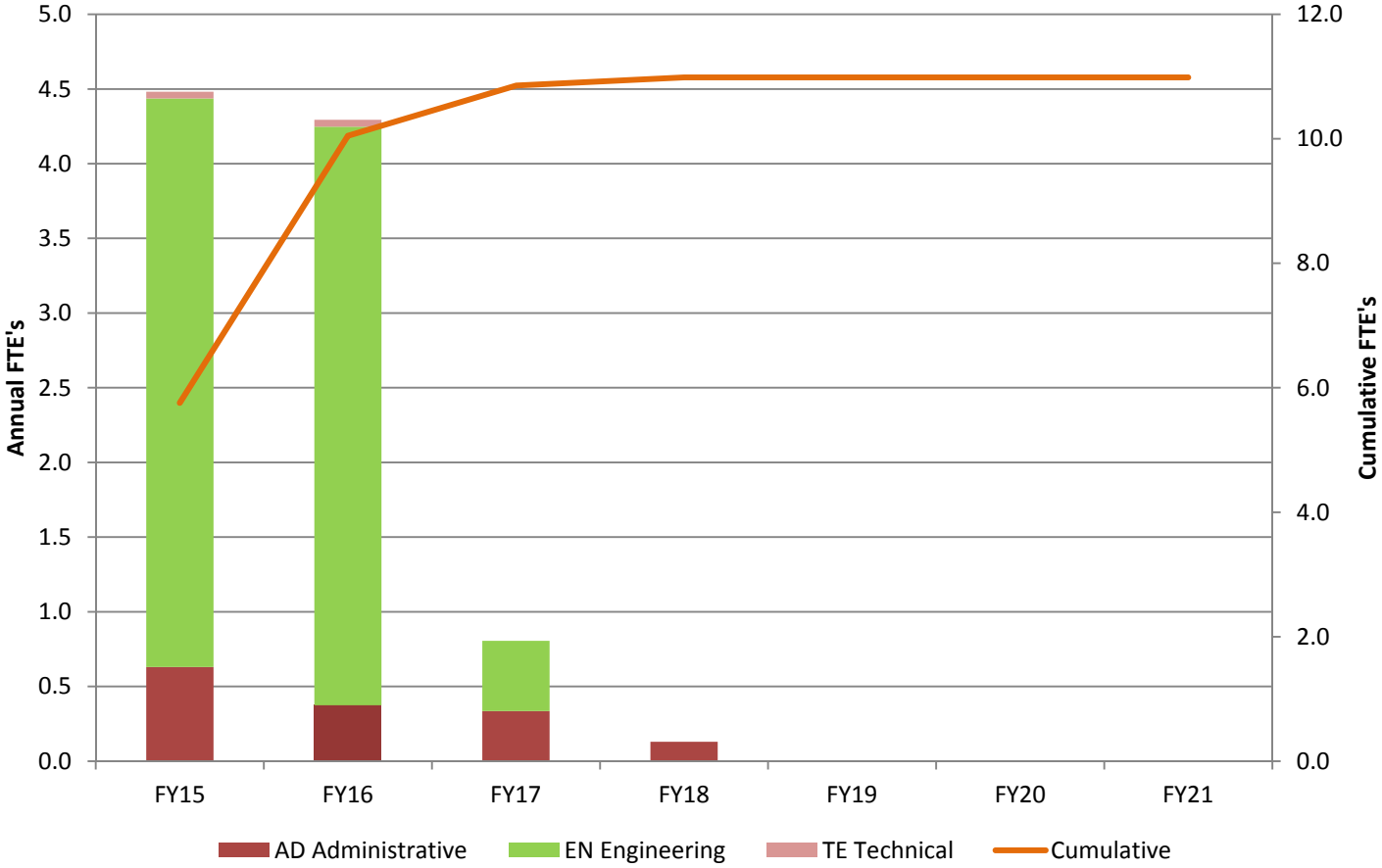


# Quality of Estimate

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# Labor Resources by FY



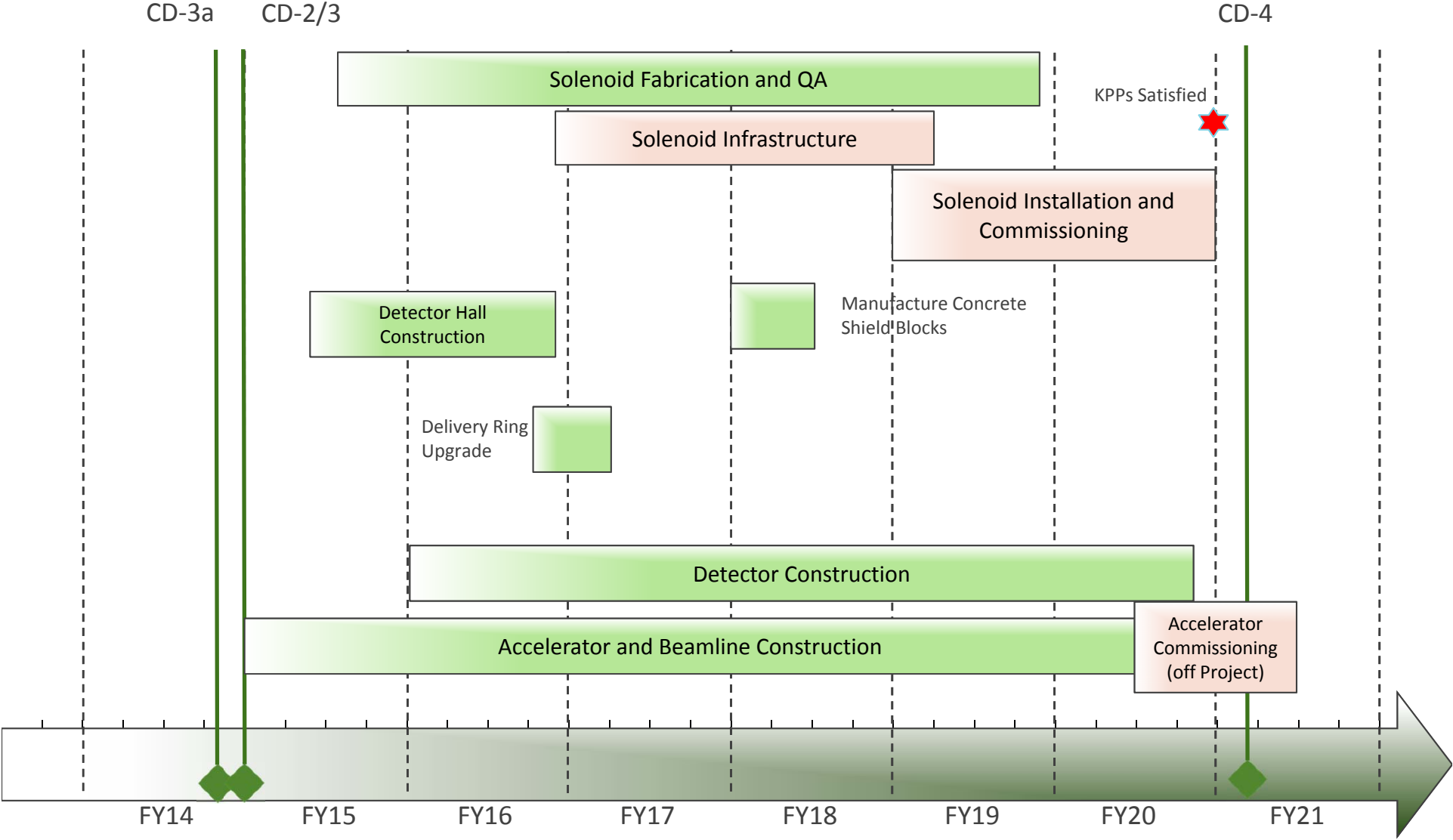
FESS Engineering provides the Construction Management and Coordination with in-house personnel.

# Major Milestones

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- L4 Requirement and design developed ready for A&E Jan. 13 (completed on schedule)
- L3 Lab wide Review Sept 13 (completed on schedule)
- L2 PO Issued for Mu2e Conventional Facilities fixed price subcontract. Jan. '15
- L2 Issue Beneficial Occupancy Sept. '16

# Schedule



# Summary

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- Requirements have matured to a final design level.
- The Mu2e Conventional Facilities final design is complete, and RFP has been issued and is ready for construction once construction funds are authorized.
- The other construction packages, Delivery Ring Upgrade and procured items are minor in scope and well defined.
- WBS 3.0, Conventional Construction is ready for CD-2 and CD-3 authorization.

# Breakout Talks

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- Document Review
- RFP, Cost and Schedule
- Environmental Permits
- Mechanical Design
- Electrical Design
- Life Safety
- Value Engineering