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**ENERGY** Office of  
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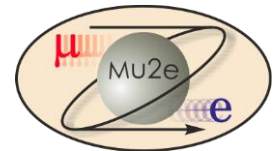
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# Mu2e WBS 5.4 Upstream External Shielding Director's CD-2 Review

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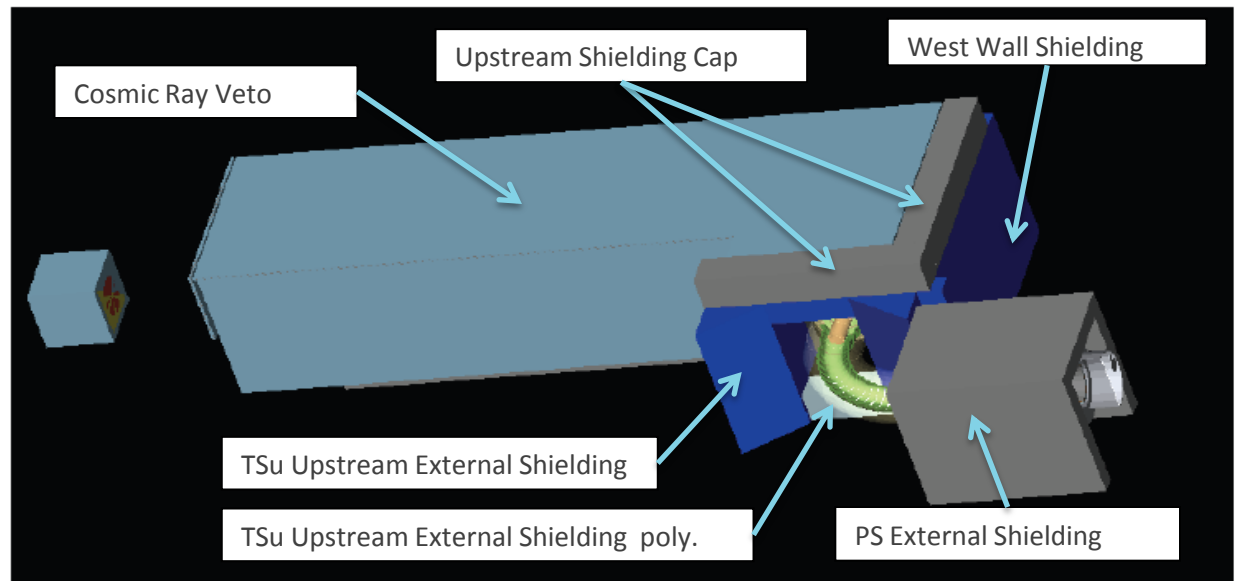
Muon Beamline Level 3 Manager

7/8/2014



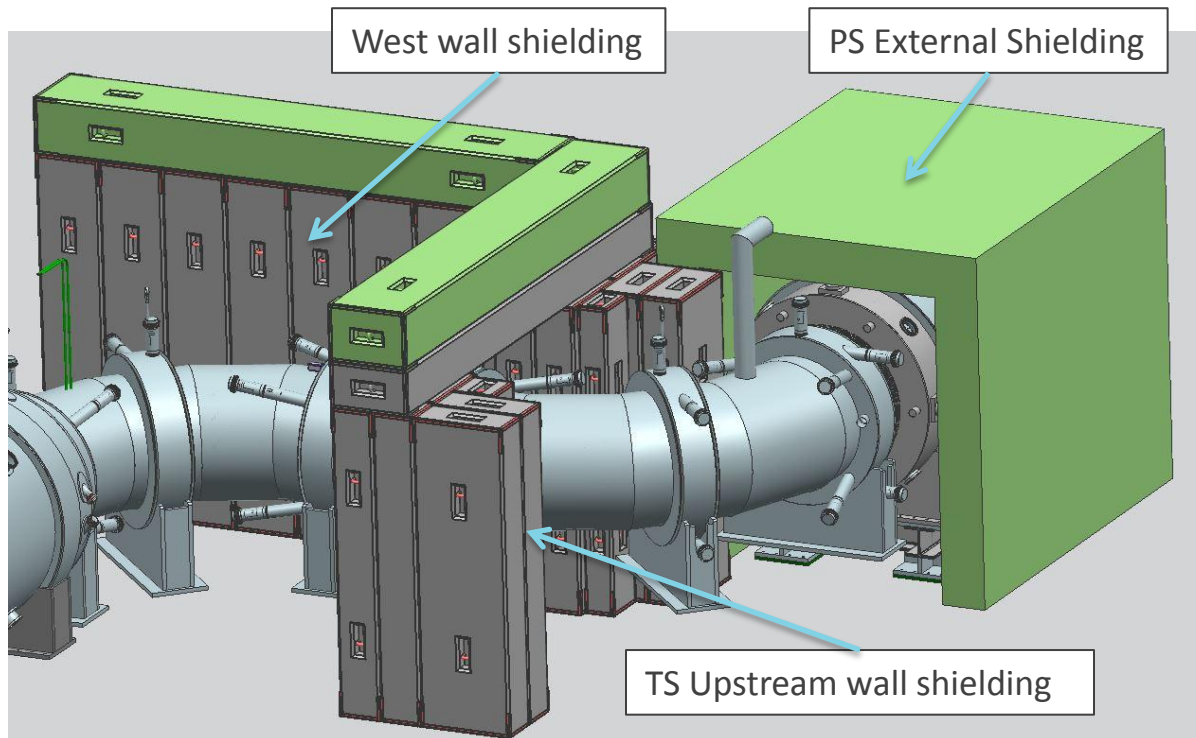
# Physics Requirements

- The primary purpose of the Upstream External Shielding around the PS and TSu is to reduce the rate of particles incident on the Mu2e detectors
- The rate incident upon the Cosmic Ray Veto must be suppressed to a low enough level to support efficient operation of the CRV
- The Upstream External Shielding also isolates the primary proton beamline from the DS hall, providing a natural radiation zone break and serves as an element of the airflow control system for the Mu2e Experiment Hall



# Design

The preliminary design of the Upstream External Shielding as viewed from the north east with the PS on the right hand side and the DS on the left hand side of the figure below. The grey blocks are high density barite concrete blocks, while the green elements are composed of normal density concrete.



## PS External shielding:

- Concrete cave
- 90 tons
- Cast under PS Hatch and move using rollers on floor track plates

## TS Upstream wall and West wall shielding:

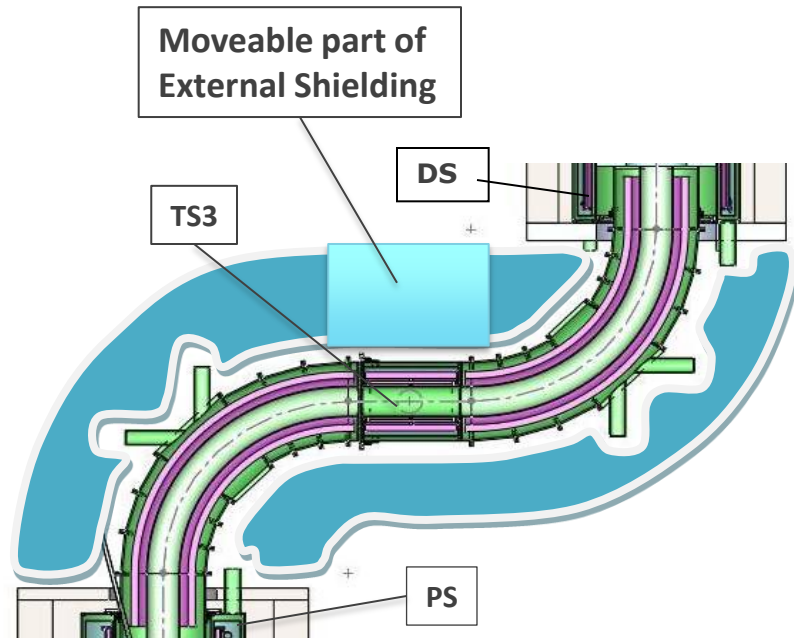
- High density (barite) concrete blocks capped with normal concrete blocks
- 242 tons high density concrete
- 48 tons normal density concrete

# Changes since CD-1

## Preliminary Design of TS Upstream External Shielding:

- Introduced PS External Shielding
- As a result of the background simulation studies, new design of TS front shielding has been developed to make TS insulation more robust
- Block type design was selected to simplify production and assembly/installation of the shielding.

## Concept of External Muon Beamline Shielding (2011)



# Value Engineering since CD-1

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## Shielding related optimizations:

- Investigate less expensive shielding materials
- Employ high density concrete instead of copper or stainless steel
- Increase concrete thickness instead of higher density concrete where possible
- Plan to cast PS external shielding
- Plan for multiple use of same hydraulic system to move the shielding parts

# Remaining work before CD-3

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- Continue shielding value engineering effort
- Optimize design of shielding for reliefs
- Finalize material choices

# Quality Assurance

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Quality Assurance in the muon beamline efforts will rely about the following tools :

- Fermilab Quality Assurance Manual
- Fermilab Engineering Manual
- Documented engineering calculations and drawings reviewed, approved and released
- Verification of physics simulations
  - Comparisons between MARS and GEANT4
- Documentation of procedures
- Delivered materials will be inspected for conformance to the specifications

# Risks

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- Damage to surrounding elements during shielding installation
  - Design to mitigate this risk (standoffs)
- Shielding installation impacts beamline alignment
  - Civil construction plans mitigate this risk
- Constructed external shielding may not adequately suppress rates in the detector area, resulting in higher than anticipated background rates in the Cosmic Ray Veto
  - Ongoing simulations aimed at minimizing this risk
- The residual risks will not be realized within the project horizon, and must therefore be transferred



## ENVIRONMENTAL HAZARDS

- **RELATED TO RADIATION ENVIRONMENT**

- Radiation levels will need to be monitored.

- **RELATED TO IRRADIATED MATERIAL AFTER OPERATION**

Radiation level of components will need to be monitored before removal. Several factors need to be considered:

- Materials can not be used which can become poisonous after activation.
- The characteristic decay time of irradiated components should be small enough to permit access after no more than 24 hours.
- Components must remain dimensionally stable until decommissioning is complete.

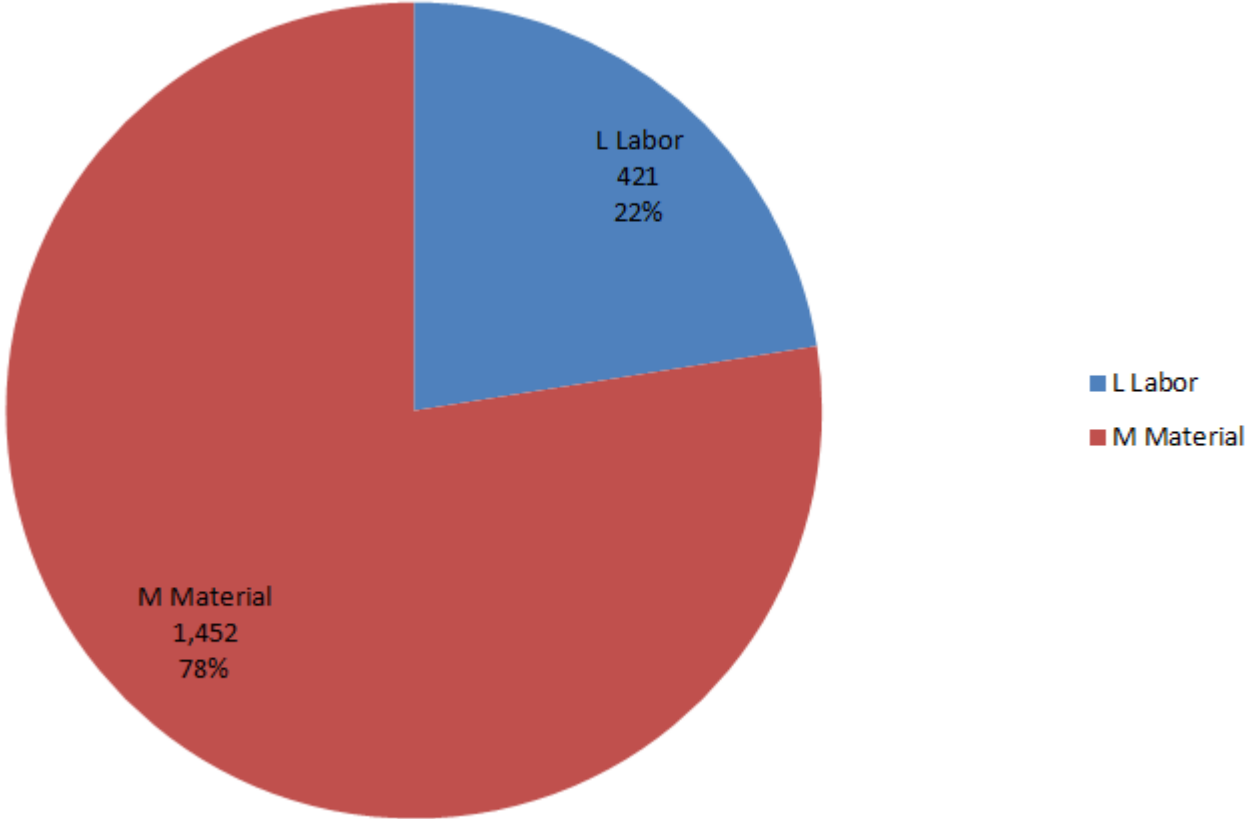
## SAFETY HAZARDS

- **HEAVY LIFTING**

- The external shield blocks are heavy objects, so during installation special care should be taken to follow Fermilab safety procedures for working with lifting equipment.

# Cost Distribution by Resource Type

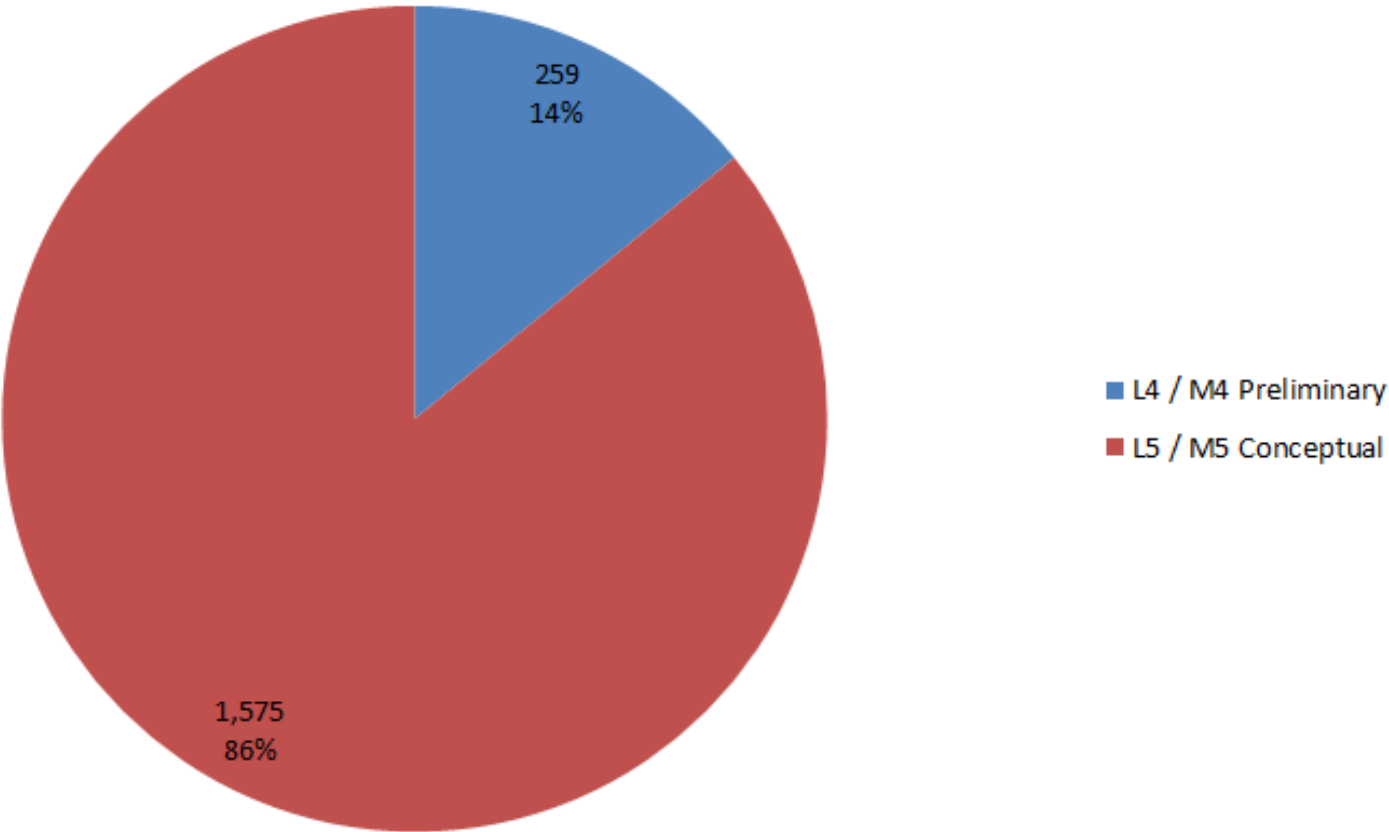
- Base Cost (AY \$k)



# Quality of Estimate

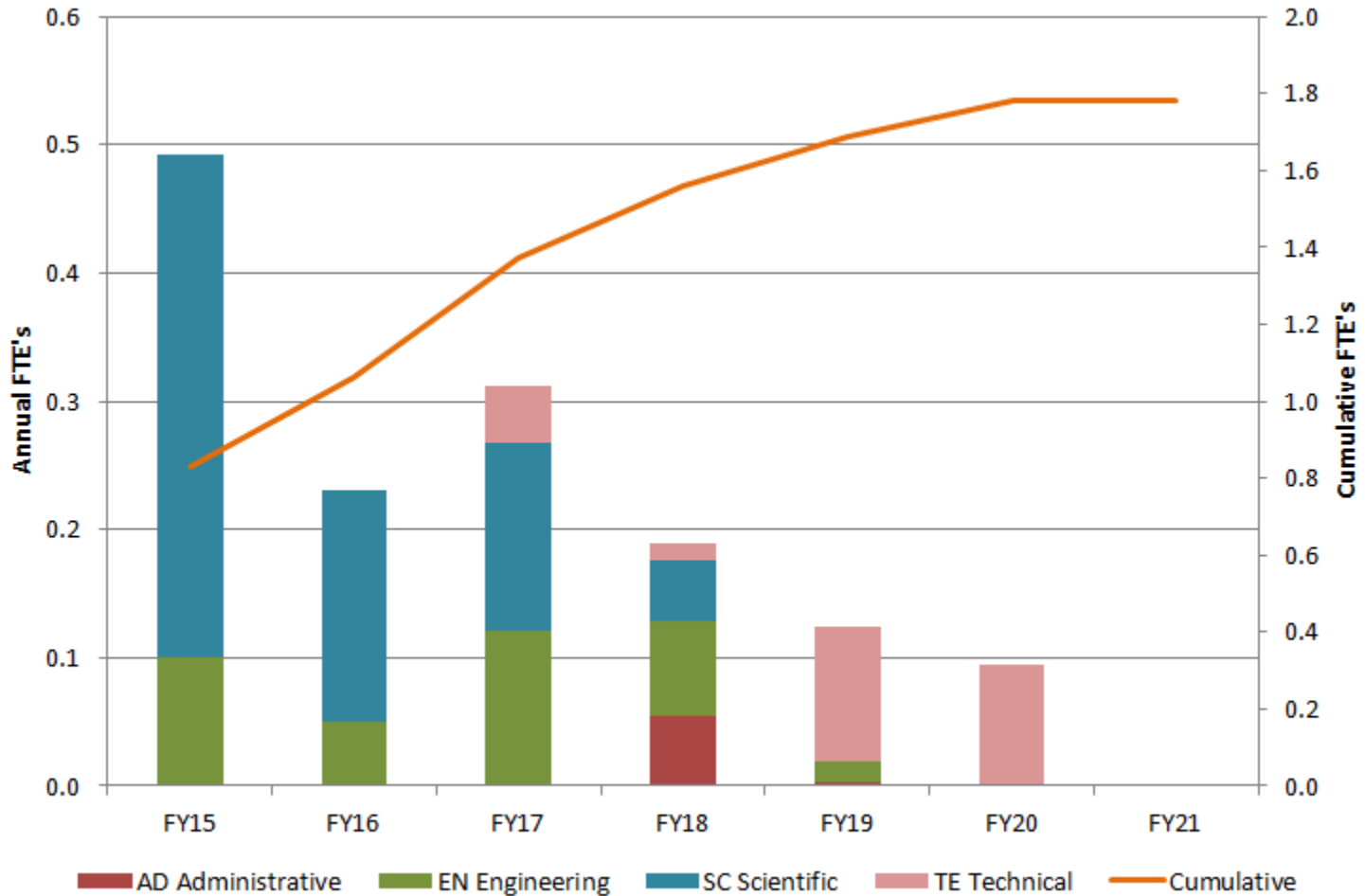
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- Base Cost by Estimate Type (AY\$k)



# Labor Resources

- FTEs by Discipline



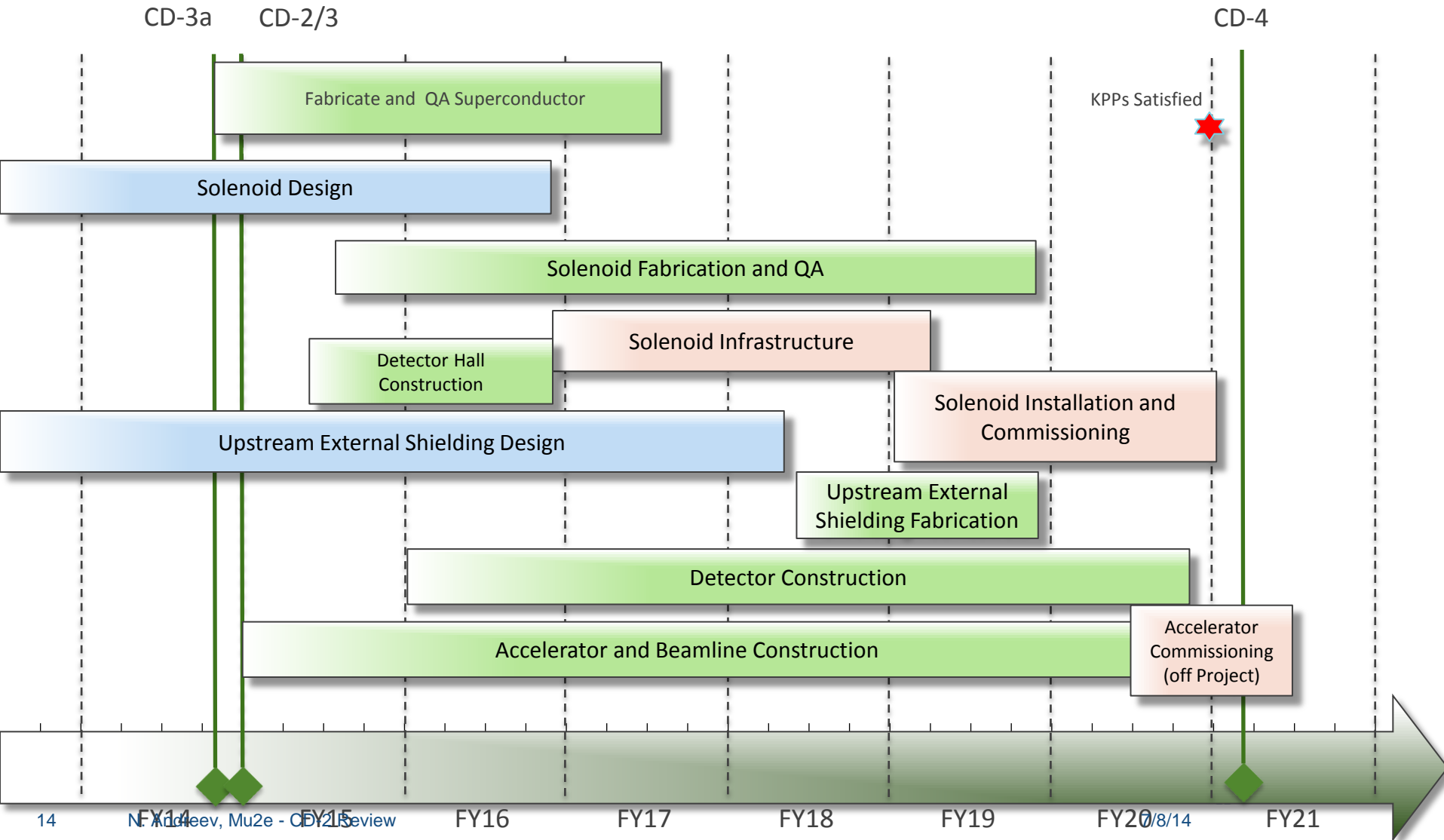
# Cost Table

- WBS 5.4 Upstream External Shielding

Costs are fully burdened in AY \$k

	Base Cost (AY k\$)			Estimate Uncertainty (on remaining costs)	% Contingency on ETC	Total Cost
	M&S	Labor	Total			
475.05 Muon Beamline						
475.05.04 Upstream External Shielding						
475.05.04 Upstream External Shielding	1,452	421	1,873	889	47%	2,762
Grand Total	1,452	421	1,873	889	47%	2,762

# Schedule



# Summary

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- Requirements & Specifications document for the Upstream External Shielding has been upgraded for the preliminary design – DocDb 1506
- 3-D model of the preliminary design for the TS Upstream External Shielding of Mu2e Beamline has been developed.
- Additional simulations are needed for the optimization of the design parameters for the Upstream External Shielding