



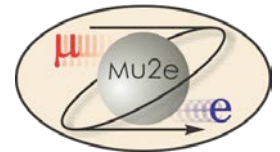
Mu2e CD-2/3b Review

8.3 CRV Scintillator Extrusions

Anna Pla-Dalmau

Mu2e CRV Scintillator Extrusions L3

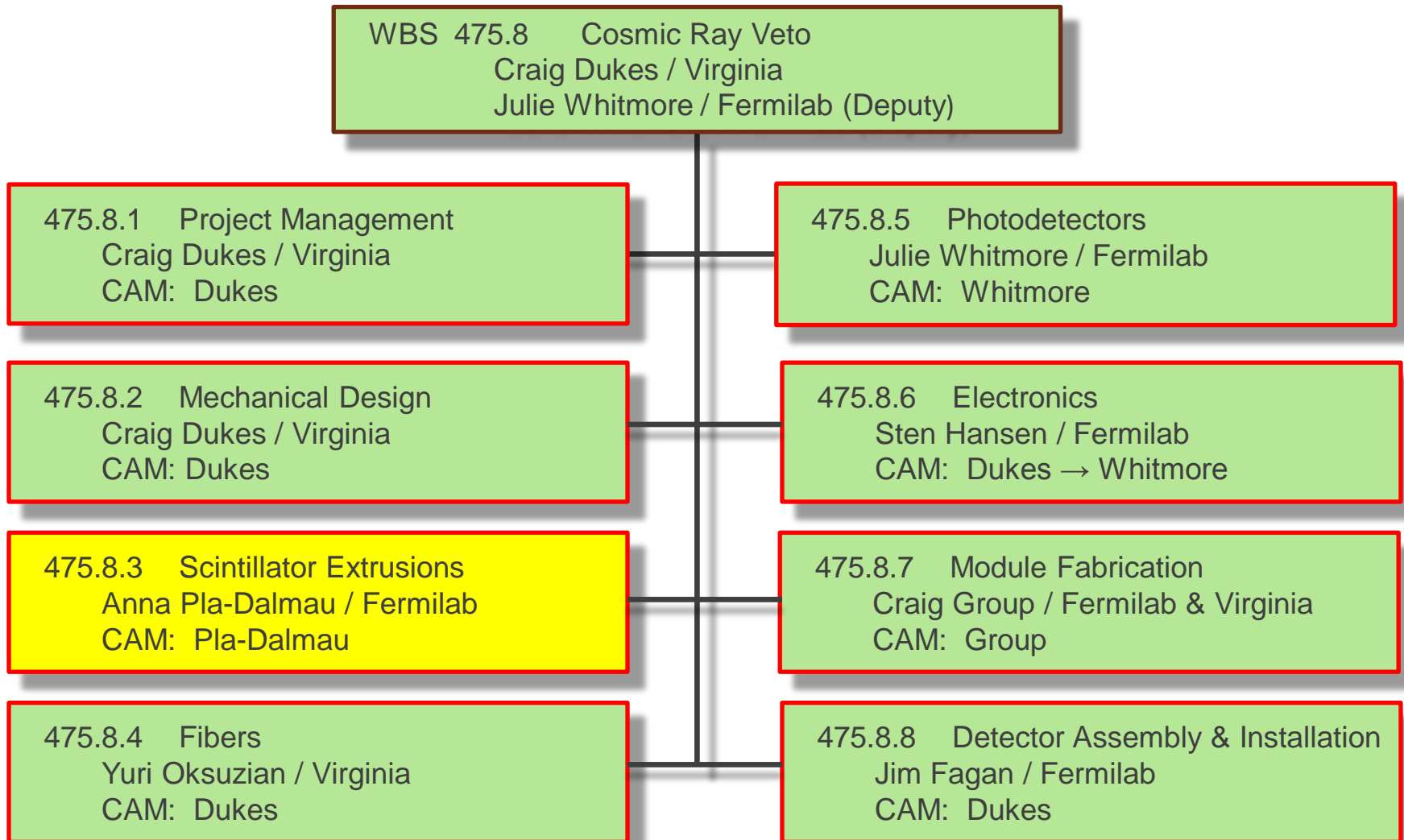
10/21/2014



CRV Scintillator Extrusion Team

- Anna Pla-Dalmau:
 - CRV Scintillator Extrusion L3 Manager
 - Fermilab – Scintillation Detector Development Group Leader (1997) – Applied Scientist – Chemist
 - Manager FNAL-NICADD Extrusion Line Facility since its start in 2003
 - L2 Manager for Scintillator for MINERvA
 - Prepared extruded scintillator for T2K, Double Chooz, Belle II, JLAB, Pierre Auger-AMIGA.
- James Wish:
 - Extrusion Line Operation
- Janina Gielata and Wanda Newby:
 - Extrusion Line Operation Assistance and Quality Control

Organizational Breakdown



Scope

WBS 8.3 Scintillator Extrusions Anna Pla-Dalmau / Fermilab

8.3.1 Die Design and Procurement

This task covers the design of the die needed for the production of the scintillation counters, its procurement and testing through the fabrication of prototype extrusions. We assume that two dies will be needed: a prototype and a production die.

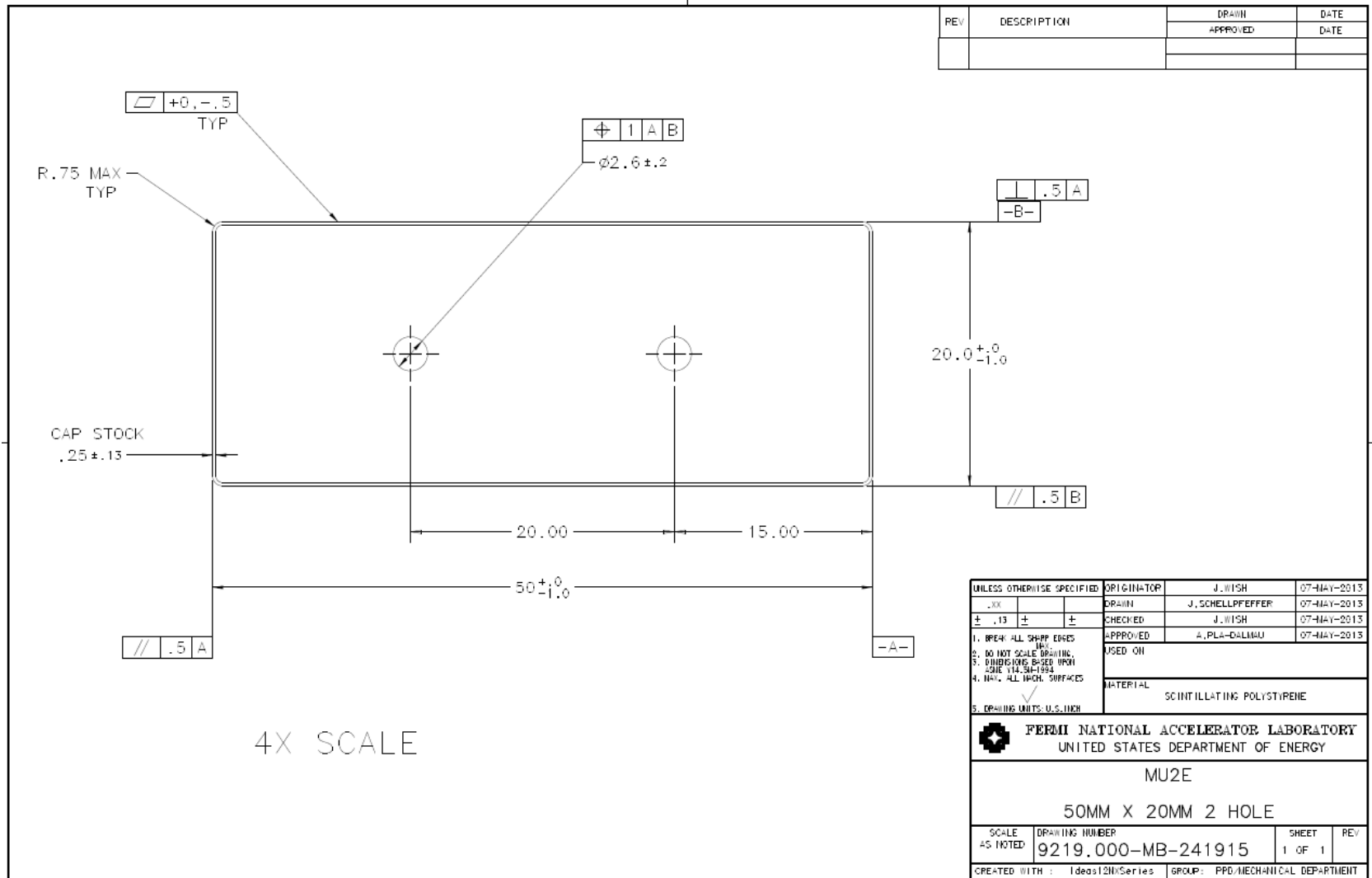
8.3.2 Scintillator Extrusion Production

This task covers the procurement of the scintillator extrusions for prototype tests, pre-production tests, and production of the cosmic ray veto. It includes: (1) the procurement of the materials, (2) the fabrication of the extrusions, (3) the quality assurance, and (4) the shipping of the extrusions to the module factory.

Requirements

- Extrude plastic scintillator for Cosmic Ray Veto – FNAL/NICADD Extrusion Line Facility:
 - Blue emitting plastic scintillator:
 - Polystyrene - DOW STYRON 665 W
 - Dopants - 1% PPO + 0.03% POPOP – Curtiss Labs.
 - 15% TiO_2 in polystyrene coating (0.25 mm)
 - Cross-section – 5 cm x 2 cm with 2 holes for WLS fibers
 - Amount – 20 metric tones

Design



Changes since CD-1

- The cross-section of the scintillator bar has changed:
 - From CD-1: 10 cm x 1 cm with 4 holes
 - To CD-2 : 5 cm x 2 cm with 2 holes

Value Engineering since CD-1

- Performed extrusion, mechanical and test-beam tests with an existing die of cross-section 4 cm x 2 cm with 3 holes and adapted to produce strips with just 2 holes.
- Worked with coating manufacturer to keep the cost/quality of TiO₂/PS coating unchanged.

Performance

- Extruded a 5 cm x 2 cm profile with 2 fairly round and consistent holes.
- Improved TiO₂/PS coating thickness uniformity
- New TiO₂/PS coating with better extrudability in a wide part

Remaining work before CD-3

- Reduce gaps between bars:
 - Address concavity of top and bottom surfaces
 - Minimize round corners

Integration and Interfaces

- INTEGRATION:
 - Attend weekly CRV meeting
- INTERFACES for 47508.3:
 - 47508.2 Counter Design (predecessor)
 - 47508.7 Module Fabrication (successor)

Quality Assurance

- Perform QC on extruded scintillator strip
 - Check light yield with radioactive source on test samples
 - Check dimensions on test samples
- Document Quality Control process
- QA: Check purity of raw materials – PS and dopants

Configuration Management:

- Use labels with barcodes for strips and test samples
- Create a database of dimensions and light yield scanning the labels on the test samples
- Document deliveries and usage of raw materials

Risks / Opportunities

Risks:

- VETO-156: Control size and shape of fiber holes
 - Size and shape of fiber holes may not match drawing specifications depending on extrusion operating parameters based on die manufactured.

Opportunities:

- VETO-163: Go to a wider extrusion to:
 - Increase tolerances on the module layer offset distance
 - Reduce numbers of fibers, SiPMs, extrusions, and electronics channels

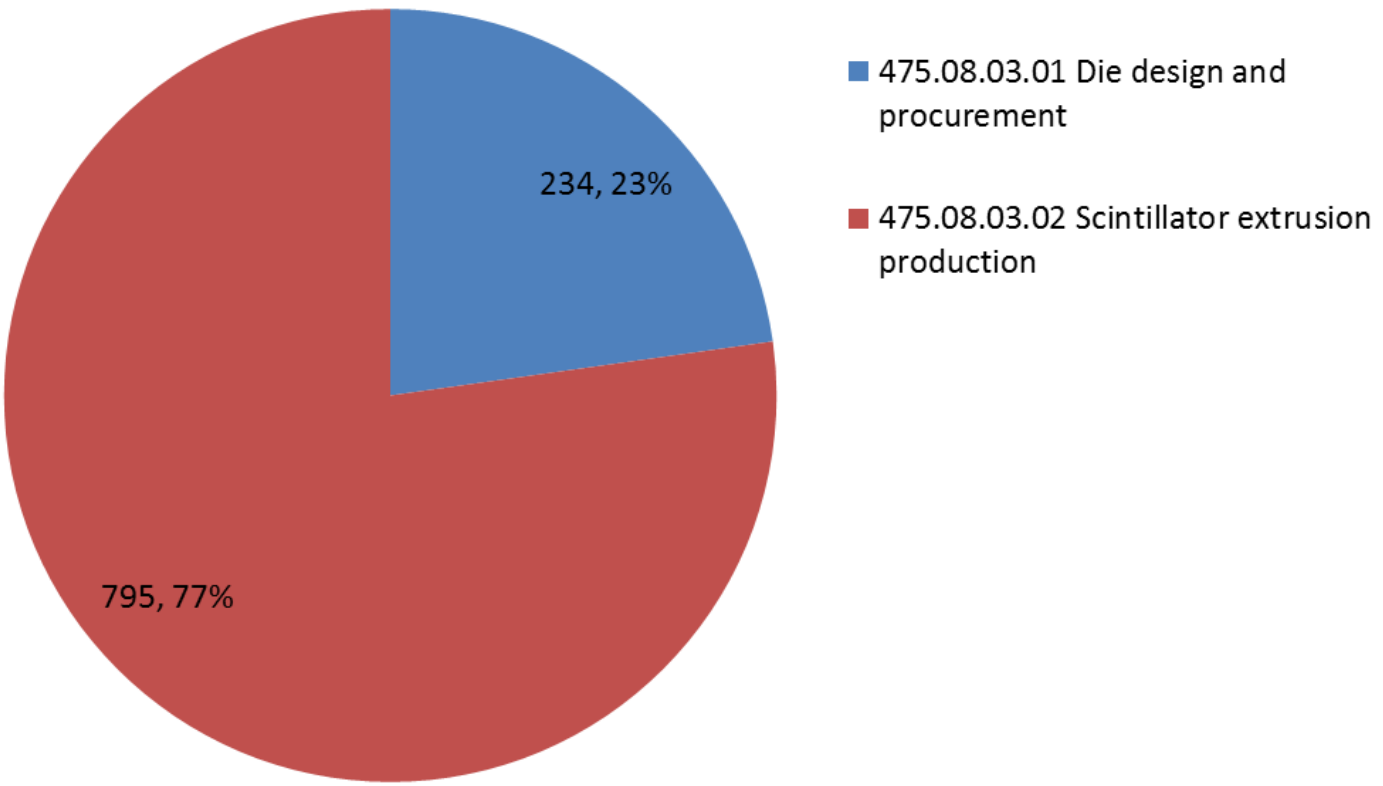
- Follow established safety procedures at Fermilab
- Follow established extrusion procedures at Fermilab

Cost Table

	Base Cost (AY K\$)			Uncertainty (on remaining budget)	% Contingency (on remaining budget)	Total Cost
	M&S	Labor	Total			
8.03.01 Die design and procurement	158	77	234	37	36%	271
8.03.02 Scintillator extrusion production	410	385	795	172	24%	967
Grand Total	567	462	1,029	209	25%	1,238

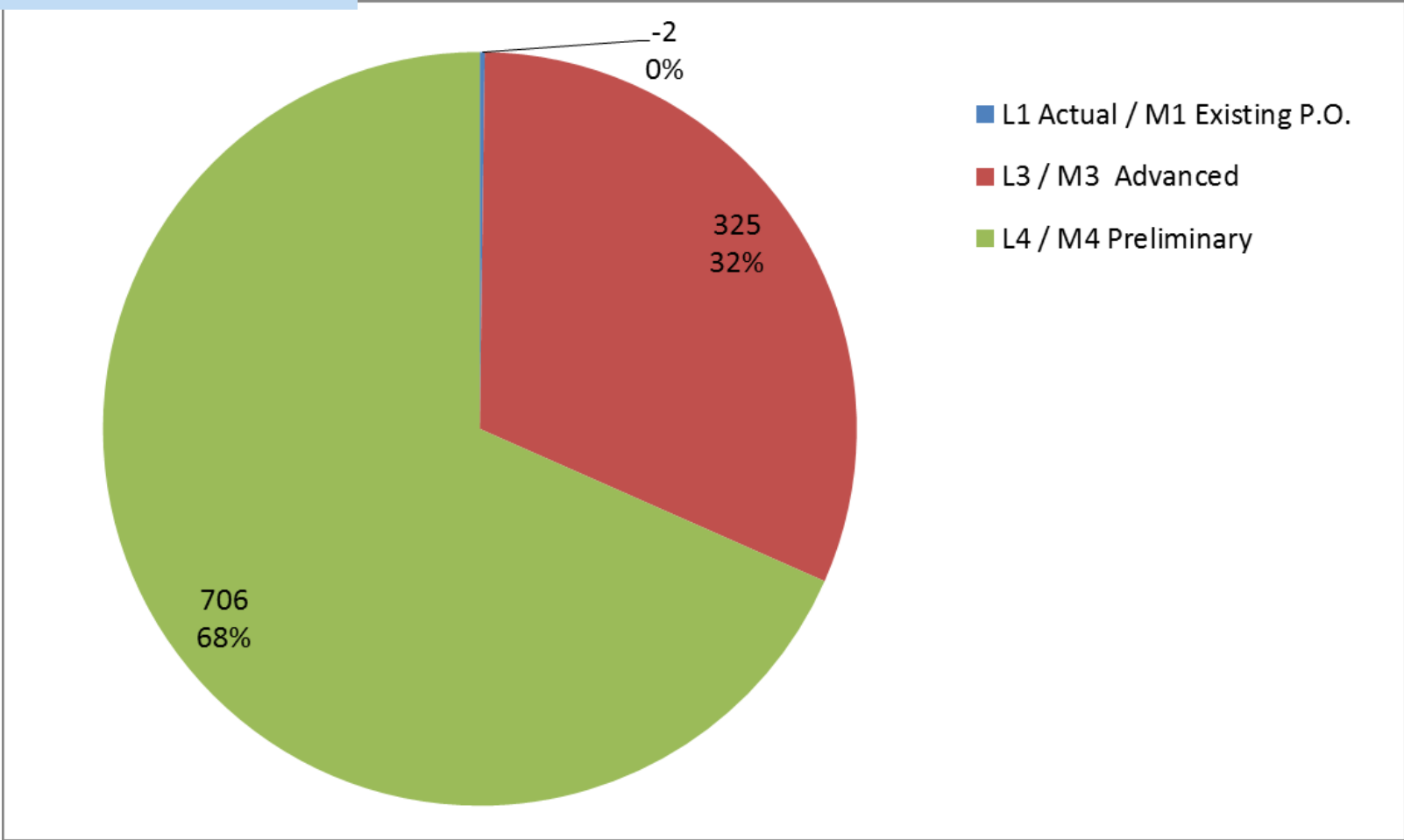
Cost Breakdown

Base Cost in AY K\$



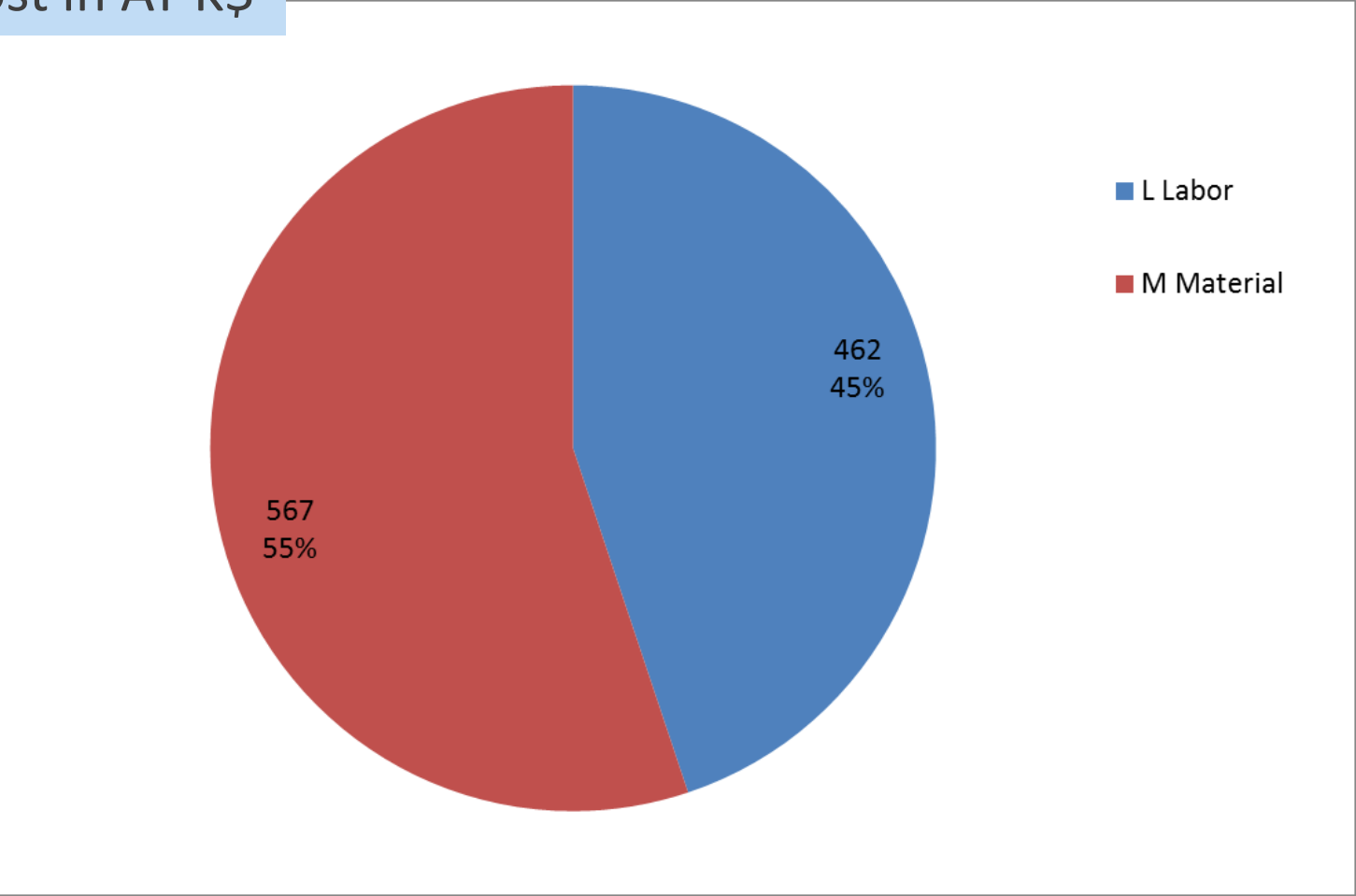
Quality of Estimate

Base Cost in AY K\$



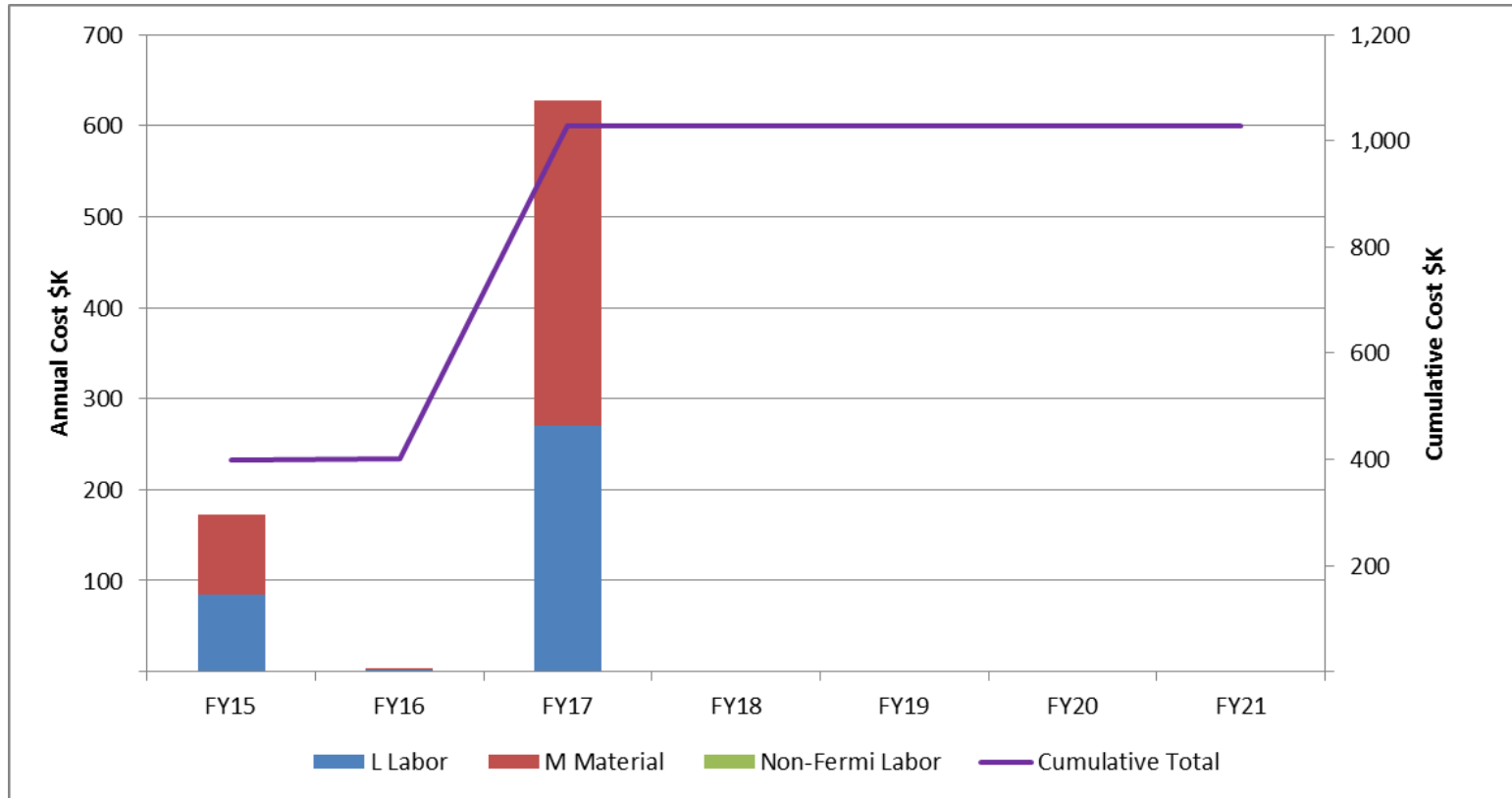
Resource Type

Base Cost in AY K\$

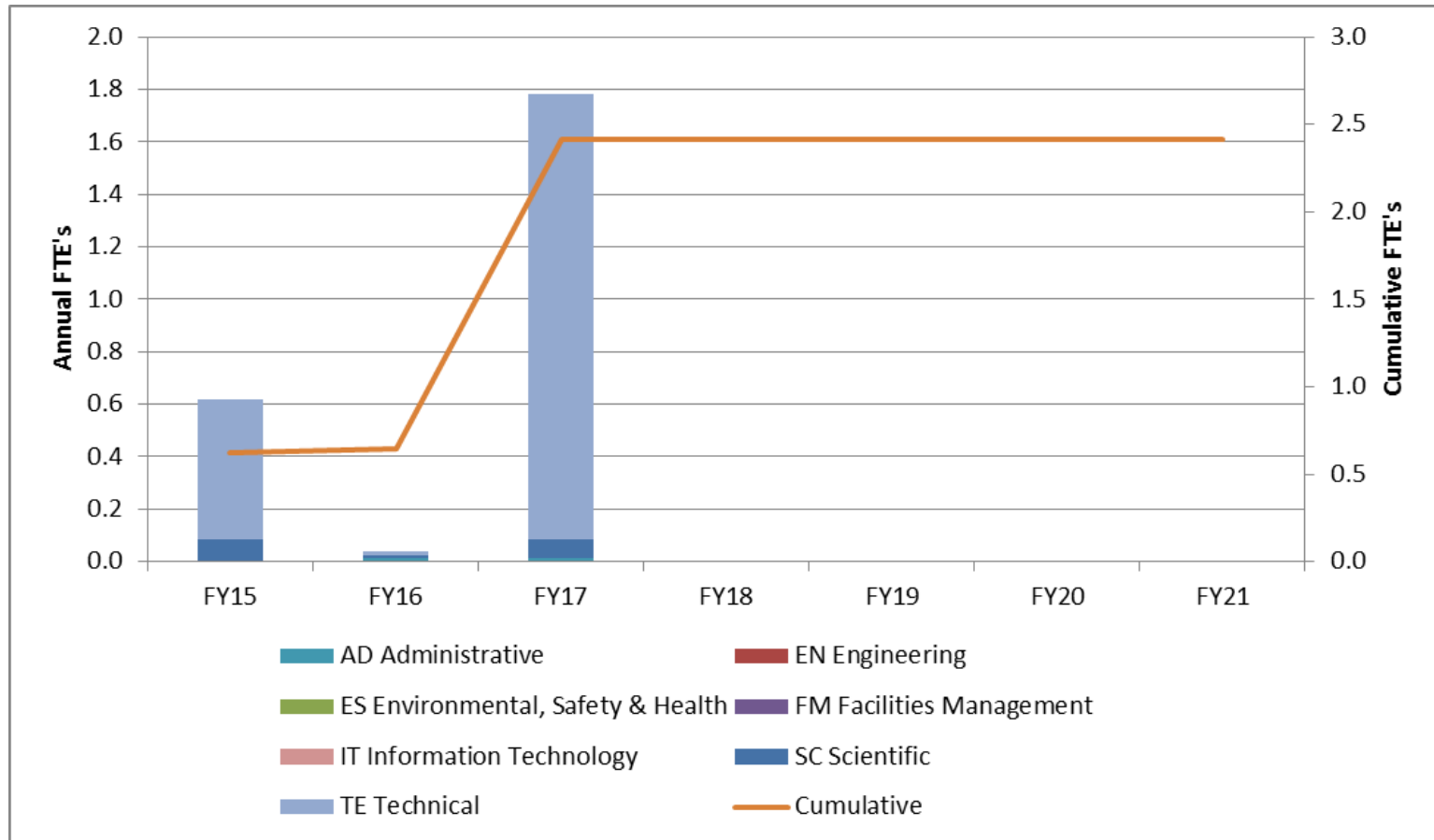


Resources by FY

Base Cost in AY K\$



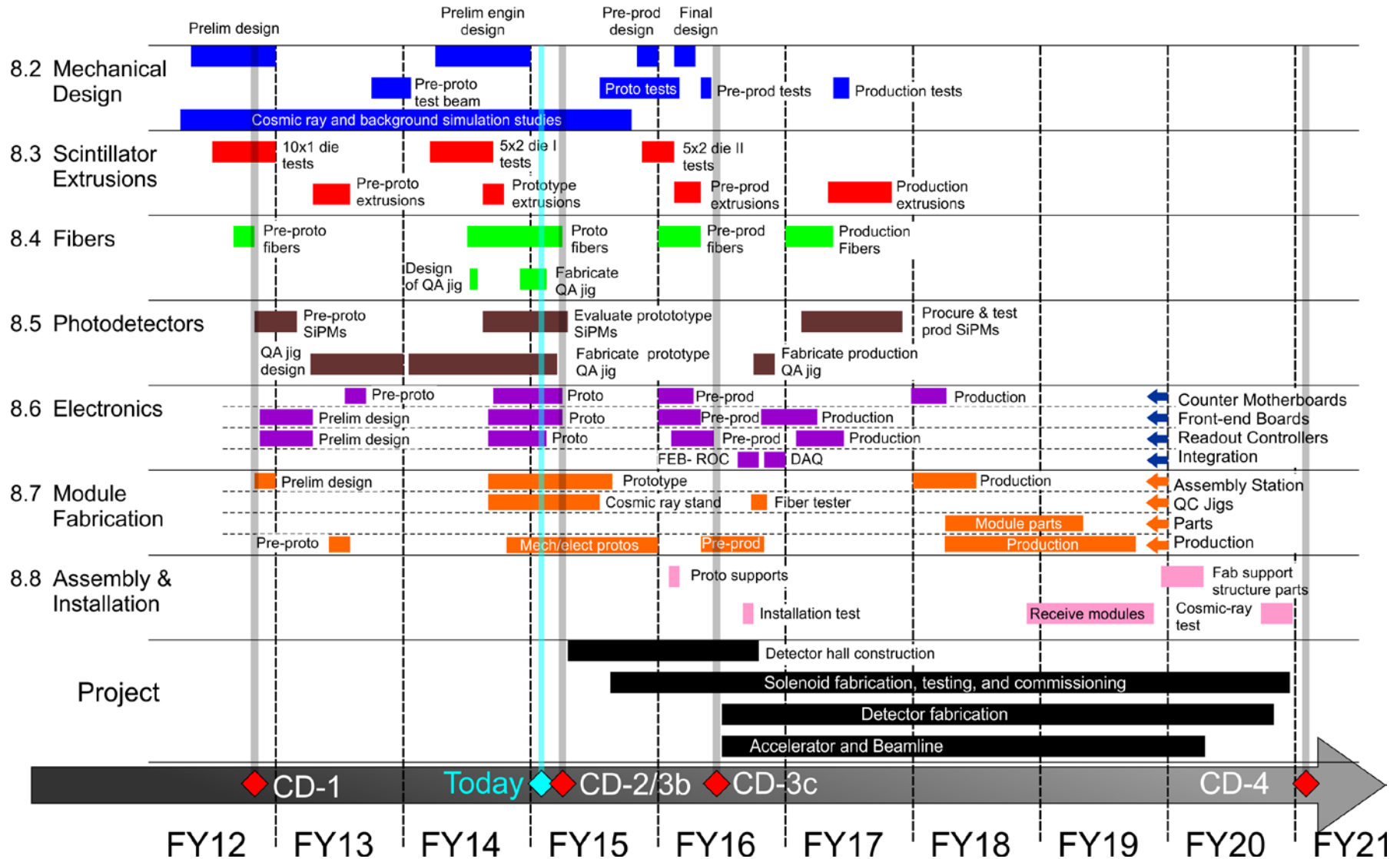
Labor Resources by FY



Major Milestones

- Aug 2015: Final die design approved
- Jul 2016: PO issued for materials for production extrusions fabrication
- Feb 2017: Production extrusions complete

Schedule



Summary

- FNAL/NICADD Extrusion Line Facility with co-extruder to deliver the white reflective coating has been in operation since 2005.
- Mu2e CRV Die for “5 cm x 2 cm – 2 holes” strip has been tested:
 - About 500 m of extruded scintillator bars were sent last June to the University of Virginia for testing.