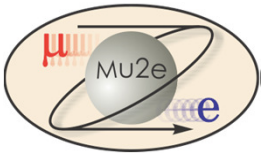
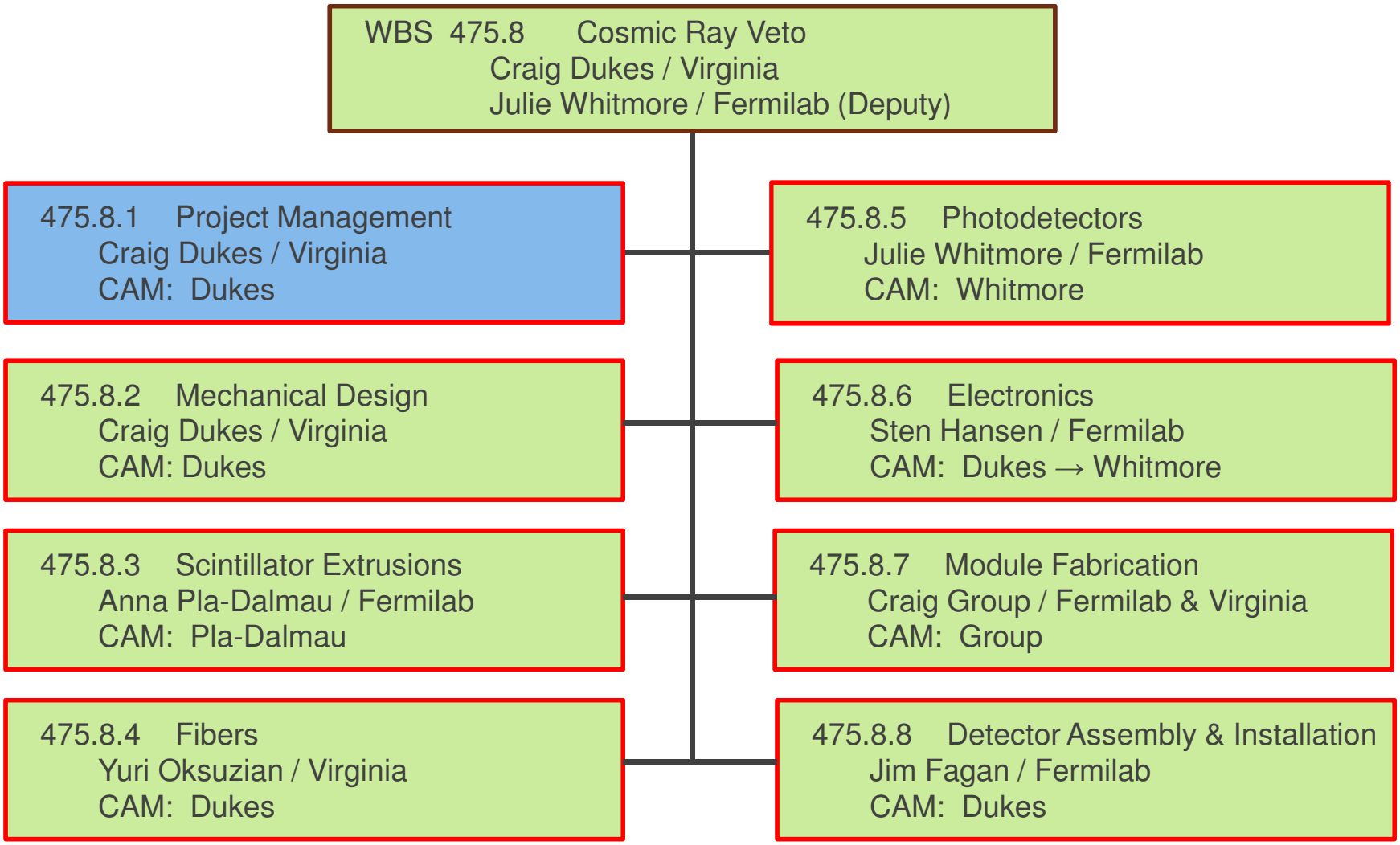
Fermilab

Mu2e Cosmic Ray Veto
8.1 Project Management



E. Craig Dukes
Level 3 Manager
October 21, 2014

Organizational Breakdown

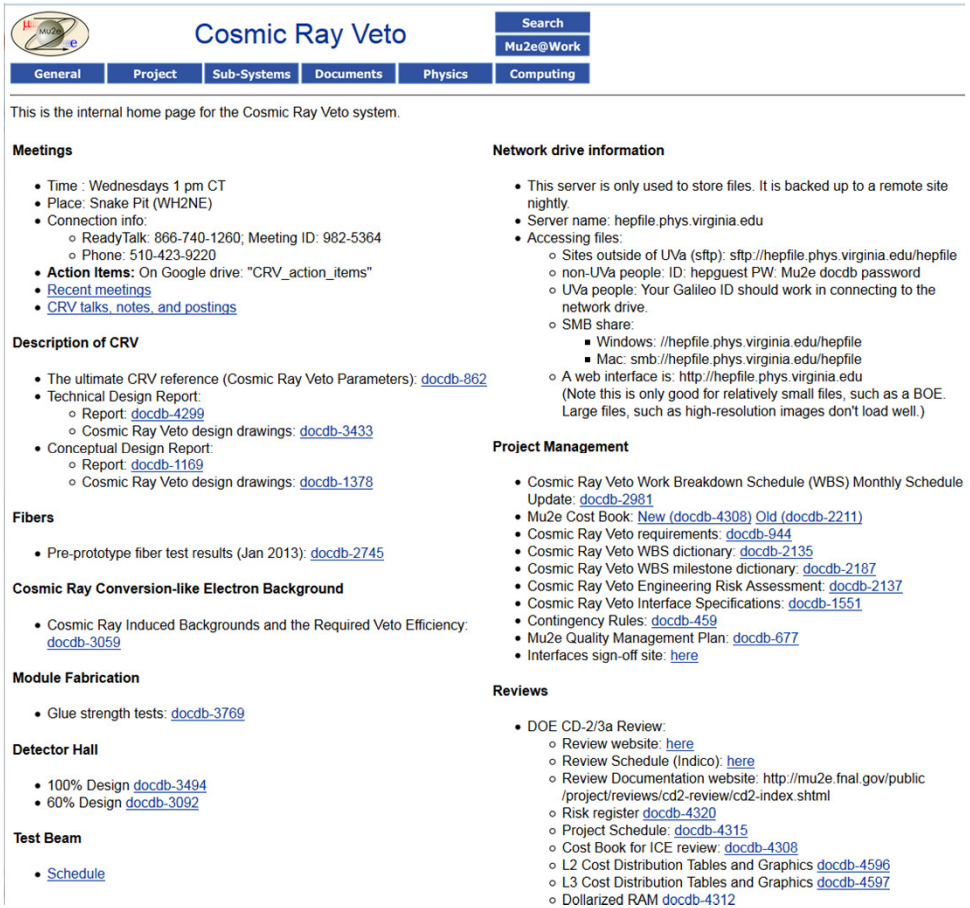


Organizational Breakdown

Cosmic Ray Veto WBS Structure					
	L3	L4	Title	CAM	BOE #
	8.1		**Project Management (Dukes)**	**Dukes**	
		8.1.1	Conceptual Design (Post CD-0; OPC)		
1		8.1.2	Preliminary & Final Design		3902
2		8.1.3	Implementatoin & Close-out		3903
	8.2		**Mechanical Design (Dukes)**	**Dukes**	
3		8.2.1	Detector Design		3904
4		8.2.2	Fabricate and Test Counter Prototypes		3905
5		8.2.3	Cosmic Ray Veto Simulations		3906
	8.3		**Scintillator Extrusions (Pla-Dalmau)**	**Pla-Dalmau**	
6		8.3.1	Die Design and Procurement		3907
7		8.3.2	Scintillator Extrusion Production		3908
	8.4		**Fibers (Oksuzian)**	**Dukes**	
8		8.4.1	Waveshifting Fiber Procurement		3909
9		8.4.2	Waveshifting Fiber Quality Assurance Design and Fabrication		3910
	8.5		**Photodetectors (Whitmore)**	**Whitmore**	
10		8.5.1	Photodetector Procurement		3911
11		8.5.2	Photodetector Quality Assurance Design and Fabrication		3912
	8.6		**Electronics (Hansen)**	**Dukes**	
12		8.6.1	Counter Mother Boards		3913
13		8.6.2	Front End Boards		3914
14		8.6.3	Readout Controllers		3915
15		8.6.4	Integration with DAQ		3928
	8.7		**Module Fabrication (Group)**	**Group**	
16		8.7.1	Design and Fabricate Assembly Station		3916
17		8.7.2	Assembly Station Quality Assurance Design and Fabrication		3917
18		8.7.3	Fabrication of Module Parts		3918
19		8.7.4	Module Production, Testing, and Shipping		3919
20		8.7.5	Breakdown of Module Factory		3920
	8.8		**Detector Assembly and Installation (Fagan)**	**Dukes**	
21		8.8.1	Test Installation		3921
22		8.8.2	Receive Production Modules at Fermilab		3922
23		8.8.3	Cosmic Ray Test Stand		3923
24		8.8.4	Module Support Structure		3924
25		8.8.5	Detector Installation and Testing		3925

How Do We Share Information?

- Weekly CRV meetings
- Meeting talks, memos, permanent repository: Mu2e docdb
- Temporary repository: Network drive hosted at UVa with web interface
- CRV webpage has important links
- Google doc on Google Drive for action items



Cosmic Ray Veto

Search | Mu2e@Work

General | Project | Sub-Systems | Documents | Physics | Computing

This is the internal home page for the Cosmic Ray Veto system.

Meetings

- Time : Wednesdays 1 pm CT
- Place: Snake Pit (WH2NE)
- Connection info:
  - ReadyTalk: 866-740-1260; Meeting ID: 982-5364
  - Phone: 510-423-9220
- **Action Items:** On Google drive: "CRV_action_items"
- Recent meetings
- CRV talks, notes, and postings

Description of CRV

- The ultimate CRV reference (Cosmic Ray Veto Parameters): docdb-862
- Technical Design Report:
  - Report: docdb-4299
  - Cosmic Ray Veto design drawings: docdb-3433
- Conceptual Design Report:
  - Report: docdb-1169
  - Cosmic Ray Veto design drawings: docdb-1378

Fibers

- Pre-prototype fiber test results (Jan 2013): docdb-2745

Cosmic Ray Conversion-like Electron Background

- Cosmic Ray Induced Backgrounds and the Required Veto Efficiency: docdb-3059

Module Fabrication

- Glue strength tests: docdb-3769

Detector Hall

- 100% Design docdb-3494
- 60% Design docdb-3092

Test Beam

- Schedule

Network drive information

- This server is only used to store files. It is backed up to a remote site nightly.
- Server name: hepfile.phys.virginia.edu
- Accessing files:
  - Sites outside of UVa (sftp): sftp://hepfile.phys.virginia.edu/hepfile
  - non-UVa people: ID: hepguest PW: Mu2e docdb password
  - UVa people: Your Galileo ID should work in connecting to the network drive.
  - SMB share:
    - Windows: //hepfile.phys.virginia.edu/hepfile
    - Mac: smb://hepfile.phys.virginia.edu/hepfile
  - A web interface is: http://hepfile.phys.virginia.edu (Note this is only good for relatively small files, such as a BOE. Large files, such as high-resolution images don't load well.)

Project Management

- Cosmic Ray Veto Work Breakdown Schedule (WBS) Monthly Schedule Update: docdb-2981
- Mu2e Cost Book: New (docdb-4308) Old (docdb-2211)
- Cosmic Ray Veto requirements: docdb-944
- Cosmic Ray Veto WBS dictionary: docdb-2135
- Cosmic Ray Veto WBS milestone dictionary: docdb-2187
- Cosmic Ray Veto Engineering Risk Assessment: docdb-2137
- Cosmic Ray Veto Interface Specifications: docdb-1551
- Contingency Rules: docdb-459
- Mu2e Quality Management Plan: docdb-677
- Interfaces sign-off site: here

Reviews

- DOE CD-2/3a Review:
  - Review website: here
  - Review Schedule (Indico): here
  - Review Documentation website: http://mu2e.fnal.gov/public/project/reviews/cd2-review/cd2-index.shtml
  - Risk register docdb-4320
  - Project Schedule: docdb-4315
  - Cost Book for ICE review: docdb-4308
  - L2 Cost Distribution Tables and Graphics docdb-4596
  - L3 Cost Distribution Tables and Graphics docdb-4597
  - Dollarized RAM docdb-4312

A Few Notes

- Spares are off-project.
  - Put into 475.10
  - This sometimes leads to curious gaps between activities that should be contiguous in the Gantt chart
- Installation off project (WBS 8.8.5)
- 475.8.9 is where OPC costs have been rolled up
- Baseline start date is May 1, 2014
- You may find apparent differences between BOEs and WBS (P6)
  - Most should be due to the fact that when SOWs (To UVa for example) are executed, hours are converted to $ in P6.
- Labor to non-Fermilab institutions shows up at M&S
- Two major resources:
  - TDR (docdb-4299)
  - crv_parameters.xlsx (docdb-862): has every important number

Design: External Review

- We had a day-long external review of: (1) design, (2) photodetectors, (3) electronics, and (4) module fabrication.
- Reviewers: Jim Freeman (Fermilab), Karen Kephart (Fermilab), Iouri Musienko (Notre Dame), Dave Pushka (Fermilab), and Sergey Los (Fermilab).
- Findings are written up in docdb-4250.
- No major issues with either design and plan.

Plan for CD2

- Simulations
  1. Refine the cosmic-ray background simulation to: (1) model changes in the detector hall design, (2) incorporate improvements in the tracking algorithm, and (3) speed it up to allow determine the required position dependence of the CRV efficiency.
  2. Refine and complete the neutron background rate estimates — Done
- Complete preliminary counter and module design — Done
- Fabricate prototype extrusions
  1. Measure their flatness and curvature ("banana") to determine gap size — Done
- Fabricate prototype counters:
  1. Measure their photoelectron yield — Done
  2. Measure their neutron efficiency — Postponed: no longer critical
- Evaluate SiPMs — First round done: new models ordered
- Fabricate prototype front-end electronics boards — Underway: awaited new rate estimate
- Module fabrication
  1. Fabricate a mockup module to test and optimize fabrication procedures — Done
  2. Fabricate and test working module with electronics: "vertical slice test" — Postponed
- QA/QC: determine procedures, procure free equipment, and design fabrication and testing equipment — Advanced
- Value management — Always

R&D Plan

- Critical parameter in meeting the efficiency requirement is the light yield
- A test beam run in fall of 2013 showed that the light yield with pre-prototype counters was insufficient
- A test beam run is scheduled in early 2015 to measure the light yield with what should be the final extrusions, fibers, SiPMs, and electronics
- Radiation tests of SiPMs and electronics are planned
- Neutron response test is planned
- Full-size module to be fabricated and shipped to Fermilab for mounting test
- Two electronics tests modules to be fabricated; one for Fermilab
- There is another round of pre-prototyping that is in the schedule
- Simulations:
  - Working on full simulation of detector response in framework, validating our model with test-beam data
  - Once model is complete we will redo the neutron/gamma rates
  - Conversion background simulation will continue with goal of 10X live time

Pre-CD-3 Tasks

- **Simulations:**
  - Verification non-factorized simulations in software framework to confirm work done on rates and radiation levels by the Neutron Working Group.
  - Complete the conversion-like electron background simulations: the goal is to simulate targeted areas with at least 10X the expected flux.
- **Design:** produce final engineering design.
- **Requirements:** fabricate and measure PE yield at the Fermilab Meson Test Beam Facility of counter prototypes using baseline fiber, SiPMs, and extrusions. Use results to select the fiber size.
- **SiPMs:** perform radiation and longevity tests; select vender.
- **Electronics:** produce and test prototype counter motherboards, front-end boards and readout controllers.
- **Module fabrication:** make a large mechanical prototype module, two small electronics test modules, two large side modules.
- **Detector installation:** test mounting scheme for side modules.

Risks & Opportunities

There are no major cost or schedule risks

- More sophisticated simulations indicate higher rates
  - Risk: low
  - Mitigation: more shielding in targeted areas
- Photoelectron yield too low / too high
  - Risk/Opportunity: low/moderate
  - Mitigation: tune fiber diameter
- Fiber vender goes out of business
  - Risk: low
  - Mitigation: order fiber asap; use larger diameter inferior fibers
- Simulations indicate that more CRV coverage needed
  - Risk: moderate
  - Mitigation: fabricate several extra modules

8.1 Project Management Activities

- Project planning.
- Scheduling.
- Costing.
- Integration and maintenance of the fabrication databases
- Miscellaneous management activities.
- Travel to Fermilab for the L2 head of the cosmic ray veto group.
- Partial support for L3 managers.
- Resources are generally assigned as level of effort.

Cosmic Ray Veto

Reviews and Recommendations

Director's Independent Design Review

Date: May 3-5, 2011
Reviewers: Jeff Nelson, Julie Whitmore, Rainer Novotny

Recommendations:

- As full-statistics background simulations and light yield data become available both for cosmic ray backgrounds in the experiment and for backgrounds in the veto system (e.g. from neutrons), continue to revise the design in anticipation of the next design phase.

This has been done, and the design is quite a bit different now.

Director's CD-1 Review

Date: April 3-5, 2012
Reviewers: Rafe Schindler

Recommendations:

20. Funding should be made available in a timely way to complete the necessary R&D work toward CD-2.

21. Adopt a more significant preproduction phase (e.g. 5-10%) after the indicated R&D program that would allow for validation of the construction staffing model, production-tooling, quality control and production throughput.

22. Develop a resource-leveled schedule that ensures better continuity of the task's technical staff throughout the R&D, production and testing.

23. Complete the neutron background simulations, which will inform the final optical design prior to CD-2.

These have all been implemented.

DOE CD-1 Review

Date: June 5-7, 2012
Reviewers: Steve Kettell, Douglas Bryman, Rik Yoshida

Recommendations:

20. Consider possible experiments to measure the production of 105 MeV delta rays from cosmic muons to validate the simulation used for the background estimate.

We did not have the resources to mount such an experiment. However, a comparison was made between Geant4 and theory which shows excellent agreement. At JLab the Kaon Aerogel Detector is being fabricated. High energy delta rays (p > 2.1 MeV/c) will fire the Cerenkov detector, producing a background. They will measure the rate of delta production and compare it to Geant4.

Director's Independent Design and CD-2/3 Review

Date: July 8-10, 2014
Reviewers: RIch Talaga

Recommendations:

30. Production of a suitable number of spare modules supported by Project funding should be considered.

We will fabricate 9 spare modules in addition to prototype and pre-production modules. They will be fabricated at the same time: only the funding source will be different.

Independent Cost Review

Date: August 26, 2014

ICE Team Review. The majority of the costs for this WBS element are in fabrication of module parts, and module production, testing, and shipping. The fabrication sub-element is over 90% procurement, and these M&S costs are supported by current vendor quotes from a known supplier. The production sub-element uses the parts acquired in the fabrication activity to assemble the module. The estimate is very explicit describing the number of modules needed; the epoxy and other consumables needed to build the modules; the rental space required to assemble the modules; the average cost for rental space in Charlottesville, Virginia; specs and pricing for shipping containers to transport the modules from University of Virginia to Fermilab; and freight quotes.

The BOE, assumptions, and backup are reasonable for this WBS element. The level of detail is very good.

Reply to Review Charge

Review Charge

I request that you conduct an Independent Project Review of the Muon-to-Electron Conversion (Mu2e) Project on August 19–21, 2014 at Fermilab. The purpose of this review is to evaluate the project's readiness for Critical Decision CD-2 which will approve of the proposed Performance Management Baseline for technical scope, cost and schedule, as well as the project's readiness for Critical Decision CD-3b which will approve the continuation of procurement and fabrication. Critical Decision CD-3a permitted the initial procurement of conductor for the project.

Your review committee is requested to perform a general assessment of the project's progress, current status, and the identification of potential issues, as well as addressing the following specific questions for CD-2:

1. Do the proposed technical design and associated implementation approach satisfy the performance requirements? How has the project team ensured that the subsystems will be fully integrated? Are the CD-4 goals reasonable and well defined?
2. Is the cost estimate and schedule consistent with the plan to deliver the technical scope? Is the contingency adequate for the risk?
3. Are the management structure and resources adequate to deliver the proposed technical scope within the baseline budget and schedule as specified in the PEP?
4. Is the documentation required by DOE Order 413.3B for CD-2 complete?
5. Are ES&H aspects being properly addressed given the project's current stage of development?
6. Has the project responded satisfactorily to the recommendations from the previous independent project review?

The committee is also asked to address the following questions specifically for CD-3b:

7. Is the detailed design sufficiently mature so that the project can continue with procurement and fabrication? Has there been adequate progress on the long-lead procurement activities approved under CD-3a?
8. Is the documentation required by DOE Order 413.3B for CD-3b complete?

Charge # 1

- Do the proposed technical design and associated implantation approach satisfy the performance requirements? How has the project team ensured that the subsystems will be fully integrated? Are the CD-4 goals reasonable and well defined.
  - The design is well understood and much effort has been expended to insure that it meets the requirements, a plan is in place to measure that the requirements are met.
  - Requirements and Interface documents have been approved by stakeholders.
  - The following link take you to the Fermi Project Management Policies and procedures. http://www.fnal.gov/directorate/OPMO/PolProc/home.htm

Charge #2

- Is the cost estimate and schedule consistent with the plan to deliver the technical scope? Is contingency adequate for the risk?
  - Independent Cost REview (ICE): "The BOE, assumptions, and backup are reasonable for this WBS element. The level of detail is very good."
  - Estimates for the Cosmic Ray Veto are complete: 91% of cost understood at the Preliminary Design level or higher, with most estimates based on very similar systems, with the same personnel, that have recently been built at Fermilab.
  - Contingency of 38% is adequate at this stage of the project.
  - Risks are minor and understood, mitigated where possible.

Charge #3

- Are the management structure and resources adequate to deliver the proposed technical scope within the baseline budget and schedule as specified in the PEP?
  - From the sub-project management level the PM has communicated the need to stay within the cost and schedule baseline. The tools and personnel to monitor and analyze the work status exists.

Charge #4

- Is the documentation structure by DOE Order 413.3b for CD-2 complete?
  - While many of the documents have been completed by the Level One project manager WBS 475.08 has:
    - Contributed to a number of the documents such as the: TDR, BOEs, Requirements, WBS Dictionary, WBS Milestone Dictionary, Engineering Risk Assessment, Interface Specifications, Quality Management Plan.
    - Have read, not memorized, all of the management documents such a PEP, PMP, and Acquisition Strategy. Know where to find what I need to manage my subproject.
  - Addressed and completed those items unique to my sub-project.

Charge #5

- Are ES&H aspects being addressed given the project's current stage of development?
  - ES&H was considered and addressed in the design.
    - Electrical hazards
    - Life safety
    - Proper handling and use of toxic materials
  - Extensive documentation
    - Project: Mu2e Hazard Analysis document (Mu2e-doc-675)
    - Cosmic Ray Veto: Quality Assurance and Safety Program for the Cosmic Ray Veto Module Factory (Mu2e-doc-4150)

Charge #6

- Has the project responded satisfactorily to the recommendations from the previous independent project review?
  - Responses from past reviews.

Mu2e-doc-#	Title	Author(s)	Topic(s)	Last Updated
4405-v8	Replies to Recommendations from Director's pre-CD-2/3b Review	Doug Glenzinski *et al.*	FNAL Reviews	13 Oct 2014
4657-v0	Replies to Recommendations from Solenoid AOC meeting no. 6	Michael J Lamm *et al.*	Internal Reviews Solenoids	10 Oct 2014
2358-v8	Replies to CD-1 Recommendations	Doug Glenzinski *et al.*	CD-1	10 Oct 2014
2067-v9	Replies to Recommendations from Independent Design Review	Doug Glenzinski *et al.*	FNAL Reviews	10 Oct 2014
4316-v2	Replies to Action Items from the CD-3a Review	Doug Glenzinski *et al.*	DoE Reviews	10 Oct 2014
4155-v2	Replies to Action Items for DOE 27-February-2014 Briefing	Doug Glenzinski *et al.*	DoE Reviews	25 Jun 2014
3457-v4	Replies to Action Items for DOE 25-September-2013 Briefing	Doug Glenzinski *et al.*	DoE Reviews	14 May 2014
2240-v7	Responses to Recommendations from the Director's pre-CD1 Review	Doug Glenzinski *et al.*	FNAL Reviews CD-1	14 May 2014
4076-v2	Minutes from IB Meeting of 17 April 2014	Doug Glenzinski	Institutional Board	28 Apr 2014
4112-v1	Questions/Replies from Tracker digitizer review	Vadim L Rusu	Internal Reviews	25 Apr 2014
2579-v5	Replies to Nov-2012 DOE mini-Review Recommendations	Doug Glenzinski *et al.*	DoE Reviews	25 Feb 2014
3300-v1	Responses to Recommendations from the Solenoid AOC	Giorgio Ambrosio *et al.*	Internal Reviews Solenoids	13 Nov 2013
2939-v2	Replies to Recommendations for DOE 09-April-2013 mini-Review	Doug Glenzinski *et al.*	DoE Reviews	28 Oct 2013
2500-v1	Replies to CD-1 Recommendations Relevant for 19-Nov-2012 DOE mini-Review	Doug Glenzinski	Project Management CD-1	05 Nov 2012
2466-v2	Responses to Tracker Review Committee	Aseet Mukherjee	T Tracker	25 Oct 2012

Charge #7

- Is the detailed design sufficiently mature so that the project can continue with procurement and fabrication? Has there been adequate progress on the long-lead procurement activities approved under CD-3a?
  - Not applicable to CRV at CD-2 stage.

Charge #8

- Is the documentation required by DOE Order 413.3b for CD-3b complete?
  - Not applicable to CRV at CD-2 stage.

Level 2 Graphics and Tables

Cost Table: CRV

Costs are fully burdened in AY $K
Includes actuals

Note: Labor Fermilab only;
Univ. labor captured in M&S.

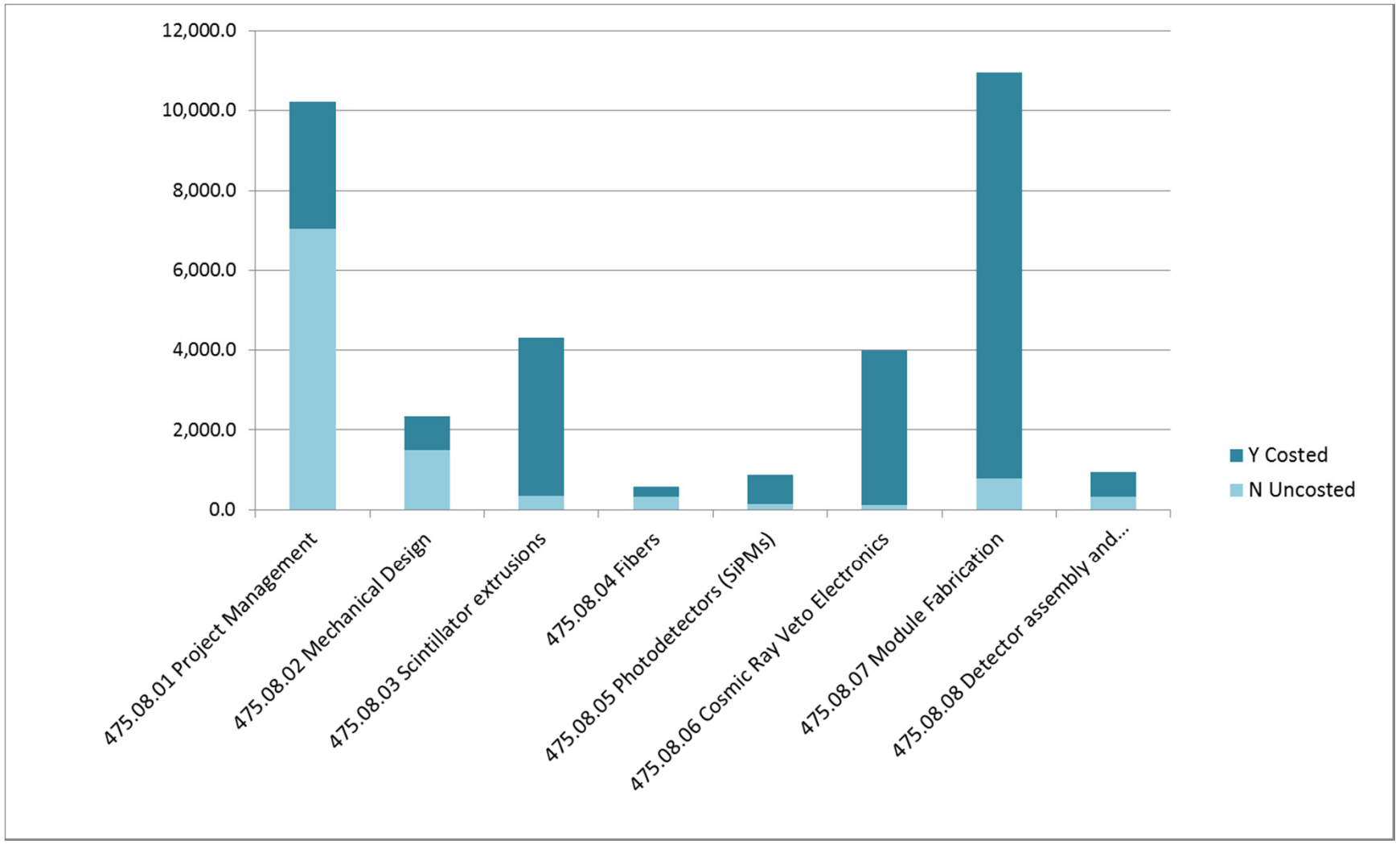
	Base Cost (AY K$)					
	M&S	Labor	Total	Uncertainty (on remaining budget)	% Contingency (on remaining budget)	Total Cost
475.8.1 Project Management	267	178	445	75	21%	520
475.8.2 Mechanical Design	135	3	138	24	38%	162
475.8.3 Scintillator extrusions	567	462	1,029	209	25%	1,238
475.8.4 Fibers	462		462	106	24%	568
475.8.5 Photodetectors (SiPMs)	464	305	769	190	41%	959
475.8.6 Electronics	1,314	407	1,720	511	33%	2,231
475.8.7 Module Fabrication	1,482	8	1,490	466	35%	1,956
475.8.8 Detector assembly and installation	127	81	208	64	35%	273
475.8.9 Conceptual Design/R&D	258	252	511		0%	511
475.8.99 Risk Based Contingency				318	-	318
Grand Total	5,077	1,696	6,773	1,963	38%	8,735

Cost Table: CRV

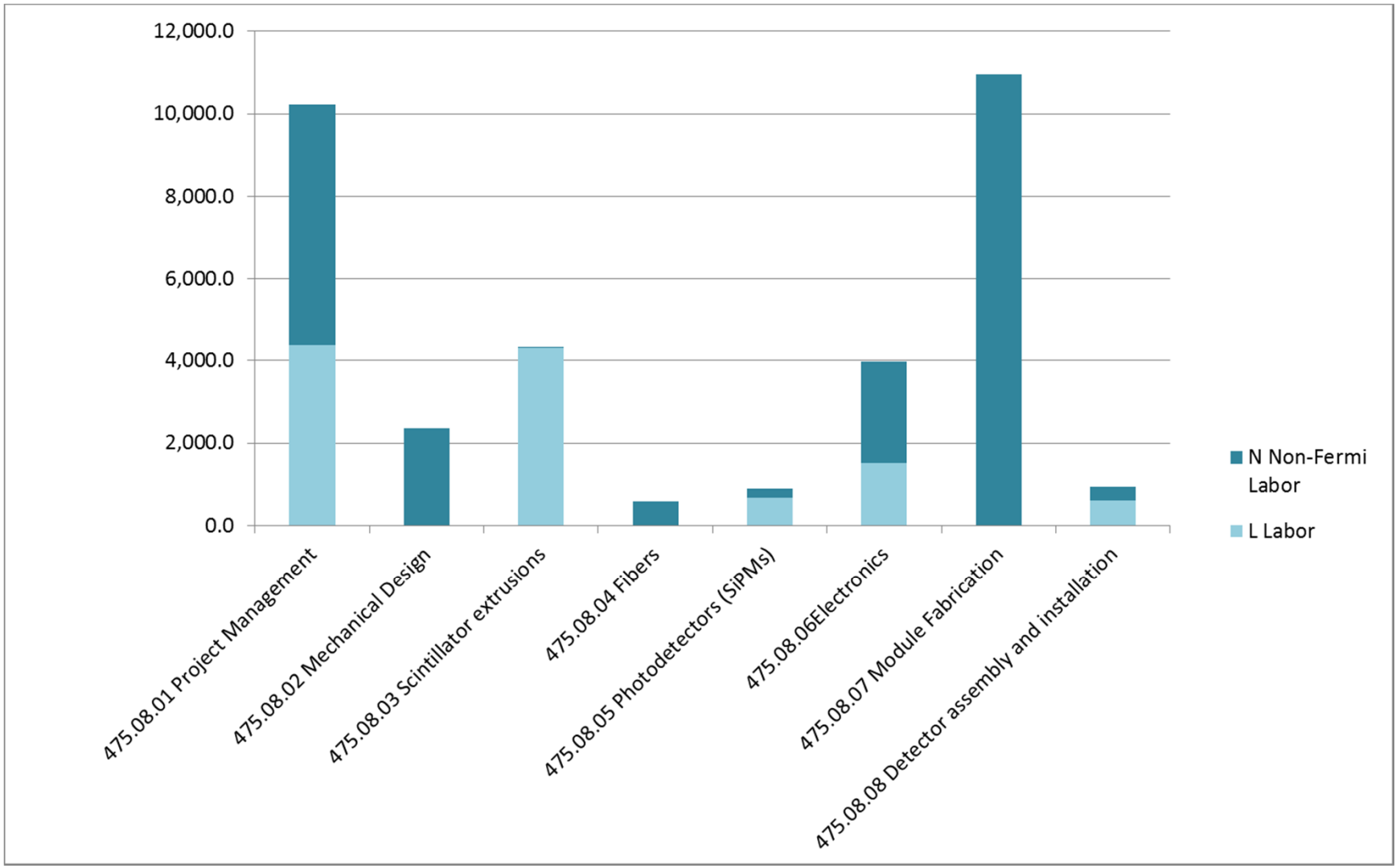
Costs are fully burdened in AY $K

Mu2e Cost Book	October 10, 2014		CD-2/3b DoE Review				
WBS	Direct Labor Hours	Direct Non-Fermi Hours	Direct M&S	B A C	Estimate Uncertainty	Total	Contingency on remaining budget
475.08 Cosmic Ray Veto	20,394	24,189	3,846,811	6,772,668	1,962,633	8,735,302	38%
475.08.01 Cosmic Ray Veto Project Management	4,785	6,103	138,842	445,056	74,716	519,773	21%
475.08.01.02 Preliminary & Final Design (Post CD-1; PED)	1,548	1,765	91,960	181,062	21,918	202,979	25%
475.08.01.03 Implementation & Close-out (Post CD-3; Line Item)	3,237	4,337	46,882	263,995	52,799	316,794	20%
475.08.02 Cosmic Ray Veto Mechanical Design	31	2,760	106,532	137,940	24,112	162,052	38%
475.08.02.01 Detector Design		640	60,110	64,761	9,261	74,023	54%
475.08.02.02 Fabricate and test Counter Prototypes	27	1,540	28,653	55,036	14,851	69,887	32%
475.08.02.03 Cosmic Ray Veto Simulations	4	580	17,769	18,143		18,143	-
475.08.03 Scintillator extrusions	5,948	32	449,229	1,028,891	209,322	1,238,213	25%
475.08.03.01 Die design and procurement	1,388	32	125,057	234,195	36,982	271,177	36%
475.08.03.02 Scintillator extrusion production	4,561		324,172	794,695	172,341	967,036	24%
475.08.04 Cosmic Ray Veto Fibers		616	430,223	462,325	105,992	568,318	24%
475.08.04.01 Waveshifting fiber (WF) procurement		596	416,273	447,881	104,548	552,428	24%
475.08.04.02 WF quality Assurance design and fabrication		20	13,950	14,445	1,444	15,889	11%
475.08.05 Silicon Photomultipliers (SiPMs)	2,631	332	406,763	769,193	189,941	959,134	41%
475.08.05.01 Silicon Photomultipliers (SiPMs) procurement	312	212	374,341	444,617	147,962	592,579	36%
475.08.05.02 Silicon Photomultipliers (SiPMs) quality assurance design	2,319	120	32,423	324,576	41,979	366,555	80%
475.08.06 Cosmic Ray Veto Electronics	3,113	2,857	976,891	1,720,262	510,552	2,230,815	33%
475.08.06.01 Counter Mother Boards	335	1,453	210,584	350,098	86,024	436,122	29%
475.08.06.02 Front-end Boards	2,258	340	566,551	988,896	267,959	1,256,855	29%
475.08.06.03 Readout Controllers	40	904	174,539	268,023	86,145	354,168	33%
475.08.06.04 Integration with DAQ	480	160	25,217	113,246	70,424	183,670	80%
475.08.07 Cosmic Ray Veto Module Fabrication	663	11,152	1,005,146	1,489,982	465,611	1,955,593	35%
475.08.07.01 Design and fabricate assembly station		891	123,161	163,040	61,674	224,714	47%
475.08.07.02 Assembly Station Quality assurance design and fabrication	663	440	83,421	105,795	23,448	129,243	65%
475.08.07.03 Fabrication of Module Parts		80	413,000	453,551	93,061	546,612	21%
475.08.07.04 Module Production, Testing, Shipping		9,084	379,564	741,324	276,258	1,017,582	41%
475.08.07.05 Breakdown of Module Factory		657	6,000	26,272	11,170	37,442	43%
475.08.08 Detector assembly and installation	797	337	95,367	208,353	64,385	272,738	35%
475.08.08.01 Test Installation	224			20,643	7,225	27,867	35%
475.08.08.02 Recieve Production Modules at Fermilab	188	177		18,022	6,308	24,330	35%
475.08.08.03 Detector Assemly and Installation: Cosmic Ray Test Stand	289	160	3,000	36,411	10,870	47,281	80%
475.08.08.04 Module Support Structure	96		92,367	133,277	39,983	173,260	30%
475.08.09 Cosmic Ray Veto Conceptual Design/R&D	2,426		237,818	510,665		510,665	-
475.08.09 Cosmic Ray Veto Conceptual Design/R&D	2,426		237,818	510,665		510,665	-
475.08.99 Risk Based Contingency					318,000	318,000	-
475.08.99 Risk Based Contingency					318,000	318,000	-
Grand Total	**20,394**	**24,189**	**3,846,811**	**6,772,668**	**1,962,633**	**8,735,302**	**38%**

Costed / Uncosted Labor by Hours

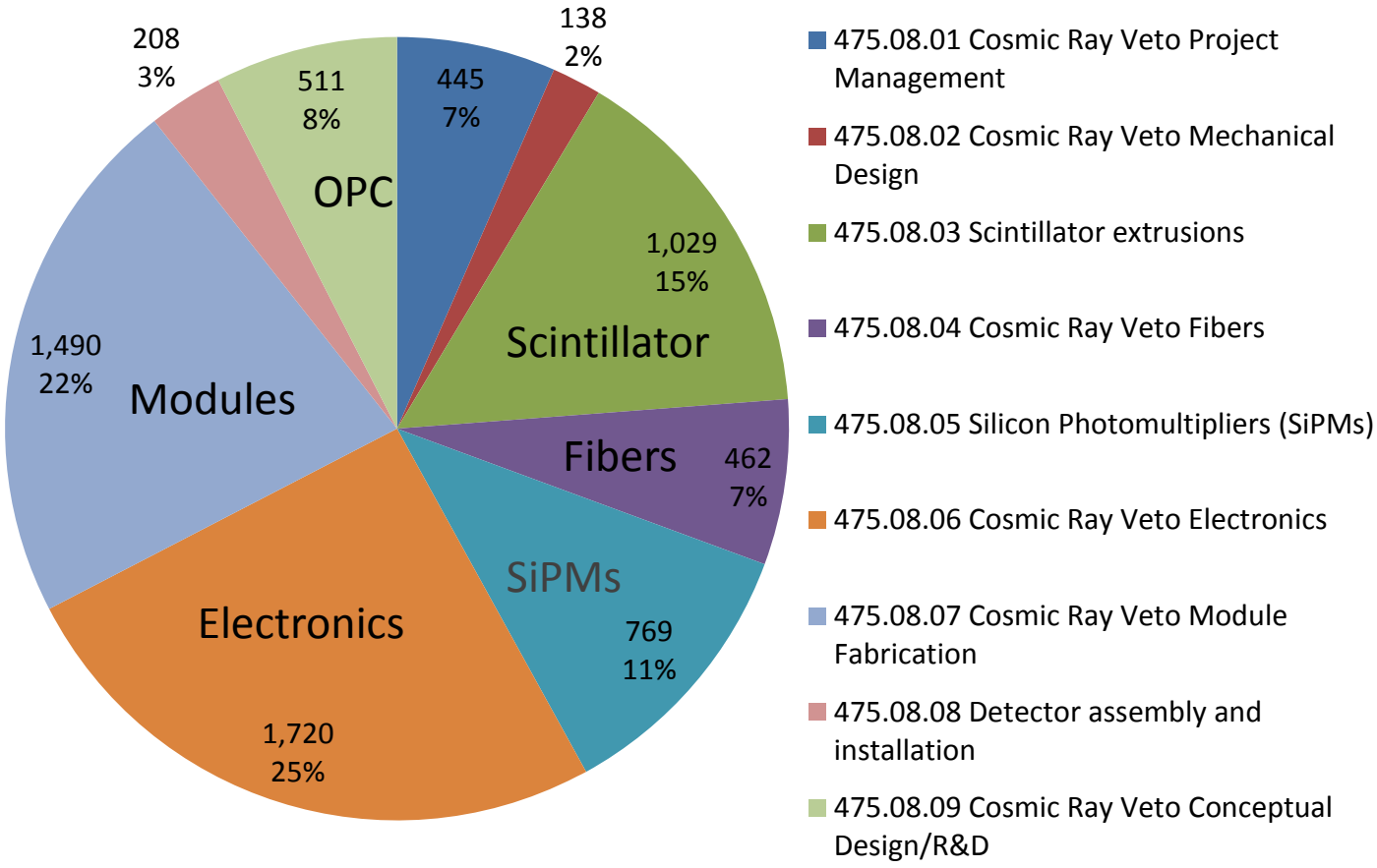


Fermilab / non-Fermilab Labor by Hours



Cost Breakdown: Sub-Project

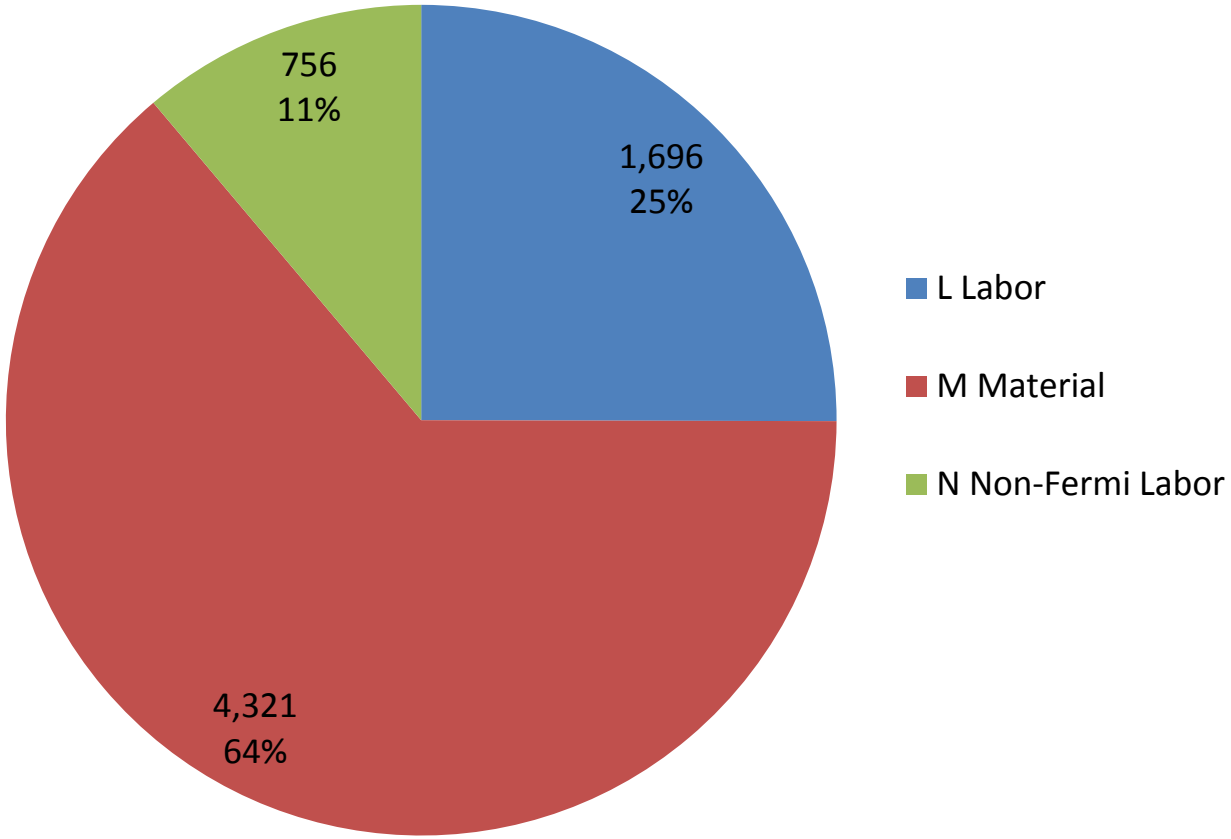
Base Cost in AY K$



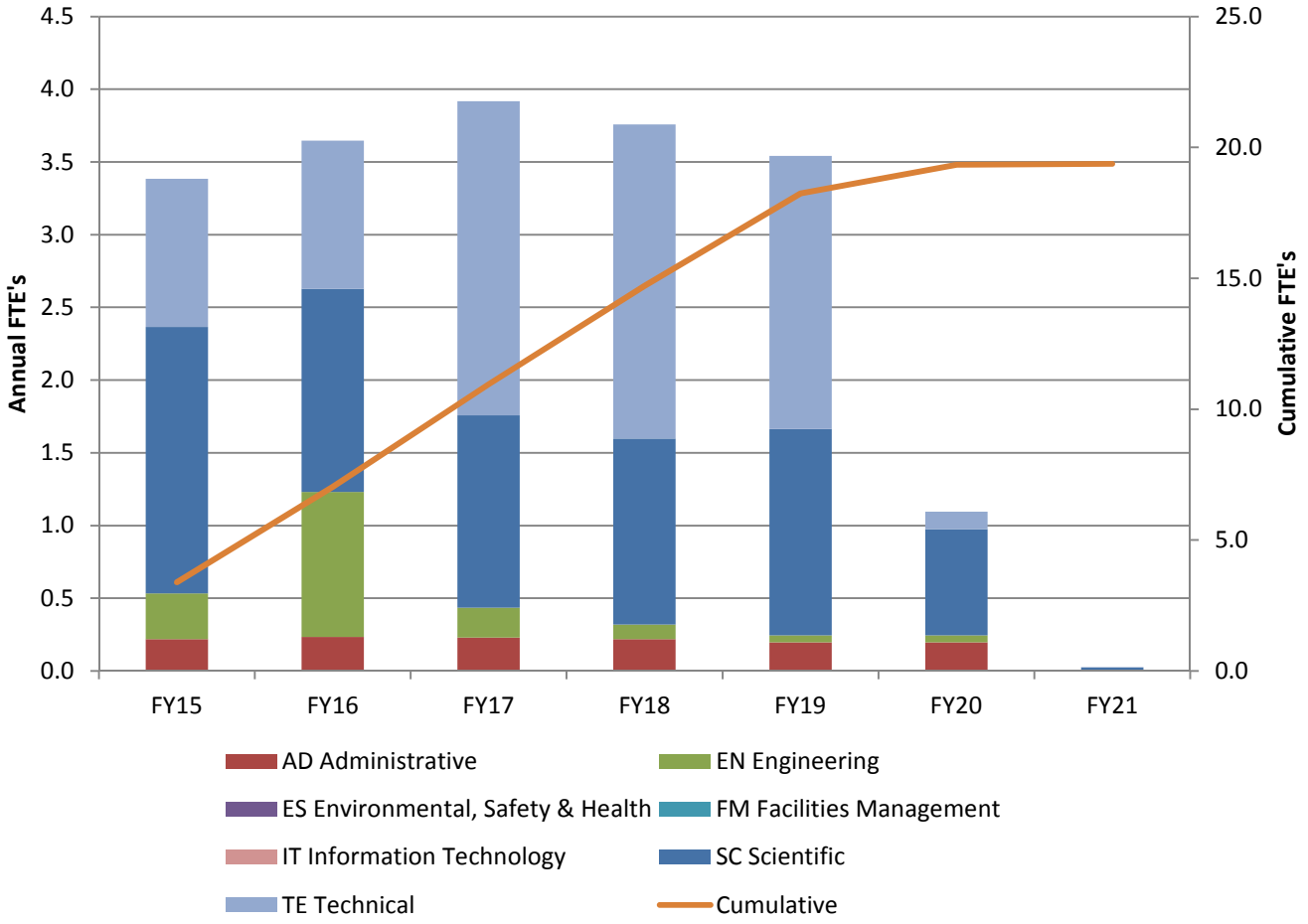
Cost Breakdown: Resource Type

Base Cost in AY K$

Note: non-Fermi labor hours > Fermi

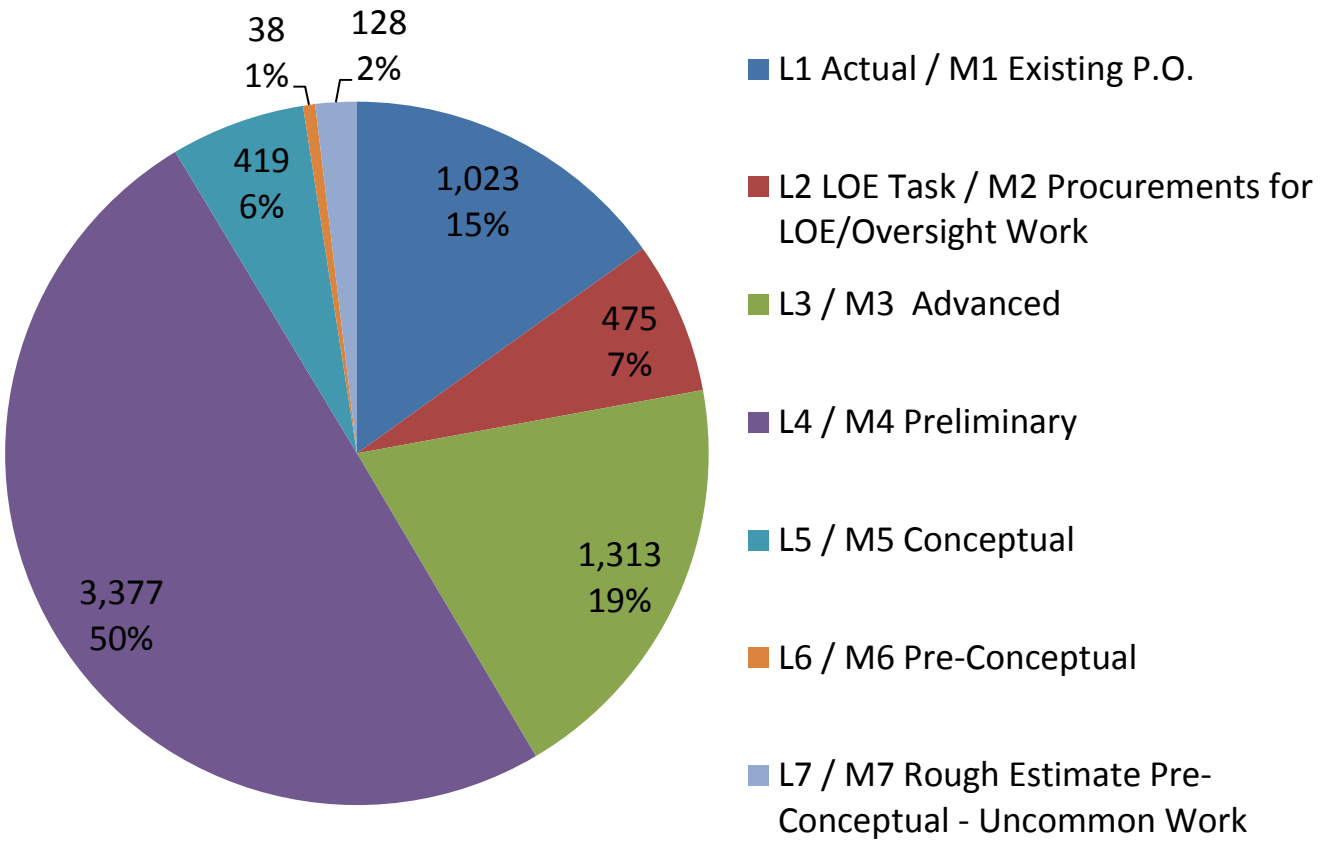


Labor Resources by FY

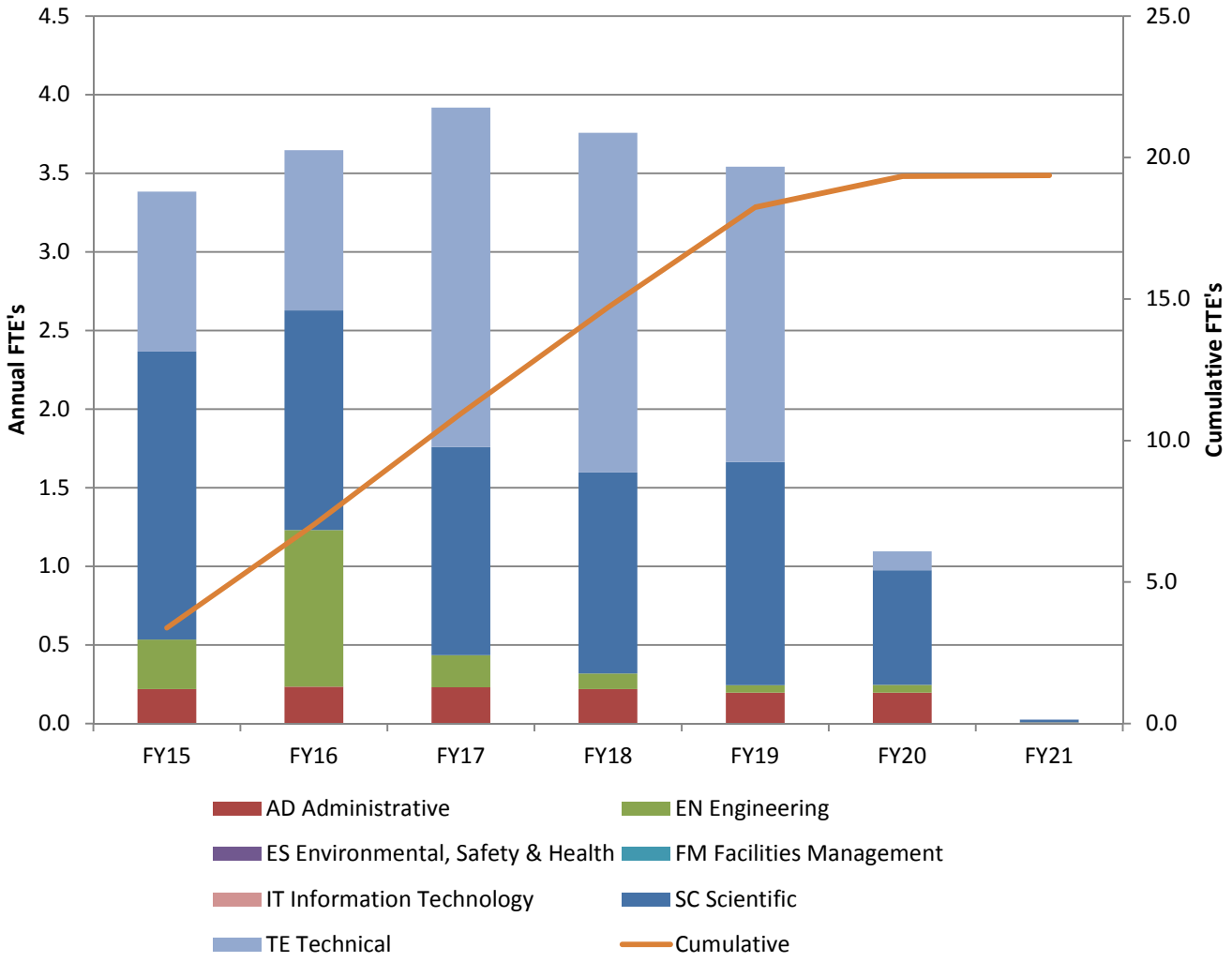


Quality of Estimate

Base Cost in AY K$

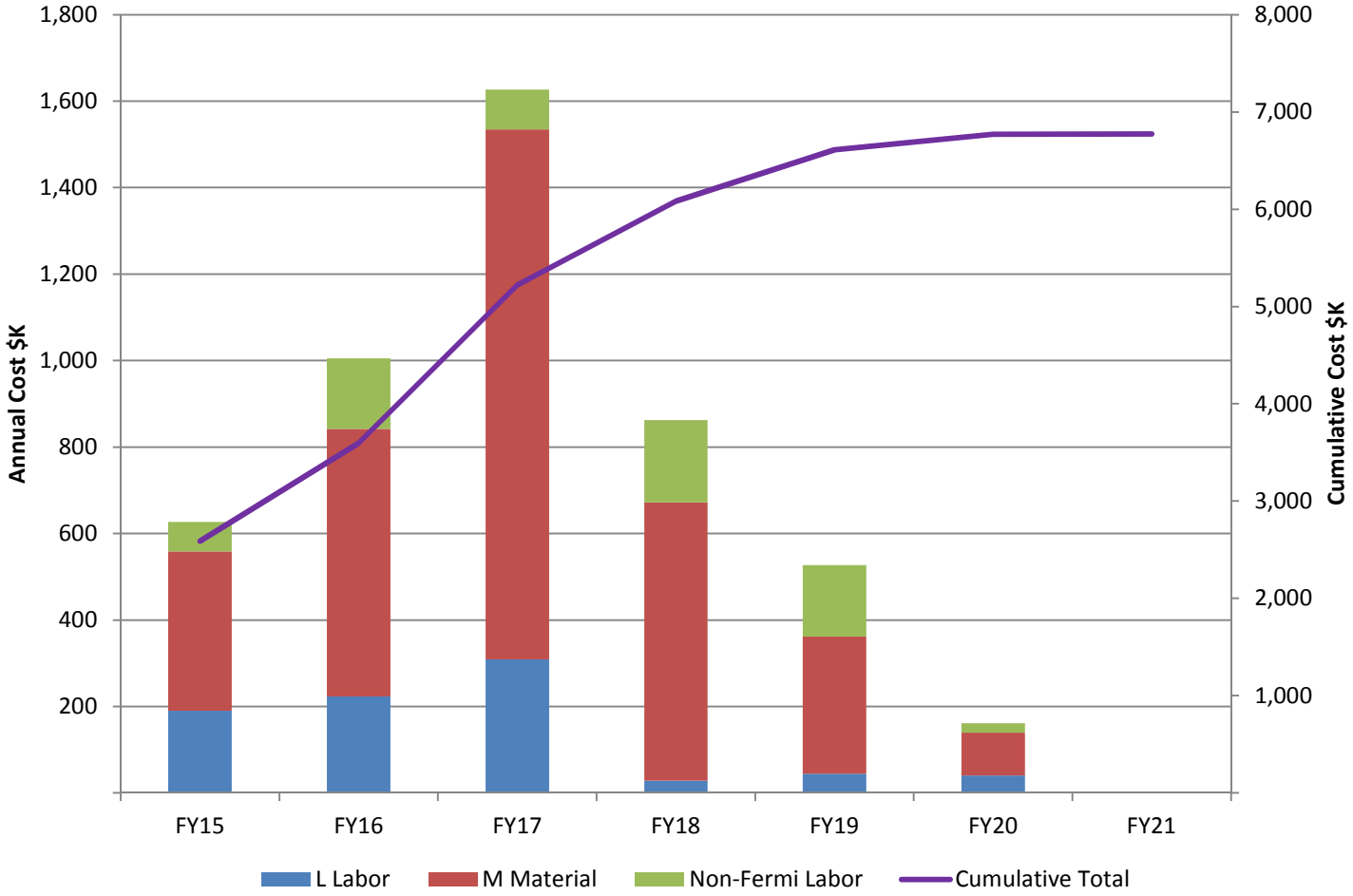


Labor Resources by FY



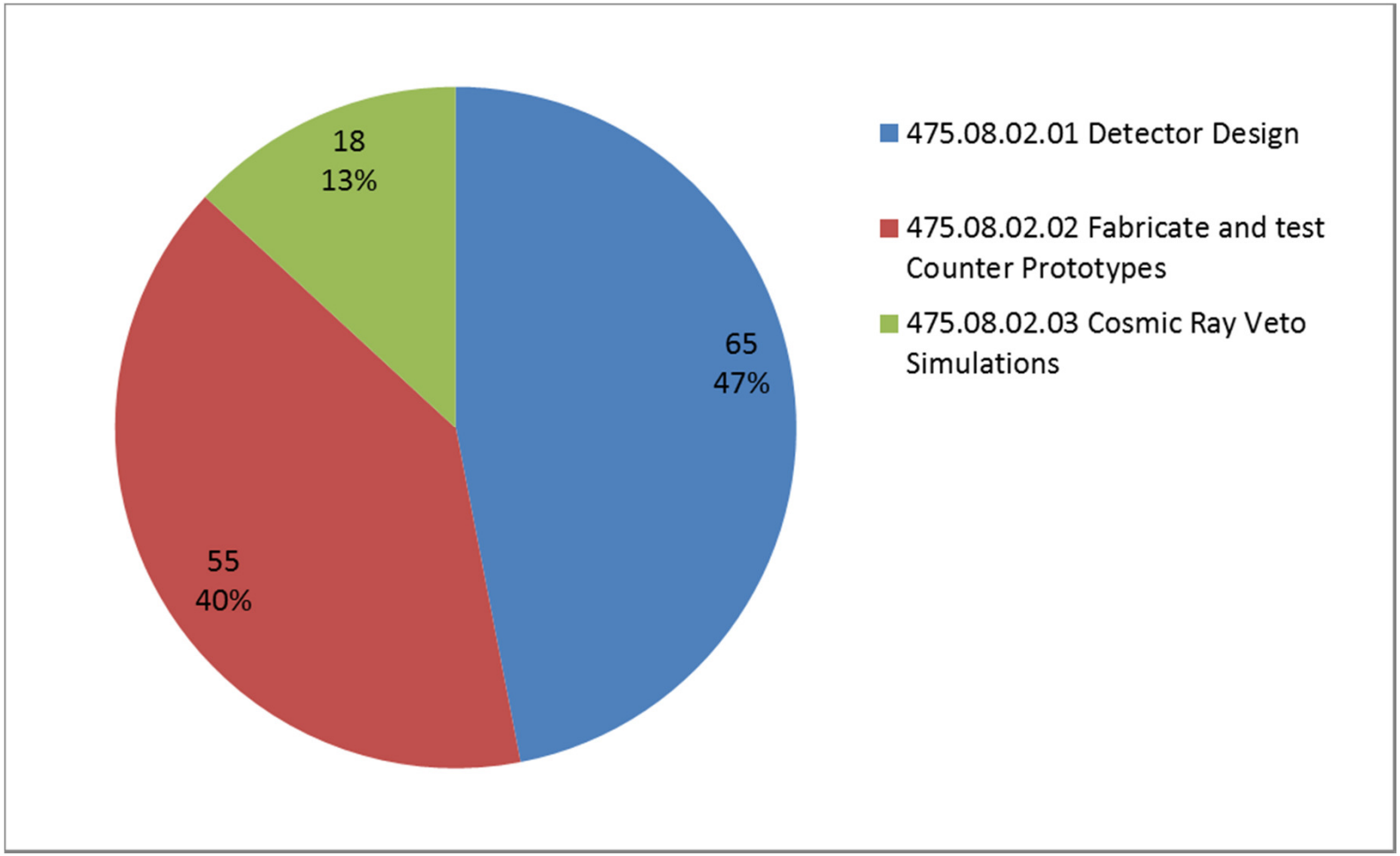
Labor / Material Breakdown by FY

Base Cost in AY K$

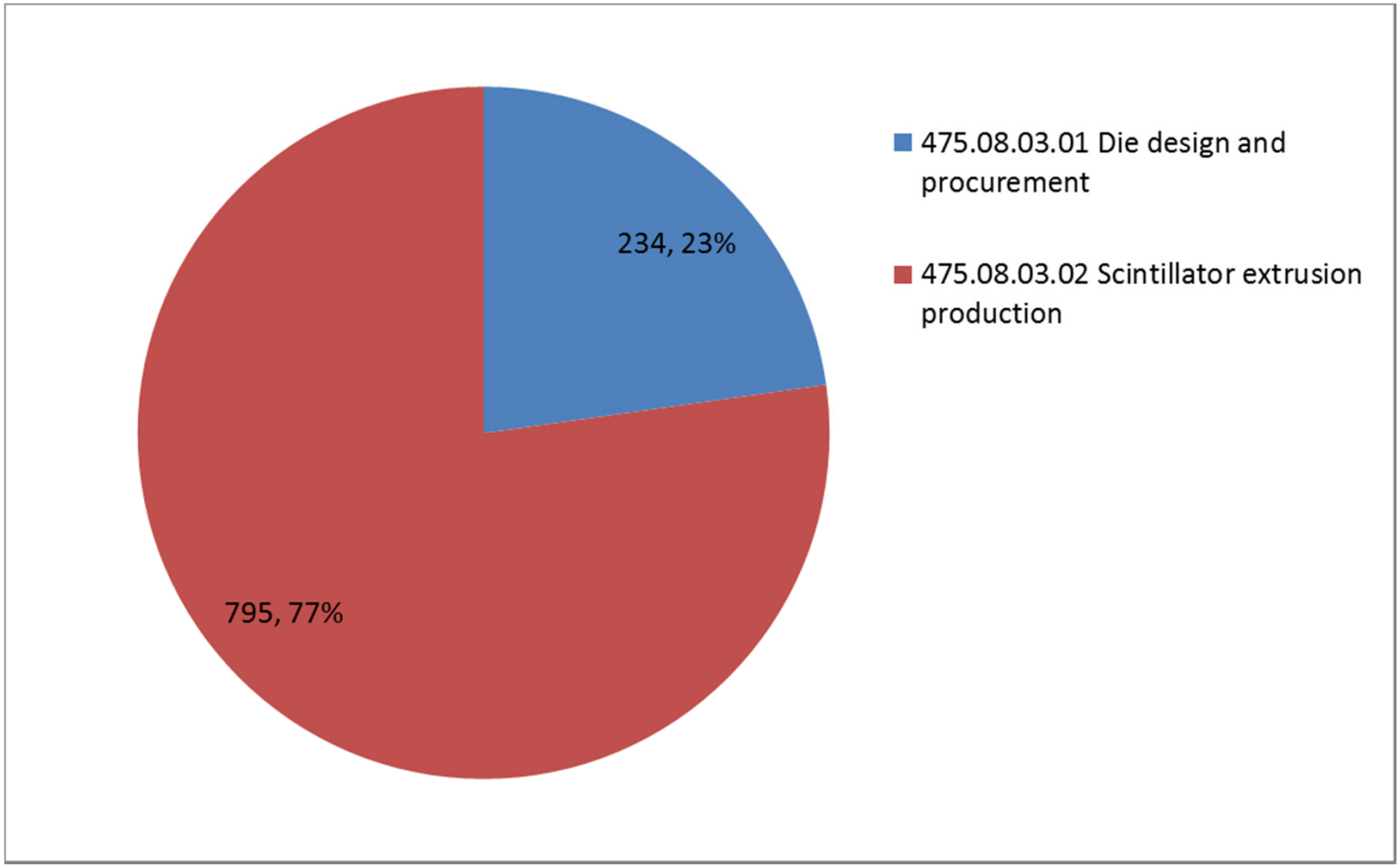


Project Slides: Cost Breakdown

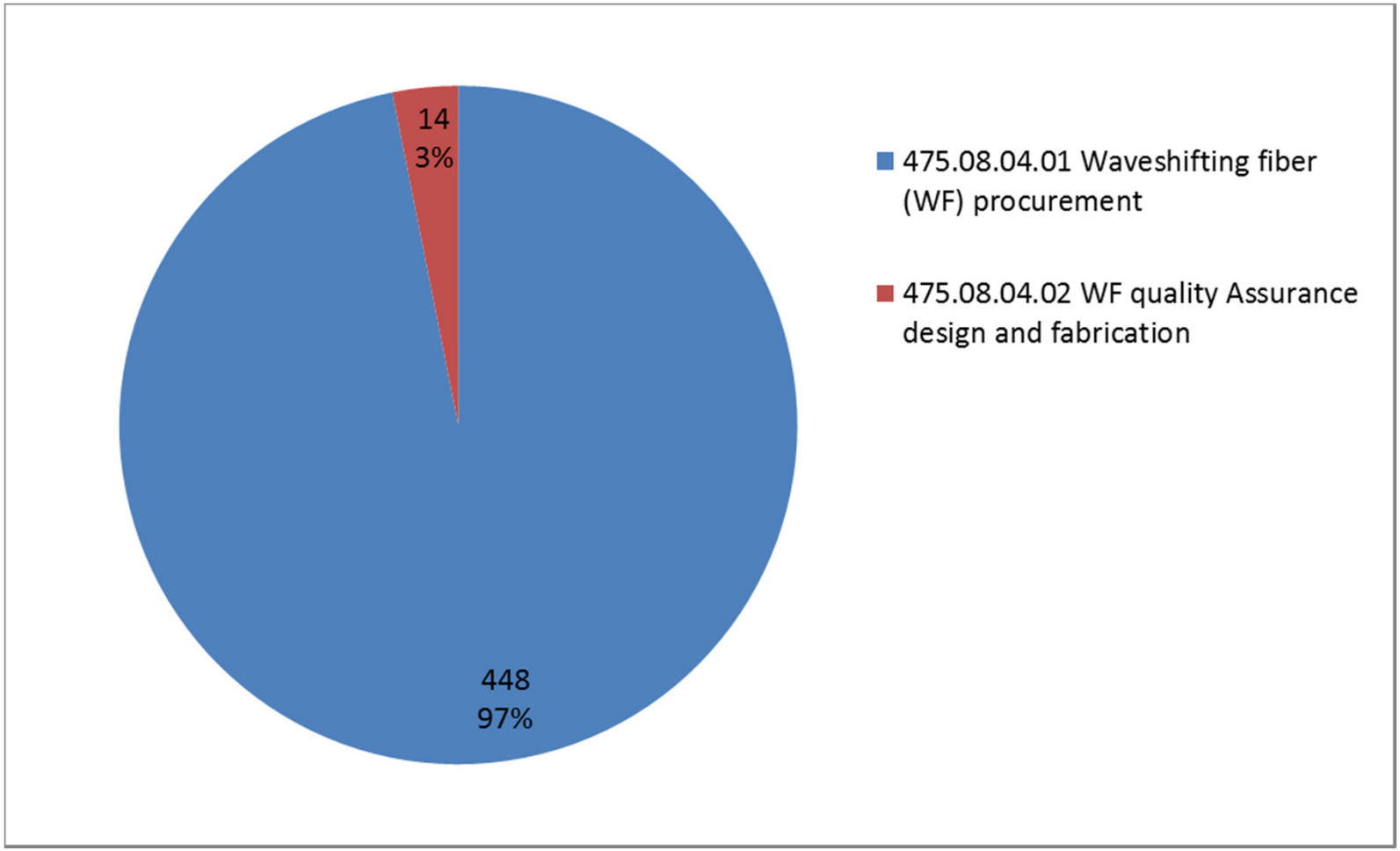
8.2 Mechanical Design



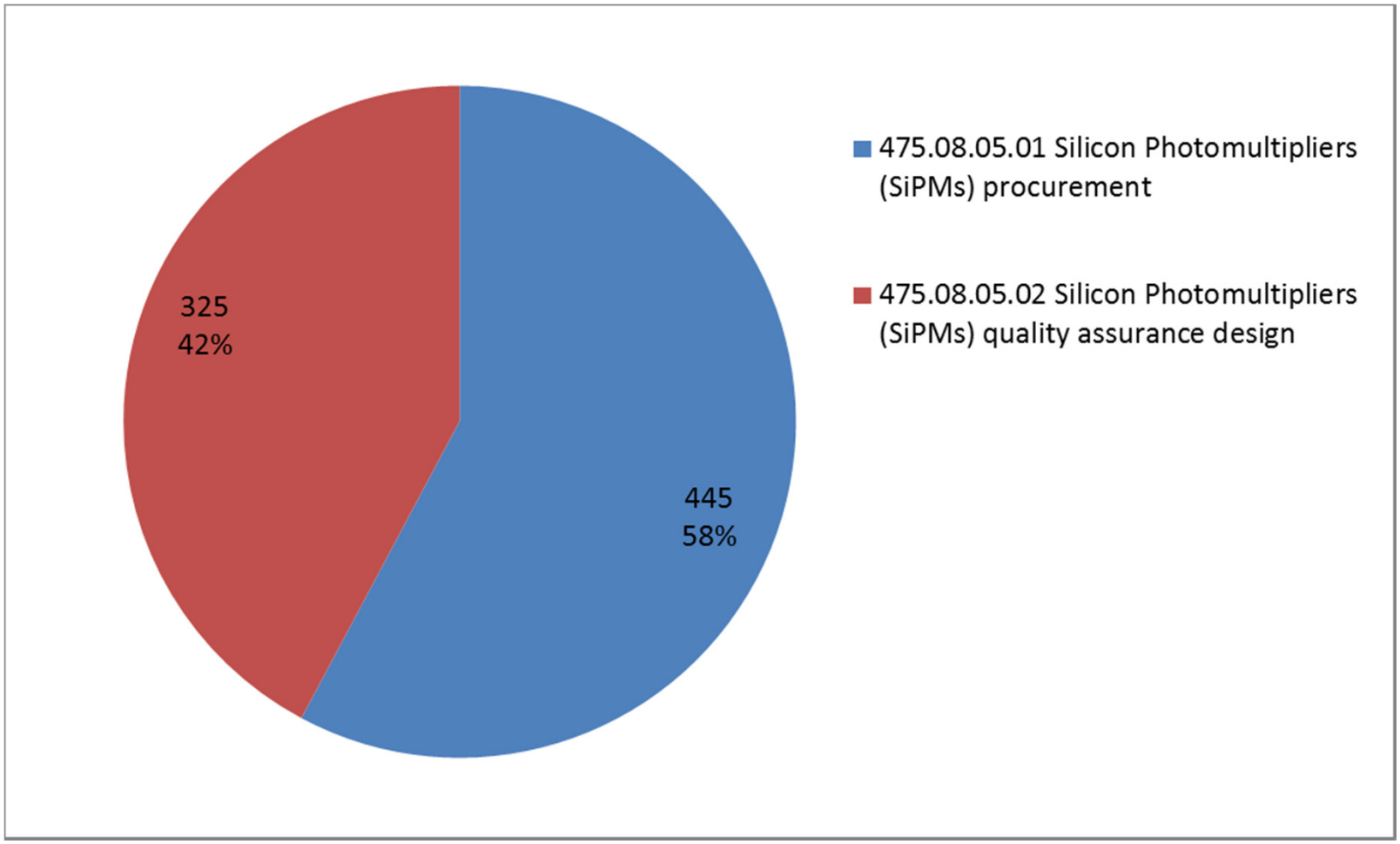
8.3 Scintillator Extrusions



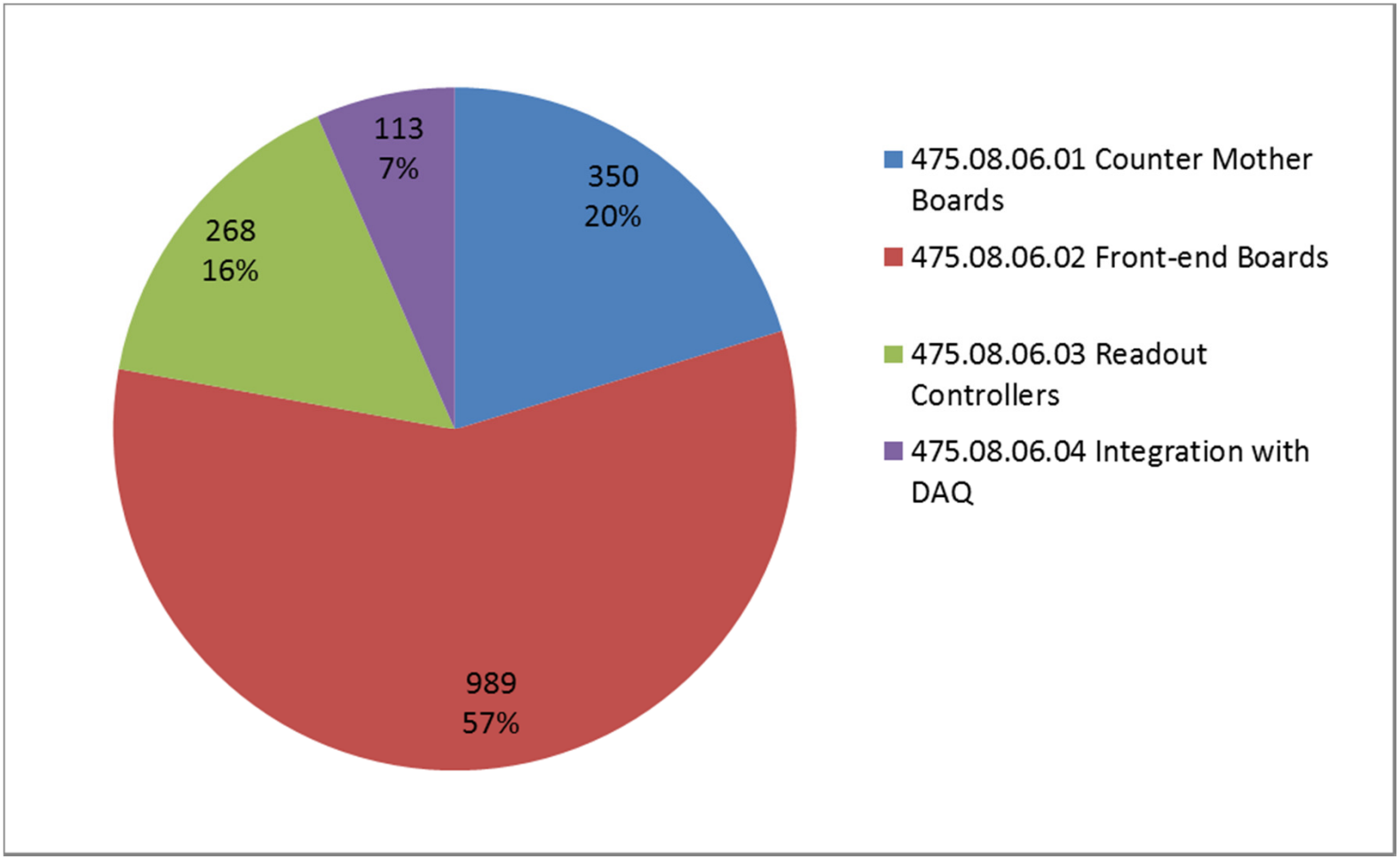
8.4 Fibers


14
3%
448
97%
475.08.04.01 Waveshifting fiber (WF) procurement
475.08.04.02 WF quality Assurance design and fabrication

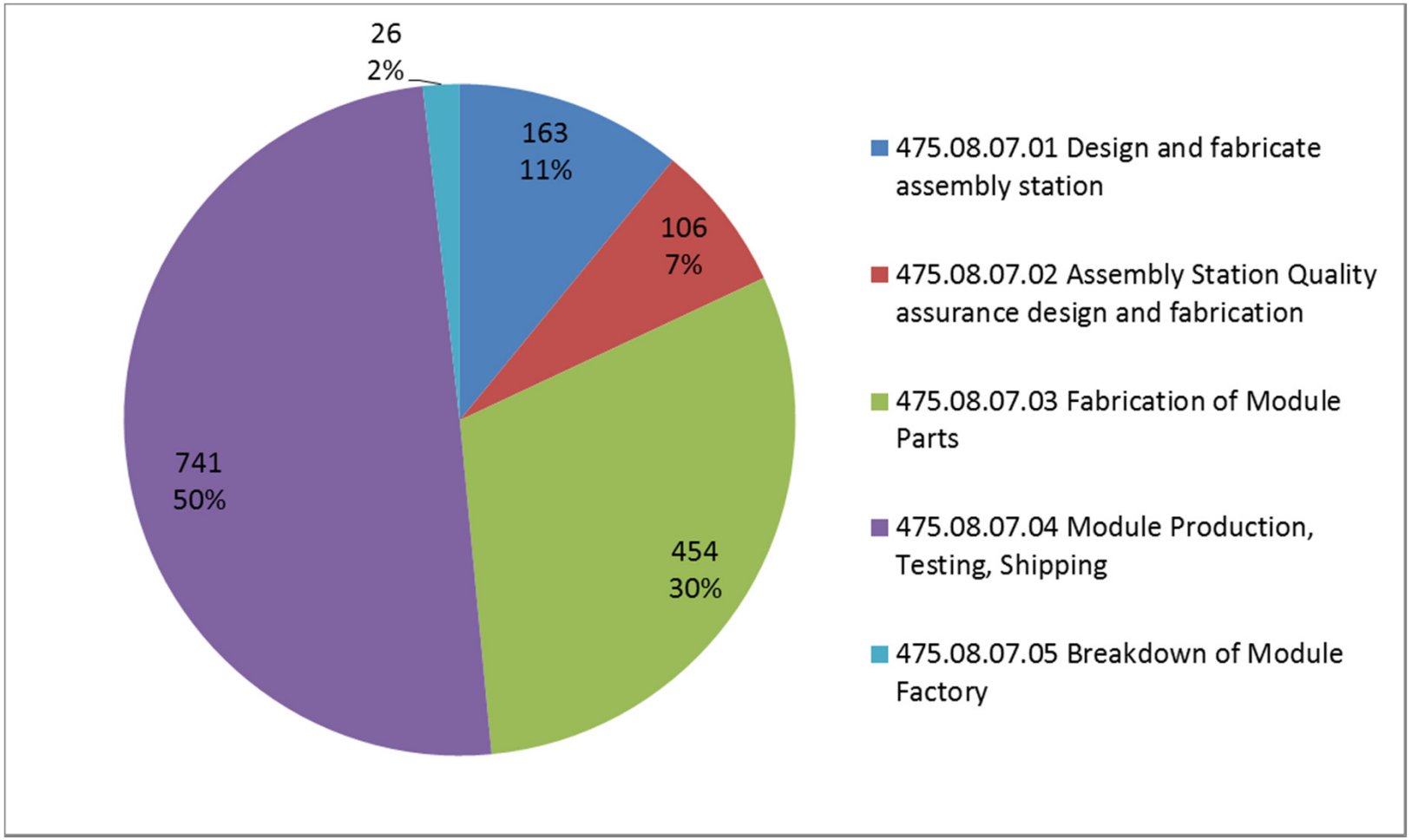
8.5 Photodetectors (SiPMs)



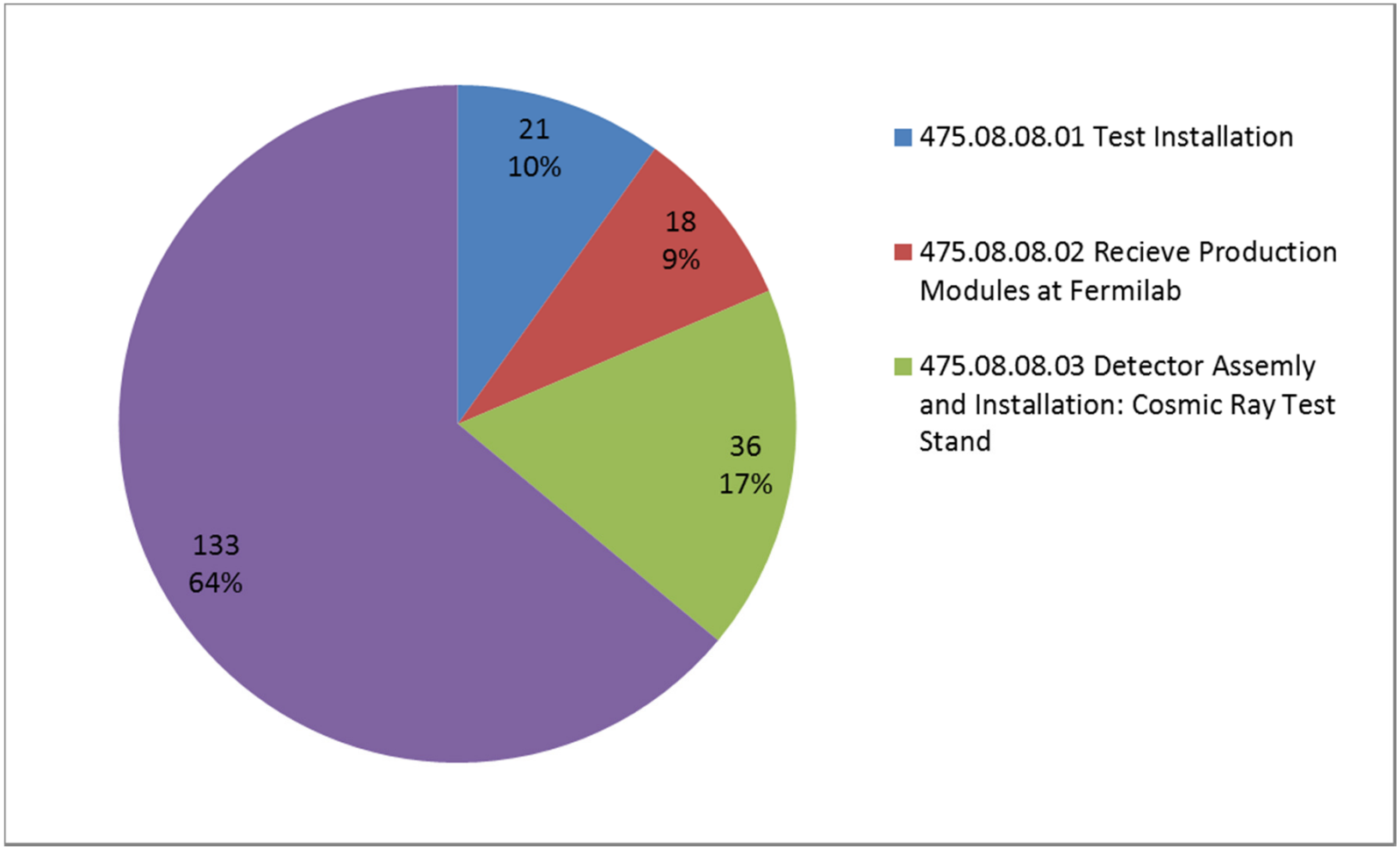
8.6 Electronics



8.7 Module Fabrication

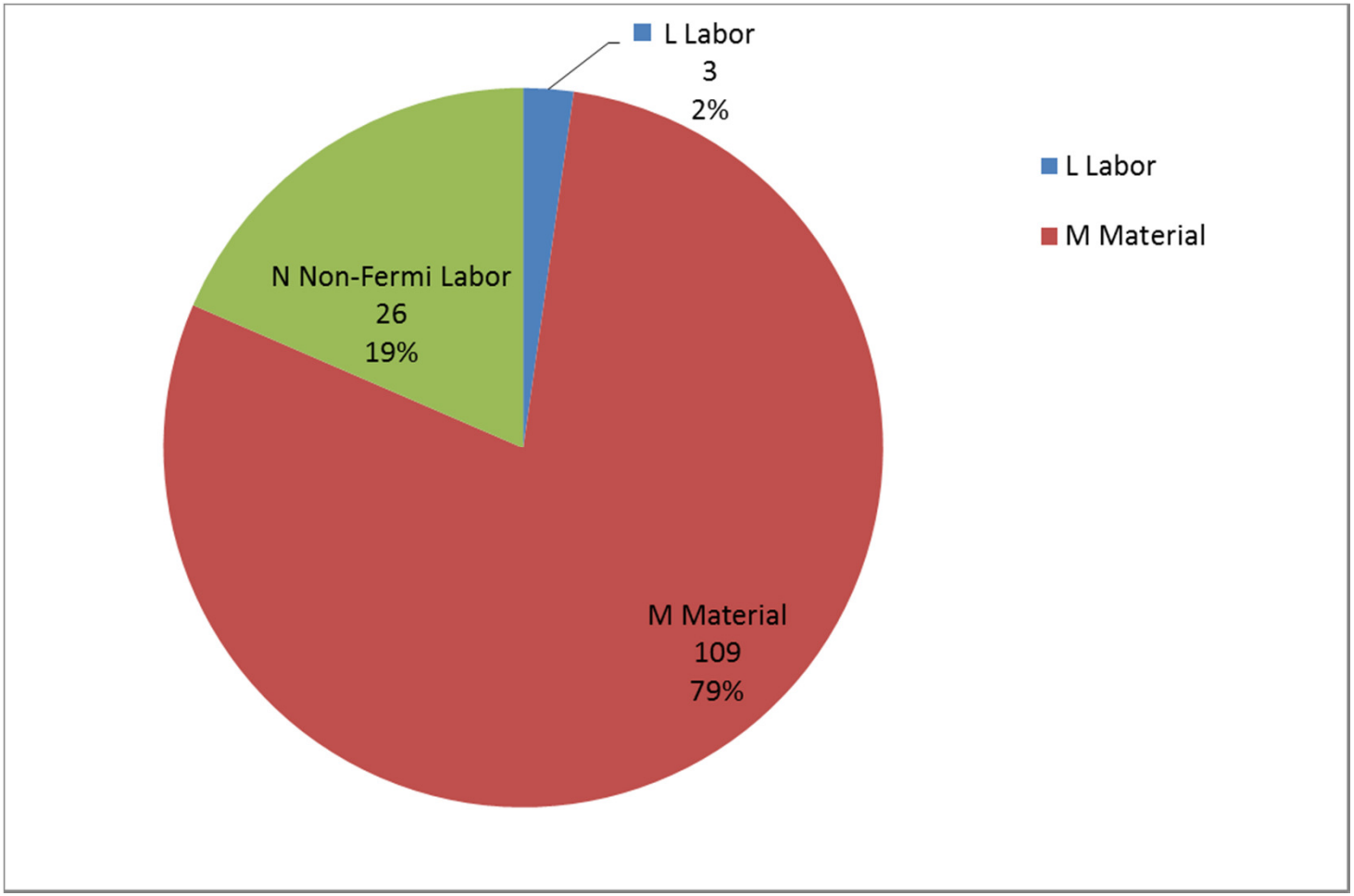


8.8 Detector Installation & Assembly

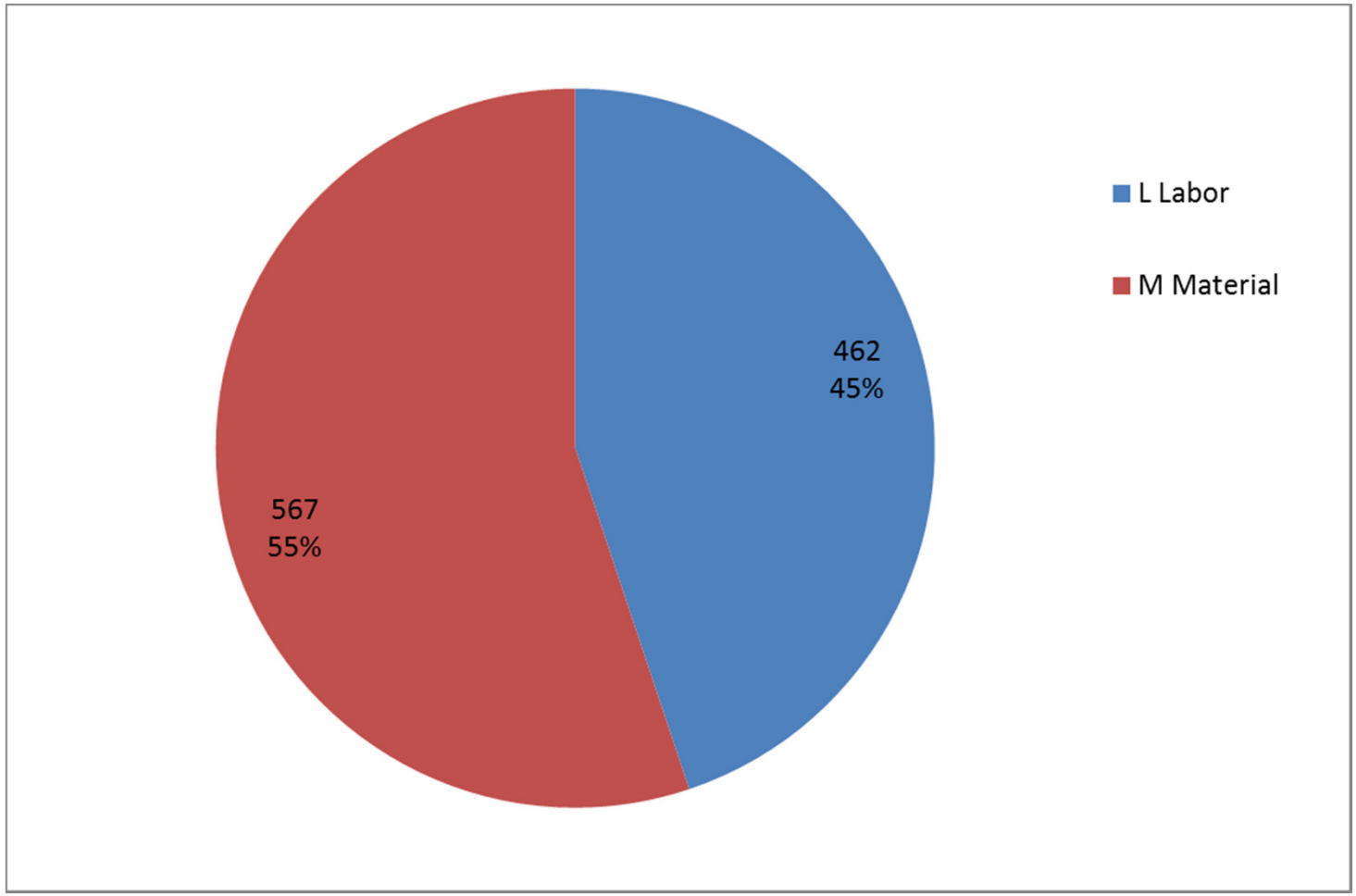


Project Slides: Resource Type

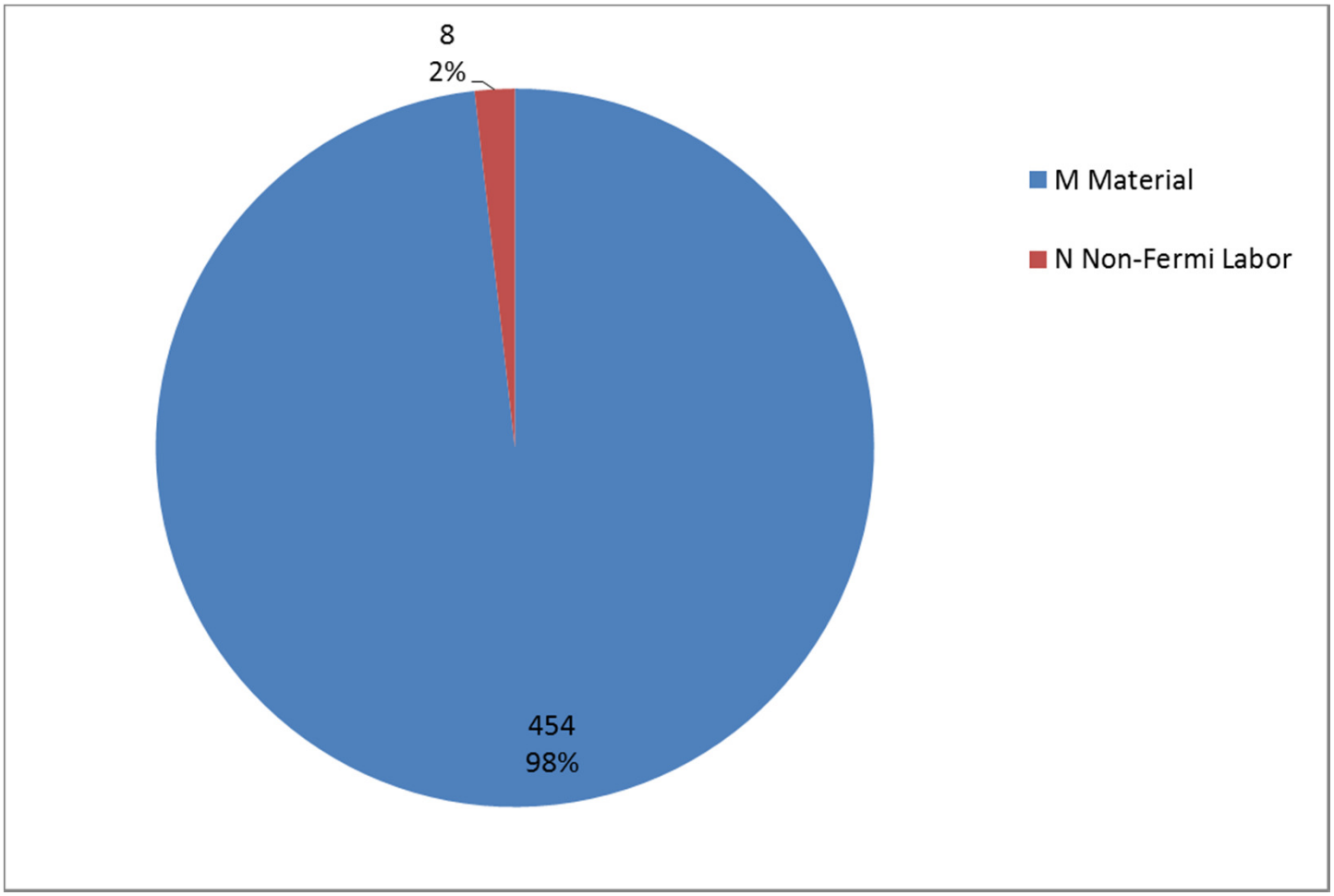
8.2 Mechanical Design



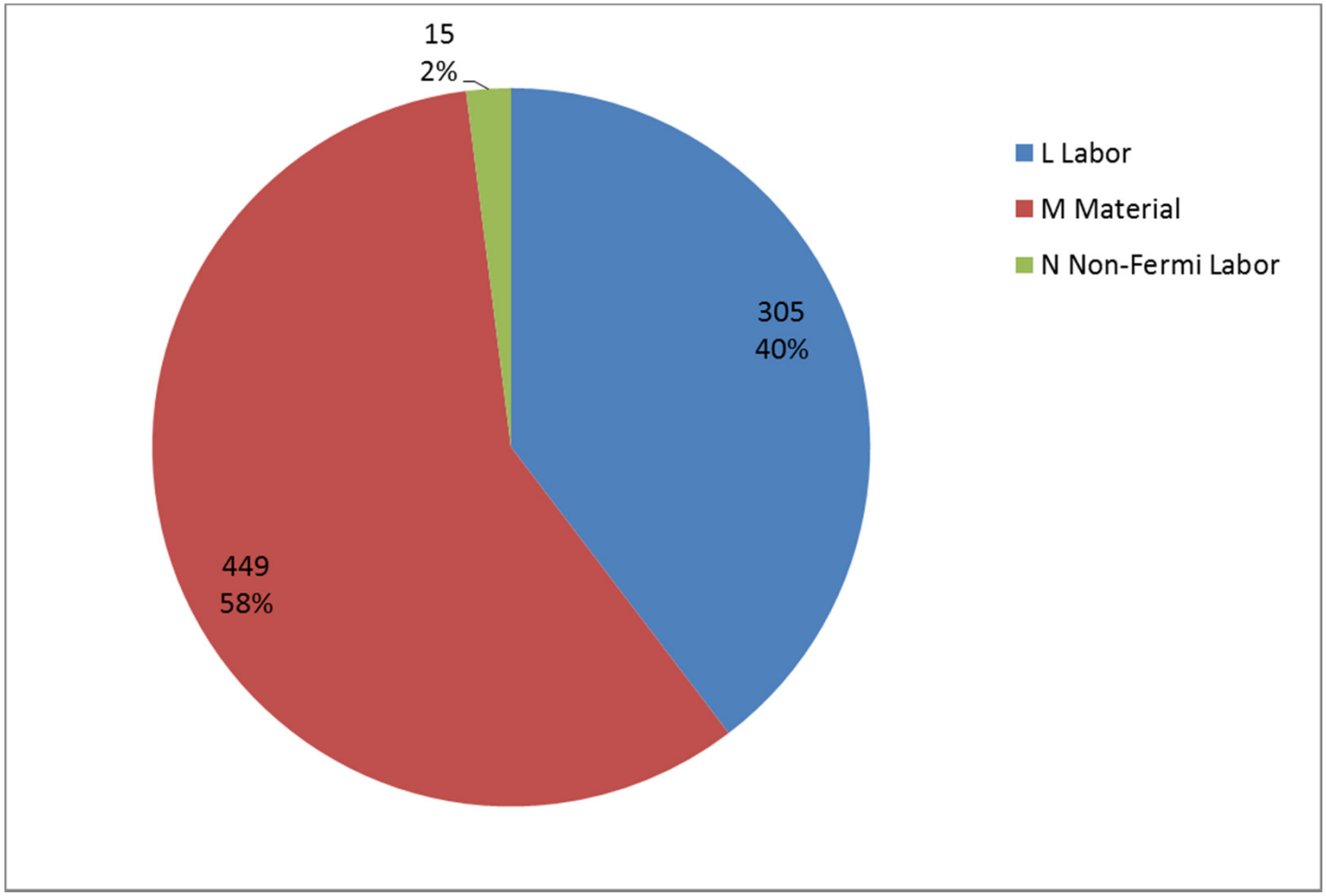
8.3 Scintillator Extrusions



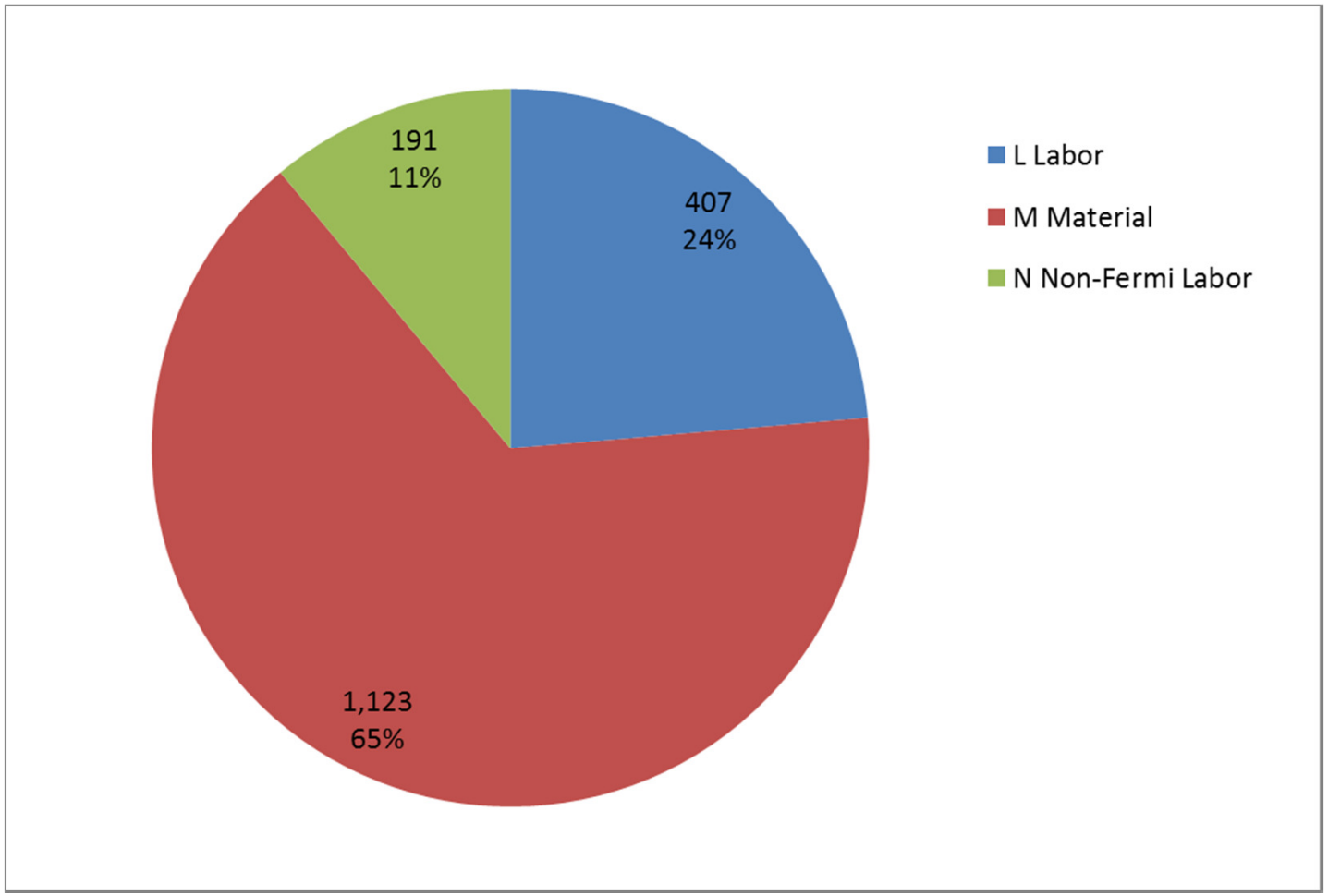
8.4 Fibers



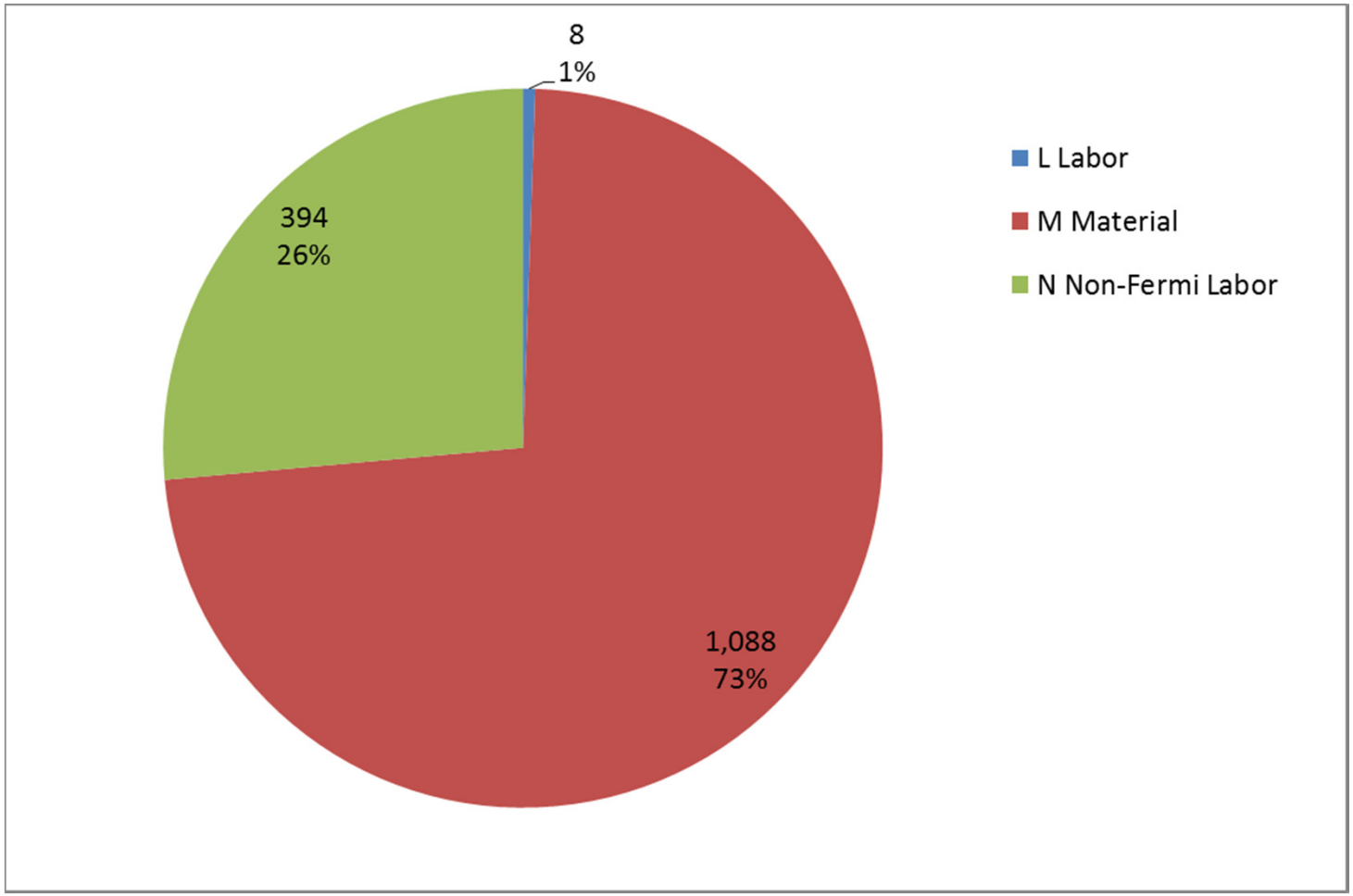
8.5 Photodetectors (SiPMs)



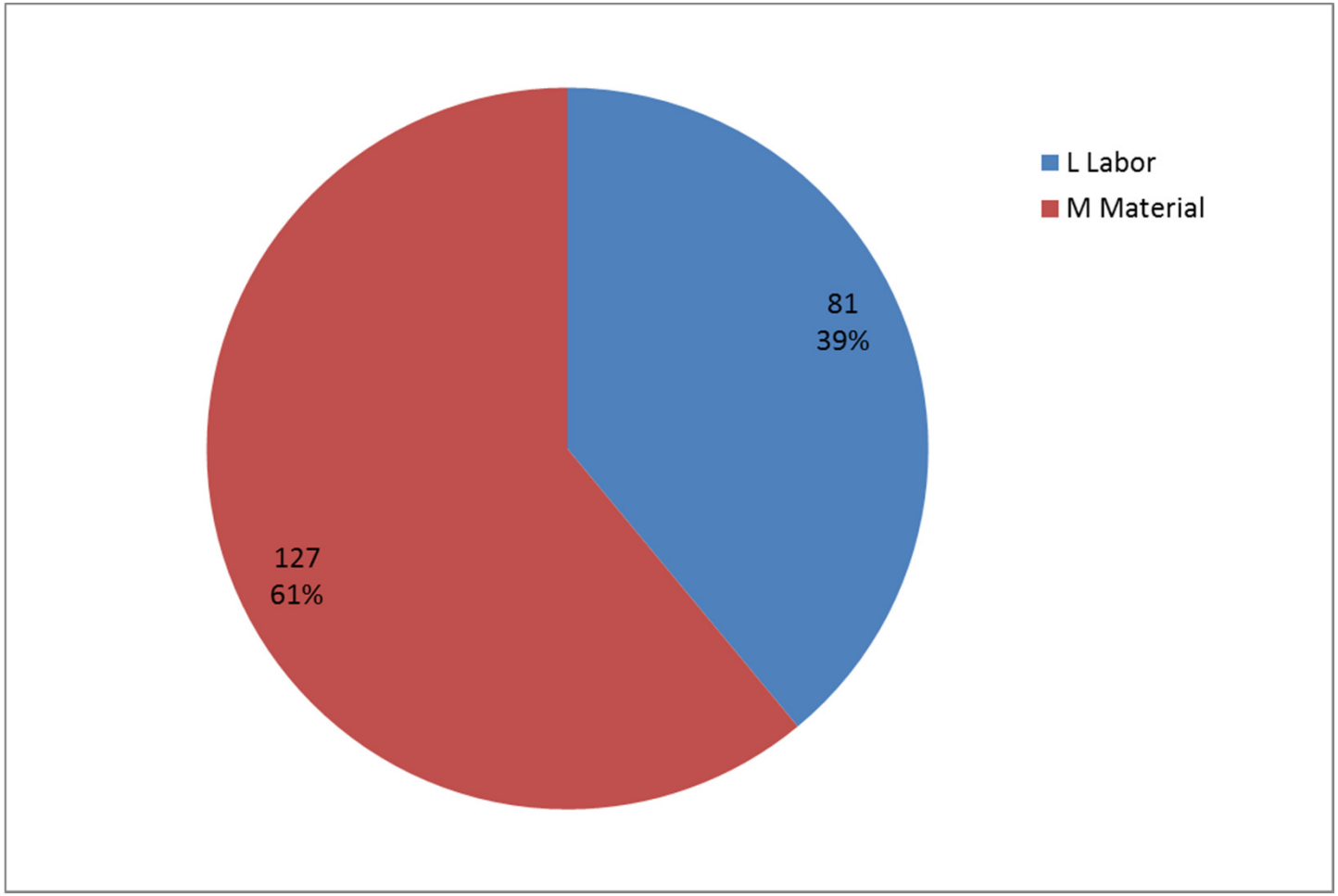
8.6 Electronics



8.7 Module Fabrication

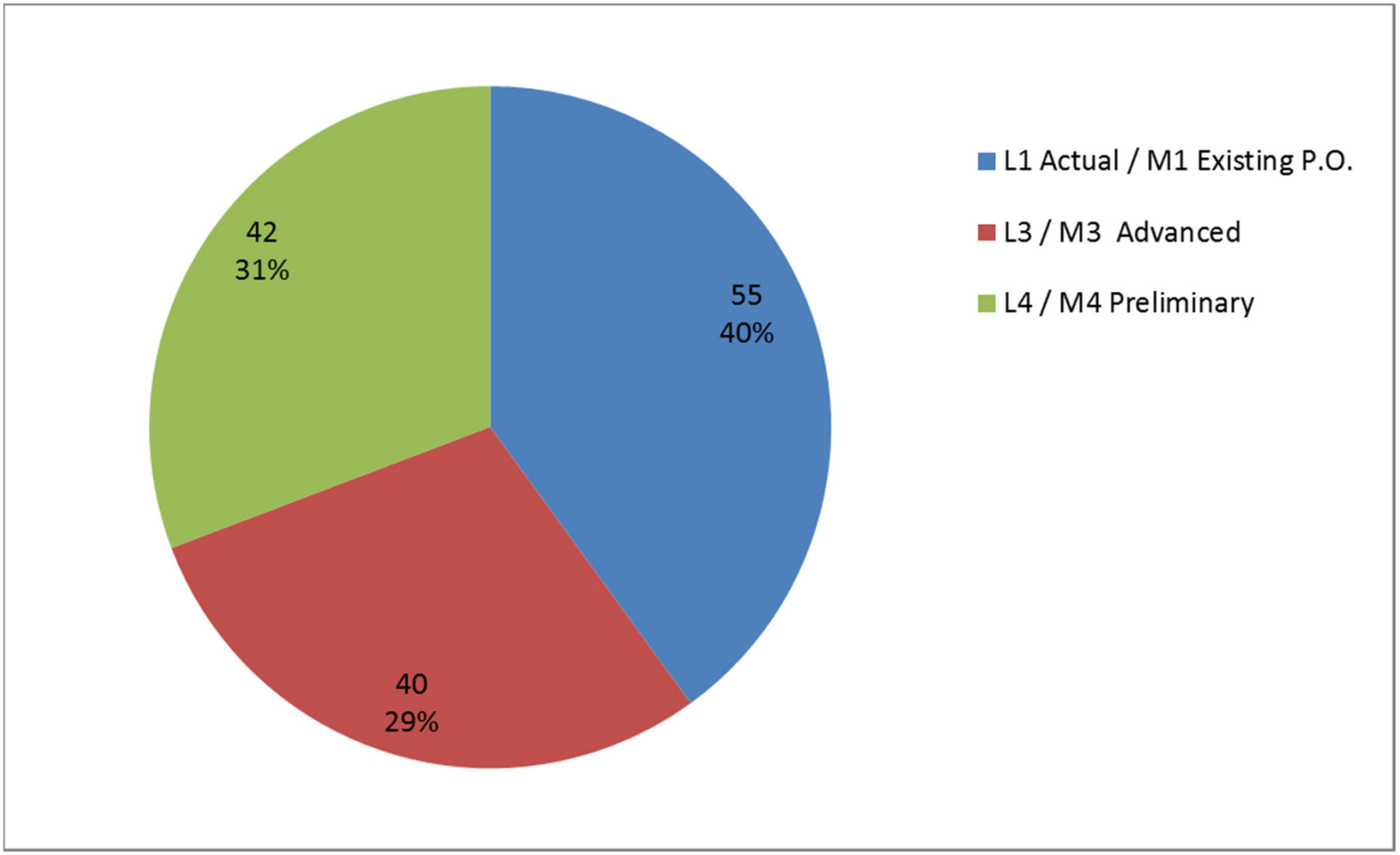


8.8 Detector Installation & Assembly

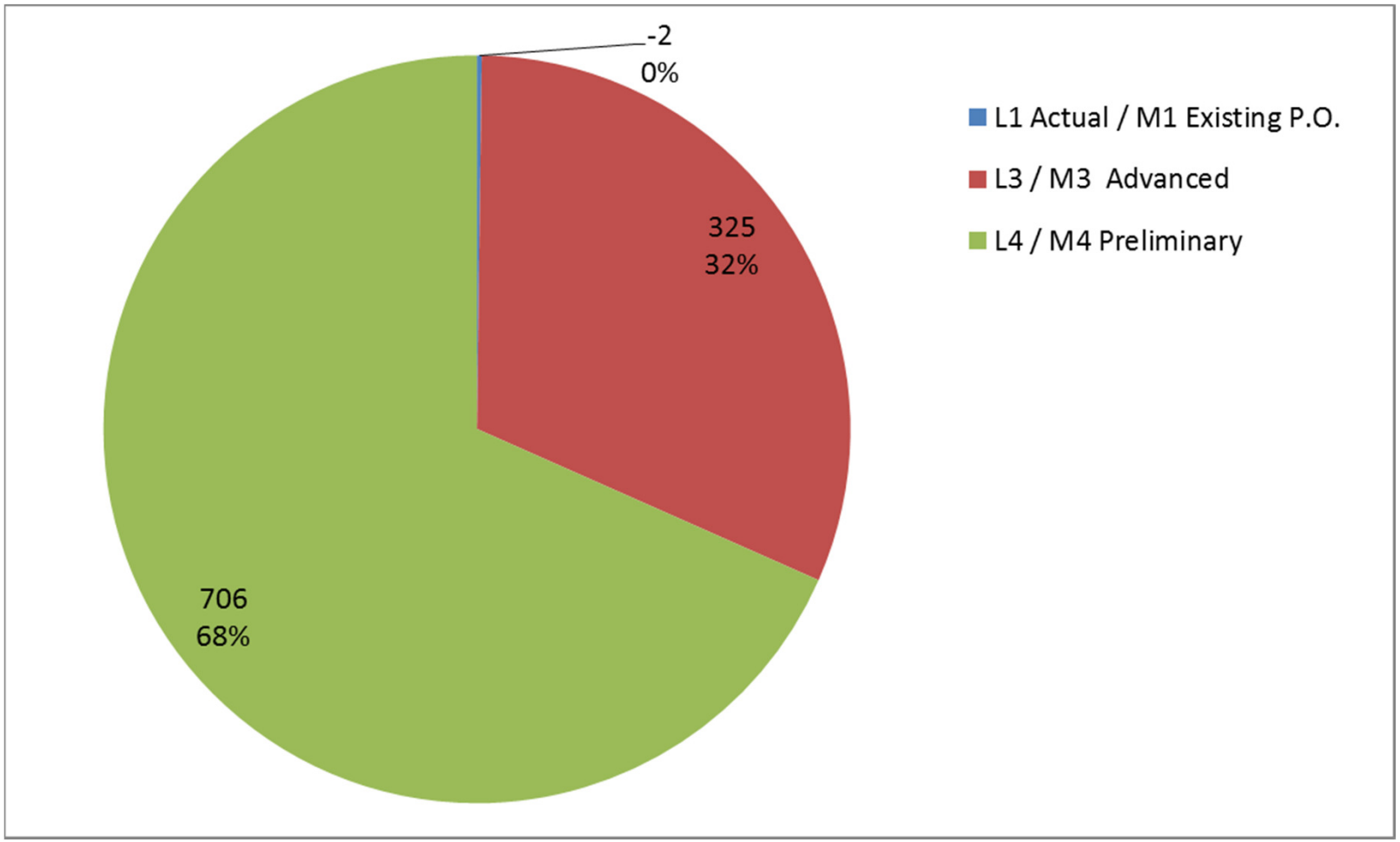


Project Slides: Quality of Estimate

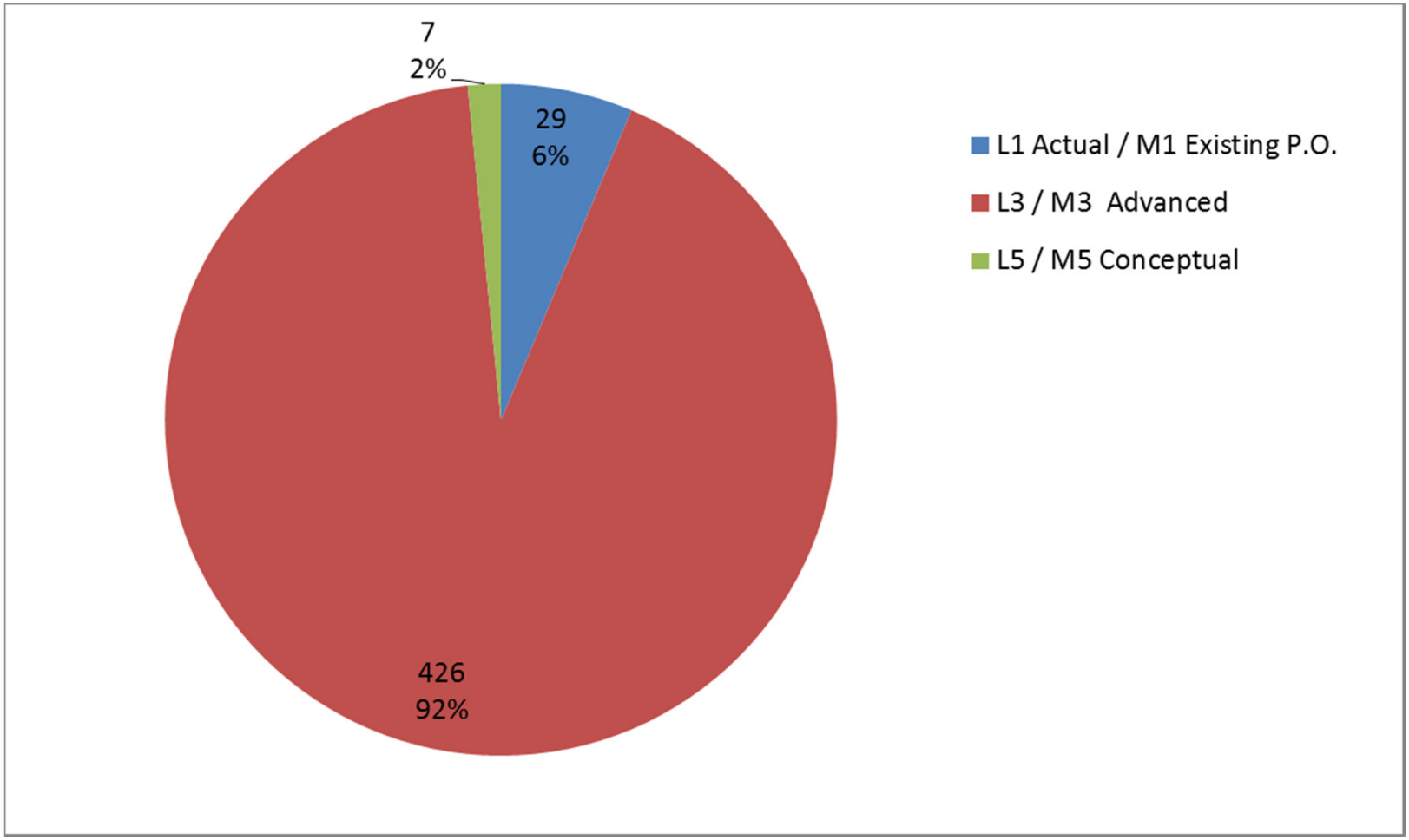
8.2 Mechanical Design



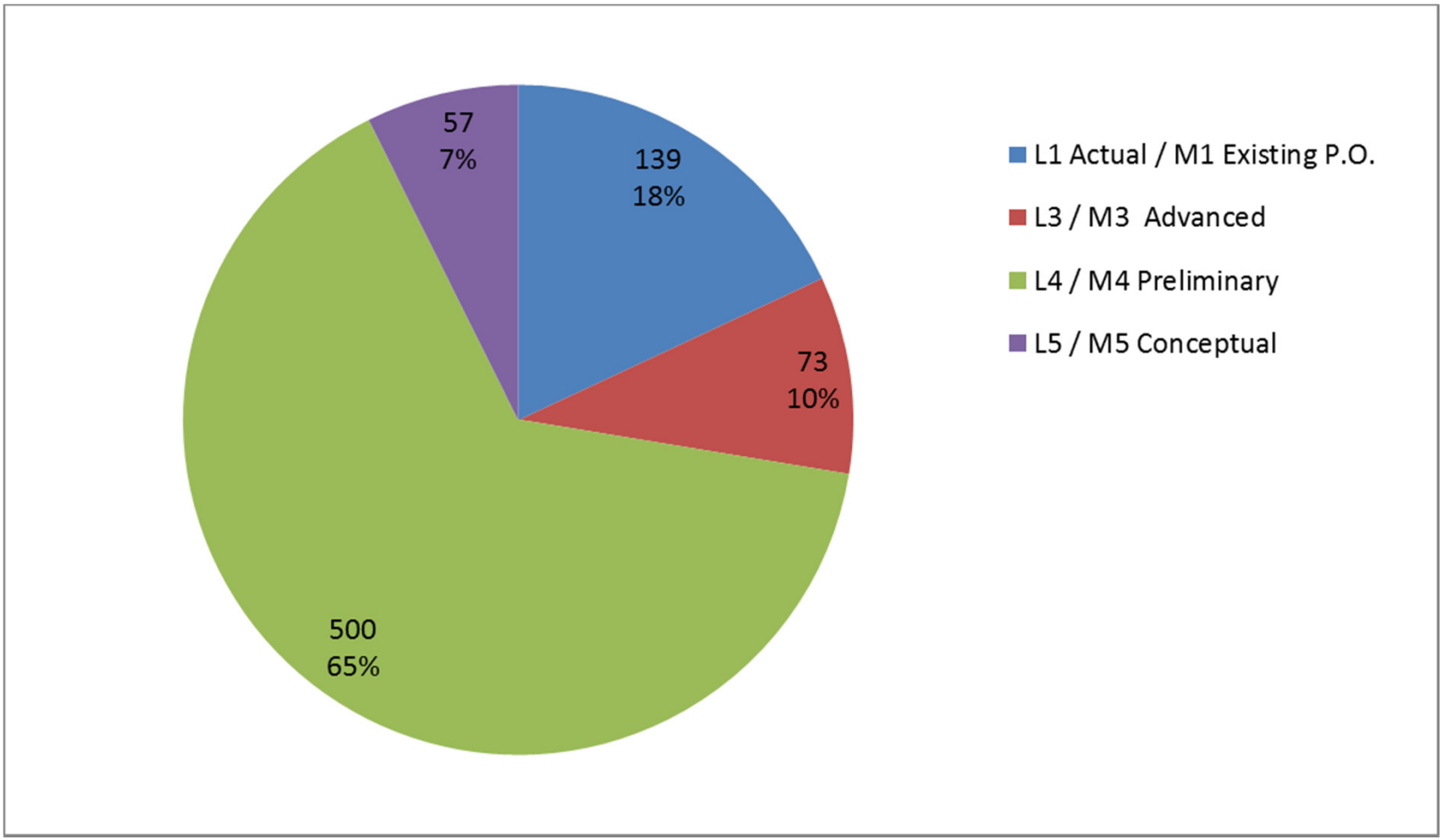
8.3 Scintillator Extrusions



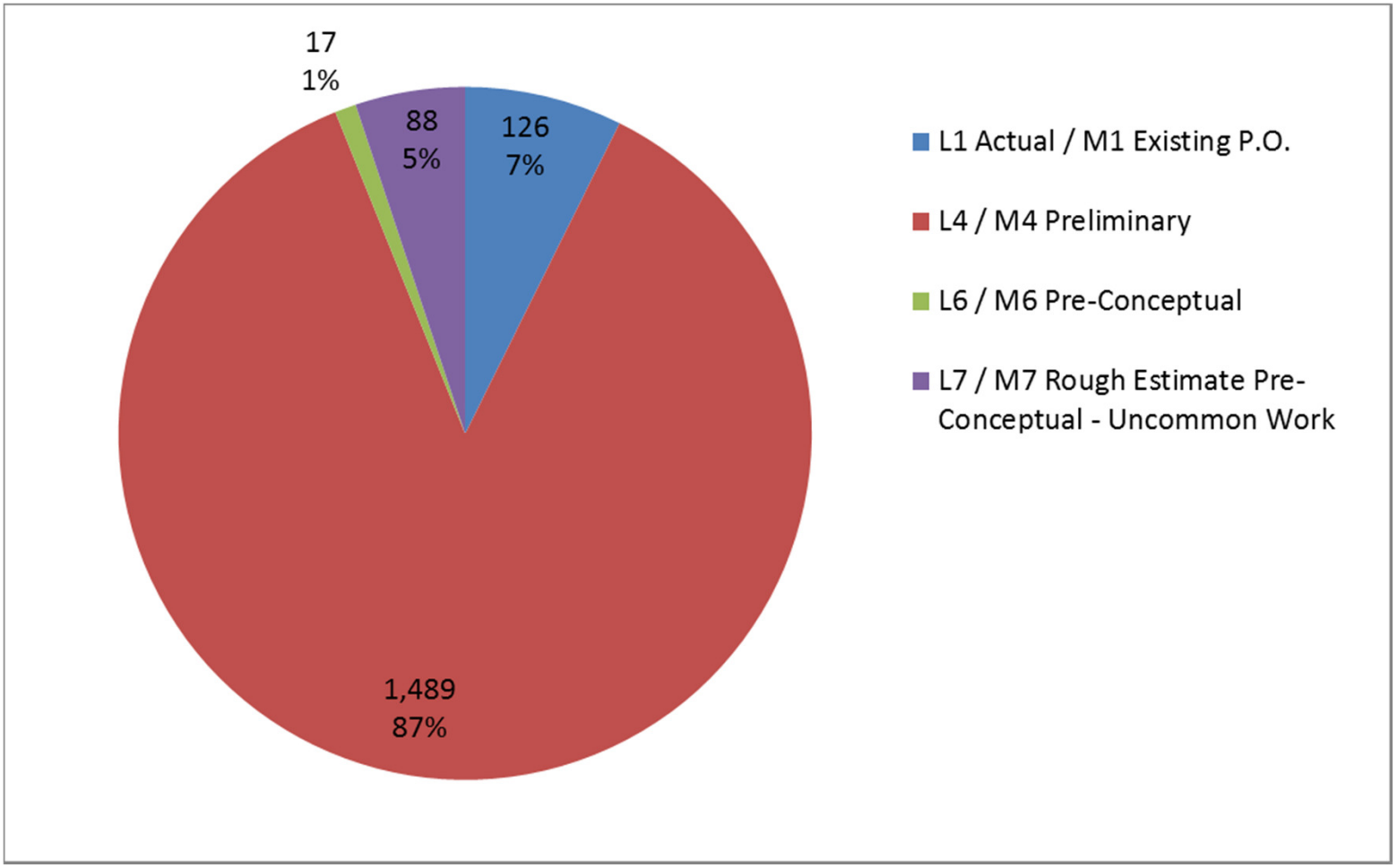
8.4 Fibers


7
2%
29
6%
426
92%
L1 Actual / M1 Existing P.O.
L3 / M3 Advanced
L5 / M5 Conceptual

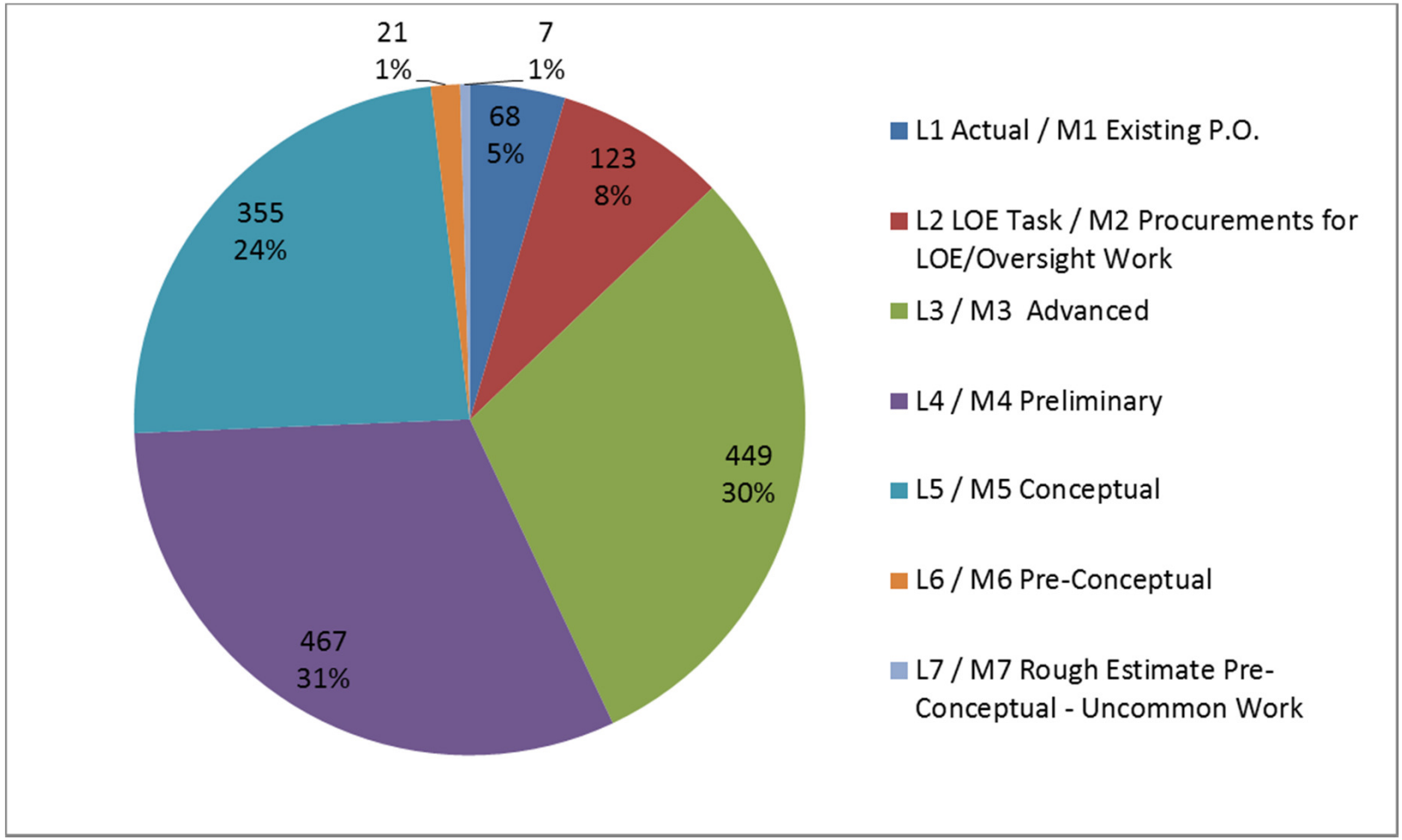
8.5 Photodetectors (SiPMs)



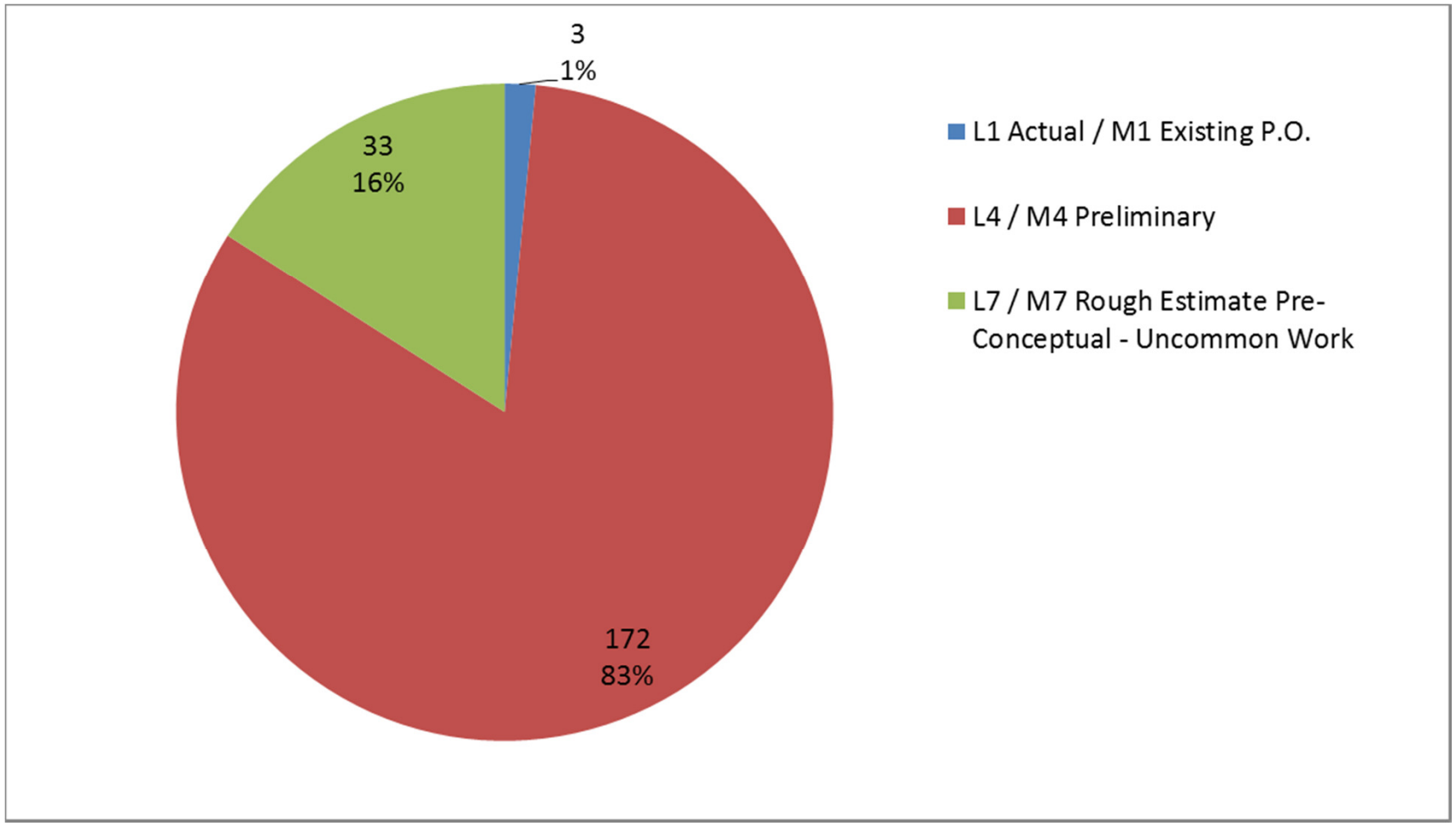
8.6 Electronics



8.7 Module Fabrication



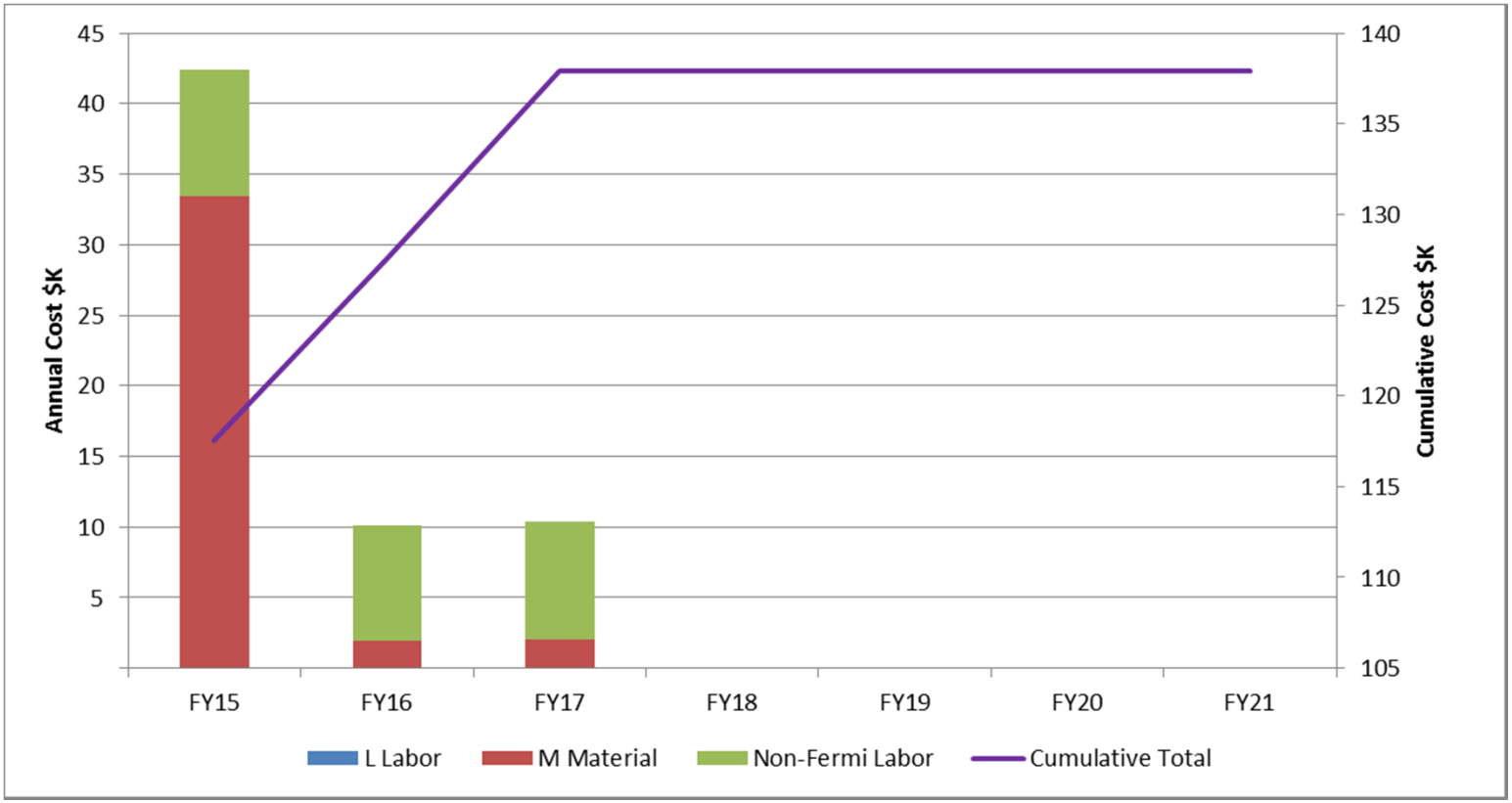
8.8 Detector Installation & Assembly



Project Slides: Labor / Material Breakdown

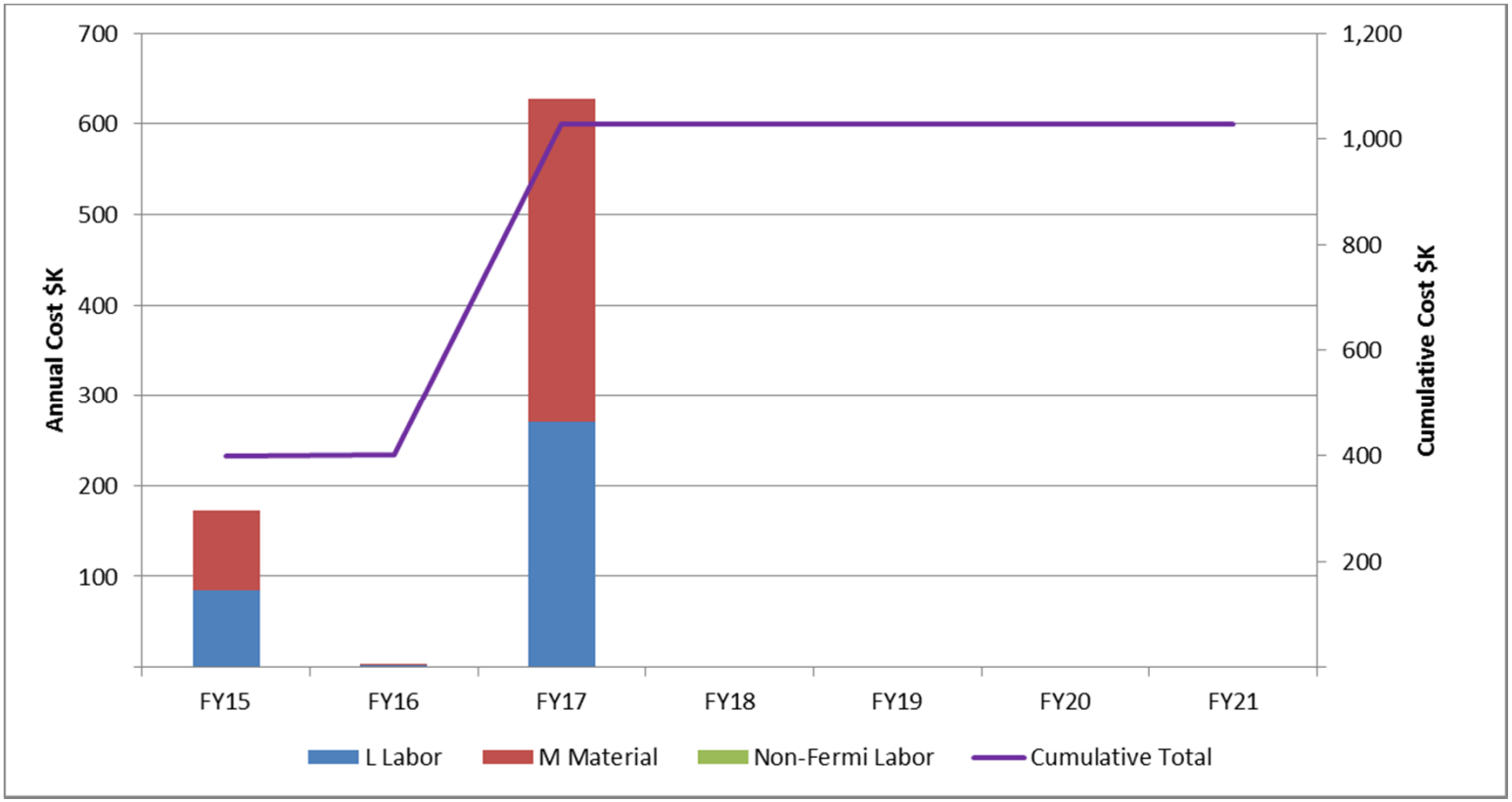
8.2 Mechanical Design

Base Cost in AY K$



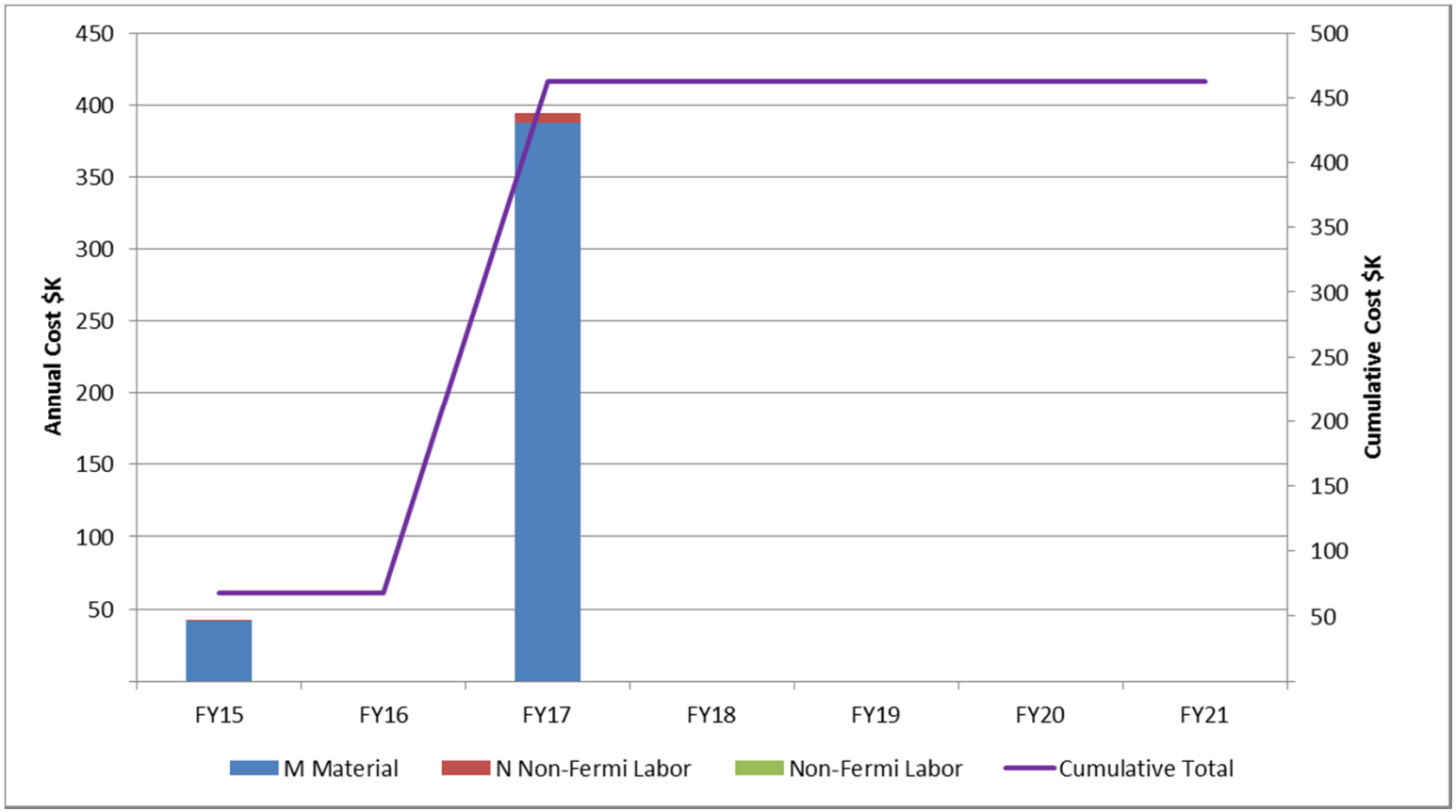
8.3 Scintillator Extrusions

Base Cost in AY K$



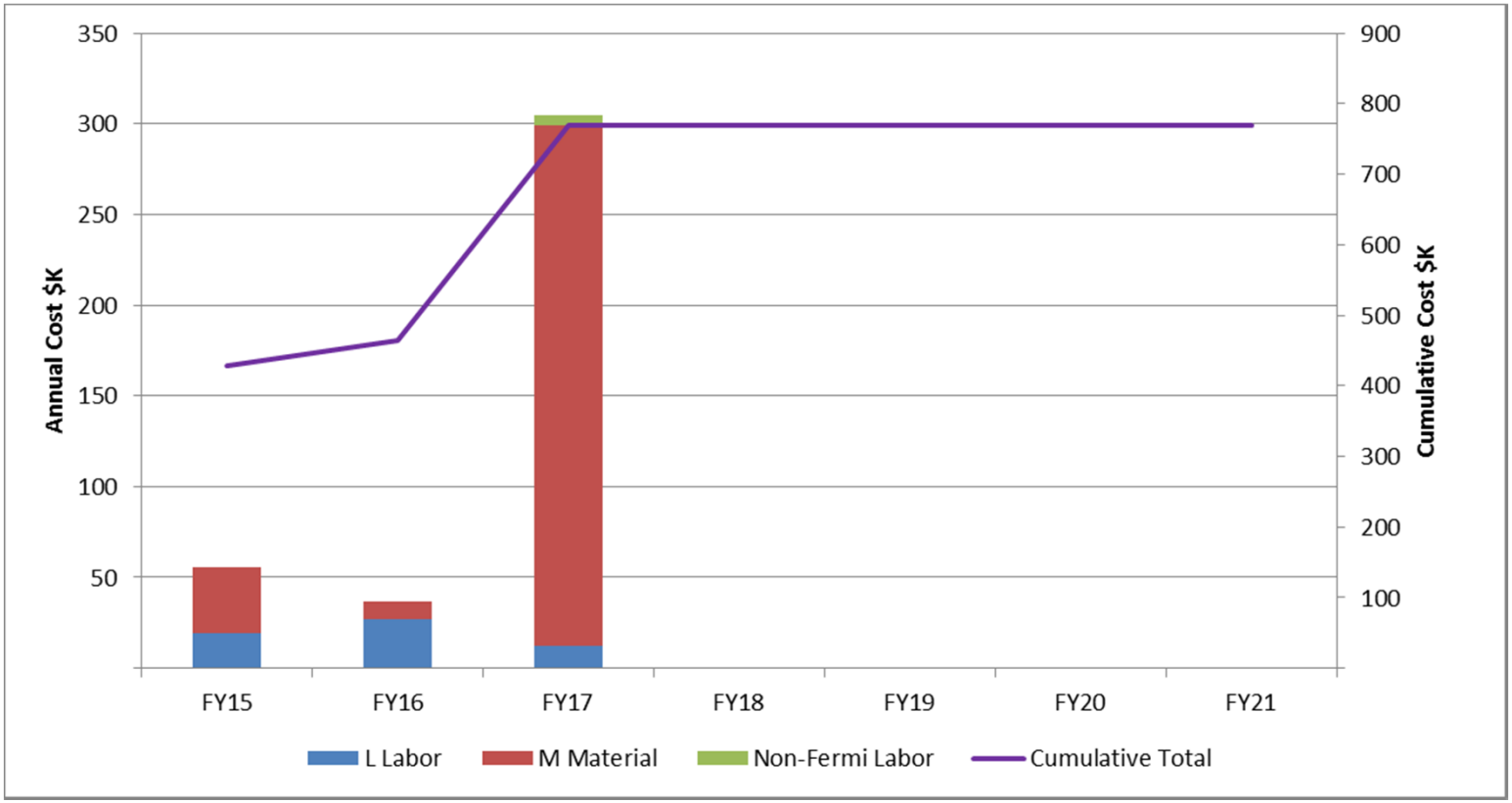
8.4 Fibers

Base Cost in AY K$



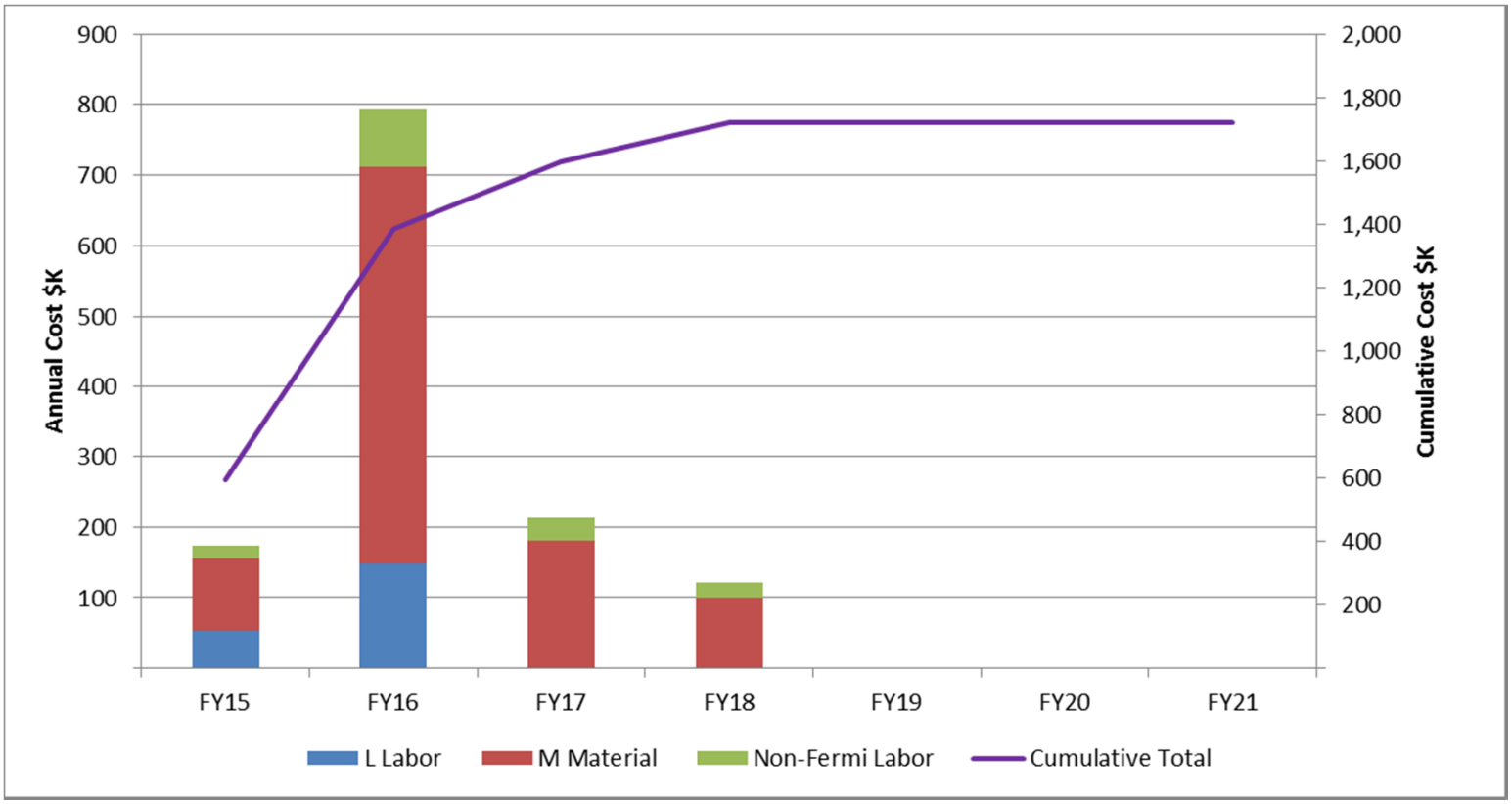
8.5 Photodetectors (SiPMs)

Base Cost in AY K$



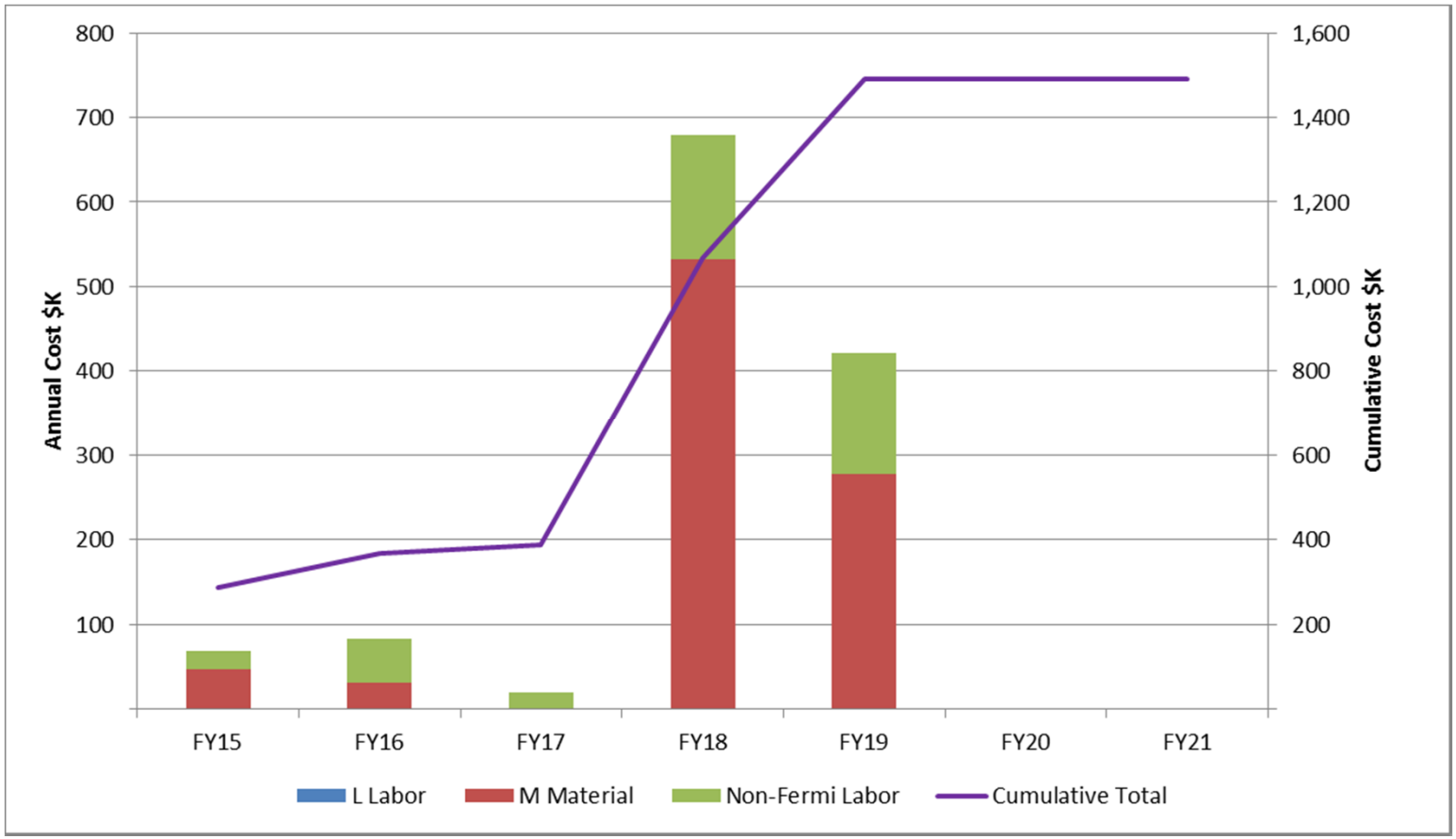
8.6 Electronics

Base Cost in AY K$



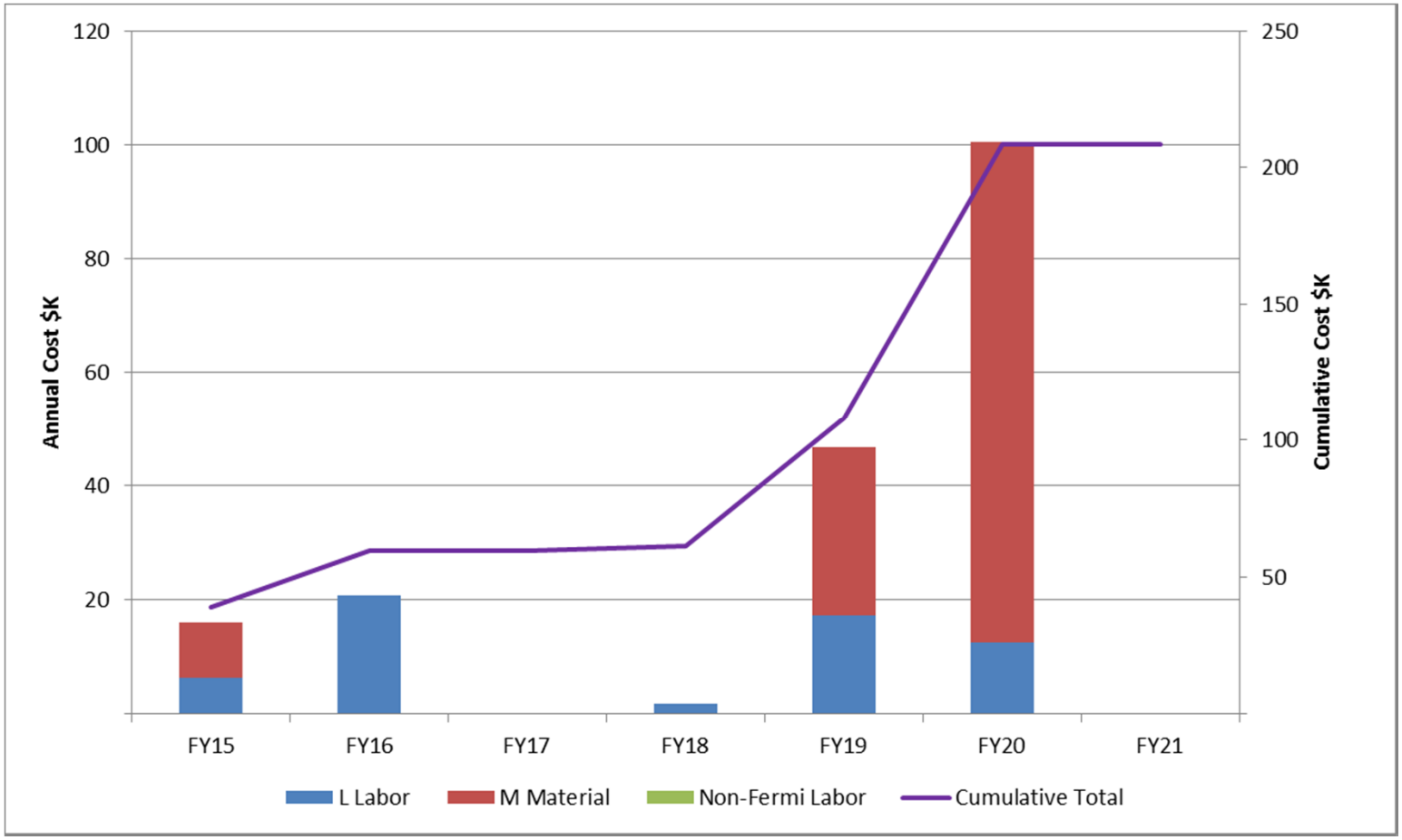
8.7 Module Fabrication

Base Cost in AY K$



8.8 Detector Installation & Assembly

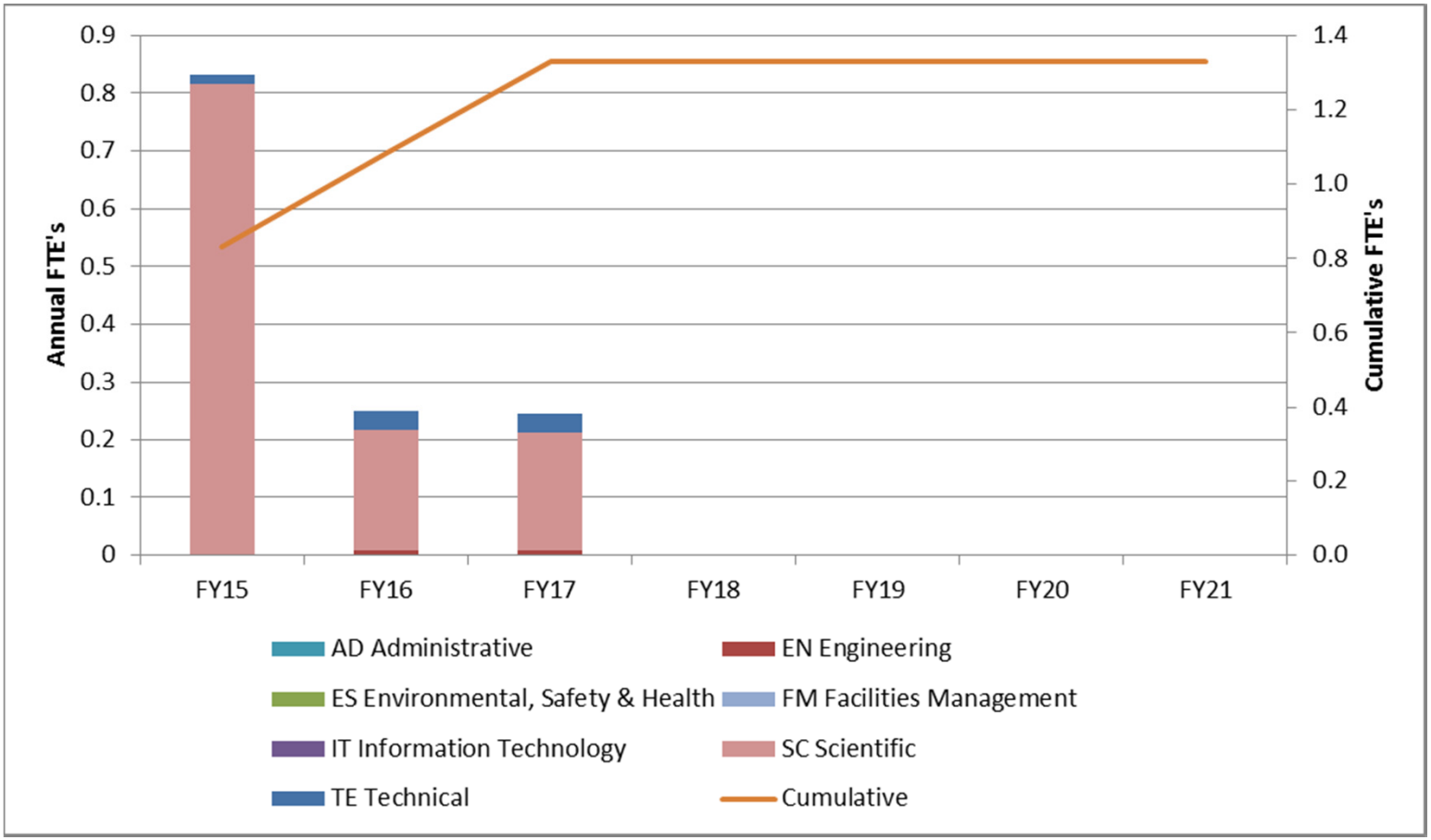
Base Cost in AY K$



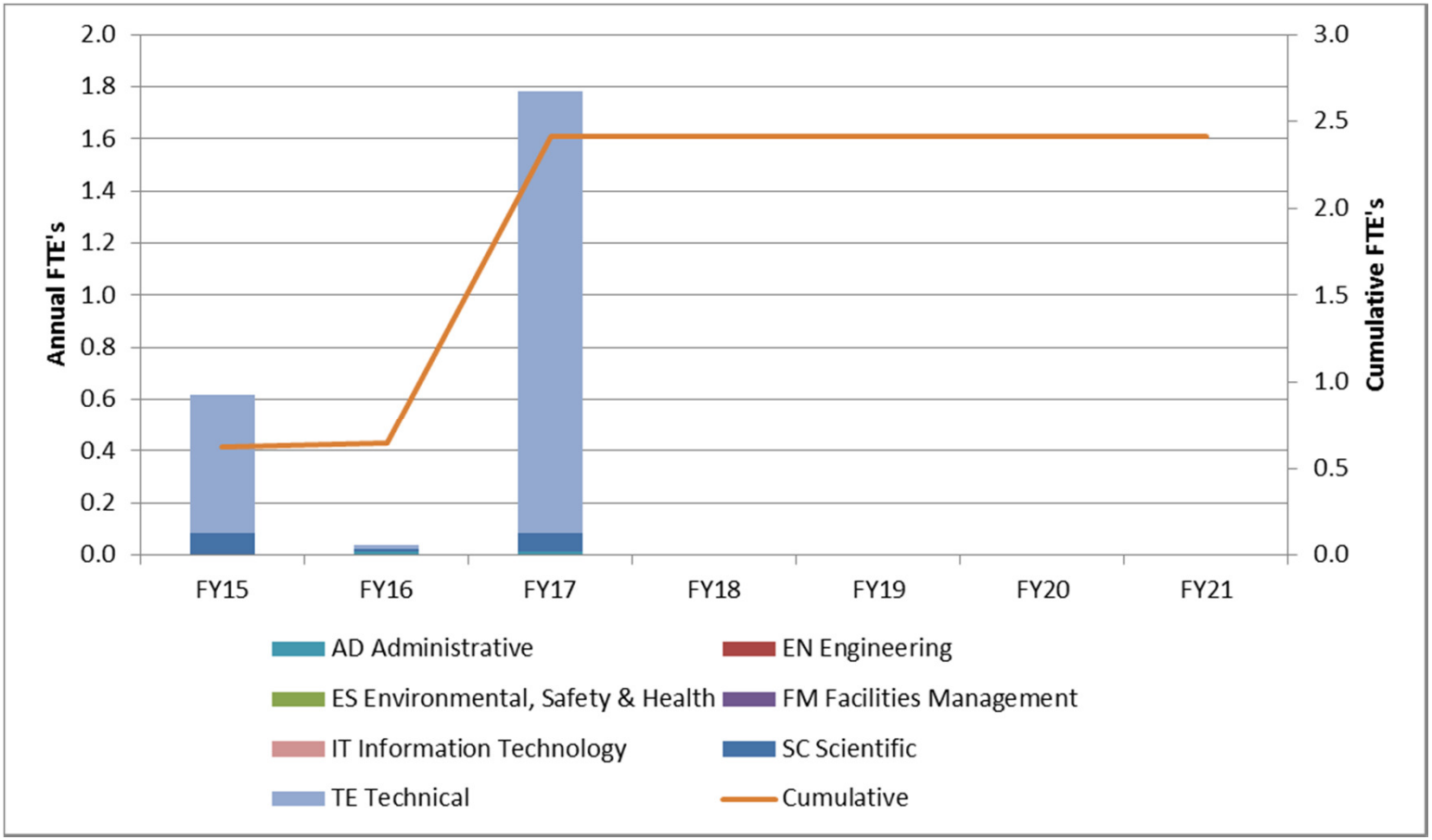
Cosmic Ray Veto

Project Slides: FTE's by Discipline

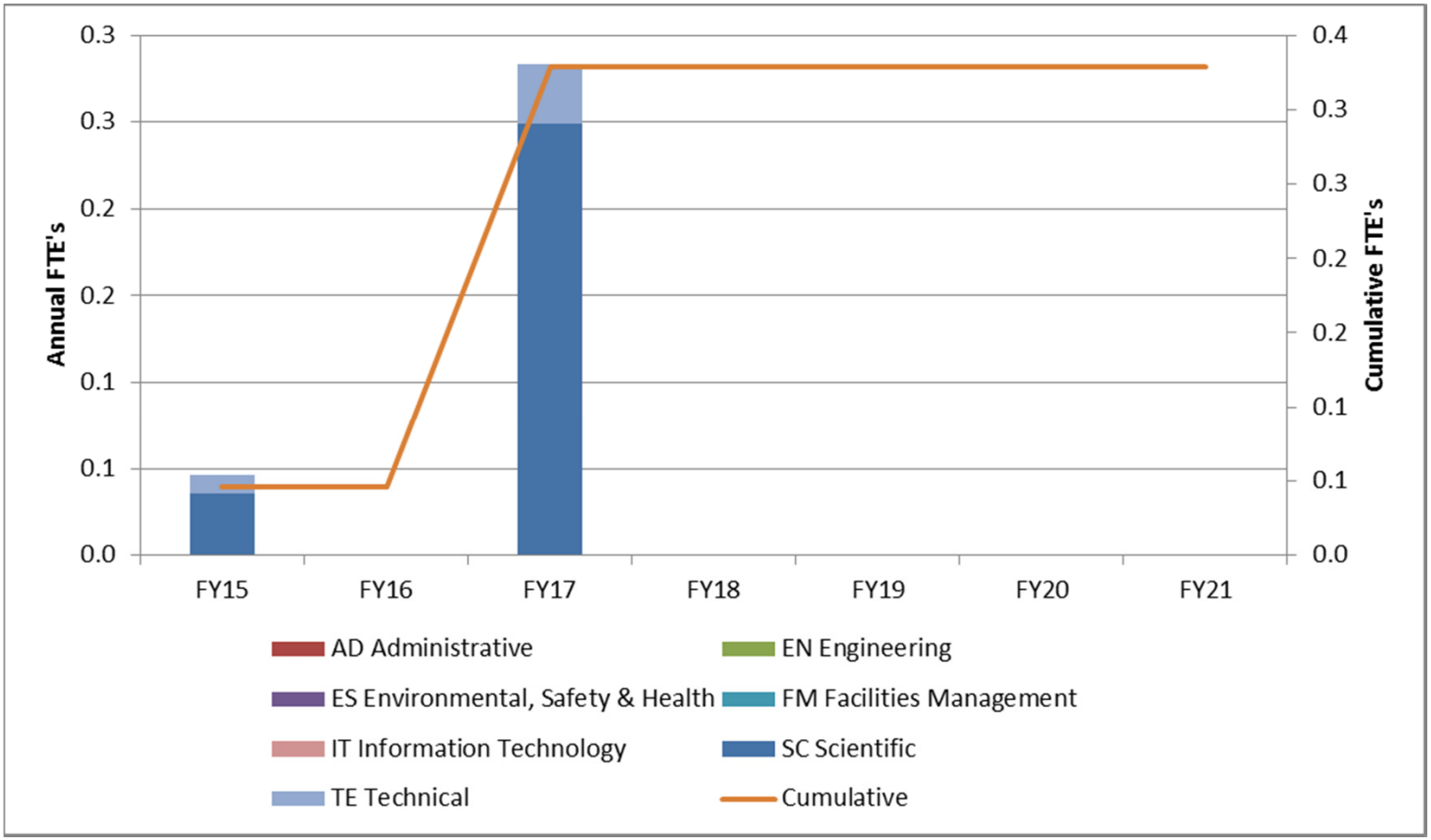
8.2 Mechanical Design



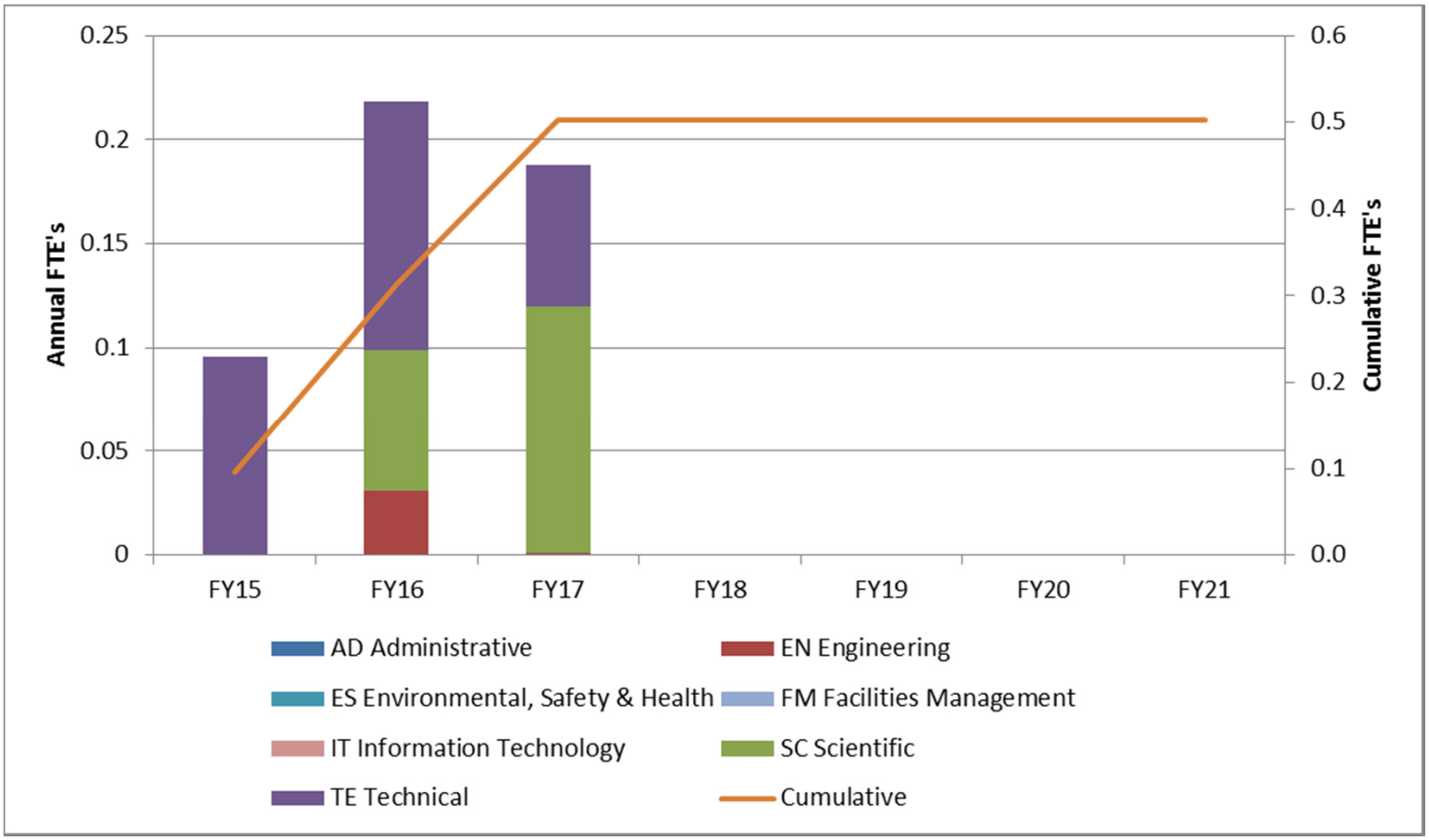
8.3 Scintillator Extrusions



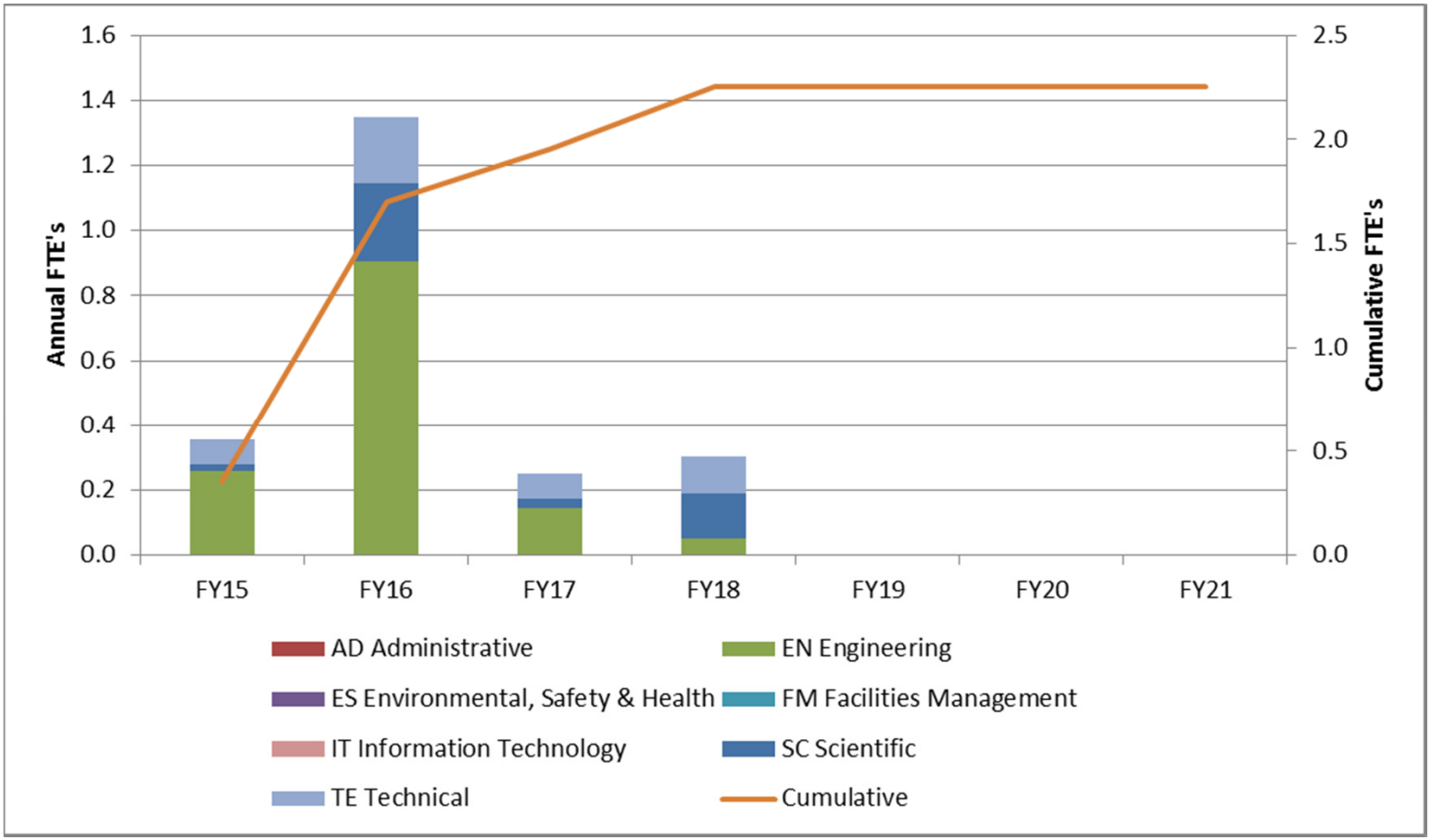
8.4 Fibers


0.3
0.3
0.2
0.2
0.1
0.1
0.0
Annual FTE's
0.4
0.3
0.3
0.2
0.2
0.1
0.1
0.0
Cumulative FTE's
FY15
FY16
FY17
FY18
FY19
FY20
FY21
AD Administrative
EN Engineering
ES Environmental, Safety & Health
FM Facilities Management
IT Information Technology
SC Scientific
TE Technical
Cumulative

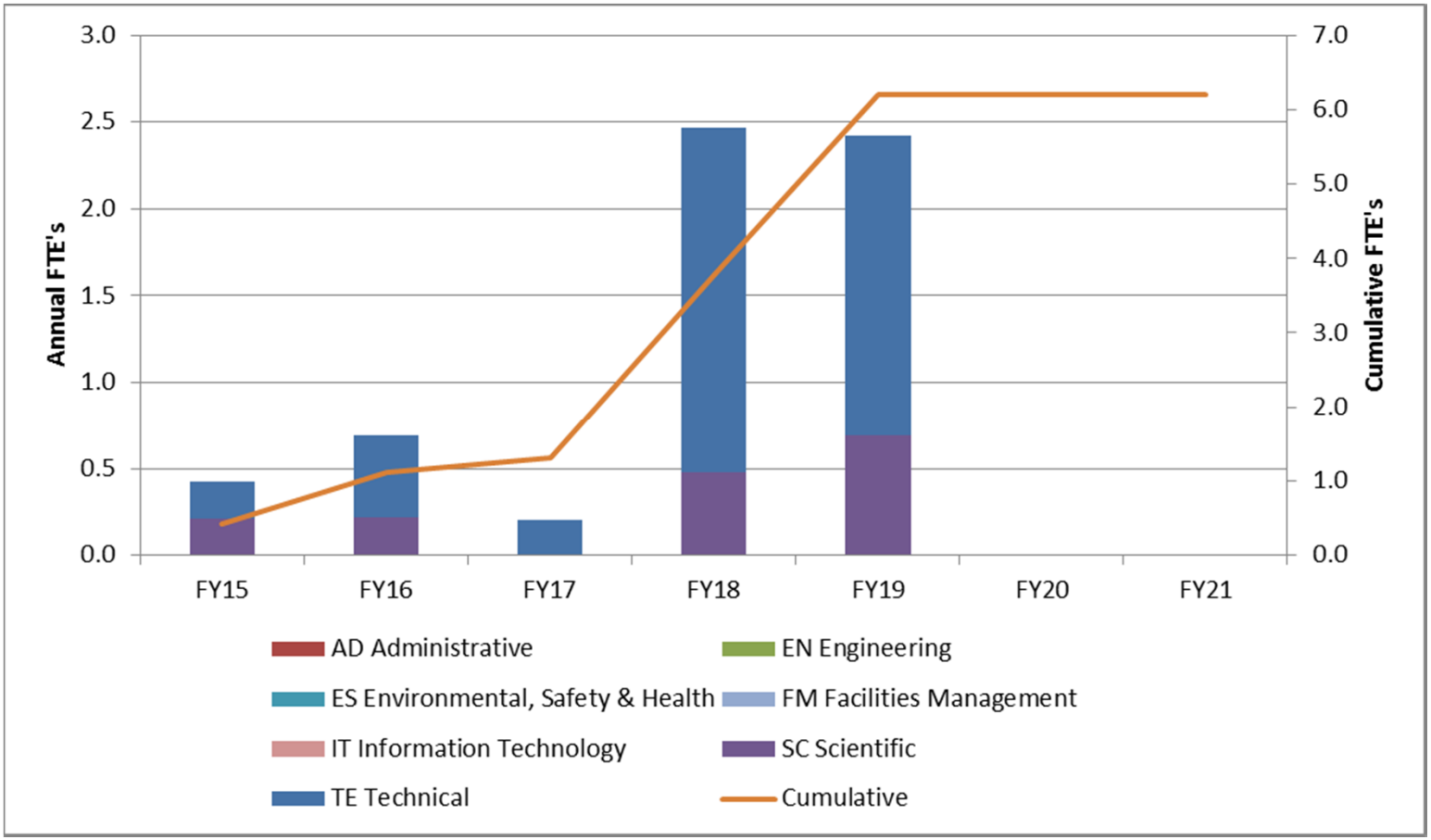
8.5 Photodetecters (SiPMs)



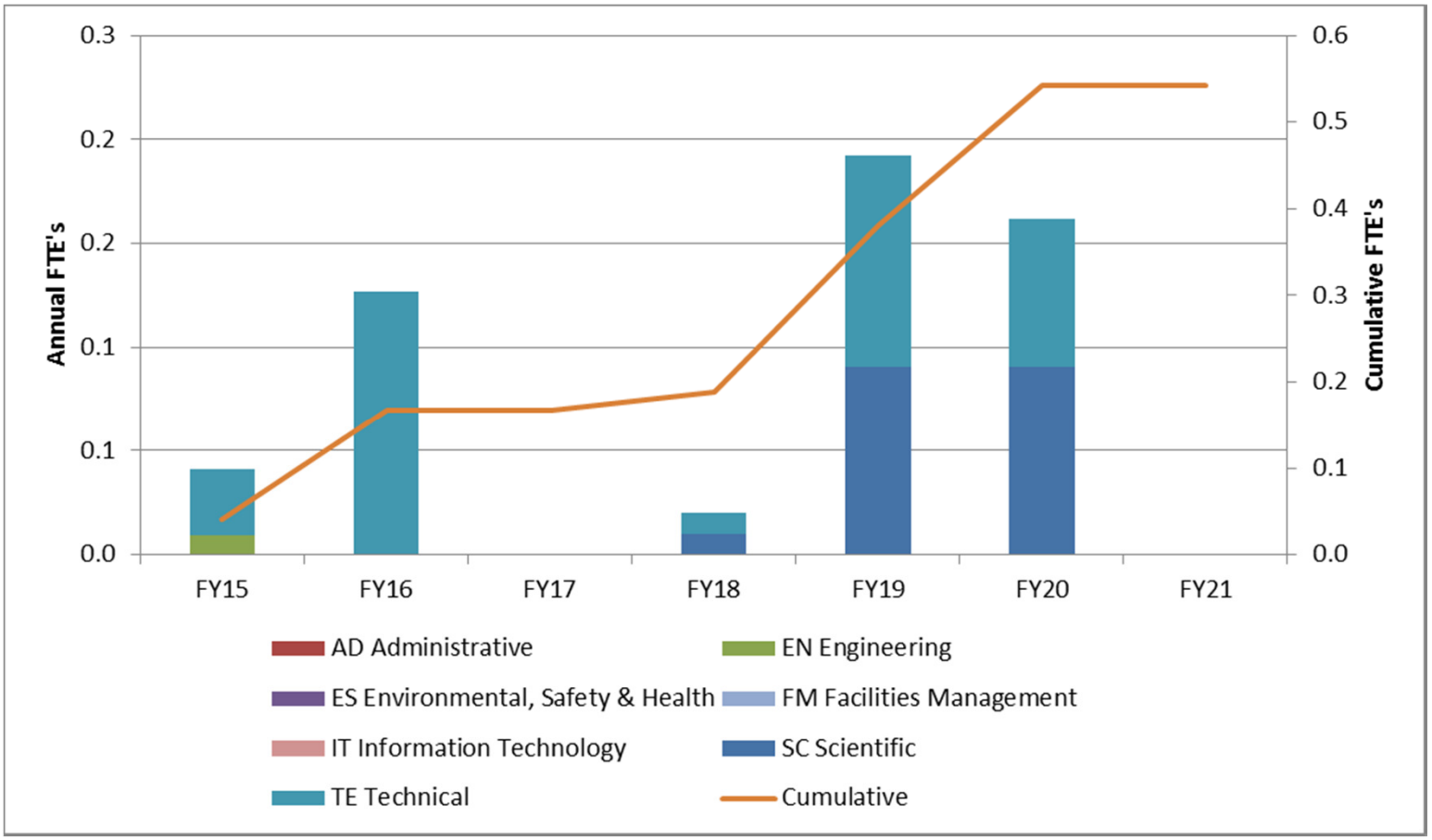
8.6 Electronics



8.7 Module Fabrication



8.8 Detector Installation & Assembly



Project Slides: Cost Book

475.8 Cost Book

	Base Cost (AY K$)					
	M&S	Labor	Total	Uncertainty (on remaining budget)	% Contingency (on remaining budget)	Total Cost
475.8.1 Project Management	267	178	445	75	21%	520
475.8.2 Mechanical Design	135	3	138	24	38%	162
475.8.3 Scintillator extrusions	567	462	1,029	209	25%	1,238
475.8.4 Fibers	462		462	106	24%	568
475.8.5 Photodetectors (SiPMs)	464	305	769	190	41%	959
475.8.6 Electronics	1,314	407	1,720	511	33%	2,231
475.8.7 Module Fabrication	1,482	8	1,490	466	35%	1,956
475.8.8 Detector assembly and installation	127	81	208	64	35%	273
475.8.9 Conceptual Design/R&D	258	252	511		0%	511
475.8.99 Risk Based Contingency				318	-	318
Grand Total	5,077	1,696	6,773	1,963	38%	8,735

8.1 Project Management

	Base Cost (AY K$)					
	M&S	Labor	Total	Uncertainty (on remaining budget)	% Contingency (on remaining budget)	Total Cost
8.01.02 Preliminary & Final Design (Post CD-1; PED)	123	58	181	22	25%	203
8.01.03 Implementation & Close-out (Post CD-3; Line Item)	144	120	264	53	20%	317
Grand Total	267	178	445	75	21%	520

8.2 Mechanical Design

	Base Cost (AY K$)					
	M&S	Labor	Total	Uncertainty (on remaining budget)	% Contingency (on remaining budget)	Total Cost
8.02.01 Detector Design	65		65	9	54%	74
8.02.02 Fabricate and test Counter Prototypes	52	3	55	15	32%	70
8.02.03 Cosmic Ray Veto Simulations	18		18		-	18
Grand Total	135	3	138	24	38%	162

8.3 Scintillator

	Base Cost (AY K$)					
	M&S	Labor	Total	Uncertainty (on remaining budget)	% Contingency (on remaining budget)	Total Cost
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

8.4 Fibers

	Base Cost (AY K$)					
	M&S	Labor	Total	Uncertainty (on remaining budget)	% Contingency (on remaining budget)	Total Cost
8.04.01 Waveshifting fiber (WF) procurement	448		448	105	24%	552
8.04.02 WF quality Assurance design and fabrication	14		14	1	11%	16
Grand Total	462		462	106	24%	568

8.5 Photodetectors (SiPMs)

	Base Cost (AY K$)					
	M&S	Labor	Total	Uncertainty (on remaining budget)	% Contingency (on remaining budget)	Total Cost
8.05.01 Photodetectors (SiPMs) procurement	409	36	445	148	36%	593
8.05.02 Photodetectors (SiPMs) quality assurance design	56	269	325	42	80%	367
Grand Total	464	305	769	190	41%	959

8.6 Electronics

	Base Cost (AY K$)					
	M&S	Labor	Total	Uncertainty (on remaining budget)	% Contingency (on remaining budget)	Total Cost
8.06.01 Counter Mother Boards	314	36	350	86	29%	436
8.06.02 Front-end Boards	697	292	989	268	29%	1,257
8.06.03 Readout Controllers	262	6	268	86	33%	354
8.06.04 Integration with DAQ	41	73	113	70	80%	184
Grand Total	1,314	407	1,720	511	33%	2,231

8.7 Module Fabrication

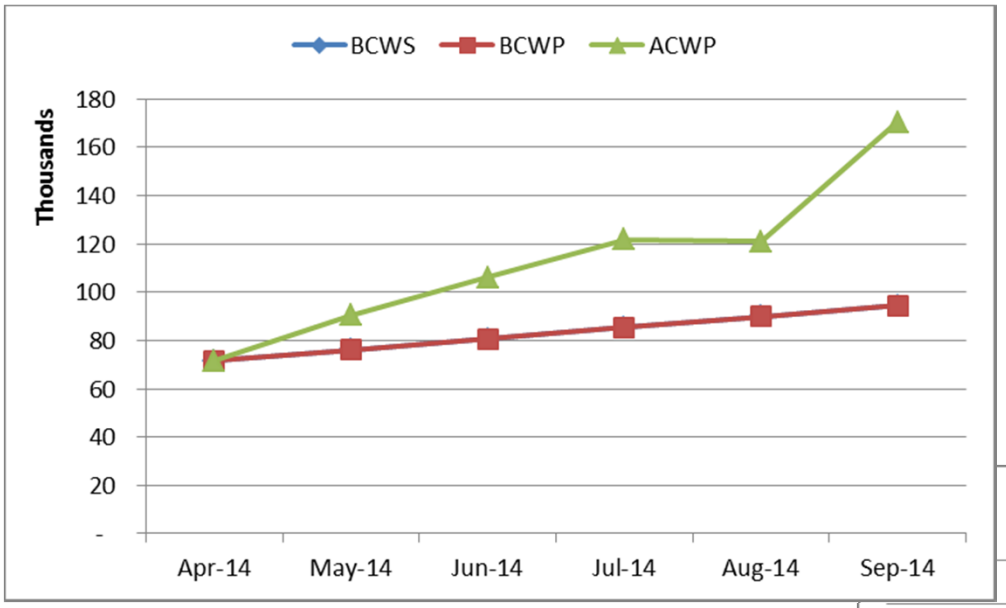
	Base Cost (AY K$)					
	M&S	Labor	Total	Uncertainty (on remaining budget)	% Contingency (on remaining budget)	Total Cost
8.07.01 Design and fabricate assembly station	163		163	62	47%	225
8.07.02 Assembly Station Quality assurance design & fabrication	98	8	106	23	65%	129
8.07.03 Fabrication of Module Parts	454		454	93	21%	547
8.07.04 Module Production, Testing, Shipping	741		741	276	41%	1,018
8.07.05 Breakdown of Module Factory	26		26	11	43%	37
Grand Total	1,482	8	1,490	466	35%	1,956

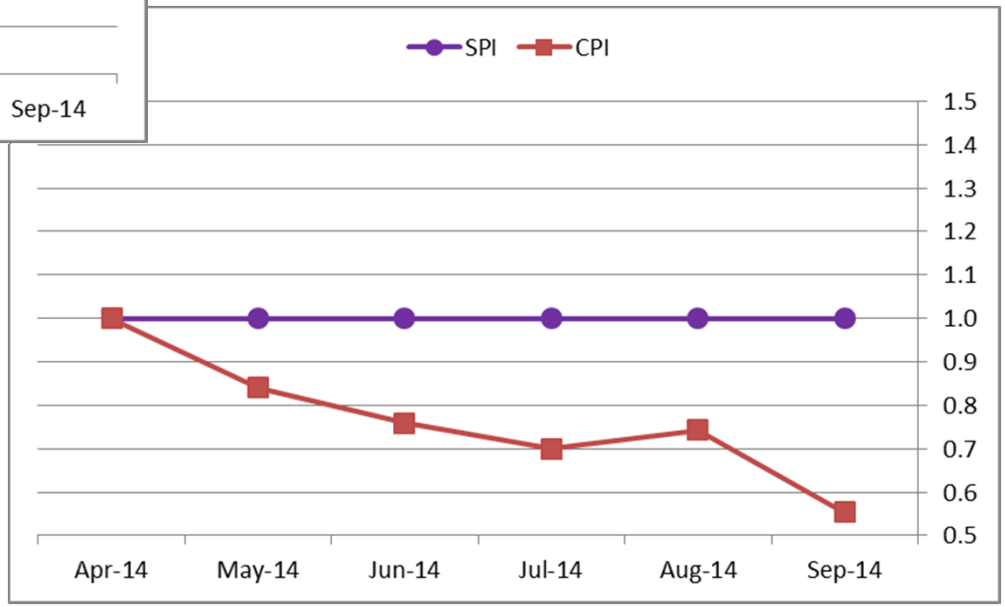
8.8 Detector Assembly & Installation

	Base Cost (AY K$)					
	M&S	Labor	Total	Uncertainty (on remaining budget)	% Contingency (on remaining budget)	Total Cost
8.08.01 Test Installation		21	21	7	35%	28
8.08.02 Recieve Production Modules at Fermilab		18	18	6	35%	24
8.08.03 Detector Assemly & Installation: Cosmic Ray Test Stand	4	32	36	11	80%	47
8.08.04 Module Support Structure	123	10	133	40	30%	173
Grand Total	127	81	208	64	35%	273

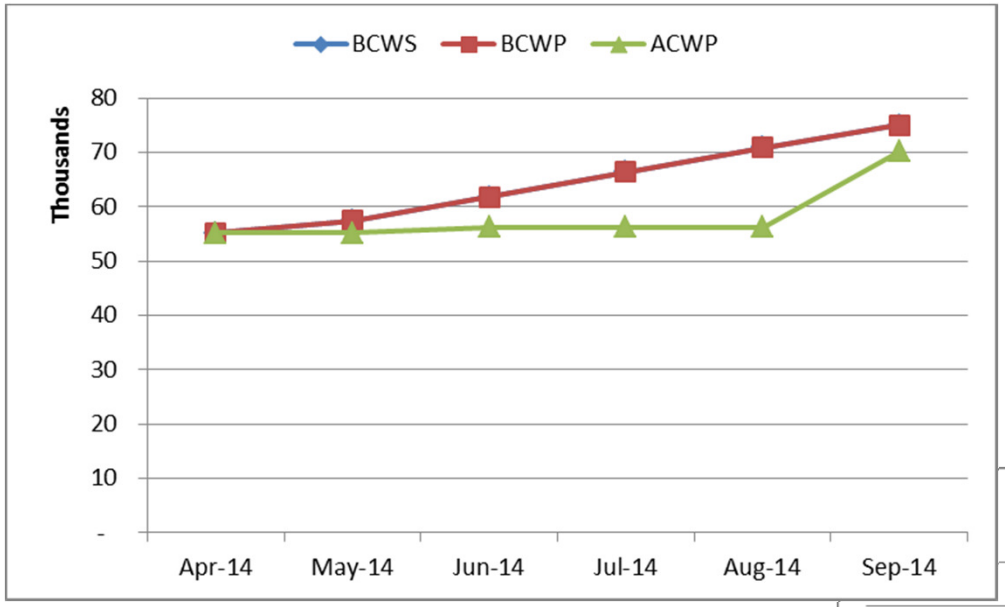
Project Slides: EVMS

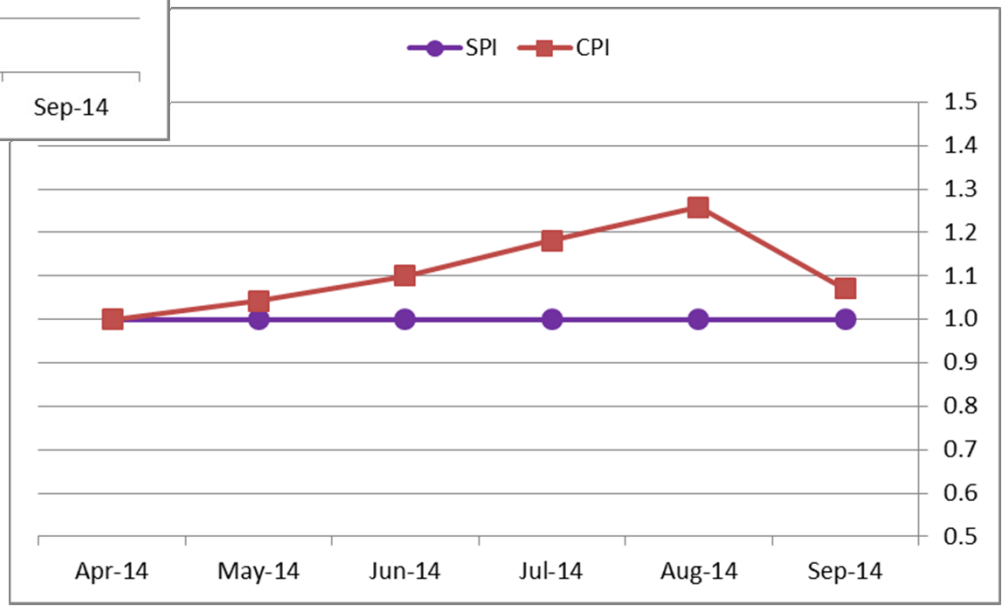
8.1 Project Management



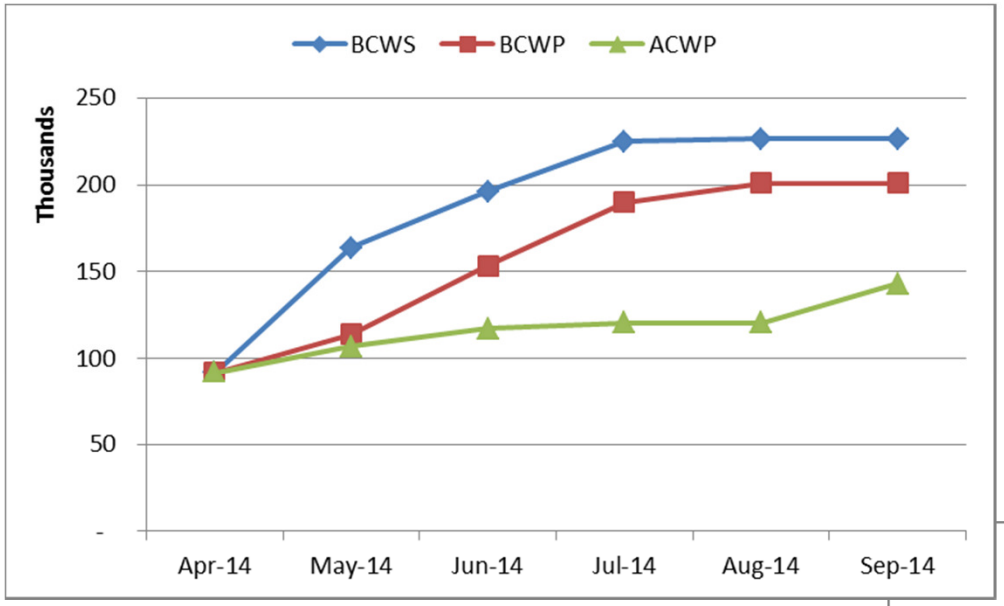


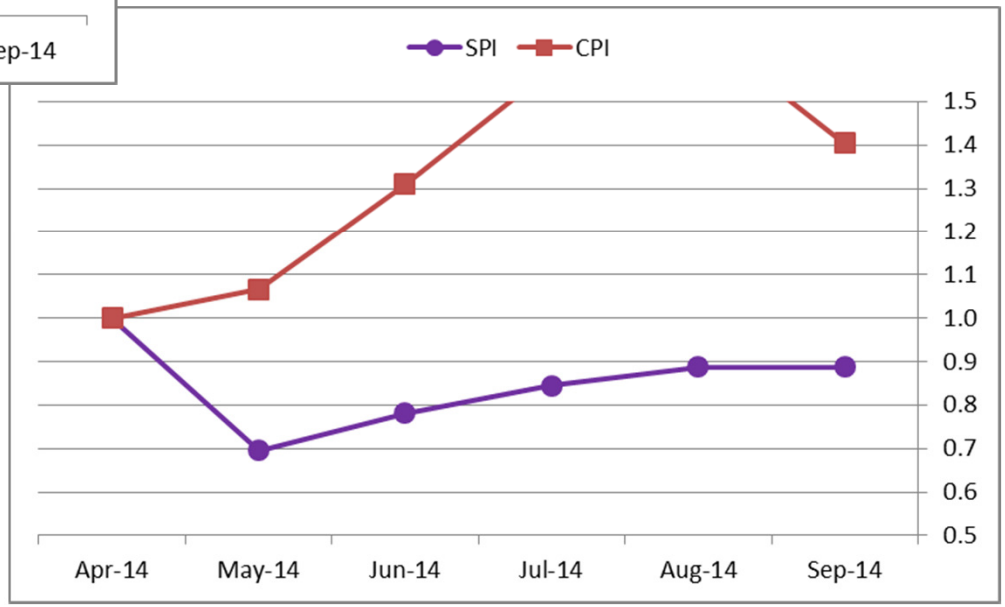
8.2 Mechanical Design



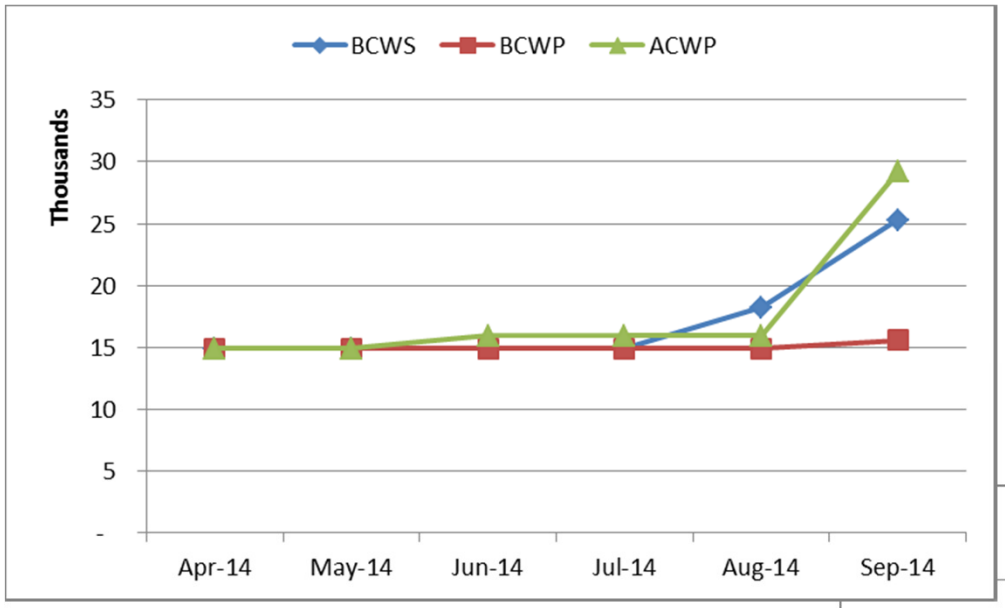


8.3 Scintillator





8.4 Fibers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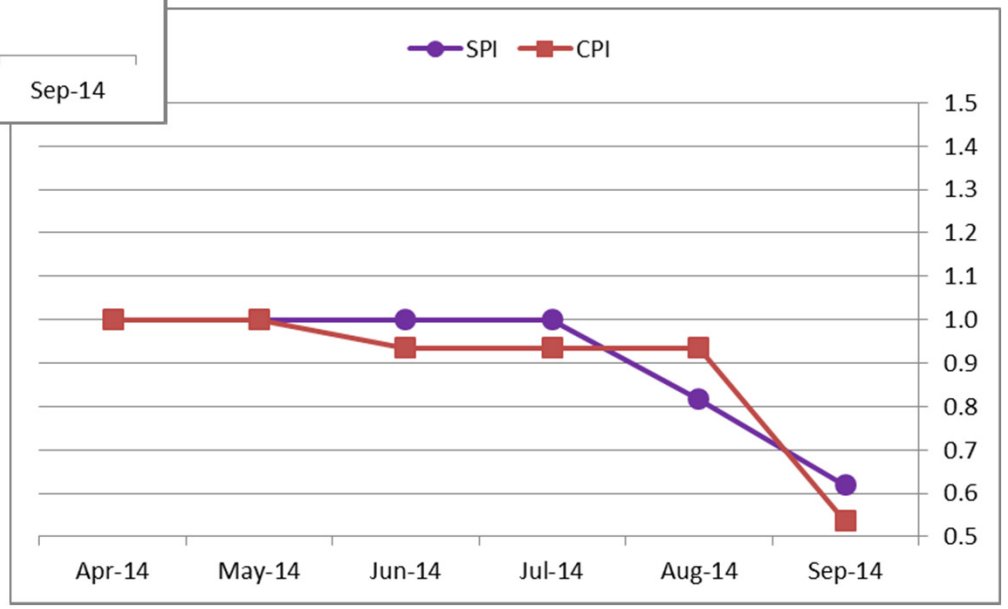
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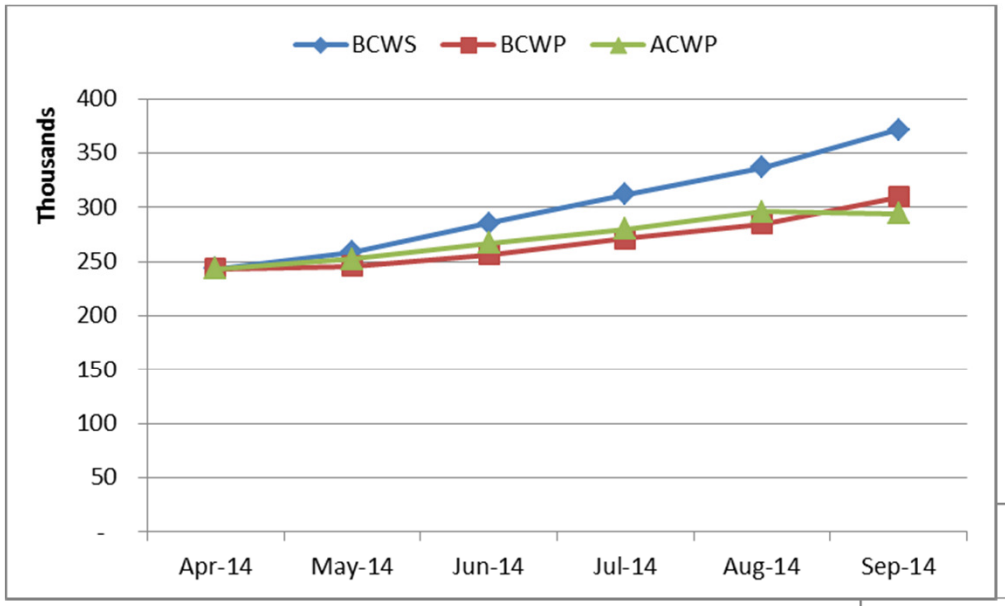
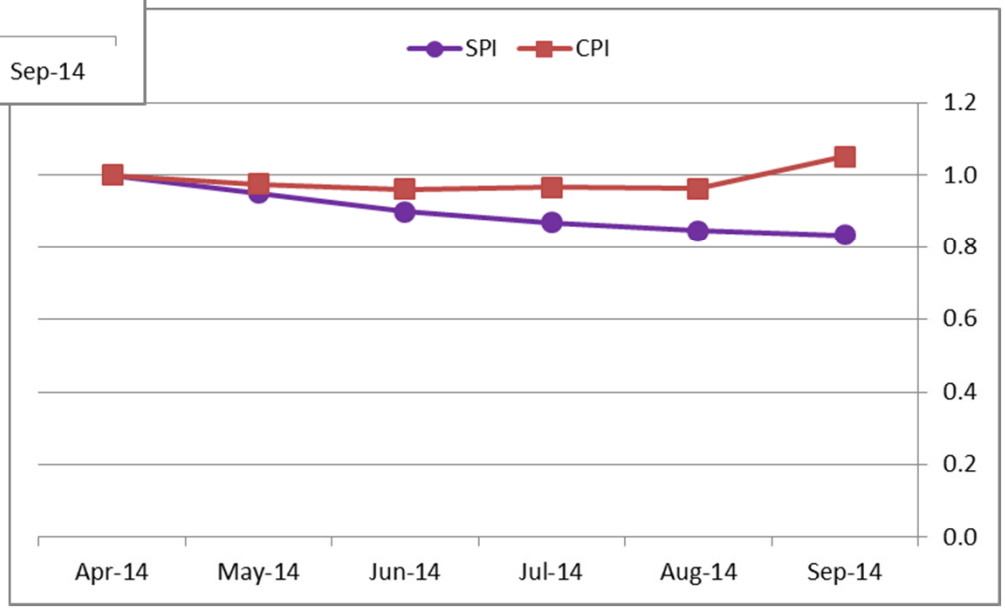
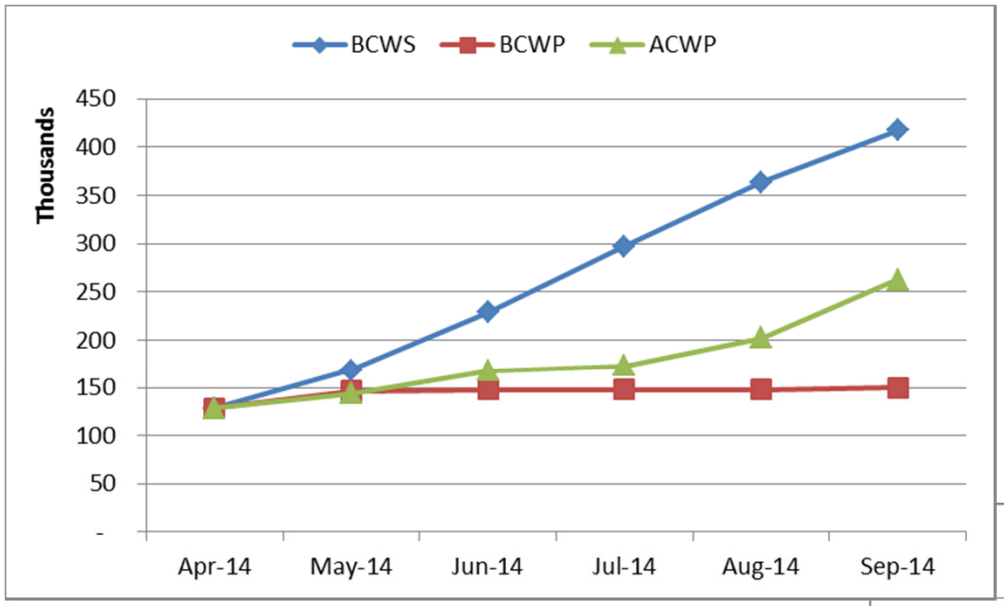
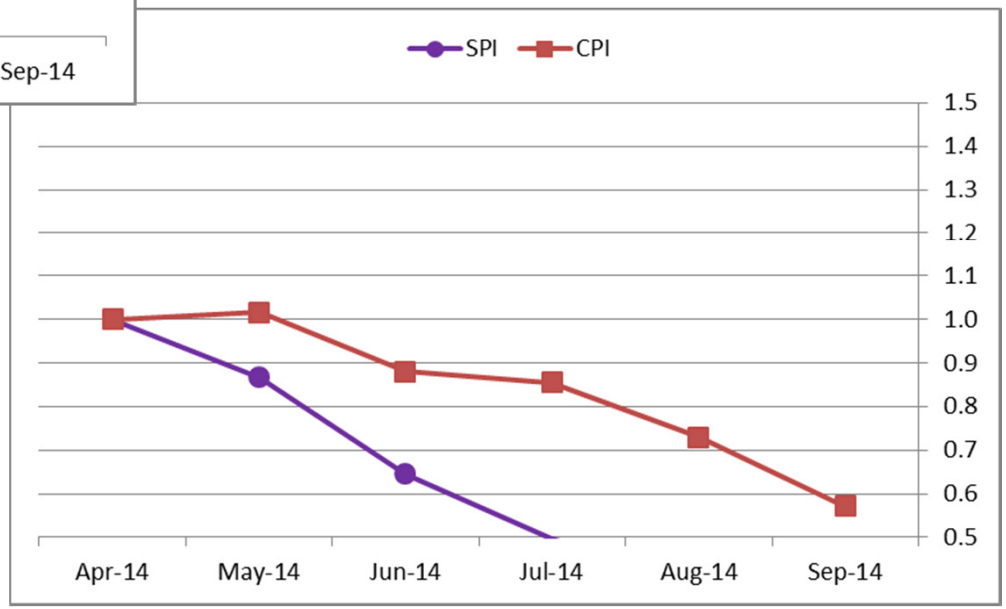
8.5 Photodetectors



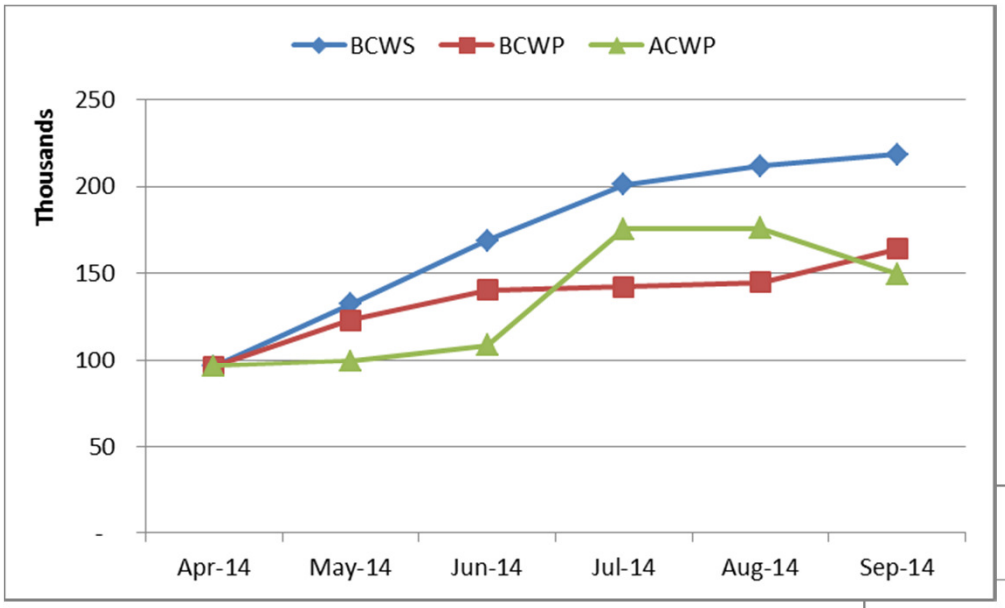


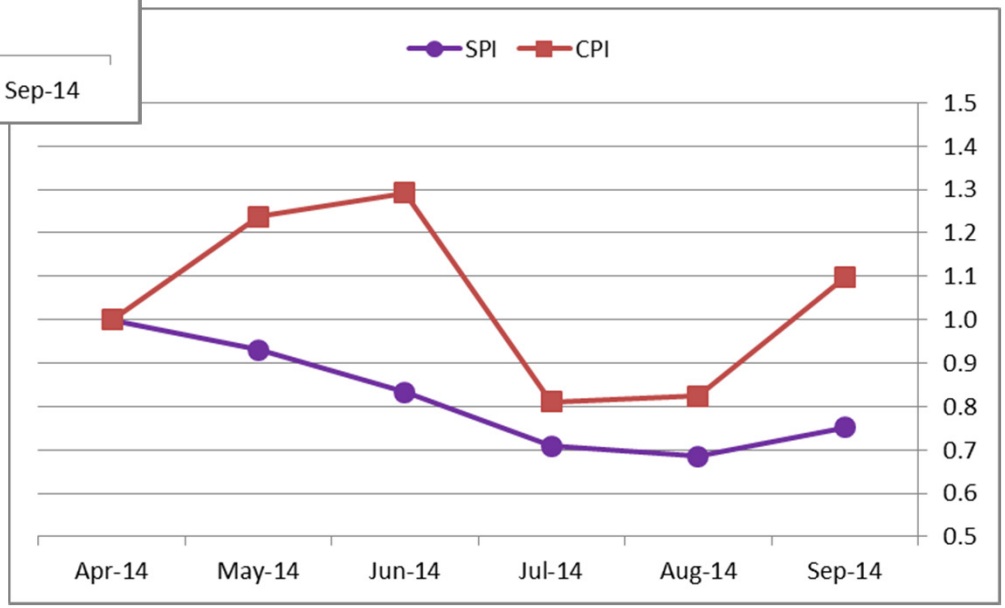
8.6 Electronics



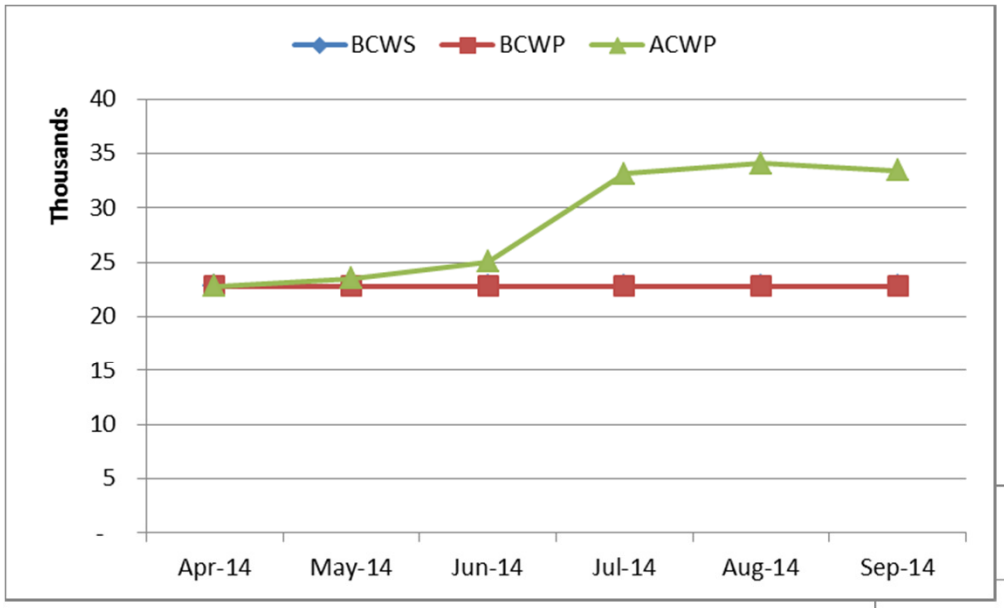


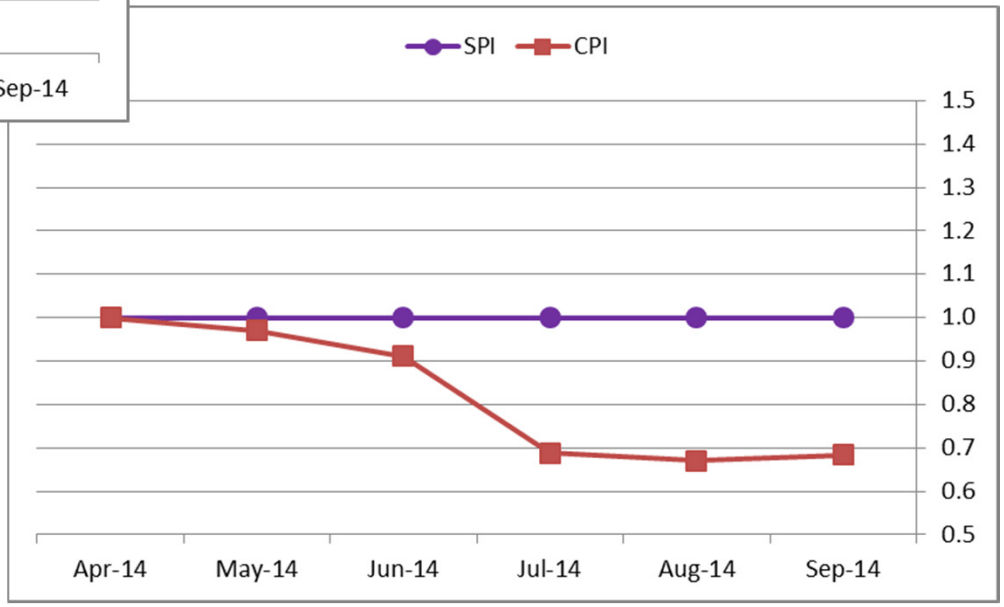
8.7 Module Fabrication



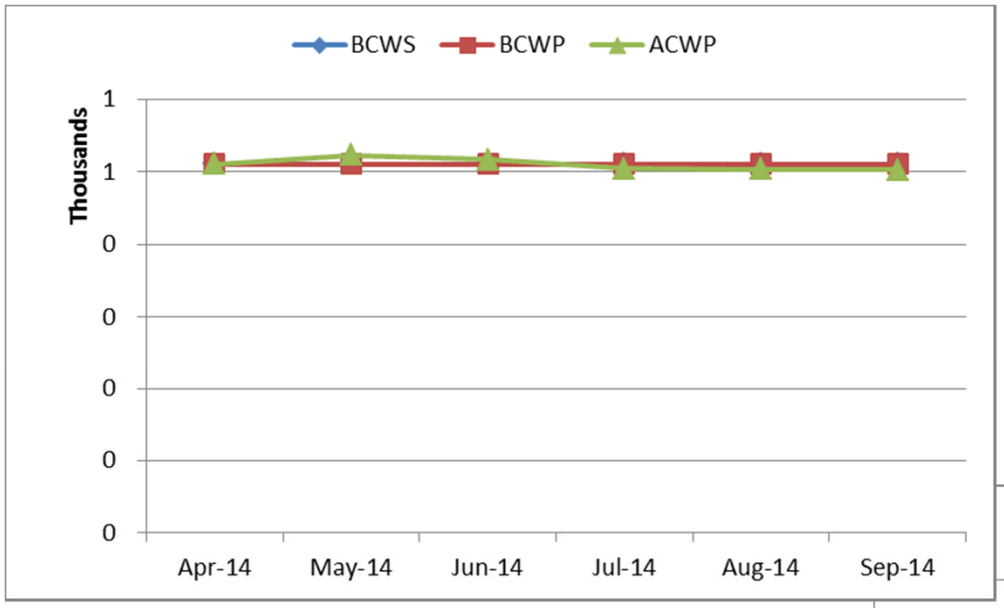


8.8 Detector Assembly & Installation





8.9 OPC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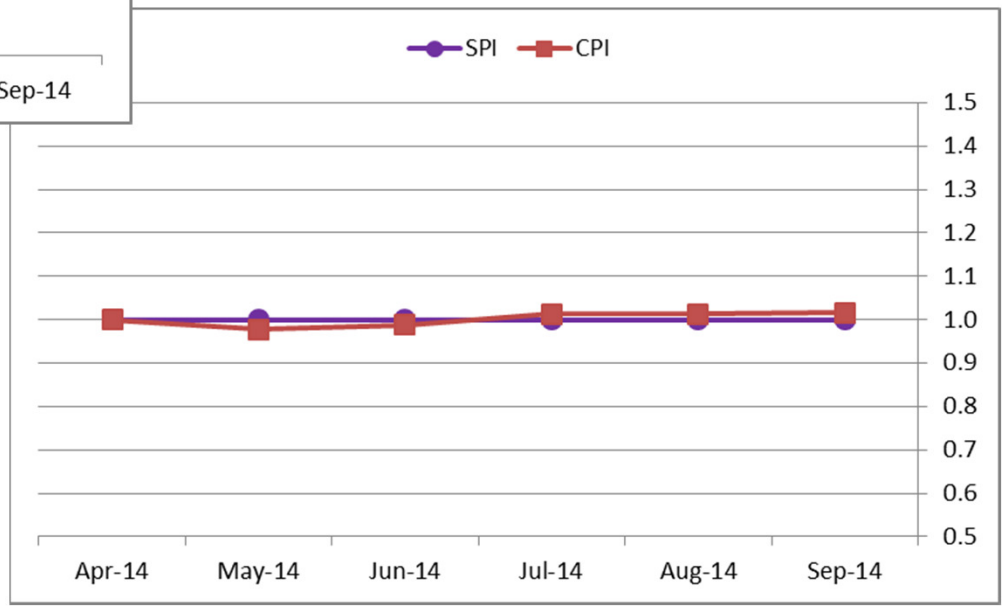
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Sep-14

CRV CPR

Report: **CPR Format 5 MG**-Cost Performance Report Format 5 - Explanations and Problem Analysis

Project: **S8-47508**-Mu2e Cosmic Ray Veto Aug2014
Status Date: 08/31/2014

CLASSIFICATION (When Filled In)

CONTRACT PERFORMANCE REPORT
FORMAT 5 - Explanations and Problem Analysis

FORM APPROVED
OMB No. 0704-0188

1. CONTRACTOR	2. CONTRACT		3. PROGRAM	4. REPORT PERIOD
a. NAME Fermilab	a. NAME Mu2e		a. NAME Mu2e Cosmic Ray Veto Aug2014	a. FROM (YYYYMMDD) 2014 / 08 / 01
b. LOCATION (Address and ZIP Code)	b. NUMBER 475		b. PHASE Electronics	b. TO (YYYYMMDD) 2014 / 08 / 31
	c. TYPE	d. SHARE RATIO	c. EVMS ACCEPTANCE No X Yes (YYYYMMDD 2010 / 01 / 28	

5. Evaluation

475.08.06 Cosmic Ray Veto Electronics

	Budget	Earned	Actuals	SV in $	SV in %	CV in $	CV in %	SPI	CPI
Current:	67	0	29	-67	-100%	-29	-	0.00	0.00
Cumulative:	364	148	202	-216	-59%	-55	-37%	0.41	0.73
	BAC	**EAC**	**VAC in $**	**VAC in %**	**TCPI to BAC**	**TCPI to EAC**			
At Complete:	1,720	1,635	85	5%	1.04	1.10			

Explanation of Variance/Description of Problem:

Current Period:

Schedule Variance is within the threshold

Cost Variance is within the threshold

Cumulative:

The unfavorable schedule variance results from the completion dates of the Counter Motherboard and Readout Controller activities being extended from September to the end of December. The reason for the delay is due to the consideration of an alternative readout chip, VMM2 being fabricated at BNL. Evaluation of this alternative took longer than anticipated and resulted in delays to the prototype electronics fabrication.

Cost Variance is within threshold

Impact:

The is sufficient float that there is no schedule impact. The VMM2 chip was found not to meet requirements.

Corrective Action:

Reschedule the electronics activities to be completed in January 2015.

Monthly Summary (to include technical causes of VARs, Impacts) and Corrective Action(s):

Prepared by:	**Date:**	**Approved by:**	**Date:**
Michael Gardner, Project Controls	10/8/14	Craig Dukes, CAM - via email	**10/9/14**