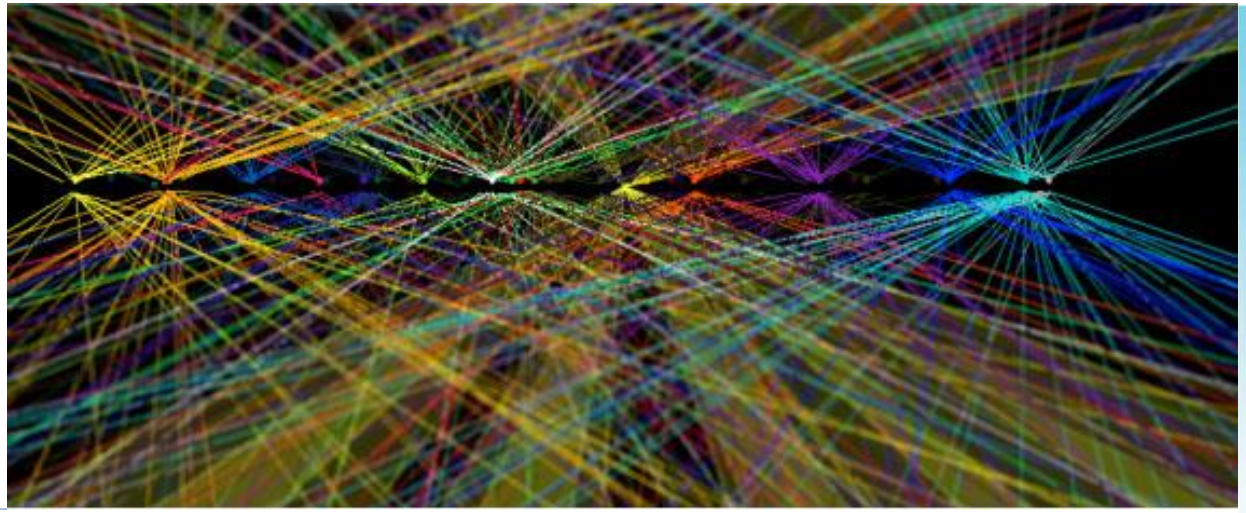
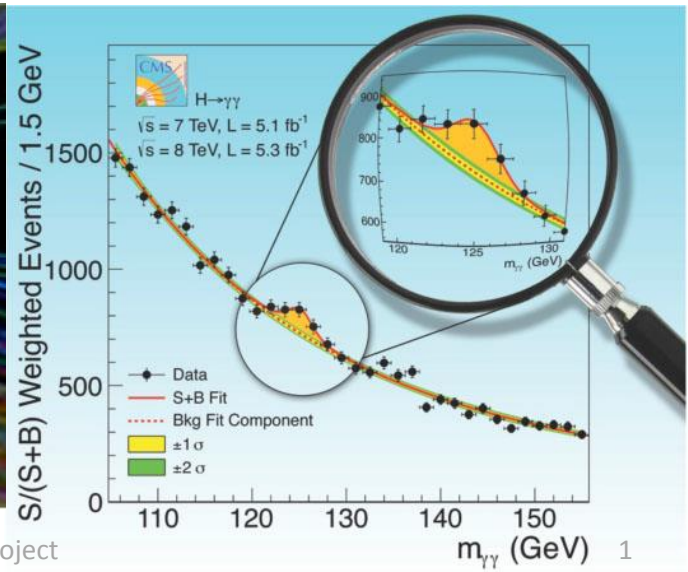
The LHC CMS Detector Upgrade Project

Steve Nahn, Project Manager

December 10th , 2014





Roadmap

- Quick tour LHC CMS Detector Upgrade Project
  - aka Project 401, or U.S. CMS Upgrades Phase 1
- Organizational Structure
- RLS
- EVMS
- Change Control

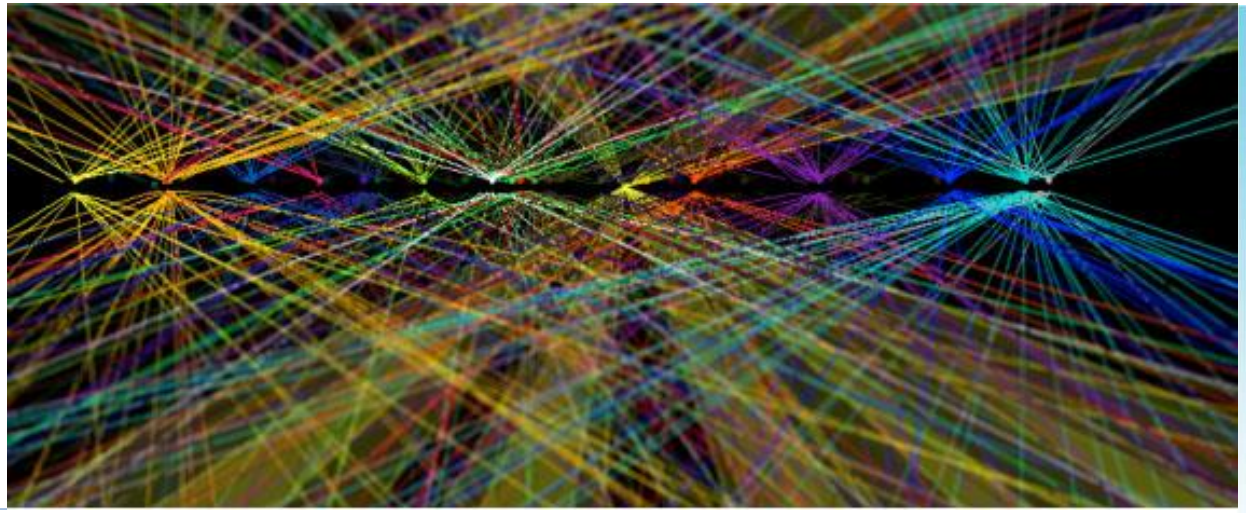
The 401 Project in a slide

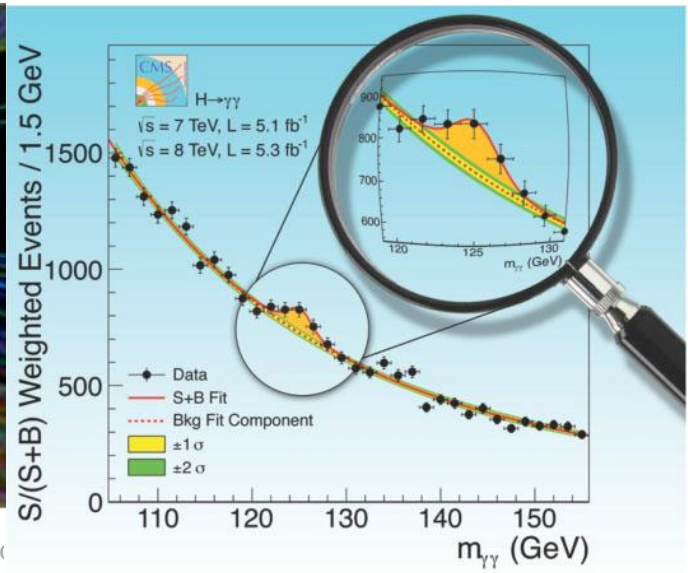
- Scope: Upgrade 3 subsystems to sustain current performance with increasing difficult conditions
  - Hadron Calorimeter – HCAL – WBS 401.02
  - Forward Pixels – FPIX- WBS 401.03
  - Level 1 Trigger – TRIG or L1T – WBS 401.04
- Schedule: Motivated by Large Hadron Collider (LHC) plans
  - Target installation dates driven by LHC Technical Stops
  - Part of a larger Upgrade coordinated by International CMS
- TPC: DOE 33.22M + NSF 9.67M = 42.9M
  - Approval history

CD-0	September 18, 2012
CD-1	October 17, 2013
NSF Approval of Cooperative Agreement	June 21, 2014
CD-2 and CD-3	**November 12, 2014**

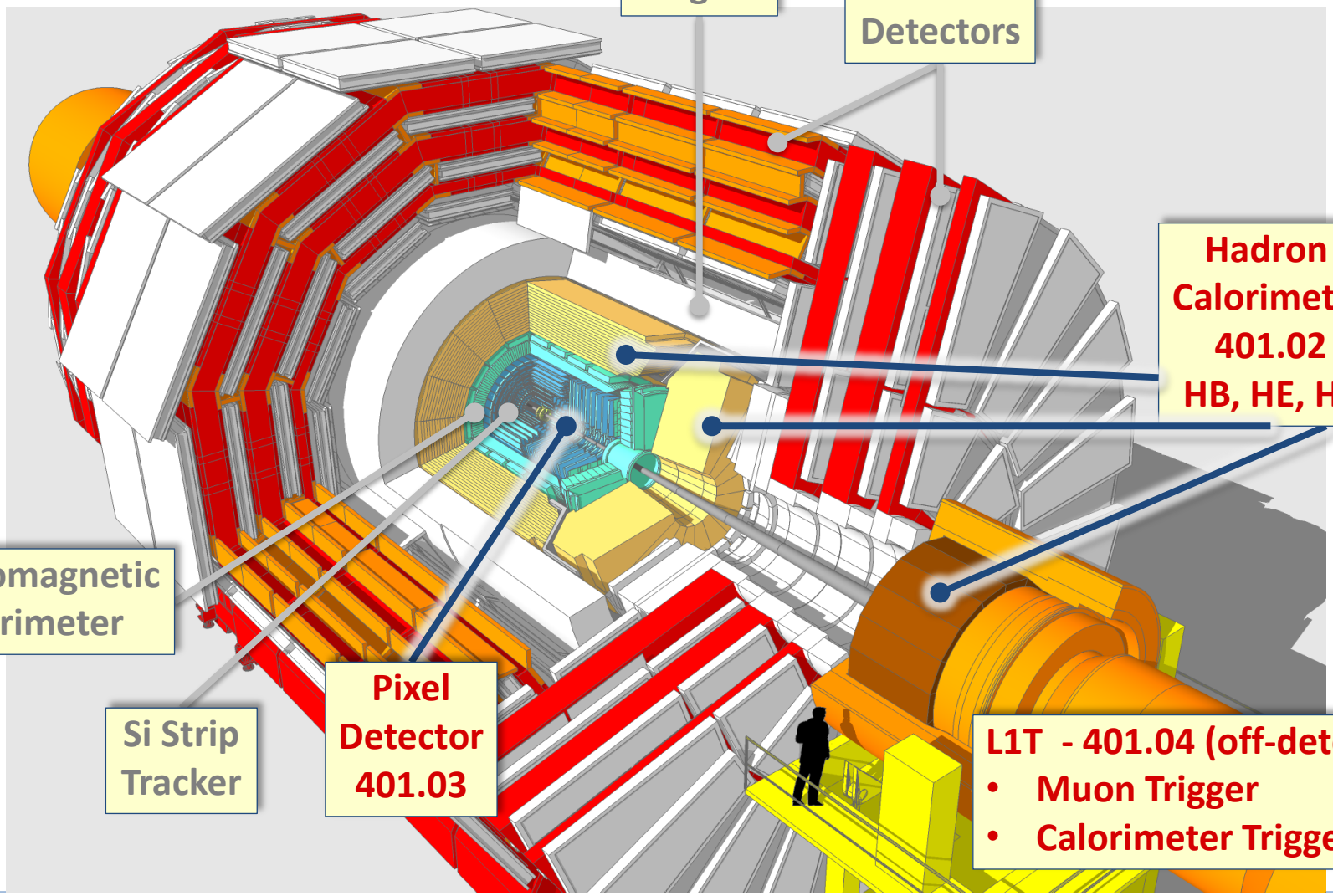
Motivation

P5 Recommendation 10: Complete the LHC phase-1 upgrades and continue the strong collaboration in the LHC with the phase-2 (HL-LHC) upgrades of the accelerator and both general-purpose experiments (ATLAS and CMS). The LHC upgrades constitute **our highest-priority near-term large project.**



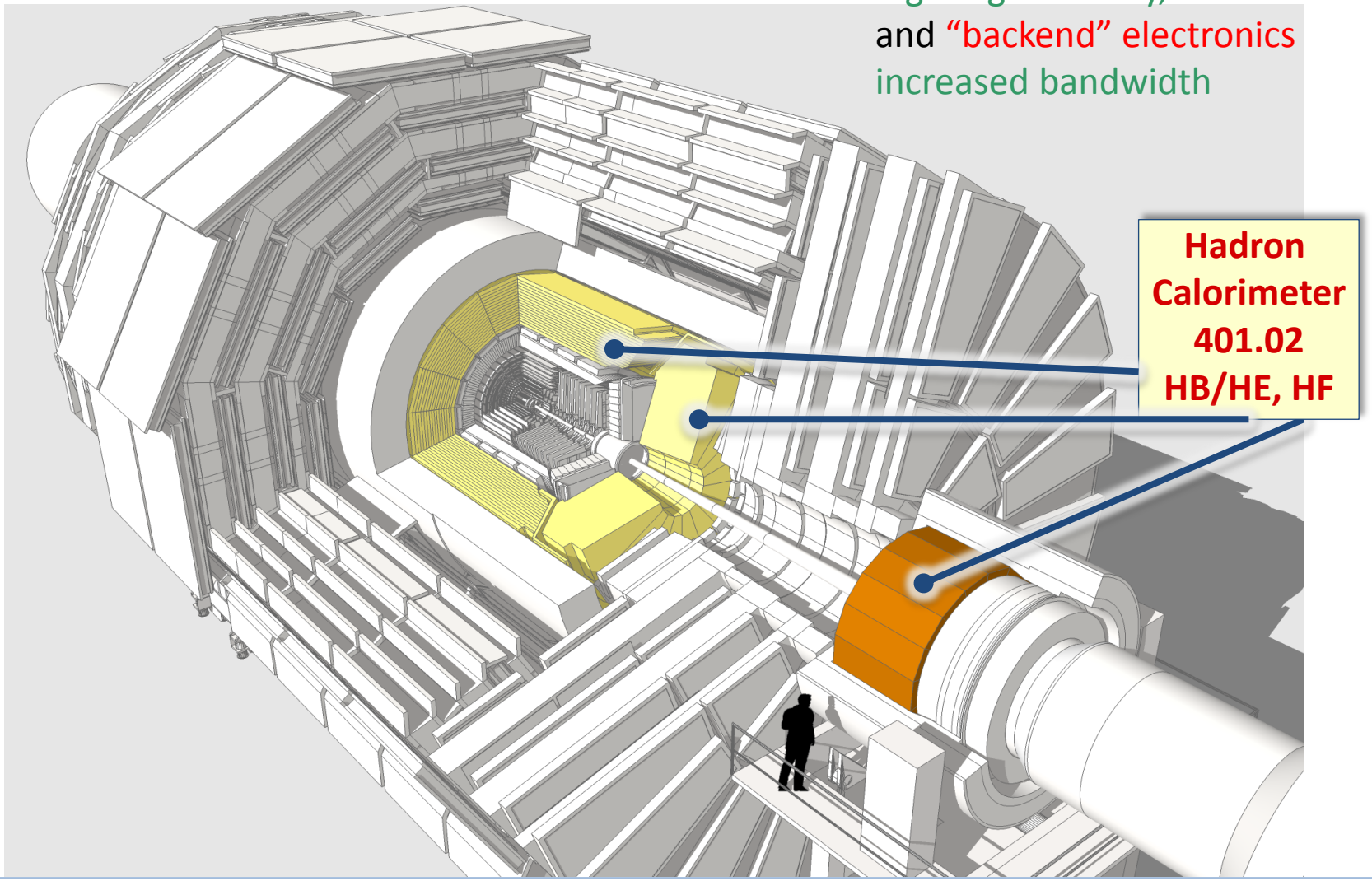


U.S. CMS Detector Phase 1 Upgrades



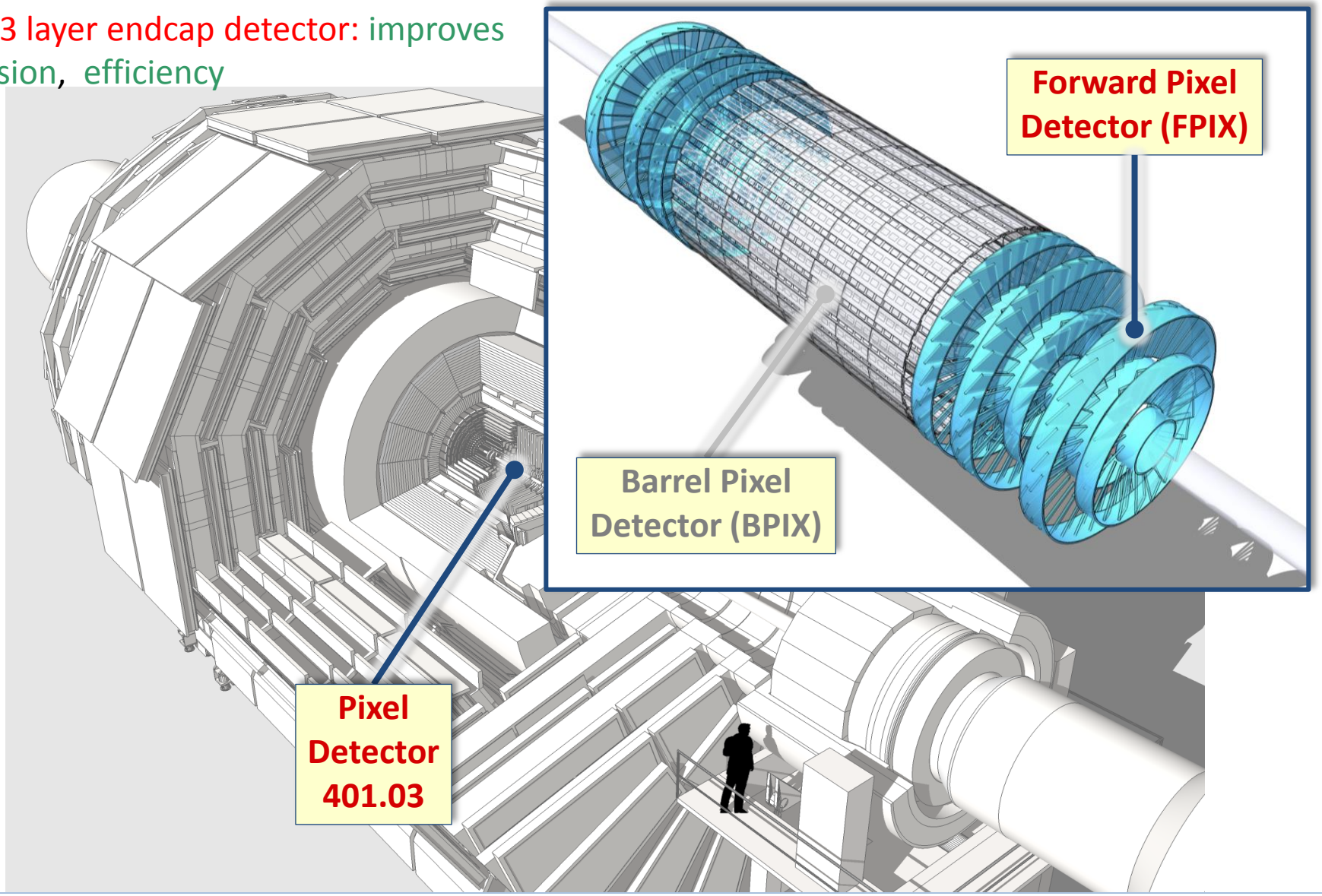
Hadron Calorimeter (HCAL) Upgrades

New "frontend" photodetector:
higher granularity, time info
and "backend" electronics
increased bandwidth



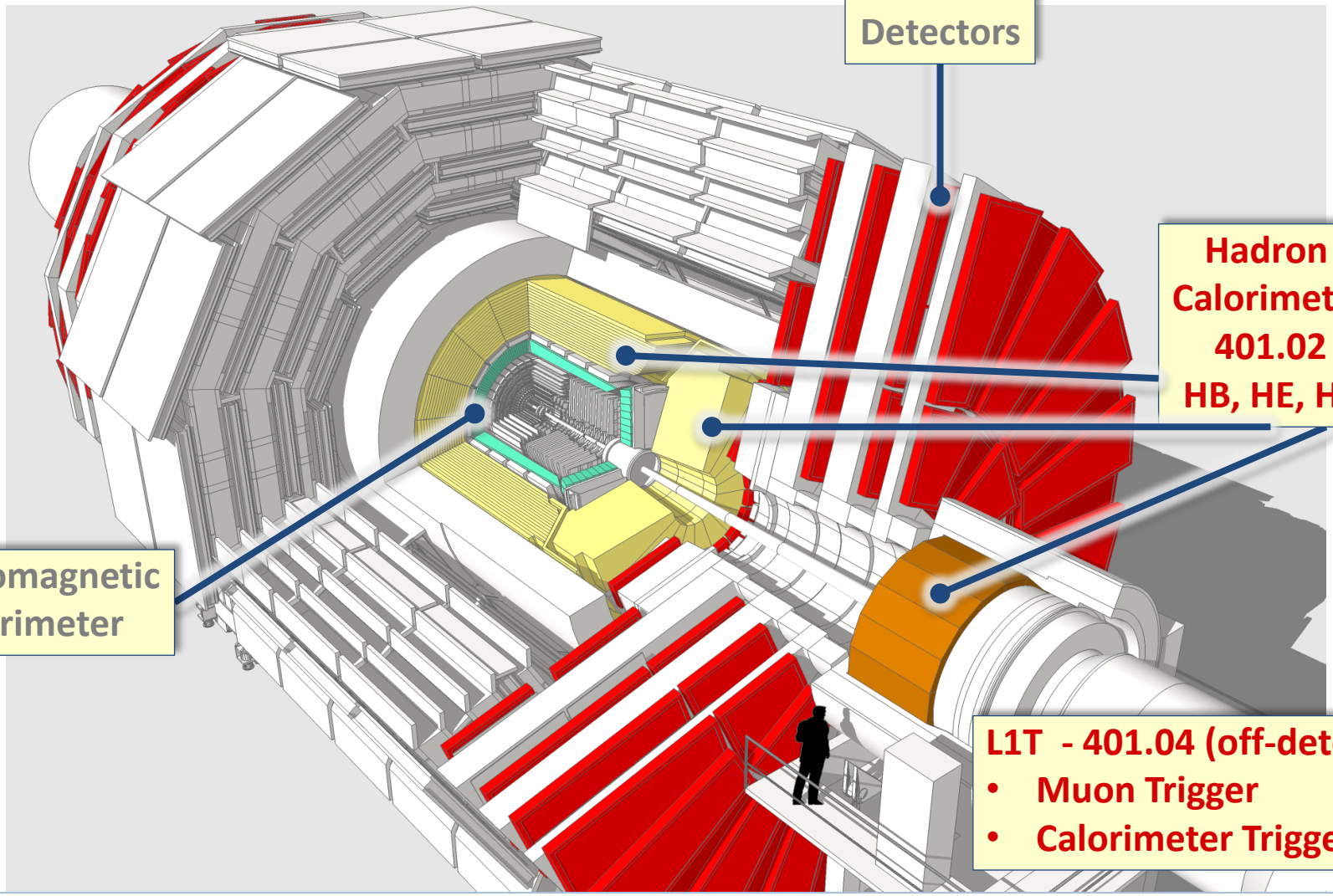
Forward Pixel (FPIX) Upgrades

New 3 layer endcap detector: improves precision, efficiency



L1 Trigger Upgrades

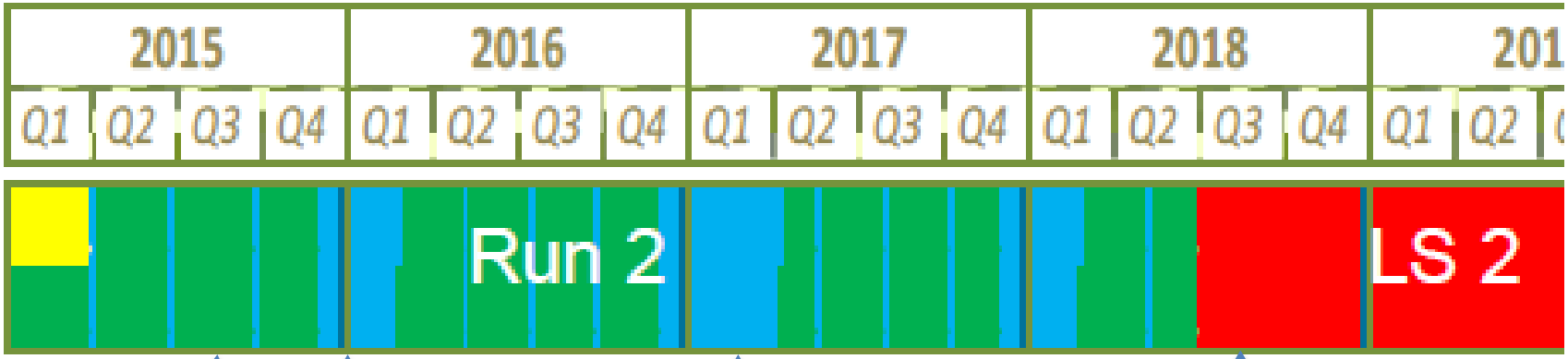
Modern electronics system: more sophisticated filtering



L1T - 401.04 (off-detector)

- **Muon Trigger**
- **Calorimeter Trigger**

The LHC schedule



HCAL BE Install
L1T Install/Commission

HF FE Install

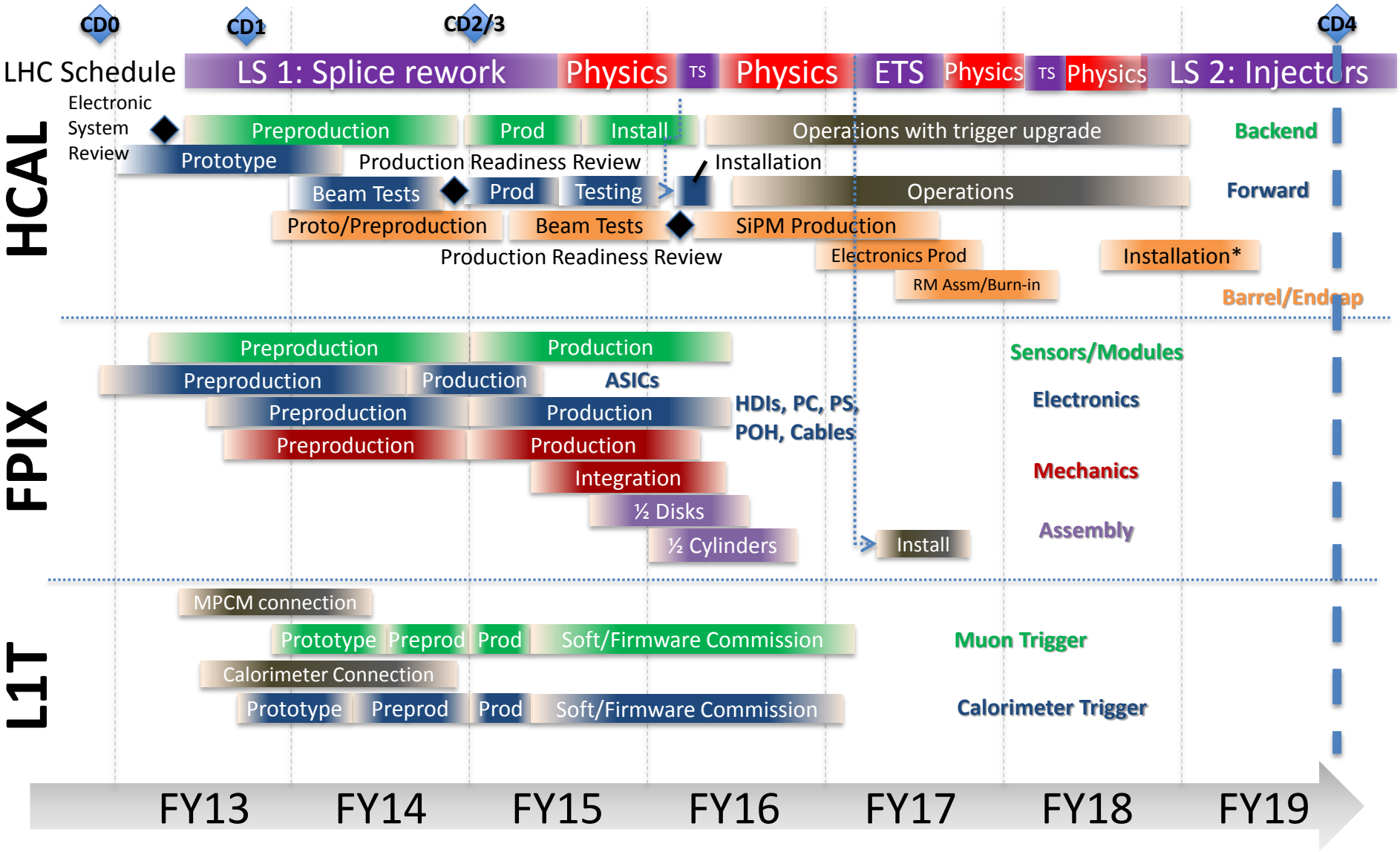
FPIX Install

HB FE Install
HE FE Install

Outside detector hall: Install at will
Inside detector hall: Installation windows

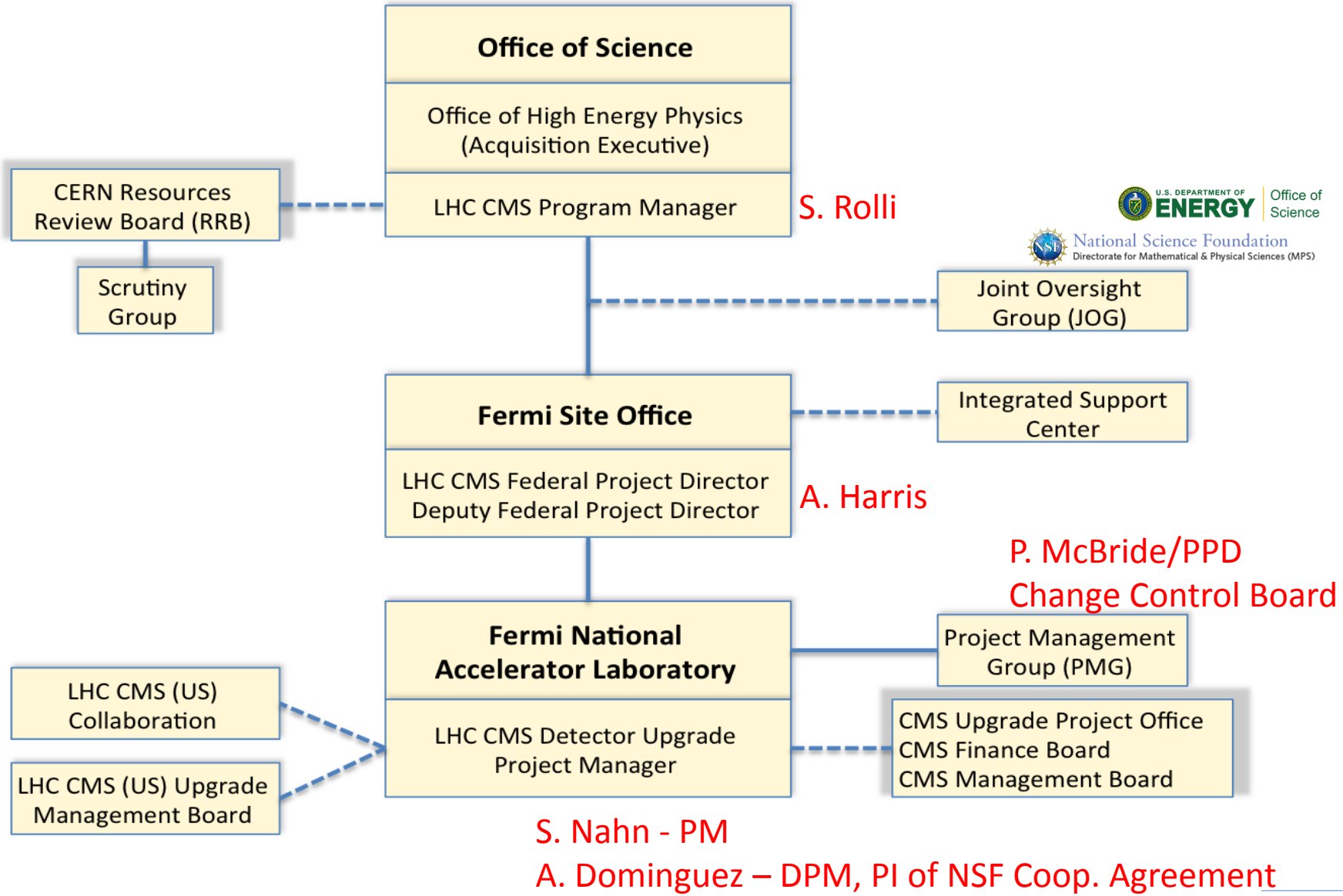
To avoid dependence on the LHC schedule, “threshold” success defined as delivering completed components to CERN and demonstrating that they work there.

Coarse Granularity Schedule



Project Organization

Organization – Funding Agencies



LHC CMS Detector Project Organization

401.01 LHC CMS Detector Upgrade Project

Project Office

Project Manager:	Steve Nahn
Deputy Project Manager:	Aaron Dominguez
Deputy Project Manager:	Lucas Taylor
ESH&Q Coordinator:	Stefan Gruenendahl
Project Controls:	Bill Freeman
Project Finance:	Jenny Teng
Risk Manager:	Lucas Taylor
Project Electronics Engineer	Michael Matulik
Project Mechanical Engineer	Greg Derylo

401.02 HCAL

L2 Manager: Jeremy Mans
Deputy L2 Manager: Frank Chlebana

- **401.02.03 HF Front End** — L3 Manager: Ulrich Heintz
- **401.02.04 HB/HE Front End** — L3 Manager: James Hirschauer
- **401.02.05 HCAL Back End** — L3 Manager: Yuichi Kubota

401.03 FPIX

L2 Manager: Will Johns
Deputy L2 Manager: Marco Verzocchi

- **401.03.03 FPIX Components** — L3 Manager: Harry Cheung
- **401.03.04 FPIX Assembly & Testing** — L3 Managers: Cecilia Gerber, Petra Merkel
- **401.03.05 FPIX Pilot System** — L3 Manager: Karl Ecklund

401.04 Trigger

L2 Manager: Wesley Smith
Deputy L2 Manager: Darin Acosta

- **401.04.03 Muon Trigger** — L3 Manager: Ivan Furic
- **401.04.04 Calorimeter Trigger** — L3 Manager: Sridhara Dasu

Key features of the project

- Multiple stakeholders, Global context
  - Funding Agencies, CERN, International CMS Collaboration, U.S. CMS Collaboration, U.S. CMS Operations Program
    - Other org charts which we interface with

- Upgrade of existing experiment
  - Fit in existing volumes, use existing interfaces to environmental controls, data acquisition, etc
  - Avoid interfering with concurrent Operations and LHC schedule
  - Borrows procedures well established from 15 years of working in this environment
    - Sets the standard for international collaboration (P5)

Resource Loaded Schedule

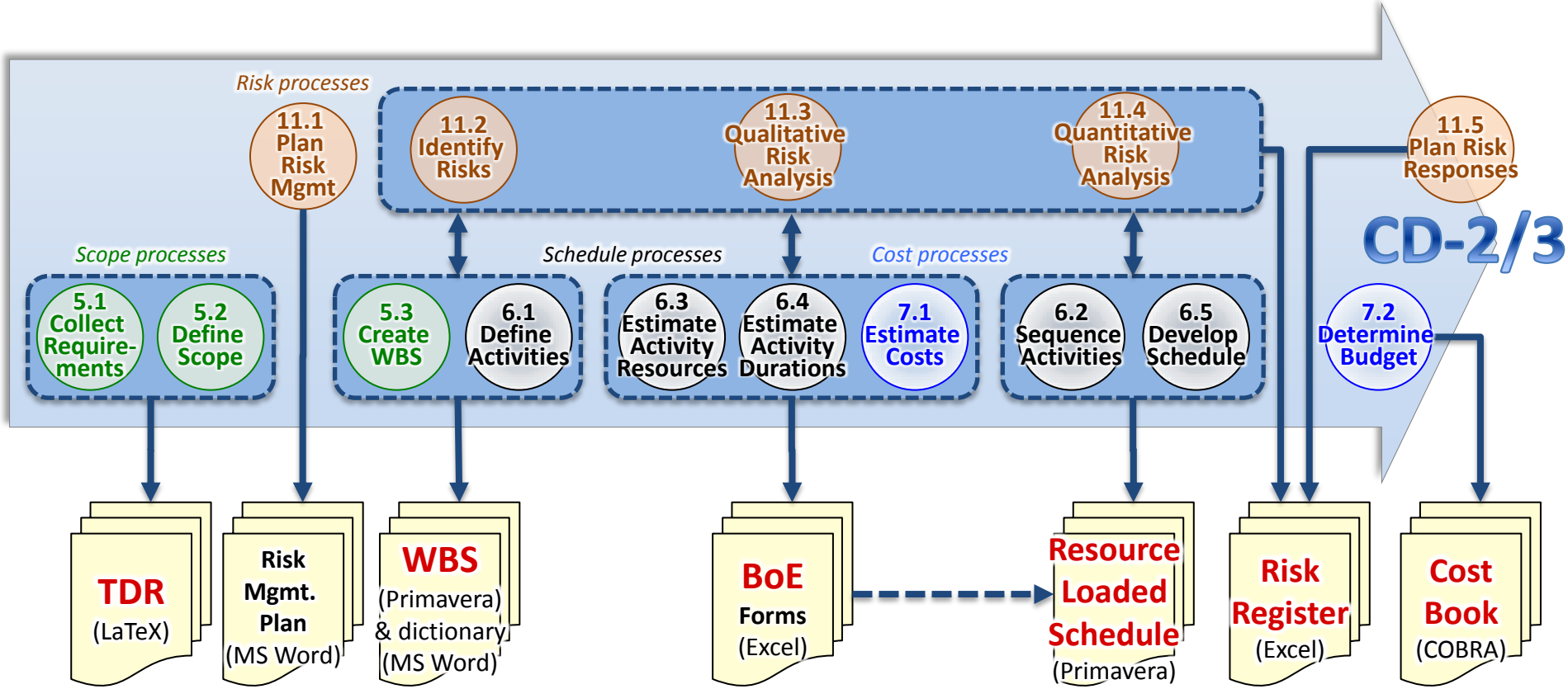
Project Development

- Development of Resource Loaded Schedule (RLS)
  - CAMs and L2s work closely with Project Controls and PM to build RLS bottoms up
    - CD-1: Cost tool, to predict Cost Range
    - CD-2/3: Fully logically consistent Schedule with structure suitable for EVMS
  - Implemented in Primavera (P6) + Cobra, lab standard for Project Controls

- Development of Total Project Cost
  - Basis of Estimate support for each WBS element (lowest level)
    - Bottoms up from the activities of that WBS
  - Estimate Uncertainty Contingency ("EU") based on Maturity of Estimate
  - Full blown Risk Analysis using Primavera Risk Analysis (PRA)

Project Planning Process

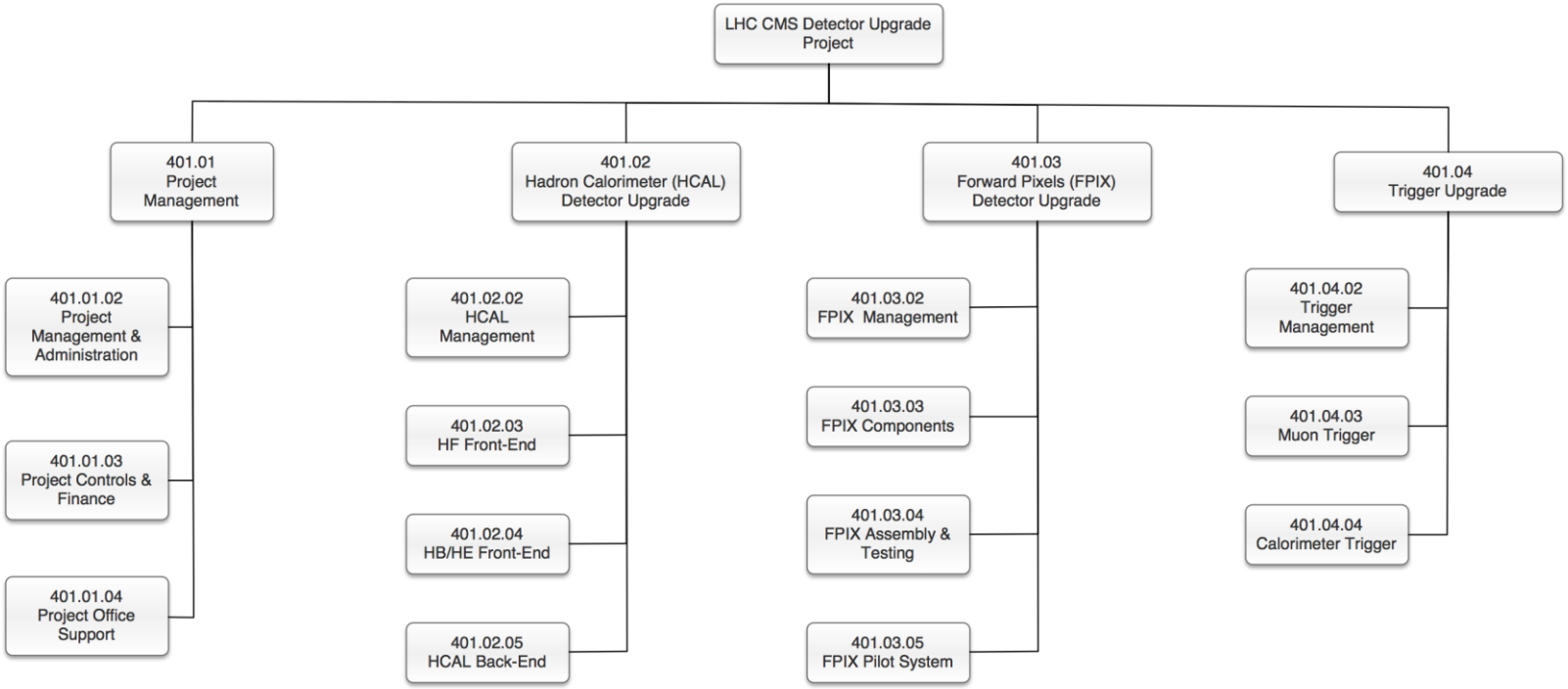
- We follow well established standards and practices
  - Fermilab: http://www.fnal.gov/directorate/OPMO/OPMOhome.html
  - DOE 413.3b: http://science.energy.gov/opa/project-management/processes-and-procedures/
  - ANSI / PMI-99-001-2008, "PMBOK" http://www.pmi.org/PMBOK-Guide-and-Standards.aspx



Note: process numbers refer to "PMBOK", 4th Ed, ANSI / PMI 99-001-2008.

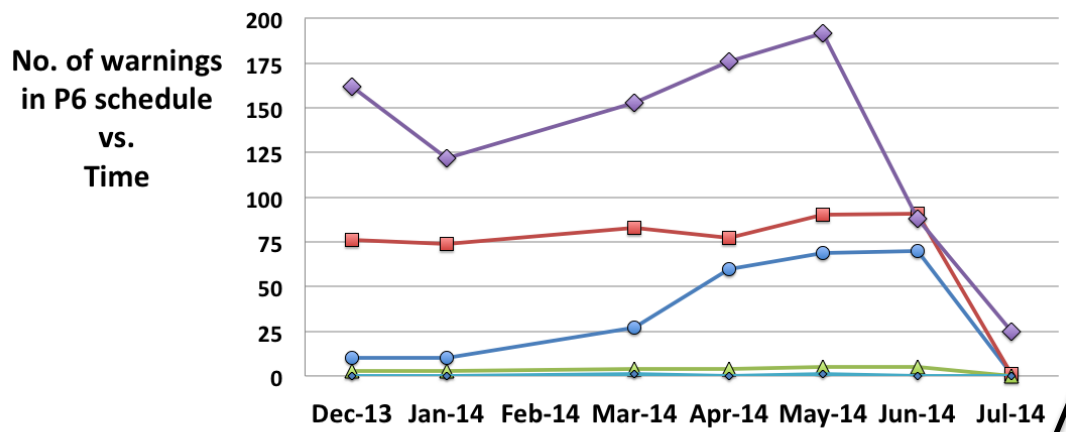
Work Breakdown Structure

- All project scope (DOE and NSF) is included in a hierarchical product-oriented Work Breakdown Structure
  - https://cms-docdb.cern.ch/cgi-bin/DocDB/ShowDocument?docid=11605 (all)
  - https://cms-docdb.cern.ch/cgi-bin/DocDB/ShowDocument?docid=11606 (HCAL)
  - https://cms-docdb.cern.ch/cgi-bin/DocDB/ShowDocument?docid=11607 (FPIX)
  - https://cms-docdb.cern.ch/cgi-bin/DocDB/ShowDocument?docid=11608 (Trigger)



RLS Characteristics

	401.01 PM	401.02 HCAL	401.03 FPIX	401.04 Trigger	TOTAL
Activity -- Level of Effort	4	9	4	17	34
Activity -- Task Dependent	83	1133	1027	417	2660
Activity – Obligation	20	167	144	35	366
Milestone	8	278	165	76	527
T1 (DOE Program)	5				5
T2 (DOE Federal Project Director)	2	12	9	7	30
T3 (Fermilab Line Management)		17	14		31
T4 (Project Manager)		102	41	28	171
T5 (L2 Manager)	1	147	101	41	290
Grand Total	**115**	**1587**	**1340**	**545**	**3587**



	12/6/13	1/16/14	3/4/14	4/9/14	5/15/14	6/22/14	7/1/14
Activity without predecessor	10	10	27	60	69	70	1
Activity without successor	76	74	83	77	90	91	1
Milestone with invalid relationship	3	3	4	4	5	5	0
Actual Date later than Data Date	0	0	1	0	1	0	0
Activity Constraints (excluding FYnn milestones)	162	122	153	176	192	88	25

7/1/14	Target no.
1	1 (project start)
1	1 (project end)
0	0
0	0
25	As few as needed

EVMS

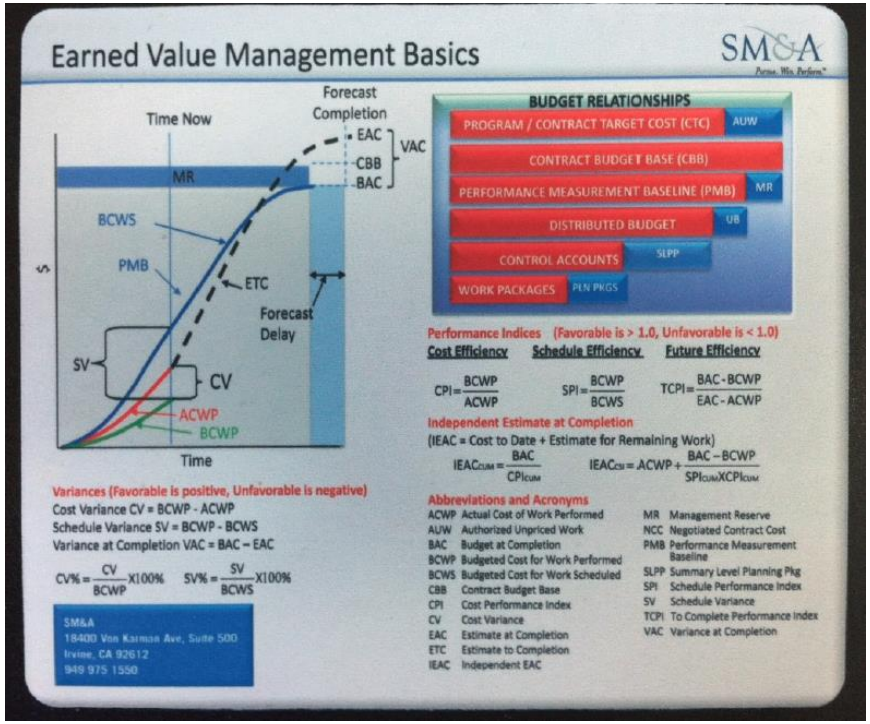
What is EVMS

Earned value management

From Wikipedia, the free encyclopedia

Earned value management (**EVM**), or **Earned value project/performance management** (**EVPM**) is a project management technique for measuring project performance and progress in an objective manner.

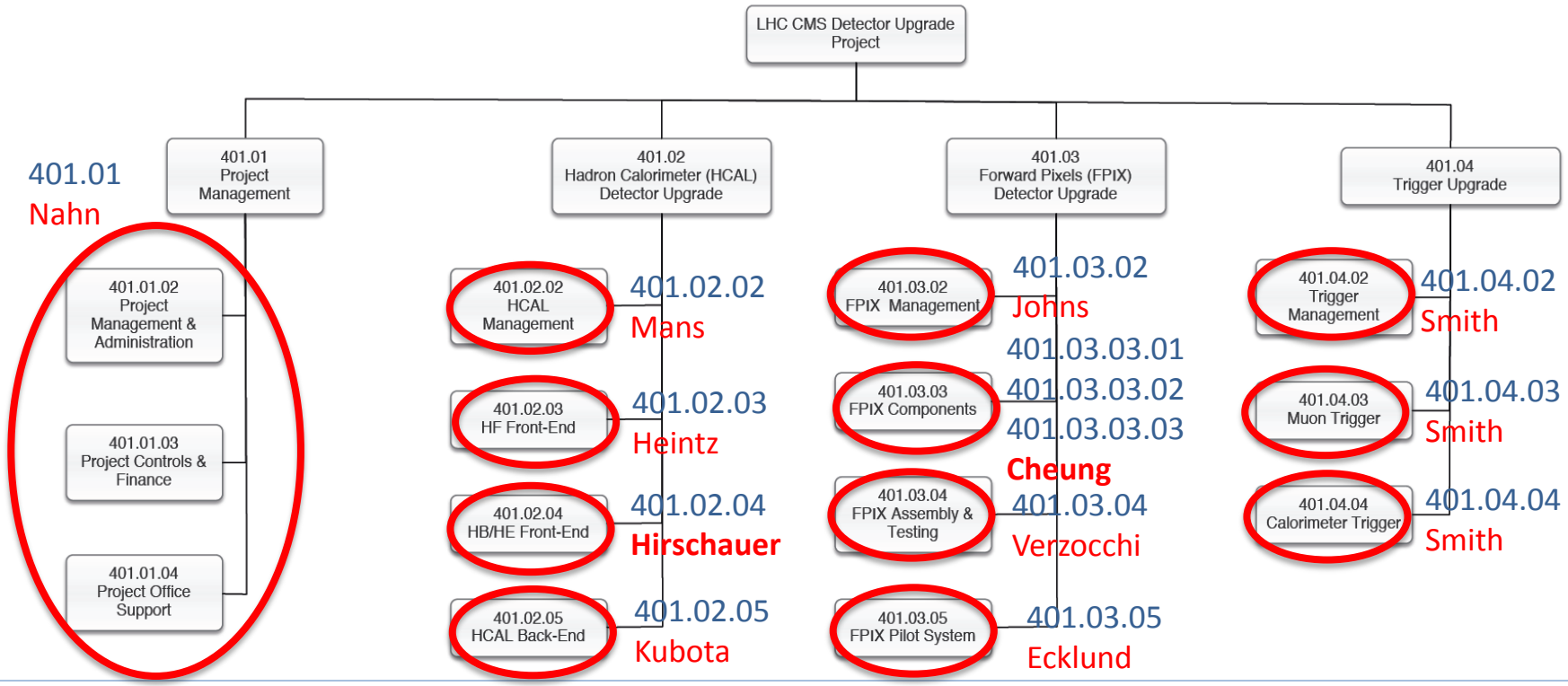
- Systematic metric for measuring progress vs. plan
- Ingredients
  - A Plan: Budgeted Cost of Work Scheduled (BCWS)
  - Status: Work Scheduled (WS) becomes Work Performed (BCWP)
  - Actuals: Cost of Work Performed (ACWP)
- Measurements
  - Cost Performance (BCWP, ACWP)
  - Schedule Performance (BCWP, BCWS)
  - Differences → Variance
  - Ratios → Performance Indices



The basics on a free mouse pad from training

EVMS Structure: CAs and CAMs

- EVMS underpinned by Control Accounts (CA) managed by Control Account Managers (CAMs)
  - Control Account = High level correlated set of tasks
  - Maps naturally to WBS structure
  - CAs further divided into Chargable Task Codes (CTCs)
    - Used by FNAL finance system



Dollarized RAM

		Total Project		29.36%	34,312,952
WBS L2	Control Account	CAM	% LOE	%Complete	TOTAL
401.01 Project Management	401.01 Project Management	Nahn, Steve	100.00%	30.11%	6,135,558
401.01 Project Management Total				30.11%	6,135,558
401.02 Hadron Calorimeter (HCAL) Detector Upgrade	401.02.02 HCAL Management	Mans, Jeremiah	100.00%	31.80%	397,538
	401.02.03 HF Front-End	Heintz, Ulrich	0.00%	70.99%	1,637,093
	401.02.04 HB/HE Front-End	Hirschauer, James F	1.74%	13.11%	9,003,338
	401.02.05 HCAL Back End	Kubota, Yuichi	1.08%	31.29%	1,739,651
401.02 Hadron Calorimeter (HCAL) Detector Upgrade Total				23.58%	12,777,620
401.03 Forward Pixels (FPIX) Detector Upgrade	401.03.02 FPIX Management	Johns, Will	81.84%	50.63%	537,585
	401.03.03.01 Components - Module	Cheung, Harry	0.00%	22.21%	2,752,976
	401.03.03.02 Components - Electronics	Cheung, Harry	11.17%	37.06%	3,027,797
	401.03.03.03 Components - Mechanical Structures & Cooling	Cheung, Harry	0.00%	43.14%	2,050,061
	401.03.04 Assembly & Testing	Verzocchi, Marco	21.74%	9.27%	1,361,282
	401.03.05 Pilot System	Ecklund, Karl	39.01%	60.99%	90,008
401.03 Forward Pixels (FPIX) Detector Upgrade Total				31.27%	9,819,709
401.04 Trigger Upgrade	401.04.02 Trigger Management	Smith, Wesley H.	100.00%	36.00%	184,971
	401.04.03 MUON Trigger	Smith, Wesley H.	18.00%	23.16%	2,338,652
	401.04.04 Calorimeter Trigger	Smith, Wesley H.	22.69%	50.15%	3,056,442
401.04 Trigger Upgrade Total				38.37%	5,580,065

WADs and CAPs

- Formalizes CAM scope of work and resources
  - WAD
  - Activity table
  - FY CAP and current FY monthly CAP by Activity and Resource

Work Authorization Document

Control Account Information	
Control Account Manager:	Verzocchi, Marco
Control Account Number:	401.03.04
Control Account Description:	Assembly & Testing

Period of Performance			
Baseline Start:	2-Jan-2013	Finish:	5-Jan-2017

WAD Scope

This element covers all the activities related to the tests, characterization, and calibration of the modules, half disks, half cylinders and all the installation activities of modules into half disks and of half disks into half cylinders, their transport to CERN, and the commissioning of the CMS Upgrade Forward Pixel detector prior to its installation in CMS in an extended end of year shutdown. This also includes the development of the detector control system, of the calibration and readout software and of the database system used during the construction of the detector.

Budget	HOURS	DIRECT	BAC
Funding Type DOE.HEP.MIE	**9,749**	**220,116**	**401,982**
Labor	7,902	88,171	247,163
Material	0	92,900	114,240
Non-Fermi Labor	1,847	39,044	40,579
Funding Type DOE.HEP.OPC	**3,167**	**73,318**	**143,980**
Labor	2,472	35,872	102,351
Material	0	19,700	23,351
Non-Fermi Labor	695	17,746	18,278
Funding Type In Kind	**20**	**1,597**	**1,730**
Material	0	500	617
Non-Fermi Labor	20	1,097	1,113
Funding Type NSF	**20,910**	**792,306**	**813,590**
Material	0	447,571	462,729
Non-Fermi Labor	20,910	344,735	350,861
Total Budget:	**33,846**	**1,087,336**	**1,361,282**

Authorization Signatures			
CAM:	Marco Verzocchi	Date:	12/4/2014
L2 Manager:		Date:	12/5/2014
Deputy Project Manager:		Date:	12/5/2014
Project Manager:		Date:	12/4/14

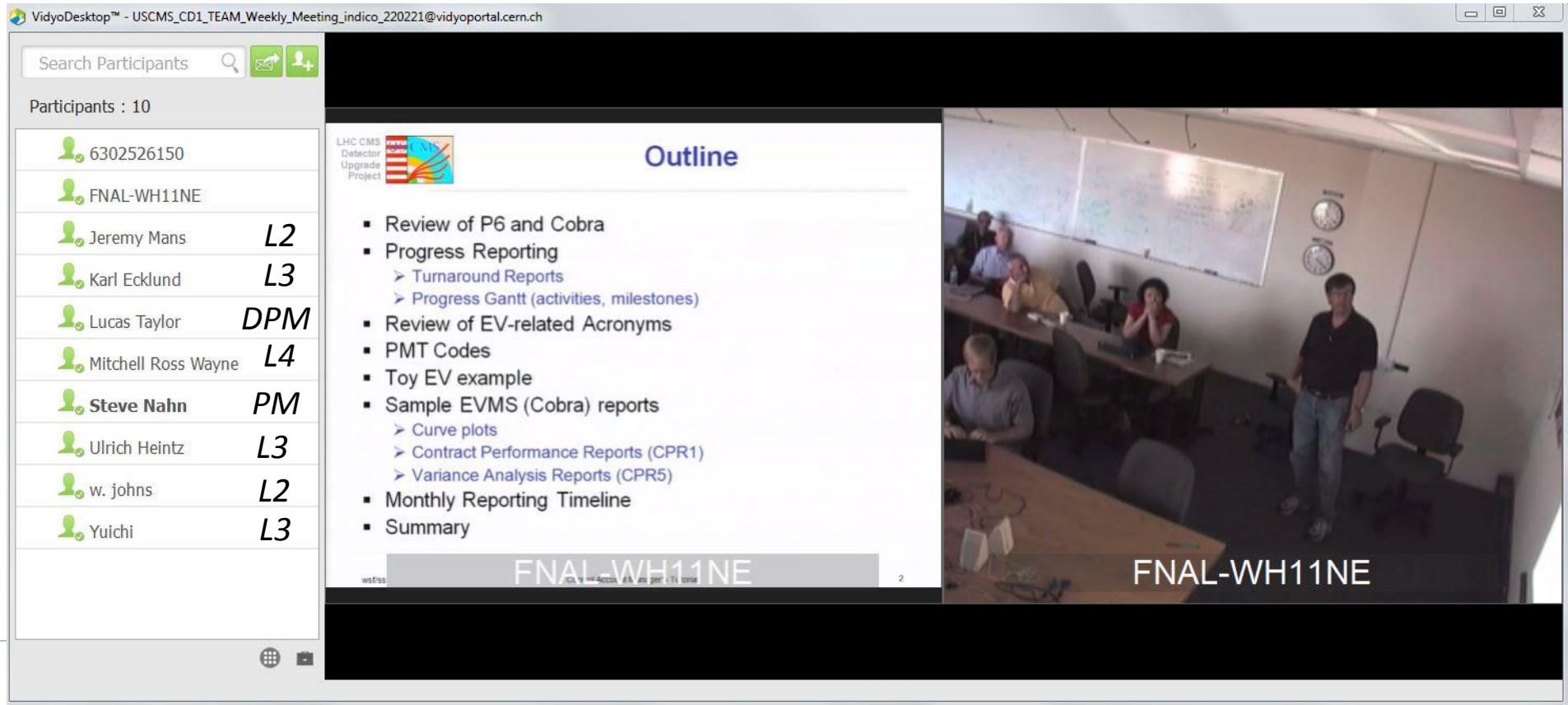
Training

- Lab has arranged for several EVMS and P6 training sessions for personnel
  - 2-day EVMS training (twice)
  - P6 training (twice)
  - 23-session x 4 hours PMP training attended by PM
  - DPM (LT) has ~80 class hours in general PM, cost, scheduling, quality, risk, case studies, etc and has passed PMP certification twice
- The best training has been actually practicing EVM ahead of being baselined

CAM Bootcamp July 3rd, 2014

- Presentations by R. Marcum, PSS, and B Freeman, NOνA/USCMS on CAM duties and necessary knowledge
  - Attended by 18 USCMSers locally, 8 teleconference, plus ~ 20 from g-2 and μ2e

https://indico.cern.ch/event/323645/ access: uscms_utb



EVMS procedures

Labwide approach to EVMS

- Step 1: Collect Monthly Statistics
  - BCWS – budgeted cost comes from P6 via Cobra
  - BCWP – work performed determined by collecting input from CAMs and determined via a variety of algorithms
    - 0 or 100%
    - Units (eg. widgets produced)
    - Milestones or steps
    - Effort to make non-LOE activity durations ≤ 2 months
  - ACWP – the actual cost to complete the work performed
    - Interfaced to fiscal system for
      - Fermilab labor and M&S
      - Monthly invoices from vendors and participating institutes
    - Accruals to account for time lag between performance and invoice when necessary
- Step 2: Compute EVM metrics and produce trend plots at various levels from whole project to workpackage

The Reporting Cycle

- Shared Calendar
  - Automated reminders at 7 days and 2 days

Thu Nov 20, 2014	12:00pm – 1:00pm	Accruals Due
Fri Nov 21, 2014	8:00am – 9:00am	UTB - Sunset/Vidyo
Mon Nov 24, 2014	8:00am – 11:00am	HCAL HF FE Status Review - Vidyo
	9:00am – 11:30am	HDI Production Readiness Revieew - West Wing
Tue Nov 25, 2014	All day	Pixel/Pilot IRR - https://indico.cern.ch/event/349977
	5:00pm – 6:00pm	Turnaround Report issued
Wed Nov 26, 2014	All day	Pixel/Pilot IRR - https://indico.cern.ch/event/349977
	10:00am – 11:30am	FPIX Upgrade Meeting
Fri Nov 28, 2014	5:00pm – 6:00pm	Monthly Report/PARS II
Mon Dec 1, 2014	All day	Configuration Control Audit
Tue Dec 2, 2014	8:30am – 10:30am	POG
	12:00pm – 1:00pm	LHC Ops Meeting - Phase II - Vidyo
Wed Dec 3, 2014	10:00am – 11:30am	FPIX Upgrade Meeting
	5:00pm – 6:00pm	P6 Preliminary Status
Fri Dec 5, 2014	8:00am – 9:00am	UTB - Sunset/Vidyo
	5:00pm – 6:00pm	P6 Final Status/Actuals into COBRA
Mon Dec 8, 2014	5:00pm – 6:00pm	P6-COBRA Integration
Tue Dec 9, 2014	10:30am – 11:30am	LHC CMS IPT - Eagles Landing Conference Room
Wed Dec 10, 2014	All day	evms review
	10:00am – 11:30am	FPIX Upgrade Meeting
	5:00pm – 6:00pm	Estimate To Completion Review/Approval
Thu Dec 11, 2014	All day	evms review
	5:00pm – 6:00pm	2nd P6-COBRA Integration
Fri Dec 12, 2014	All day	Mechanics Review
	8:00am – 9:00am	UTB - Sunset/Vidyo
	5:00pm – 6:00pm	Variance/Change Request Package Ready
Mon Dec 15, 2014	5:00pm – 6:00pm	Turnaround Report issued
Tue Dec 16, 2014	12:00pm – 1:00pm	LHC Ops Meeting - Phase I - InstantMeeting
Wed Dec 17, 2014	11:00am – 12:00pm	Bock bullets
	1:00pm – 2:30pm	Upgrade PMG - Hornet's Nest WH8XO
Thu Dec 18, 2014	12:00pm – 1:00pm	Accruals Due
Fri Dec 19, 2014	8:00am – 9:00am	UTB - Sunset/Vidyo
	5:00pm – 6:00pm	Monthly Report/PARS II
Tue Dec 23, 2014	10:30am – 11:30am	LHC CMS IPT - Eagles Landing Conference Ro
Fri Dec 26, 2014	8:00am – 9:00am	UTB - Sunset/Vidyo
Tue Dec 30, 2014	12:00pm – 1:00pm	LHC Ops Meeting - Phase II - Vidyo

Monthly Reporting

- One entry per month includes all relevant files

My preferences | Email notifications | Limit my groups | Logout

CMS Document 12521-v2

USCMS Phase 1 Upgrade -- October 2014

Document #:
CMS-doc-12521-v2
Document type:
Report
Submitted by:
Steven Christopher Nahn
Updated by:
Steven Christopher Nahn
Document Created:
24 Nov 2014, 16:23
Contents Revised:
01 Dec 2014, 06:07
Metadata Revised:
01 Dec 2014, 06:07

Update Document
Update Metadata
Add Files
Create Similar
Watch Document

Abstract:
Monthly Report for October 2014

Files in Document:

- CPR1 - For Reporting (CPR1- For Reporting - Oct 14.pdf, 375.5 kB)
- EAC Analysis for October (EAC_Analysis_1410.pdf, 286.0 kB)
- Monthly Report (USCMSU_MonthlyReport_1410.pdf, 1.0 MB)

Other Files:

- MR Source (USCMSU_MonthlyReport_1410.docx, 1.6 MB)
- VAR for CA 401.01 (CPR5 - CA 401.01 - Oct2014.pdf, 197.6 kB)
- VAR for CA 401.03.03.01 (CPR5 - For VARS- CA 401.03.03.01_HC.pdf, 199.1 kB)
- VAR for CA 401.03.03.03.03 (CPR5 - For VARS- CA 401.03.03.03_HC.pdf, 202.8 kB)
- Var for CA 401.02.03 (CPR5 - For VARS- CA 401.02.03.pdf, 197.5 kB)
- Var for CA 401.02.04 (CPR5 - For VARS- CA 401.02.04-PeriodOct2014-Prepared26...pdf, 199.6 kB)

Get all files as tar.gz, zip.

Topics:

Viewable by:

- USCMS-MGMT
- USCMS-UP-REVIEWS
- USCMS-UP-TEAM

Modifiable by:

- USCMS-MGMT

Quick Links:
Latest Version
Public Version

Other Versions:
CMS-doc-12521-v1
24 Nov 2014, 17:04

Monthly Reporting

- Contract Performance Report Format 1
  - Information available at L2, CA, CTC, and WP level

8. PERFORMANCE DATA													
Cntrl Acct (2)	CURRENT PERIOD					CUMULATIVE TO DATE					AT COMPLETION		
Cntrl Acct	BUDGETED COST		ACTUAL	VARIANCE		BUDGETED COST		ACTUAL	VARIANCE		BUDGETED	ESTIMATED	VARIANCE
ITEM (1)	WORK SCHEDULED (2)	WORK PERFORMED (3)	COST WORK PERFORMED (4)	SCHEDULE (5)	COST (6)	WORK SCHEDULED (7)	WORK PERFORMED (8)	COST WORK PERFORMED (9)	SCHEDULE (10)	COST (11)	(14)	(15)	(16)
401.01 Project Management	129,631	129,631	101,959	0	27,672	1,847,633	1,847,633	1,642,378	0	205,255	6,135,558	5,930,302	205,255
401.01 Project Management	129,631	129,631	101,959	0	27,672	1,847,633	1,847,633	1,642,378	0	205,255	6,135,558	5,930,302	205,255
401.02 Hadron Calorimeter (HCAL) Detector Upgrade	425,295	193,932	238,881	-231,363	-44,949	3,564,013	3,013,496	2,746,927	-550,517	266,570	12,777,620	12,534,090	243,530
401.02.02 HCAL Management	8,531	8,531	34,222	0	-25,691	126,399	126,399	64,268	0	62,130	397,538	335,408	62,130
401.02.03 HF Front-End	208,799	26,448	95,921	-182,351	-69,474	1,209,730	1,162,247	1,254,640	-47,483	-92,392	1,637,093	1,731,561	-94,467
401.02.04 HB/HE Front-End	175,390	135,813	109,841	-39,576	25,972	1,685,185	1,180,479	1,072,285	-504,707	108,194	9,003,338	8,911,557	91,780
401.02.05 HCAL Back End	32,574	23,139	-1,104	-9,435	24,243	542,699	544,371	355,734	1,672	188,637	1,739,651	1,555,565	184,086
401.03 Forward Pixels (FPIX) Detector Upgrade	155,780	143,129	309,549	-12,651	-166,421	3,562,485	3,070,994	2,885,703	-491,491	185,291	9,819,709	9,657,016	162,693
401.03.02 FPIX Management	0	0	-3,236	0	3,236	272,177	272,177	139,308	0	132,869	537,585	404,716	132,869
401.03.03.01 Components - Module	39,735	38,938	155,510	-798	-116,572	759,716	611,454	461,900	-148,262	149,554	2,752,976	2,609,805	143,171
401.03.03.02 Components - Electronics	29,778	61,436	77,168	31,657	-15,732	1,210,894	1,122,016	1,039,172	-88,878	82,843	3,027,797	2,947,998	79,800
401.03.03.03 Components - Mechanical Structures & Cooling	72,701	26,805	79,945	-45,896	-53,140	1,074,182	884,319	1,110,171	-189,864	-225,853	2,050,061	2,283,710	-233,649
401.03.04 Assembly & Testing	13,566	15,950	0	2,384	15,950	190,621	126,133	70,038	-64,488	56,095	1,361,282	1,310,562	50,720
401.03.05 Pilot System	0	0	163	0	-163	54,896	54,896	65,113	0	-10,218	90,008	100,226	-10,218
401.04 Trigger Upgrade	138,371	718,567	865,876	580,196	-147,309	1,646,499	2,140,919	1,771,877	494,420	369,042	5,580,065	5,199,784	380,282
401.04.02 Trigger Management	5,826	5,826	5,090	0	735	66,596	66,596	35,038	0	31,558	184,971	153,413	31,558
401.04.03 MUON Trigger	67,503	44,059	18,352	-23,444	25,707	655,323	541,557	386,840	-113,766	154,717	2,338,652	2,186,805	151,847
401.04.04 Calorimeter Trigger	65,042	668,683	842,434	603,641	-173,751	924,580	1,532,766	1,349,999	608,186	182,767	3,056,442	2,859,566	196,876
d. UNDISTRIBUTED BUDGET											0	0	0
e. SUBTOTAL	849,076	1,185,258	1,516,264	336,182	-331,006	10,620,630	10,073,042	9,046,884	-547,588	1,026,158	34,312,952	33,321,192	991,759

- Earned Value Summaries
  - Color Coded summaries at CA or CTC level

CMS Upgrade Master Project
October 31, 2014
Currency in: Fully Burdened AY$

	Current Period							Cumulative to Date									At Complete				
Cntrl Acct	Budget	Earned	Actuals	SV ($)	SV (%)	CV ($)	CV (%)	Budget	Earned	Actuals	SV ($)	SV (%)	CV ($)	CV (%)	SPI	CPI	BAC	EAC	VAC	% Spent	% Complete
401.01 Project Management	129,631	129,631	101,959	0	0%	27,672	21%	1,847,633	1,847,633	1,642,378	0	0%	205,255	11%	1.00	1.12	6,135,558	5,930,302	205,255	28%	30%
401.02.02 HCAL Management	8,531	8,531	34,222	0	0%	(25,691)	-301%	126,399	126,399	64,268	0	0%	62,130	49%	1.00	1.97	397,538	335,408	62,130	19%	32%
401.02.03 HF Front-End	208,799	26,448	95,921	(182,351)	-87%	(69,474)	-263%	1,209,730	1,162,247	1,254,640	(47,483)	-4%	(92,392)	-8%	0.96	0.93	1,637,093	1,731,561	(94,467)	72%	71%
401.02.04 HB/HE Front-End	175,390	135,813	109,841	(39,576)	-23%	25,972	19%	1,685,185	1,180,479	1,072,285	(504,707)	-30%	108,194	9%	0.70	1.10	9,003,338	8,911,557	91,780	12%	13%
401.02.05 HCAL Back End	32,574	23,139	(1,104)	(9,435)	-29%	24,243	105%	542,699	544,371	355,734	1,672	0%	188,637	35%	1.00	1.53	1,739,651	1,555,565	184,086	23%	31%
401.03.02 FPIX Management	0	0	(3,236)	0	0%	3,236	-	272,177	272,177	139,308	0	0%	132,869	49%	1.00	1.95	537,585	404,716	132,869	34%	51%
401.03.03.01 Components - Module	39,735	38,938	155,510	(798)	-2%	(116,572)	-299%	759,716	611,454	461,900	(148,262)	-20%	149,554	24%	0.80	1.32	2,752,976	2,609,805	143,171	18%	22%
401.03.03.02 Components - Electronics	29,778	61,436	77,168	31,657	106%	(15,732)	-26%	1,210,894	1,122,016	1,039,172	(88,878)	-7%	82,843	7%	0.93	1.08	3,027,797	2,947,998	79,800	35%	37%
401.03.03.03 Components - Mechanical Structures & Cooling	72,701	26,805	79,945	(45,896)	-63%	(53,140)	-198%	1,074,182	884,319	1,110,171	(189,864)	-18%	(225,853)	-26%	0.82	0.80	2,050,061	2,283,710	(233,649)	49%	43%
401.03.04 Assembly & Testing	13,566	15,950	0	2,384	18%	15,950	100%	190,621	126,133	70,038	(64,488)	-34%	56,095	44%	0.66	1.80	1,361,282	1,310,562	50,720	5%	9%
401.03.05 Pilot System	0	0	163	0	0%	(163)	-	54,896	54,896	65,113	(0)	0%	(10,218)	-19%	1.00	0.84	90,008	100,226	(10,218)	65%	61%
401.04.02 Trigger Management	5,826	5,826	5,090	0	0%	735	13%	66,596	66,596	35,038	0	0%	31,558	47%	1.00	1.90	184,971	153,413	31,558	23%	36%
401.04.03 MUON Trigger	67,503	44,059	18,352	(23,444)	-35%	25,707	58%	655,323	541,557	386,840	(113,766)	-17%	154,717	29%	0.83	1.40	2,338,652	2,186,805	151,847	18%	23%
401.04.04 Calorimeter Trigger	65,042	668,683	842,434	603,641	928%	(173,751)	-26%	924,580	1,532,766	1,349,999	608,186	66%	182,767	12%	1.66	1.14	3,056,442	2,859,566	196,876	47%	50%
Total	**849,076**	**1,185,258**	**1,516,264**	**336,182**	**40%**	**(331,006)**	**-28%**	**10,620,630**	**10,073,042**	**9,046,884**	**(547,588)**	**-5%**	**1,026,158**	**10%**	**0.95**	**1.11**	**34,312,952**	**33,321,192**	**991,759**	**27%**	**29.4%**

Monthly Reporting

- VARs: CV,SV above threshold
  - Required / Recommended
  - Key Features
    - Explanation
    - Impact
    - Corrective Action
      - copied to Log
    - Summary
    - Author/Approval IDs

Variance Analysis Thresholds for Control Accounts		
Green Thresholds – Cost and Schedule Performance falling outside of yellow or red thresholds		
Yellow Thresholds		
Cost Variance Schedule Variance	**Type**	**Threshold limit**
Dollars	Current Period	≥ ± 5% to < ± 10% and ≥ $50K
	Cumulative	≥ ± 5% to < ± 10% and ≥ $100K
Hours	Current Period	≥ ± 5% to < ± 10% and ≥ 350 hrs
	Cumulative	≥ ± 5% to < ± 10% and ≥ 700 hrs
Red Thresholds		
Cost Variance Schedule Variance	**Type**	**Threshold limit**
Dollars	Current Period	≥ ± 10% and ≥ $100K
	Cumulative	≥ ± 10% and ≥ $200K
Hours	Current Period	≥ ± 10% and ≥ 700 hrs
	Cumulative	≥ ± 10% and ≥ 1400 hrs

- Estimate At Completion Analysis
  - Project Manager's summary of adjustments needed to EAC
    - Based on assessment of VARs and subsequent actions

Monthly Reporting

Variance Analysis Reports

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

Project: **401.03**-CMS Upgrade - FPIX
Status Date: 05/31/2014

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	a. NAME		a. NAME CMS Upgrade - FPIX	a. FROM (YYYYMMDD) 2014 / 05 / 01
b. LOCATION (Address and ZIP Code)	b. NUMBER		b. PHASE	b. TO (YYYYMMDD) 2014 / 05 / 31
	c. TYPE	d. SHARE RATIO	c. EVMS ACCEPTANCE No X Yes (YYYYMMDI 2010 / 01 / 28	

5. Evaluation

401.03.03.02 Components - Electronics

	Budget	Earned	Actuals	SV in $	SV in %	CV in $	CV in %	SPI	CPI
Current:	252,921	141,265	136,284	-111,656	-44%	4,982	4%	0.56	1.04
Cumulative:	718,425	524,885	544,531	-193,541	-27%	-19,646	-4%	0.73	0.96
	BAC	EAC	VAC in $	VAC in %	TCPI to BAC	TCPI to EAC			
At Complete:	2,822,594	2,842,423	-19,829	-1%	1.01	1.00			

Explanation of Variance/Description of Problem:
The bulk of the -$111K SV in the current period is due to a -$157K SV for the purchase of the production ROC wafer submission (P105100) which is delayed.The budget has been placed on this task which was scheduled on start on 13-June-14, hence the BCWS is $157K due to this task. This is offset partly by a number of smaller postive SV on other tasks in this CA.The delay is due to our supplier PSI/CERN taking longer to submit their order with their subcontractor IBM.

Impact:
The delay in the ROC wafer order could delay the delivery date of the ROC wafers, that would lead to a delay in the submission of the bump-bondng order. However the subproject will not be delayed as these tasks are not on the critical path. The ROC wafer order has a total float of 119d and the bum-bonding order has a total float of 80d.

Corrective Actions

Corrective Action:
We will monitor the status of the ROC wafer submission which is imminent, and the delivery date for the the first batch of ROC wafers to see if in fact the actual delivery is also delayed relative to our RLS. If so we can consider expediting the ROC wafer probe testing to reduce or eliminate any delay in the bump-bonding order. In order to better track the earned value we may submit a change to the RLS so that the budget is placed on the various ROC wafer delivery/received tasks since these are the tasks where the value is earned, this change will minimize the apparent SV due to a mismatch in the time-phased budget relative to the time-phased work performed/earned value.

Monthly Summary (to include technical causes of VARs, impacts, and Corrective Action(s).
The -$110K SV in this current period is dominated by a single task with a -$157K SV, which due to a delay in the submission of the ROC wafer submission. There is no impact on the overall subproject as this task has a total float of 119d, and the successor task also is not on the critical path with a total float of 80d. No corrective action is required at this time though we are monitoring the timing of the ROC wafer submssion and the eventual ROC wafer delivery dates to see if any action will be required. One possible proactive action is to submit a change request to the RLS to shift the budget for this task to where the value is actually earned to reduce future apparent SVs.

Prepared by:	Date:	Approved by:	Date:
Harry Cheung	14-Jul-14	Steve Nahn	14-Jul-14

Monthly Reporting

- Corrective Action Log

Corrective Action Number	Reporting period	Monthly Report DocDB # with hyperlink	L2 Project	Control Account	CAM	Corrective Action	PM Approval (Date)	Action Completed (Date)	Status
1	2014-05	12316	FPIX	401.03.03.02 Components - Electronics	Harry Cheung	We will monitor the status of the ROC wafer submission which is imminent, and the delivery date for the the first batch of ROC wafers to see if in fact the actual delivery is also delayed relative to our RLS. If so we can consider expediting the ROC wafer probe testing to reduce or eliminate any delay in the bump-bonding order. In order to better track the earned value we may submit a change to the RLS so that the budget is placed on the various ROC wafer delivery/received tasks since these are the tasks where the value is earned, this change will minimize the apparent SV due to a mismatch in the time-phased budget relative to the time-phased work performed/earned value.	2014-07-14	2014-07-31	Closed
2	2014-05	12316	HCAL	401.02.04 HB/HE Front End	Jim Hirschauer	The accounting team is aware of the problems with entering the missing information and expect them to be corrected for the next reporting period. We need to review which CTC work was reported to for several people and will have to move hours to the correct CTC. The work being reported to the wrong CTC occurs up to about March 2014, after which the correct CTC was used. This will take some time to sort out and may not make it into the next reporting period. We also need to enforce more timely accrual reporting for all institutes involved in the HCAL Phase 1 upgrade.	2014-07-14	2014-09-01	Closed
3	2014-05	12316	HCAL	401.02.04 HCAL Backend	Yuichi Kubota	We should account for the FY13 work so that we do not carry a positive CV which could hide real effects. The FY13 work can be removed from the baseline RLS.	2014-07-17		Open
4	2014-06	12359	FPIX	401.03.01 FPIX Management	Will Johns	The cost variance will be automatically fixed in July when the cost for the purchase of the TBM at CERN using the team account will be transferred from the 401.30001 to the 401.30021 CTC (the invoice was sent from CERN to Fermilab on July 9 and the process of transferring the corresponding cost from one CTC to the other was being completed in the week of July 14).	2014-07-20	2014-08-25	Closed

EV Measurements

- Both NSF and DOE information collected in the same manner
  - Separately tagged but within the same Control Accounts
  - Whitepaper explaining situation (ok'd by OPA)

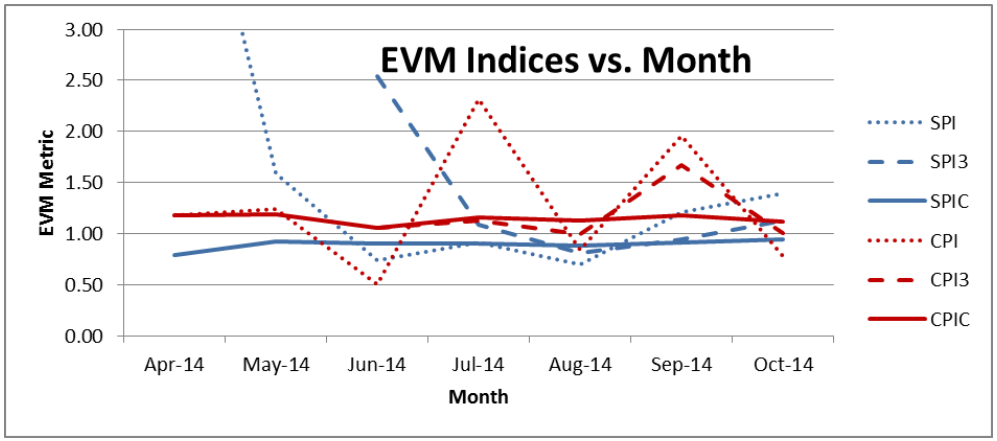
https://cms-docdb.cern.ch/cgi-bin/DocDB/ShowDocument?docid=12216&asof=2014-05-28

- Collecting Status since 12/2013
  - Up to April an exercise in getting CAMs familiar with the cycle
  - Since April exercising full machinery
    - Lessons learned
      - Misassignment of Charges early in project
      - Underestimate of Accruals, eg costed "In Kind" work early in project
      - Mistiming large procurements by one cycle
      - Subtle structure issues with initial RLS
    - Issues uncovered by CAMs in the process of understanding EVM data

How are we doing?

- July - October
  - Handful of VARs in each month
    - Mix of “one-off” and persistent issues
  - CAMs digging into Statusing files, Fiscal reports to rectify variances
    - “Because of VARs I have a better grasp on my schedule”

	Current		3 Month		Cumulative	
Month	SPI	CPI	SPI3	CPI3	SPIC	CPIC
Apr-14	5.76	1.17			0.79	1.17
May-14	1.59	1.24			0.92	1.19
Jun-14	0.74	0.50	2.54	1.06	0.90	1.06
Jul-14	0.91	2.32	1.09	1.13	0.90	1.16
Aug-14	0.70	0.84	0.81	1.00	0.89	1.13
Sep-14	1.20	1.95	0.94	1.67	0.91	1.18
Oct-14	1.40	0.78	1.13	1.00	0.95	1.11



July

Current | Cumulative

SV ($)	SV (%)	CV ($)	CV (%)	SV ($)	SV (%)	CV ($)	CV (%)
(9,370)	-8%	51,253	44%	(9,370)	-1%	104,724	7%
0	0%	5,434	49%	0	0%	62,831	65%
(26,111)	-32%	(861)	-2%	(102,654)	-11%	(81,620)	-10%
(95,192)	-58%	(31,407)	-46%	(251,479)	-23%	(17,269)	-2%
(10,461)	-39%	(7,742)	-47%	(31,925)	-7%	188,938	43%
0	0%	(23,916)	-133%	0	0%	(171,407)	-72%
(18,809)	-5%	338,968	101%	(114,573)	-17%	316,655	58%
104,414	40%	310,272	85%	(103,451)	-10%	251,335	26%
(20,117)	-51%	(16,284)	-85%	(55,432)	-6%	(89,524)	-11%
(17,581)	-55%	(4,809)	-34%	(60,254)	-40%	26,544	30%
7,202	543%	5,302	62%	(1,916)	-5%	(10,485)	-31%
0	0%	(19,557)	-367%	0	0%	4,130	8%
2,255	3%	49,663	56%	(127,018)	-26%	87,145	24%
(25,990)	-35%	5,735	12%	27,758	4%	342,643	45%

August

Current | Cumulative

SV ($)	SV (%)	CV ($)	CV (%)	SV ($)	SV (%)	CV ($)	CV (%)
9,370	9%	32,896	28%	0	0%	137,619	9%
0	0%	9,882	93%	0	0%	72,713	68%
(5,650)	-13%	(183,056)	-464%	(108,304)	-11%	(264,676)	-30%
(91,945)	-56%	60,756	83%	(343,424)	-27%	43,488	5%
10,312	71%	(31,728)	-127%	(21,614)	-4%	157,210	34%
0	0%	286,255	1664%	0	0%	114,849	45%
(30,333)	-68%	(41,821)	-296%	(144,906)	-21%	274,835	49%
(24,527)	-65%	(183,083)	-1371%	(127,978)	-12%	68,252	7%
(17,355)	-44%	(61,779)	-281%	(72,787)	-8%	(151,303)	-18%
(11,536)	-48%	5,062	41%	(71,791)	-41%	31,606	31%
1,916	10%	(1,173)	-6%	(0)	0%	(11,658)	-21%
0	0%	11,390	224%	0	0%	15,520	28%
(29,660)	-60%	(10,340)	-52%	(156,679)	-29%	76,804	20%
(6,118)	-9%	21,776	33%	21,640	3%	364,419	44%

September

Current | Cumulative

SV ($)	SV (%)	CV ($)	CV (%)	SV ($)	SV (%)	CV ($)	CV (%)
0	0%	39,964	36%	0	0%	177,583	10%
0	0%	15,108	143%	0	0%	87,821	75%
243,173	1028%	241,757	91%	134,870	13%	(22,919)	-2%
(120,153)	-49%	38,734	31%	(463,577)	-31%	82,222	8%
30,389	126%	7,184	13%	8,775	2%	164,394	32%
0	0%	14,784	86%	0	0%	129,633	48%
(2,558)	-15%	(8,709)	-60%	(147,464)	-20%	266,126	46%
8,042	11%	19,474	25%	(119,936)	-10%	87,726	8%
(70,765)	-79%	(21,410)	-115%	(143,552)	-14%	(172,713)	-20%
4,919	34%	19,389	101%	(66,872)	-36%	50,995	42%
0	0%	1,603	-	(0)	0%	(10,054)	-18%
0	0%	15,302	301%	0	0%	30,823	51%
66,357	127%	52,206	44%	(90,322)	-15%	129,010	26%
(17,332)	-32%	(7,901)	-21%	4,308	1%	356,518	41%

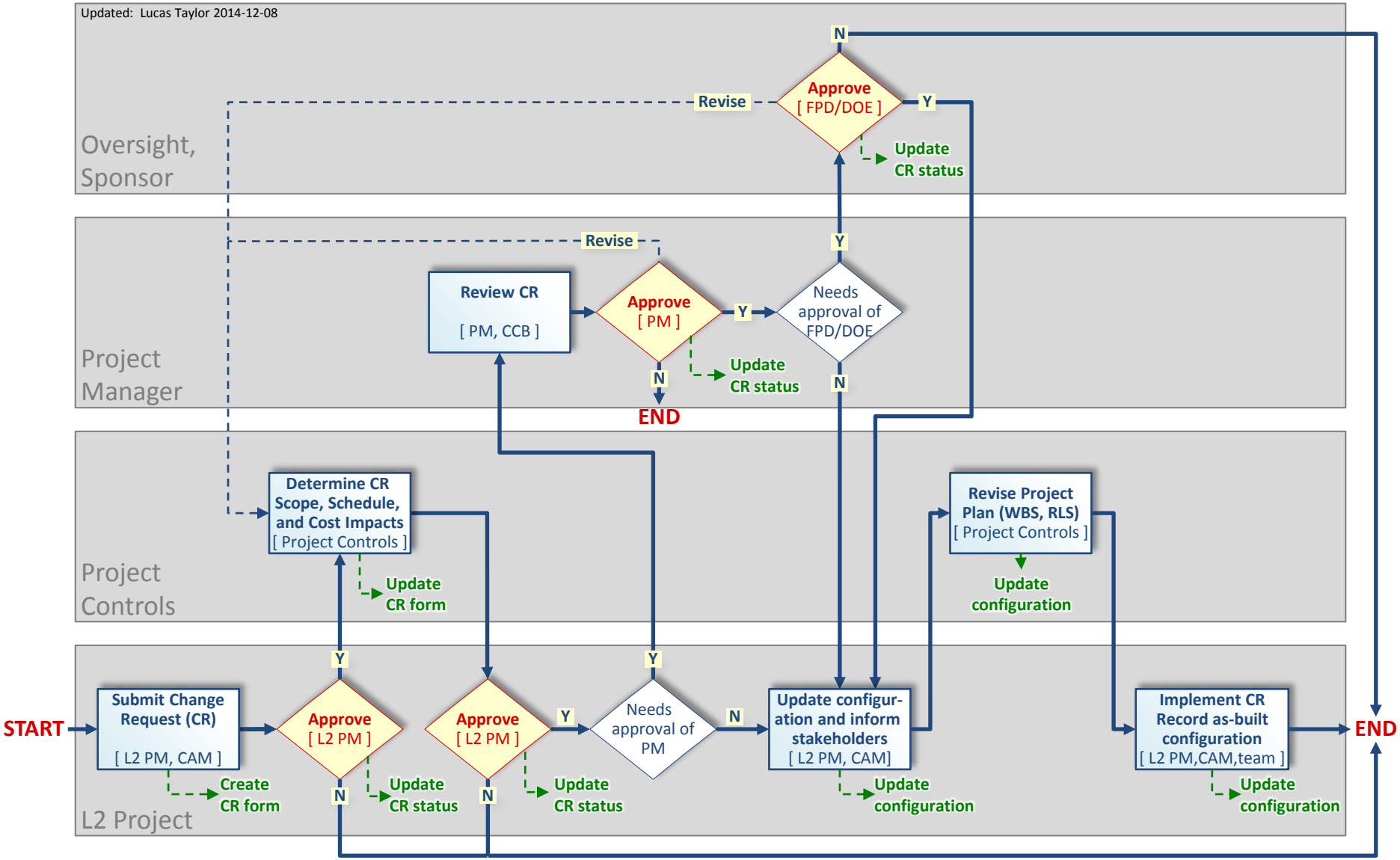
October

Current | Cumulative

SV ($)	SV (%)	CV ($)	CV (%)	SV ($)	SV (%)	CV ($)	CV (%)
0	0%	27,672	21%	0	0%	205,255	11%
0	0%	(25,691)	-301%	0	0%	62,130	49%
(182,351)	-87%	(69,474)	-263%	(47,483)	-4%	(92,392)	-8%
(39,576)	-23%	25,972	19%	(504,707)	-30%	108,194	9%
(9,435)	-29%	24,243	105%	1,672	0%	188,637	35%
0	0%	3,236	-	0	0%	132,869	49%
(798)	-2%	(116,572)	-299%	(148,262)	-20%	149,554	24%
31,657	106%	(15,732)	-26%	(88,878)	-7%	82,843	7%
(45,896)	-63%	(53,140)	-198%	(189,864)	-18%	(225,853)	-26%
2,384	18%	15,950	100%	(64,488)	-34%	56,095	44%
0	0%	(163)	-	(0)	0%	(10,218)	-19%
0	0%	735	13%	0	0%	31,558	47%
(23,444)	-35%	25,707	58%	(113,766)	-17%	154,717	29%
603,641	928%	(173,751)	-26%	608,186	66%	182,767	12%

Change Control

Change Management Workflow



BCR Form

LHC CMS Detector Upgrade Project

Change Request

CR-0029

(request CR no. from Project Controls)

CMS-doc-12429

To be completed change request creator

Title	Creator	Date
L1T: Updates to infrastructure cost	C. Newman-Holmes	16Sep14

Description:

This change request corrects some errors in the Level 1 Trigger Upgrade infrastructure budget and requests budget for some additions. A summary is in Trig Infr CR #29 v1.2.pdf.

Calorimeter Crates: A CMS collaborating institution had been planning to provide a testing system for the CTP7 test systems. This did not materialize so two additional crates are needed for the test setups to be able to analyze the CTP7 outputs for testing and validation of the prototypes and production. This is essential to maintaining the schedule.

AMC13: Two additional AMC13s are needed for the additional crates mentioned above. The other increases are due to miscounting the number needed originally.
Optical patch panels, fibers for calorimeter trigger: The extra cost is for the optical fiber plant to connect the upgrade calorimeter trigger to the legacy Global Calorimeter Trigger, which was mandated by the US CMS Cal Trigger Review. Also budget is requested for a computer for firmware builds and for shipping costs.

Change affects:

- [ ] PM
- [ ] HCAL
- [ ] FPIX
- [x] Trigger

Change affects:

- [x] Cost
- [ ] Schedule
- [ ] Scope
- [ ] Performance
- [ ] Risk

→ Upload any supporting documents / additional information to the same DocDB record as this CR (unselect "Main?" file check box)

Possible cost effects:

Cost increase of $84,300 not counting estimate uncertainty.

Possible schedule effects:

None.

→ Upload this PDF to DocDB and enter the DocDB number at the top of this form and in xxxxx of this PDF filename
→ "Who can see this?" → advanced → USCMS-MGMT + USCMS-UP-REVIEWS + USCMS-UP-TEAM (use Ctrl/CMD+click to select multiple items) and "Who can modify this?" → advanced → USCMS-MGMT
→ Select DocDB topics (in bold) as follows: Countries → USA → **US Upgrades** → **Change Request** → **401.0x ...**
→ Notify the L2 manager that a change request is ready to be considered

To be completed by the L2 Manager (may also update above fields if required)

OK to proceed with CR? (•) Yes ( ) No

L2 Manager	Date
Wesley Smith	9/16/14

→ Upload the revised PDF to DocDB and notify the creator of the status
→ If CR is approved to proceed, request Project Controls to assess the full cost and schedule impacts

CR form version 4, Lucas Taylor, 2014-06-13. Available from: https://cms-docdb.cern.ch/cgi-bin/DocDB/ShowDocument?docid=12182

To be completed by the Project Controls (may also update above fields if required)

Project Controls	Date
Bill Freeman	19Sep14

Cost impact (from full analysis):

Delta-BAC/ Delta-Cont.

CTC 40013: +16010.83 / +2401.63
CTC 40031: +32021.67 / +7471.72
CTC 40033: +41948.39 / +4194.84

Total: +89980.89 / +14068.19

Schedule impact (from full analysis):

None

Comments:

Three other tasks in the submitted CR documentation (T103230, T106910, T106920) were already marked as complete. The changes to those only involved code changes related to performing and/or responsible institutions. The code changes to those tasks were made manually in Cobra.

→ Upload the revised PDF to DocDB and update the CR log (CR status, schedule impact, cost impact, cumulative cost impact, etc.)
→ Notify the CR creator, L2 manager, and Project Manager

Approvals	Date	Approved	Rejected	Not required
Wesley H. Smith (L2 Manager)	9/19/14	(•)	( )	
NSF CA Principal Investigator		( )	( )	(•)
Steve Nahn (Project Manager)	9-19-14	(•)	( )	
Fermilab Line Management		( )	( )	(•)
NSF Program Director		( )	( )	(•)
DOE Federal Project Director:		( )	( )	(•)

→ Upload the revised PDF to DocDB and keep a paper copy for the Project Office records
→ Update the CR log (CR status, schedule impact, cost impact, cumulative cost impact, etc.) and implement the CR (if approved)

Other comments

CR form version 4, Lucas Taylor, 2014-06-13. Available from: https://cms-docdb.cern.ch/cgi-bin/DocDB/ShowDocument?docid=12182

Change Requests

- Tabulated in DocDB/Change Log Spreadsheet

CR no.	Creation date	Project	Short Title	Created by	DocDB # with hyperlink	Estimated cost increase (k$)	Status	Cost increase from P6/Cobra (k$)	L2 Manager	PI of NSF-CA	PM	NSF Program Director	DOE Federal Project Director	P6 BCR #	Work done in PCS?
1	2014-06-06	FPIX	Schedule fixes	Marco Verzocchi	12311	-46			2014-07-10	Not required	2014-07-08	Not required	Not required	In baseline	Yes
2	2014-06-09	FPIX	Schedule fixes	Marco Verzocchi	12313	0			2014-07-10	Not required	2014-07-08	Not required	Not required	In baseline	Yes
3	2014-06-16	FPIX	Al flex cable	Marco Verzocchi	12317	6			2014-07-10	Not required	2014-07-08	Not required	Not required	In baseline	Yes
4	2014-06-17	HCAL	BU and MN engineer travel	Yuichi Kubota	12320	8									
5	2014-06-18	FPIX	UIC travel fix	Marco Verzocchi	12322	0									
6	2014-06-18	FPIX	Remove Sandia irradiation cost	Marco Verzocchi	12323	-10									
7	2014-06-18	FPIX	Revise KSU wafer probe costs	Marco Verzocchi	12324	55									
8	2014-06-19	FPIX	Revise mechanics costs	Marco Verzocchi	12325	70									
9	2014-06-20	FPIX	Revise DAQ+infrastructure costs	Marco Verzocchi	12328	-51									
10	2014-06-27	HCAL	Revise ngCCM and IGLOO2	Alberto Belloni	12333	9									
11	2014-06-30	PM	Remove NSF PI teaching buyout	Steve Nahn	12334	-88									
12	2014-07-07	All	Major P6 RLS cleanup	Lucas Taylor	12335	0									
13	2014-07-11	HCAL	HBHE RBX backplane and LV	Jim Hirschauer	12351	55									
15	2014-07-13	HCAL	Add LV fuses and patch panels	Ulrich Heintz	12394	1									
14	2014-07-13	HCAL	401.02.03.09 - LV system mods	Ulrich Heintz	12353	-29									
16	2014-07-18	FPIX	Restore budget lost by Cobra	Marco Verzocchi	12364	215.8	Done	223	Not required	Not required	Not required	Not required	Not required	BCR016	Yes
17	2014-08-07	HCAL	uTCA crate acquisition	Yuichi Kubota	12400	1	Done	1	2014-08-08	Not required	2014-08-09	Not required	Not required	BCR017	Yes
18	2014-08-11	HCAL	Add Continuing Resolution	Yuichi Kubota	12402	0	Rejected	Not required	Not required	Not required	Rejected	Not required	Not required	None	No
19	2014-08-12	FPIX	Remove FNAL cost L2	Steve Nahn	12403	-183	Done	-184	2014-08-13	Not required	9/10/2014	Not required	Not required	BCR019	Yes
21	2014-08-19	FPIX	NSF costs: Cornell	Marco Verzocchi	12415	0	rejected - tasks already in progress	Not required	Not required	Not required	Not required	Not required	Not required	None	No
23	2014-08-19	FPIX	NSF costs: Kansas	Marco Verzocchi	12417	-29	Done - combined with CR020	n/a			9/16/2014	Not required	Not required	BCR020	Yes
20	2014-08-19	FPIX	NSF costs: Purdue Calumet	Marco Verzocchi	12414	2	Done	-16	2014-09-16	2014-09-16	9/16/2014	Not required	Not required	BCR020	Yes
22	2014-08-19	FPIX	NSF costs: SUNY Buffalo	Marco Verzocchi	12416	-10	Done	-11	2014-09-16	2014-09-16	9/16/2014	Not required	Not required	BCR022	Yes
24	2014-08-24	HCAL	Add AMC13 FW/SW work	Yuichi Kubota	12418	27				Not Required		Not Required	Not Required		
25	2014-08-28	All	Major estimate uncertainty revision	Lucas Taylor	12421		Done	-371	10/8/2014		10/8/2014	Not required	Not required	BCR025	Yes
26	2014-08-28	HCAL	HCAL Baseline Schedule Timing Adjustments	Jeremiah Mans	12422	0	Done	12				Not Required		BCR026	Yes
27	2014-08-29	Trigger	Change Rice paid GS to Uncosted	Cathy Newman-Holmes	12424	-9	Done	-6	9/6/2014	Not required	2014-09-06	Not required	Not required	BCR027	Yes
29	2014-09-04	Trigger	Changes to Trigger Infrastructure cost	Cathy Newman-Holmes	12429	84.3	Done	90	9/19/2014	Not required	9/19/2014	Not required	Not required	BCR029	Yes
30	2014-09-05	All	Corrections to MIE/OPC	Steve Nahn	12427	-2.6	Done	2	2014-09-05	Not required	9/5/2014	Not Required	Not Required	BCR030	Yes
32	2014-09-10	All	6 Month CR change from MIE/OPC	Steve Nahn	12431	60 (inclusive)	If Needed		2014-09-10	Not required	2014-09-10	Not Required	Not Required		
33	2014-09-10	All	9 Month CR change from MIE/OPC	Steve Nahn	12432	90 (inclusive)	If Needed		2014-09-10	Not required	2014-09-10	Not Required	Not Required		
34	2014-09-10	All	12 Month CR change from MIE/OPC	Steve Nahn	12433	116 (inclusive)	If Needed		2014-09-10	Not required	2014-09-10	Not Required			

CMS-doc-#	Title	Author(s)
12345-v5	LHC CMS Detector Upgrade Project -- Baseline Change Control Log	Lucas Taylor
12320-v6	USCMS Upgrade project change request for travel for HCAL installation	Yuichi Kubota

Take away…

- The project itself is complicated by the international nature and the consequences of being an upgrade to an existing program
- We have built an RLS appropriate for managing the Project and EVMS based on FNAL PSS standards
- We have invested in more training for our CAMs
- Executing full EVM has been a learning experience
  - CAMs understand Cost and Schedule Variances and ***what they can tell you about your project***
- We use formal Baseline Change Control

- We are using EVM as a tool to manage the project to reach a successful conclusion on time and under budget

Backup Material

Phases of CMS Upgrade

LHC Sched

LS 1: Splice rework | Physics | TS | Physics | ETS | Physics | TS | Physics | LS 2: Injectors | Ph | TS | Physics | TS | Physics | LS 3

LS1 Consolidation
- Completion of ME4
- ME1, DT electronics
- HF (new PMTs)
- HO (HPD→SiPM)
- Phase 1 Prep
- Optical splitters for TRIG
- Beampipe for FPIX

Phase 2 Upgrades
- Full Tracker Upgrade, addition of L1 Trigger ability
- HCAL/ECAL/MUON DAQ Upgrades – 1 MHz readout
- Extend Forward reach for all

Phase 1 Upgrades
- Pixel Detector Replacement
- HCAL Electronics and Photodetectors Upgrade
- L1 Calorimeter and Muon Trigger Upgrade

FY13 FY14 FY15 FY16 FY17 FY18 FY19 FY20 FY21 FY22

CAs and CTCs

- Chargeable Task Codes (CTCs) further subdivide Control Accounts
  - This is the level on which Earned Value information is rolled into

- Anatomy of a CTC

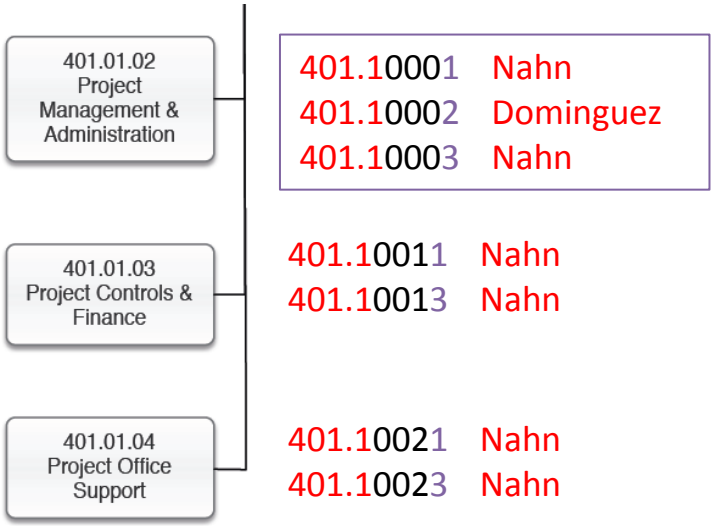
  401.*X*NNN*Y*

  X is L2 (1,2,3,4 for PM, HCAL, FPIX, L1T)

  NNN counts from 0 (max 14 so far)

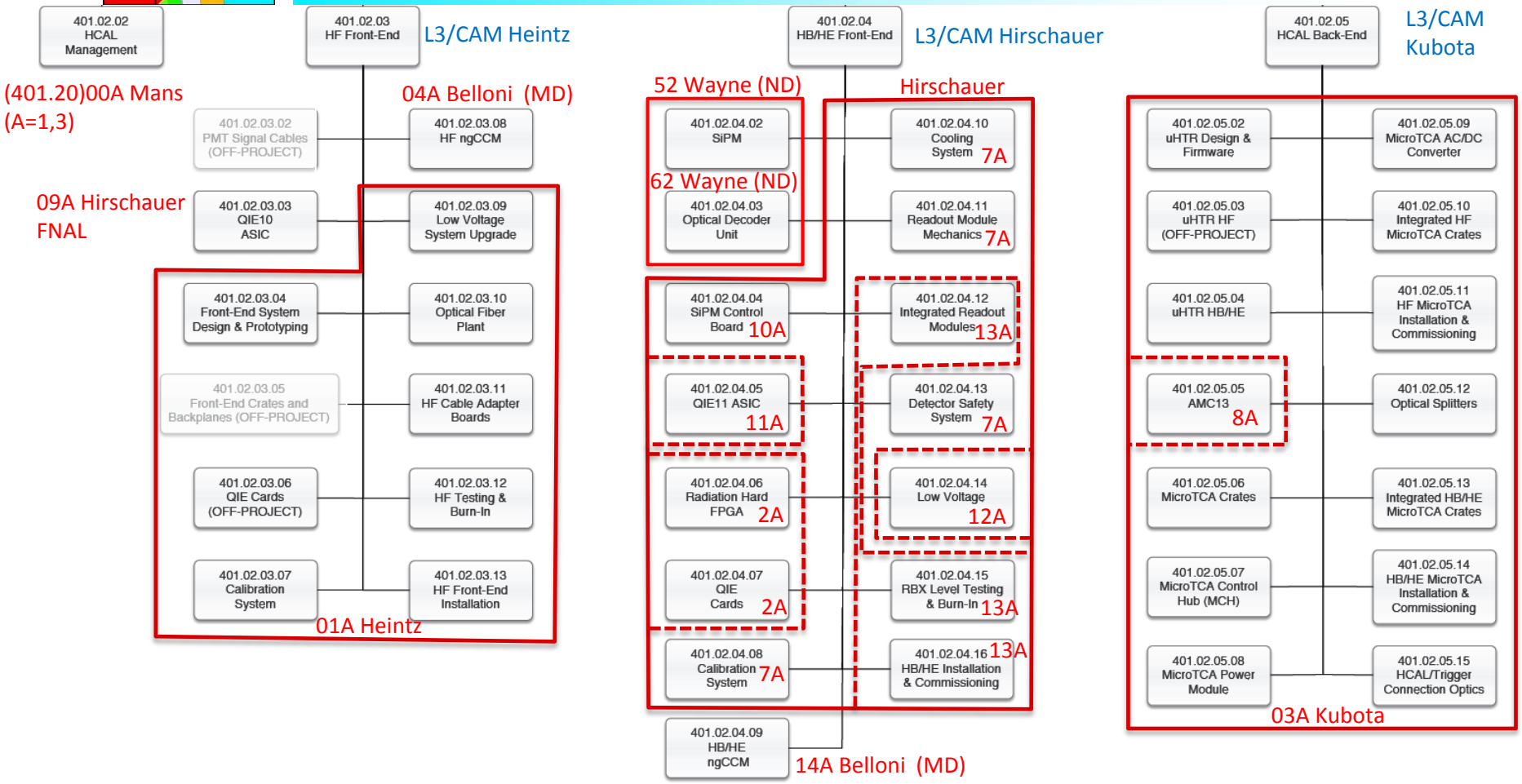
  Y is fund source

- CTCs have CTC Managers
  - Usually but not always CAM



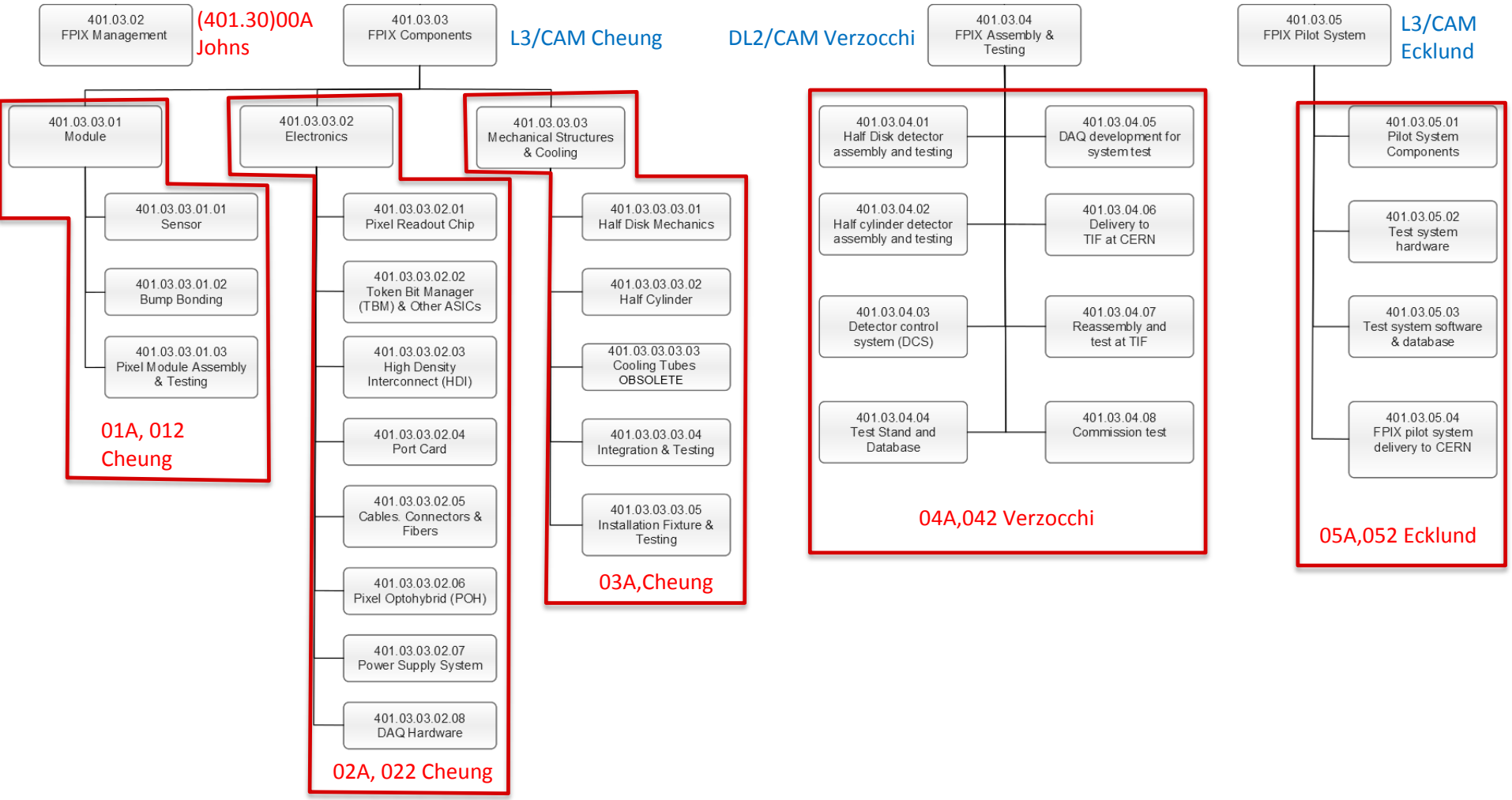
- CTC Grouping designed for
  - Segregation of LOE tasks
  - Not too much unrelated activity concentrated in any CTC
  - Not too little activity in any CTC
  - CTC Managers responsible for deliverable

CTCs and CTC Managers HCAL



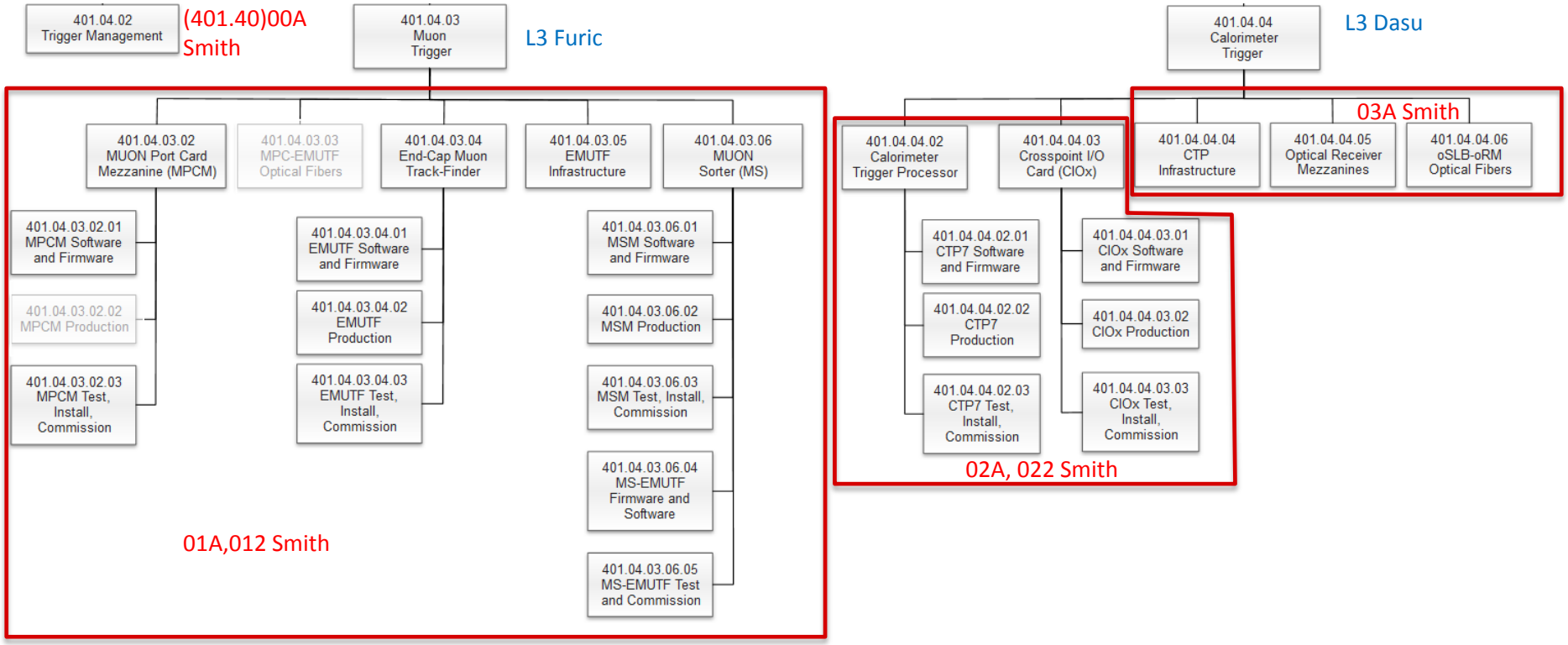
- 14 CTCs Mostly covered by L3, with some institute specific exceptions
  - Divisions done to the specifications of the responsible CAM

CTCs and CTC Managers FPIX



- One to one mapping CA to CTC, CAM to CTC manager
  - But for fund type distinction

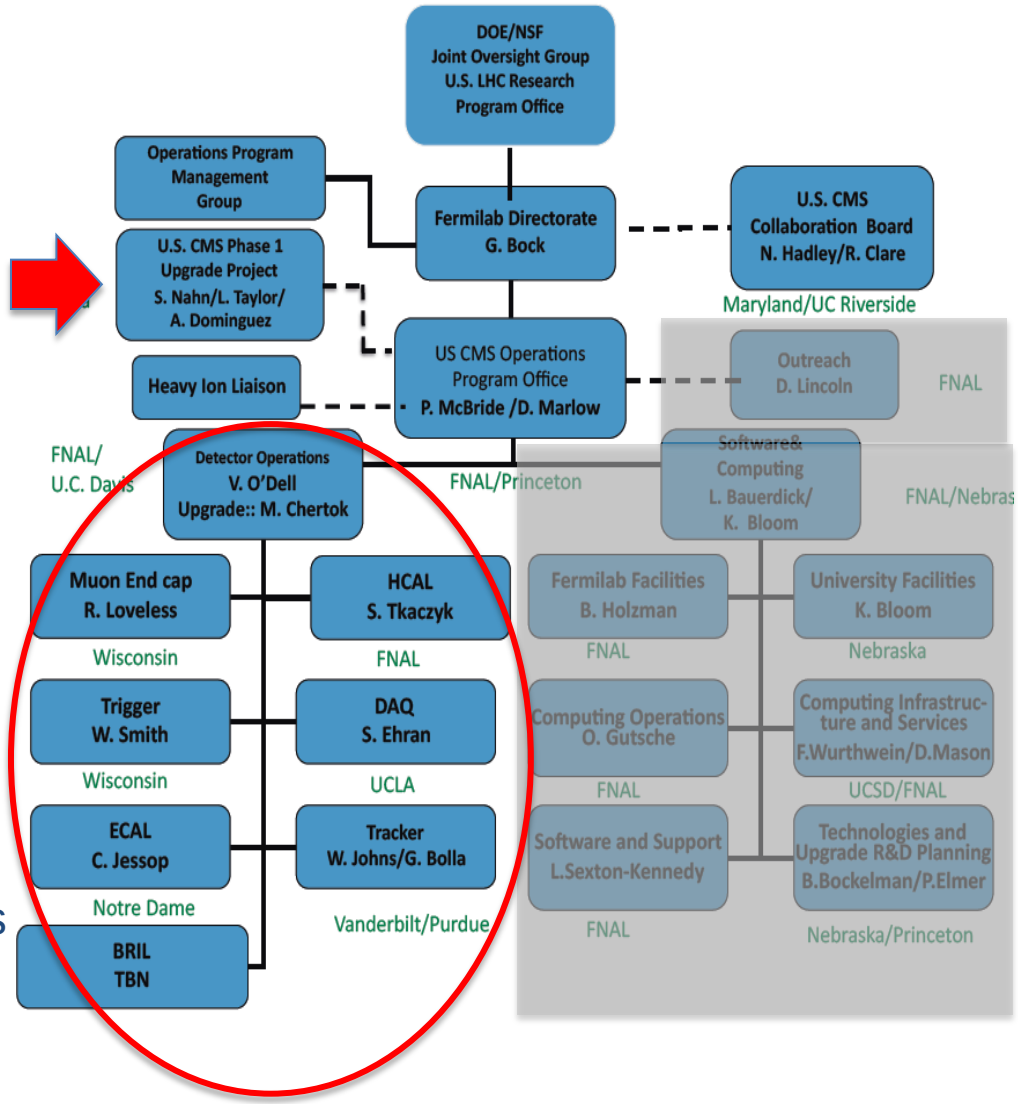
CTCs and CTC Manager L1T



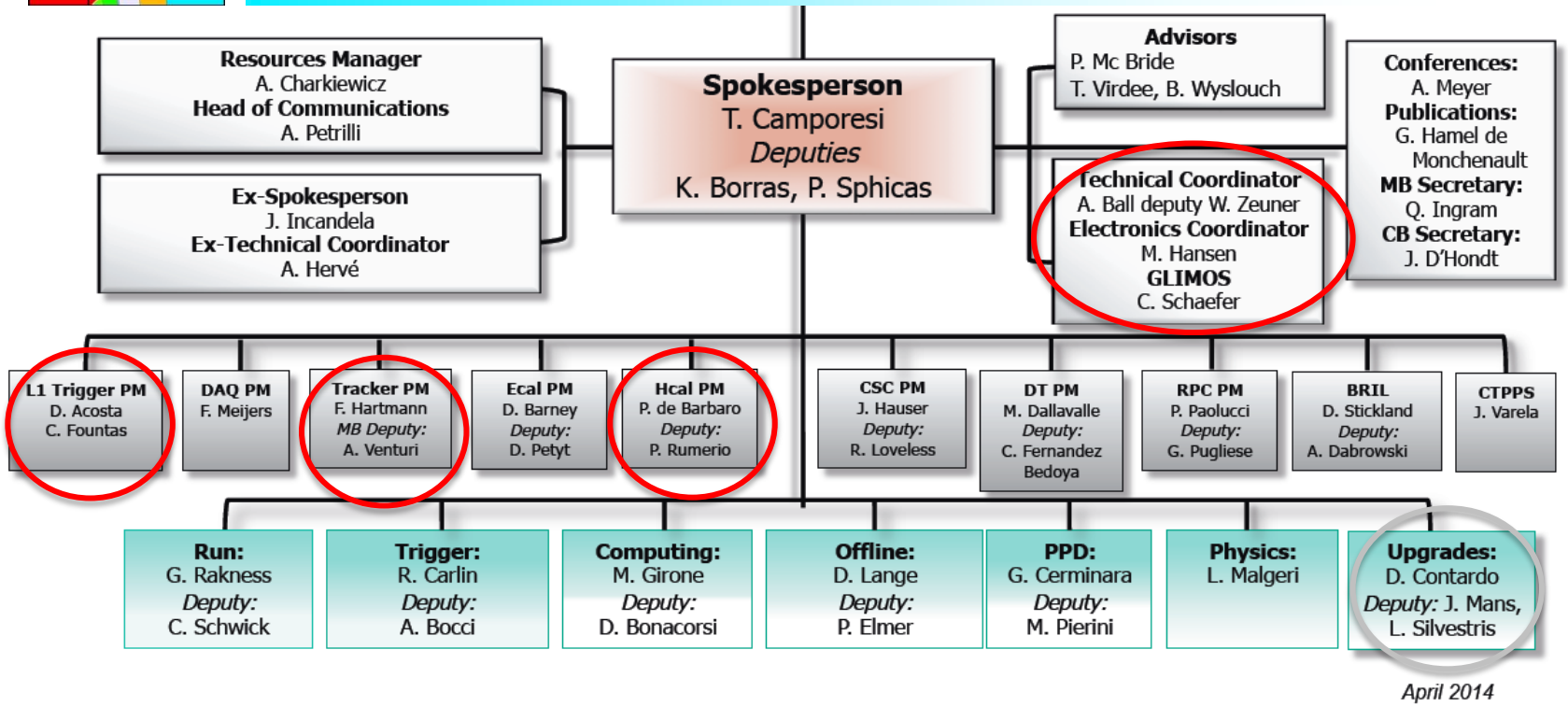
- Four CTCs (including Mgmt)
  - But for fund type distinction
- Many to one mapping (CA, CTC) to CAM

Umbrella: U.S. CMS Program

- Composition
  - 50 Institutes (30 on Upgrade)
    - 425 Fac/staff, 225 Students
  - ~ 28% of CMS
- Responsibilities
  - Overall Coordination
  - Detector Operations
    - Did R&D for Phase 1
    - Dominant overlap with Project
  - Software and Computing
- Significant Symbiosis
  - Same relationships with Funding Agencies, FNAL
  - Overlap/Complementarity of goals
  - Adopted Governance through Statements of Work (SOWs)



International CMS Organization



- Relevant for LHC CMS Detector Upgrades Project
  - Technical Coordination – Installation, Electronics Oversight, Safety
  - L1 Trigger, Tracker, HCAL Projects – Integration
    - Considerable past and current overlaps in these Organizations
  - Upgrade Coordinators (Phase 2)

On interweaved Organizations

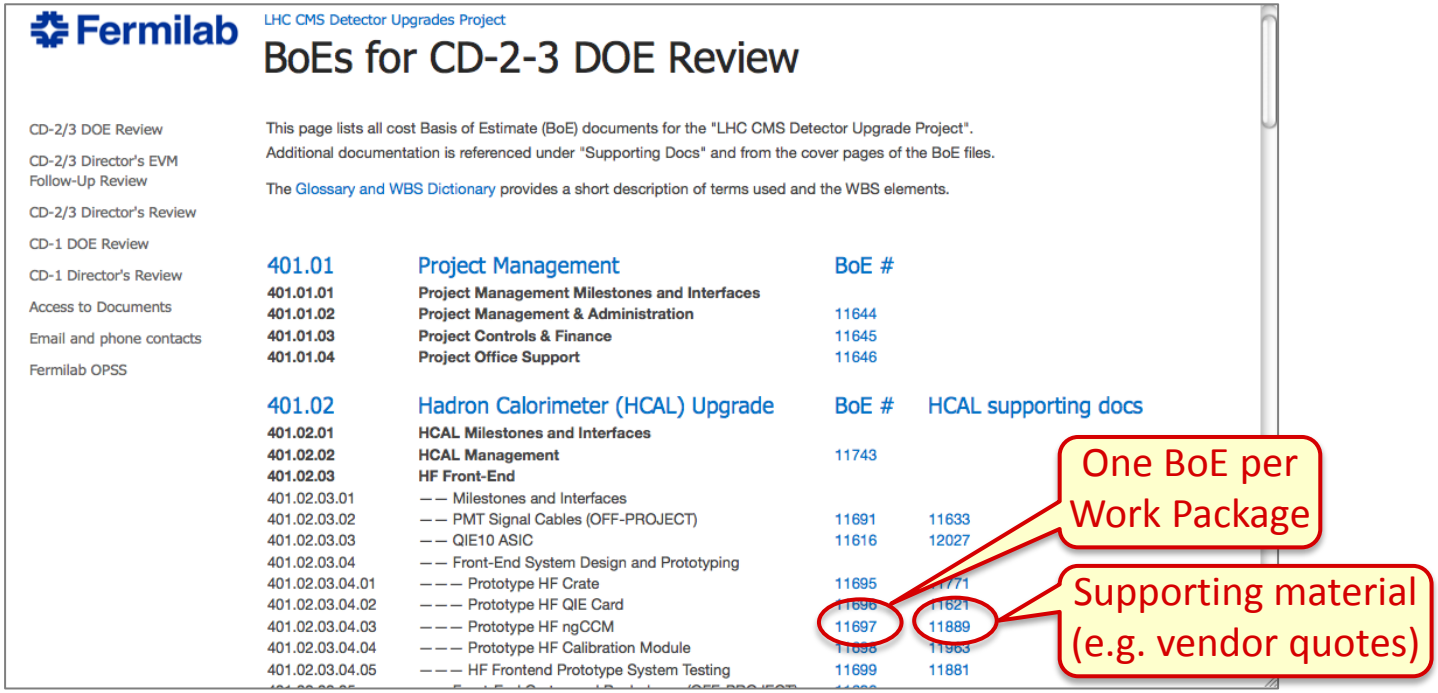
- Structure in place since Construction Project
  - Familiar with the pitfalls
  - Model for U.S. participation in international science on this scale
    - Reconfirmed recently by P5, p. 10 of draft report
- Multidimensional organization is a strength
  - Allows flexible solutions to maximize physics potential
  - Can join forces on topics of mutual interest
    - Design, Procurement Readiness, Installation Reviews
    - LS1: Operations prepares Collision Hall for Upgrade Project
- Requires frequent communication and synchronization
  - Moderate overlap in organizations facilitates coordination
    - Careful overt assessment of conflict of interests
  - High level milestones form basis of information exchange

Basis of Estimates

- Each work package and its resources are described in a "Basis of Estimate" (102 in total)

  https://web.fnal.gov/project/cmsupgrades/SitePages/BoEs%20for%20CD-2-3%20DOE%20Review.aspx

  - Created by CAMs and L2s using standard cost estimation rules including estimate uncertainty based on maturity of design guidelines



Fermilab

LHC CMS Detector Upgrades Project

BoEs for CD-2-3 DOE Review

CD-2/3 DOE Review
CD-2/3 Director's EVM Follow-Up Review
CD-2/3 Director's Review
CD-1 DOE Review
CD-1 Director's Review
Access to Documents
Email and phone contacts
Fermilab OPSS

This page lists all cost Basis of Estimate (BoE) documents for the "LHC CMS Detector Upgrade Project".
Additional documentation is referenced under "Supporting Docs" and from the cover pages of the BoE files.

The Glossary and WBS Dictionary provides a short description of terms used and the WBS elements.

401.01	Project Management	BoE #	
401.01.01	Project Management Milestones and Interfaces		
401.01.02	Project Management & Administration	11644	
401.01.03	Project Controls & Finance	11645	
401.01.04	Project Office Support	11646	

401.02	Hadron Calorimeter (HCAL) Upgrade	BoE #	HCAL supporting docs
401.02.01	HCAL Milestones and Interfaces		
401.02.02	HCAL Management	11743	
401.02.03	HF Front-End		
401.02.03.01	— Milestones and Interfaces		
401.02.03.02	— PMT Signal Cables (OFF-PROJECT)	11691	11633
401.02.03.03	— QIE10 ASIC	11616	12027
401.02.03.04	— Front-End System Design and Prototyping		
401.02.03.04.01	— — Prototype HF Crate	11695	11771
401.02.03.04.02	— — Prototype HF QIE Card	11696	11621
401.02.03.04.03	— — Prototype HF ngCCM	11697	11889
401.02.03.04.04	— — Prototype HF Calibration Module	11698	11963
401.02.03.04.05	— — HF Frontend Prototype System Testing	11699	11881

One BoE per Work Package

Supporting material (e.g. vendor quotes)

Basis of Estimate – example

LHC CMS Detector Upgrade Project

Basis of Estimate (BoE)

Basis of Estimate (BoE)

Document ID:	CMS-doc-11614
Prepared by:	Simon Kwan
Updated:	20-Jul-2014

WBS Component	
WBS Number:	401.03.03.01.01
WBS Name:	Sensor production

WBS Dictionary Description:

This element covers the activities related to the production of pixel sensors. It includes, design, prototype, testing, review, procurement, delivery, and testing of the pixel sensors needed for the FPIX upgrade. We expect to purchase a total of 147 6" (150 mm) sensor wafers. The silicon sensor is based on the design of the present silicon sensor used in the current FPIX at CERN (n+-in-n). Purdue University has handled the design of the sensor, where the most important change is the use of 6 inch silicon wafers instead of 4" silicon wafers. The University of Kansas will be handling the procurement of the 6" silicon sensor wafers from SINTEF, a Norwegian company, using funds from a NSF-CA grant. Our experience with the current FPIX, both in operation and irradiation studies, showed that the vendor we used for the current FPIX sensor produced sensors of excellent quality and the delivery was on-time. We plan to use the same vendor and the same n+-in-n technology with p-stop isolation. 23 Prototype 6" sensor wafers, purchased with NSF MRI funds, were ordered and were received on July 29th, 2013 at Fermilab. Each 6 inch wafer holds 8 full-size sensors (one full-size sensor covers a module with 2x8 Readout chips (ROC)), and also some smaller sensors that can be bump-bonded to a single ROC for irradiation tests, and for evaluation of different Pixel Unit Cell (PUC) designs. These wafers will be used for a number of important processes: for making bump-bonded single ROC 1x1 modules for irradiation tests; for a prototype bump-bonding run with full size 2x8 modules to evaluate bump-bonding yield and validate a more automated bump-bond assembly process; to set up the sensor wafer probe testing at FNAL and Purdue; to setup the assembly and testing of pixel modules at Purdue and Nebraska; and ultimately for modules for use in the pilot system, beam tests, and test stands.

Basis of Estimate – example

… scrolling down …

LHC CMS Detector Upgrade Project

Basis of Estimate (BoE)

only wafers with at least 6 good sensors. With a yield of 85%, the 147 wafers will result in 1000 good sensors to be used for bump-bonding to ROCs.

The QA testing of sensor wafers will be done at Fermilab and Purdue, by probe testing each sensor wafer. Maps of good sensors on each wafer will be created, ready to be sent to the bump-bonding company where they will be diced into sensors and bump-bonded to readout chips. The labor and time estimates for the wafer testing are based on previous experience on testing for the current FPIX detector in CMS, and the more recent experience with testing the prototype 6" sensor wafers. Throughout all the different FPIX sensor activities, all the testing results will be stored in a central database to aid in the subsequent calibration and grading of the components used in the detector assembly.

The following supporting documents are available in DocDB:

- Old 2012 SINTEF quote with description of processing, schedule, and production costs in 2012 dollars and expected increased for 2013 and 2014. (SINTEF_quote_A12-2005400.pdf).
- Updated informal quote giving more up-to-date costs (Updated_SINTEF_Informal_quote).
- Spreadsheet used to estimate the sensor yield as a function of the sensor size using the measurements from the original FPIX detector (Yield_estimate_spreadsheet.xls).
- Measurement document from Sintef and spreadsheet giving the yield for the 6" sensor prototype wafers (Summary_measurement_23July2013.pdf, sensor_yield_fromprototypes.xlsx).

Supporting Documents	
1	CMS-doc-11614
2	
3	
4	
5	

Basis of Estimate – example

only wafers with at least 6 good sensors. With a yield o
ROCs.

The QA testing of sensor wafers will be done at Fermila
wafer will be created, ready to be sent to the bump-bo
chips. The labor and time estimates for the wafer testi
and the more recent experience with testing the proto
results will be stored in a central database to aid in the

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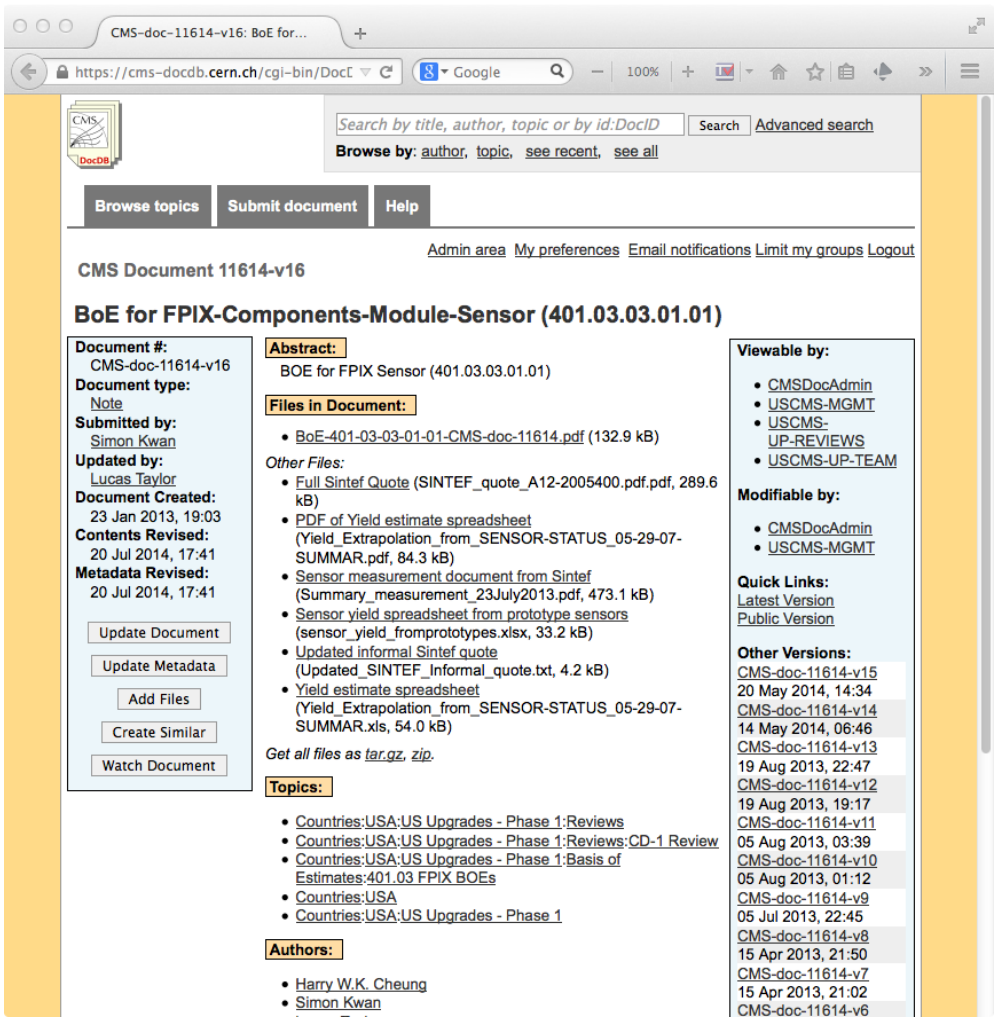
2014. (SINTEF_quote_A12-2005400.pdf).
- Updated informal quote giving more up-to-date cost
- Spreadsheet used to estimate the sensor yield as a f
(Yield_estimate_spreadsheet.xls).
- Measurement document from Sintef and sprea
(Summary_measurement_23July2013.pdf, sen

Supporting materials (e.g. vendor quotes) are in DocDB

Supporting Documents	
1	CMS-doc-11614
2	
3	
4	
5	



Note: DocDB has access control, versions, etc.

Basis of Estimate – example

Estimated resources
M&S ($) and labor (hours)

Funding

Activity ID	Activity Name	Duration (days)	Resource Name	Resource Type	M&S base estimate (k$)	Fermilab Labor base estimate (hours)	University Labor base estimate (hours)	Estimate Type	Estimate Uncert-ainty	Funding
P103140	Test prototype from 4" wafers including beam tests (FN)	64	Particle Physicist Experimental Uncosted	Fermi Labor	0	130	0	L3	0%	DOE
P103140	Test prototype from 4" wafers including beam tests (FN)	64	Particle Physics Experimental Research Associate Uncosted	Fermi Labor	0	120	0	L3	0%	DOE
P103150	Test prototype from 4" wafers including beam tests (PD)	64	Engineering Physicist - Purdue	Univ. Labor	0	0	144	L3	0%	DOE
P103150	Test prototype from 4" wafers including beam tests (PD)	64	Mechanical Technician - Purdue	Univ. Labor	0	0	120	L3	0%	DOE
P103160	Test prototype from 6" wafers before and after irradiation including beam tests (FN)	108	Particle Physics Experimental Research Associate Uncosted	Fermi Labor	0	120	0	L3	0%	DOE
P103160	Test prototype from 6" wafers before and after irradiation including beam tests (FN)	108	Particle Physicist Experimental Uncosted	Fermi Labor	0	120	0	L3	0%	DOE
P103160	Test prototype from 6" wafers before and after irradiation including beam tests (FN)	108	M&S Standard: FY13 Base Year	Material	1	0	0	L3	0%	DOE
P103170	Test prototype from 6" wafers before and after irradiation including beam tests (PD)	108	Mechanical Engineer - Purdue	Univ. Labor	0	0	165	L3	0%	DOE
P103170	Test prototype from 6" wafers before and after irradiation including beam tests (PD)	108	Engineering Physicist - Purdue	Univ. Labor	0	0	275	L3	0%	DOE
P103180	Test prototype from 6" wafers before and after irradiation including beam tests - M&S Expenses	108	M&S Pass-Thru: FY13 Base Year	Material	14	0	0	M3	0%	DOE
P103190	Analysis of test beam results and final changes to the sensor mask design (PD)	45	Engineering Physicist - Purdue	Univ. Labor	0	0	102	L4	33%	DOE
P103200	Prepare specification and acceptance document (PD)	10	Engineering Physicist - Purdue	Univ. Labor	0	0	60	L3	25%	DOE
P103210	Production readiness review (PD)	1	Engineering Physicist - Purdue	Univ. Labor	0	0	8	L3	25%	DOE
P103230	Prepare the orders for the purchase of sensor wafers	30	Scientist - Uncosted Univ. of Kansas	Univ. Labor	0	0	20	L2	20%	NSF
P103240	Place the order for the engineering of the sensor wafers and for the purchase of the 1st batch production sensor wafers	1	M&S Exempt: FY14 Base Year	Material	228	0	0	M3	20%	NSF

Resources explicitly identified

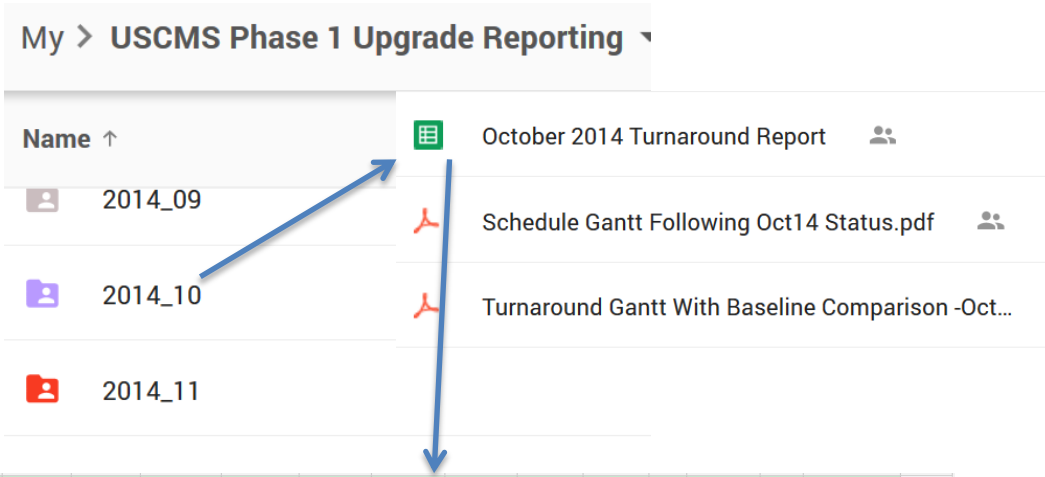
Note: in P6/Cobra terminology
"Labor" = Fermilab labor
"Nonlabor" = University labor

Resource uncertainty

Depends on resource type and estimate maturity

"Statusing" → BCWP

- How much work has been done?
  - CAM/CTC Managers estimate using variety of techniques
    - Other than LOE, effort has been made to keep tasks **less than 3 months long or use steps**
  - Information collected via Google
    - Convenient multi-user platform



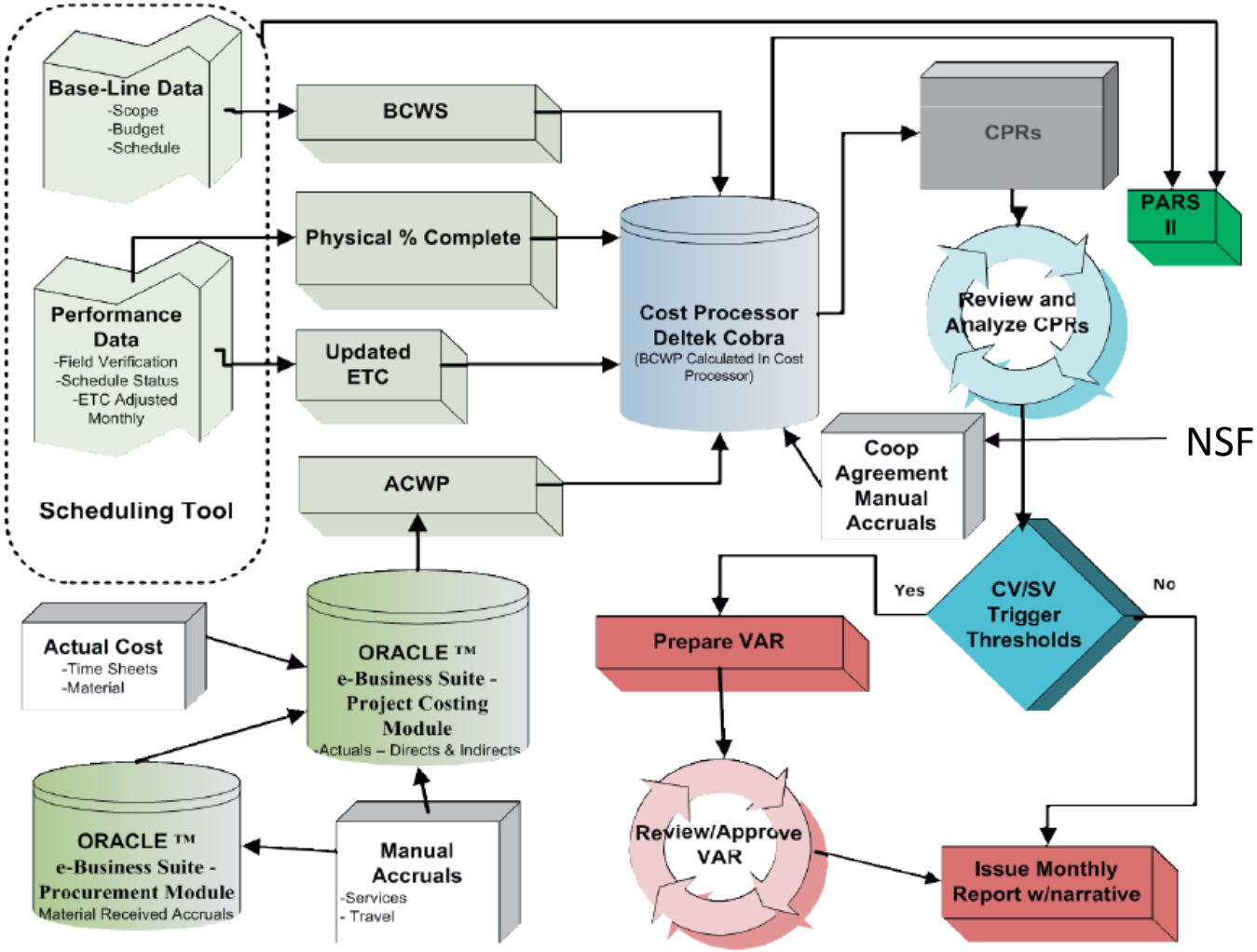
Activity ID	Activity Name	Activity Type	Activity Status	Planned Duration	Baseline Start	Baseline Finish	Start	Finish	Actual Start	Actual Finish	Expected Finish	Activity % Complete	Percent Complete Type	PMT Code	Steps Completed	Total Step Count	Comments	Last Change
H102210	OFF-PROJECT - Turkey fabricates production QIE cards	Task Dependent	Not Started	80d	23-Mar-15	14-Jul-15	20-Mar-15	13-Jul-15				0%	Physical		0	0	Not started	10/29/20
H102220	OFF-PROJECT - Brazil fabricates production QIE cards	Task Dependent	Not Started	80d	23-Mar-15	14-Jul-15	20-Mar-15	13-Jul-15				0%	Physical		0	0	Not started	10/29/20
401.02W.03.03	**QIE10 ASIC**			**356d**	**15-Jan-14**	**15-Jun-15**	**15-Jan-14 A**	**12-Jun-15**	**15-Jan-14**						**0**	**0**		
H102590	Software development for chip tester	Task Dependent	Completed	112d	15-Jan-14	6-Aug-14	15-Jan-14 A	16-Sep-14 A	15-Jan-14	16-Sep-14		100%	Physical	C	0	0		
H102680	Longevity testing of prototype QIE10 p5 (RU)	Task Dependent	Completed	30d	1-May-14	12-Jun-14	15-Jul-14 A	29-Sep-14 A	15-Jul-14	29-Sep-14		100%	Physical	C	0	0		
H102820	Vendor fabricates engineering run of QIE10 ASIC for HF	Task Dependent	Completed	66d	27-Jun-14	30-Sep-14	23-Jun-14 A	29-Sep-14 A	23-Jun-14	29-Sep-14		100%	Physical		0	0		
H102830	Delivery of engineering run of QIE10 ASIC for HF	Task Dependent	Completed	1d	1-Oct-14	1-Oct-14	30-Sep-14 A	30-Sep-14 A	30-Sep-14	30-Sep-14		100%	Physical	C	0	0		
H102840	Packaging into chip carriers of small number of engineering run QIE10 ASIC for HF	Task Dependent	Not Started	3d	2-Oct-14	6-Oct-14	1-Oct-14	3-Oct-14	10/1/2014	10/3/2014		100%	Physical	C	0	0		10/29/20
H102850	Bench testing of engineering run QIE10 ASIC for HF	Task Dependent	Not Started	40d	7-Oct-14	3-Dec-14	6-Oct-14	2-Dec-14	10/6/2014	10/23/2014		100%	Physical	C	0	0		10/29/20
H102860	Issue PO for Package production QIE10s - Obligation	Task Dependent	Not Started	1d	4-Dec-14	4-Dec-14	3-Dec-14	3-Dec-14				0%	Physical	F	0	0	Early november	10/29/20
H102870	Vendor fabricates package production QIE10s	Task Dependent	Not Started	40d	5-Dec-14	5-Feb-15	4-Dec-14	4-Feb-15				0%	Physical		0	0	Not started	10/29/20
H102880	Vendor delivers Package production QIE10s	Task Dependent	Not Started	1d	6-Feb-15	6-Feb-15	5-Feb-15	5-Feb-15				0%	Physical	C	0	0	Not started	10/29/20
H102890	Robot chip testing of production QIE10 ASIC for HF	Task Dependent	Not Started	30d	9-Feb-15	20-Mar-15	6-Feb-15	19-Mar-15				0%	Physical	C	0	0	Not started	10/29/20
H102900	Longevity testing of production QIE10 ASIC for HF	Task Dependent	Not Started	90d	9-Feb-15	15-Jun-15	6-Feb-15	12-Jun-15				0%	Physical	C	0	0	Not started	10/29/20
H102910	Radiation hardness testing of production QIE10 ASIC for HF	Task Dependent	Not Started	20d	9-Feb-15	6-Mar-15	6-Feb-15	5-Mar-15				0%	Physical	C	0	0	Not started	10/29/20
H102920	L5 - QIE10 ASICs available for shipment	Finish Milestone	Not Started	0d		20-Mar-15		19-Mar-15				0%	Duration		0	0	Not started	10/29/20
401.02W.03.04	**Front-End System Design and Prototyping**			**236d**	**11-Mar-14**	**23-Dec-14**	**11-Mar-14 A**	**16-Mar-15**	**11-Mar-14**						**0**	**0**		
401.02W.03.04.02	**Prototype HF QIE Card**			**81d**	**15-May-14**	**10-Oct-14**	**08-Aug-14 A**	**22-Dec-14**	**8-Aug-14**						**0**	**0**		
H103320	Turkey produces pre-production QIE cards - OFF-PROJECT	Task Dependent	In Progress	60d	18-Jul-14	10-Oct-14	15-Sep-14 A	22-Dec-14	15-Sep-14			5%	Physical		0	0	no additional pro	10/30/20
H103330	Brazil produces pre-production QIE cards - OFF-PROJECT	Task Dependent	In Progress	60d	18-Jul-14	10-Oct-14	15-Sep-14 A	22-Dec-14	15-Sep-14			5%	Physical		0	0	no additional pro	10/30/20
H103380	Design of mechanical components for QIE card	Task Dependent	Completed	30d	15-May-14	26-Jun-14	08-Aug-14 A	30-Sep-14 A	8-Aug-14	30-Sep-14		100%	Physical	C	0	0		
H103390	Iowa fabricates prototype mechanical components for QIE card	Task Dependent	In Progress	20d	27-Jun-14	25-Jul-14	30-Sep-14 A	21-Oct-14	30-Sep-14	10/23/2014		100%	Physical	C	0	0	Complete	11/6/201
H103430	Vendor fabricates parts for second prototype QIE card	Task Dependent	Completed	5d	21-Jul-14	25-Jul-14	19-Aug-14 A	11-Sep-14 A	19-Aug-14	11-Sep-14		100%	Physical		0	0		
H103440	Issue PO for fabrication of PCB for second prototype QIE card- Obligation	Task Dependent	Completed	1d	18-Jul-14	18-Jul-14	25-Aug-14 A	02-Sep-14 A	25-Aug-14	2-Sep-14		100%	Physical	F	0	0		
H103450	Vendor fabricates second prototype QIE card PCB	Task Dependent	Completed	10d	21-Jul-14	1-Aug-14	02-Sep-14 A	11-Sep-14 A	2-Sep-14	11-Sep-14		100%	Physical		0	0		
H103460	Vendor delivers parts for second prototype QIE card	Task Dependent	Completed	1d	28-Jul-14	28-Jul-14	11-Sep-14 A	11-Sep-14 A	11-Sep-14	11-Sep-14		100%	Physical	C	0	0		
H103470	Vendor delivers fabricated second prototype QIE card PCB	Task Dependent	Completed	1d	4-Aug-14	4-Aug-14	11-Sep-14 A	11-Sep-14 A	11-Sep-14	11-Sep-14		100%	Physical	C	0	0		
H103480	Issue PO for assembly of second prototype QIE card - Obligation	Task Dependent	Not Started	1d	5-Aug-14	5-Aug-14	1-Oct-14	1-Oct-14	10/28/2014	10/29/2014		100%	Physical	F	0	0	Complete	11/6/201
H103490	Vendor assembles second prototype QIE card	Task Dependent	Not Started	11d	6-Aug-14	20-Aug-14	2-Oct-14	16-Oct-14	10/29/2014			10%	Physical		0	0	rem dur = 10d	11/6/201
H103500	Vendor delivers assembled second prototype QIE card	Task Dependent	Not Started	1d	21-Aug-14	21-Aug-14	17-Oct-14	17-Oct-14				0%	Physical	C	0	0	Not started	
401.02W.03.04.03	**Prototype HF ngCCM**			**113d**	**11-Jun-14**	**10-Oct-14**	**21-Jul-14 A**	**2-Jan-15**	**21-Jul-14**						**0**	**0**		
H103720	Design of HF ngCCM Prototype 2 - MA	Task Dependent	Completed	40d	11-Jun-14	6-Aug-14	21-Jul-14 A	26-Sep-14 A	21-Jul-14	26-Sep-14		100%	Physical	C	0	0		
H103730	Design of HF ngCCM Prototype 2 - UV	Task Dependent	In Progress	40d	11-Jun-14	6-Aug-14	21-Jul-14 A	11-Nov-14	21-Jul-14			75%	Physical	C	0	0	rem dur=10d	11/21/20
H103740	Prototype 2 HF ngCCM firmware development	Task Dependent	In Progress	20d	7-Aug-14	4-Sep-14	24-Jul-14 A	13-Nov-14	24-Jul-14			90%	Physical	C	0	0	rem ur=2d	11/21/20
H103750	Procure parts for prototype 2 HF ngCCM	Task Dependent	Completed	20d	7-Aug-14	4-Sep-14	13-Aug-14 A	23-Sep-14 A	13-Aug-14	23-Sep-14		100%	Physical	C	0	0		

Actuals Strategy

- How much has been spent on associated work
  - FNAL M&S, Labor propagate through accounting system
  - Institute Invoices through FNAL/Nebraska accounting system
  - Accruals from CAMs account for latency in Invoices vs. Status

HCAL POs					401	Contact: Jeremy Mans											
Vendor Name	Po#	Task Number	Po Line #	PO SHIP #	PO DIST #	Item Descr	Total Oblg.	JUN-14 INVOICE	JUL-14 INVOICE	AUG-14 INVOICE	SEP-14 INVOICE	OCT14-15 INVOICE	NOV14-15 INVOICE	TOTAL INVOICED	NOV14-15 ADD'L ACCRUALS	Amt. Remaining
BROWN U	615706	401.20001	1	1	1	401.02.02 0:	$4,000.00				1,554.78			3,192.48		$807.52
BROWN U	615706	401.20011	2	1	1	401.02.03.04	$3,000.00		51.22					51.22		$2,948.78
BROWN U	615706	401.20011	3	1	1	401.02.03.04	$1,500.00							1,500.00		$0.00
BROWN U	615706	401.20031	4	1	1	401.02.05.15	$61,900.00		14,974.29		337.80			15,312.09		$46,587.91
IOWA UNI	615650	401.20011	1	1	1	WBS 401.02	$24,810.00		$3,143.10	$3,288.49				$23,873.73		$936.27
IOWA UNI	615650	401.20011	2	1	1	WBS 401.02	$22,500.00		$1,049.72	$4,244.54				$18,093.31		$4,406.69
IOWA UNI	615650	401.20011	3	1	1	WBS 401.02	$10,823.00		$1,371.13	$1,434.55				$10,414.55		$408.45
IOWA UNI	615650	401.20011	4	1	1	WBS 401.02	$4,578.00		$696.91	$245.86				$3,777.09		$800.91
IOWA UNI	615650	401.20011	5	1	1	WBS 401.02	$4,000.00		$186.62	$754.59				$3,216.60		$783.40
IOWA UNI	615650	401.20011	6	1	1	WBS 401.02	$2,500.00			$148.86				$463.39		$2,036.61
IOWA UNI	615650	401.20071	7	1	1	WBS 401.02	$16,724.00		$5,334.94	$5,581.71				$15,134.82		$1,589.18
IOWA UNI	615650	401.20071	8	1	1	WBS 401.02	$26,928.00		$5,765.09	$2,033.80				$20,302.58		$6,625.42
IOWA UNI	615650	401.20071	9	1	1	WBS 401.02	$24,684.00		$8,338.68	$2,941.70				$15,100.95		$9,583.05
MINNESOT	615642	401.20001	1	1	1	WBS 401.02	$8,500.00	$1,852.03		$2,046.28	$687.22			$5,000.00		$3,500.00
MINNESOT	615642	401.20011	2	1	1	WBS 401.02	$8,440.00			$2,905.87				$8,440.00		$0.00
MINNESOT	615642	401.20011	3	1	1	WBS 401.02	$7,260.00							$7,260.00		$0.00
MINNESOT	615642	401.20011	4	1	1	WBS 401.02	$2,500.00	$581.00						$2,500.00		$0.00
MINNESOT	615642	401.20021	5	1	1	WBS 401.02	$27,224.00							$23,776.37		$3,447.63

Flow chart of EV information processing



NSF ACWP from NE

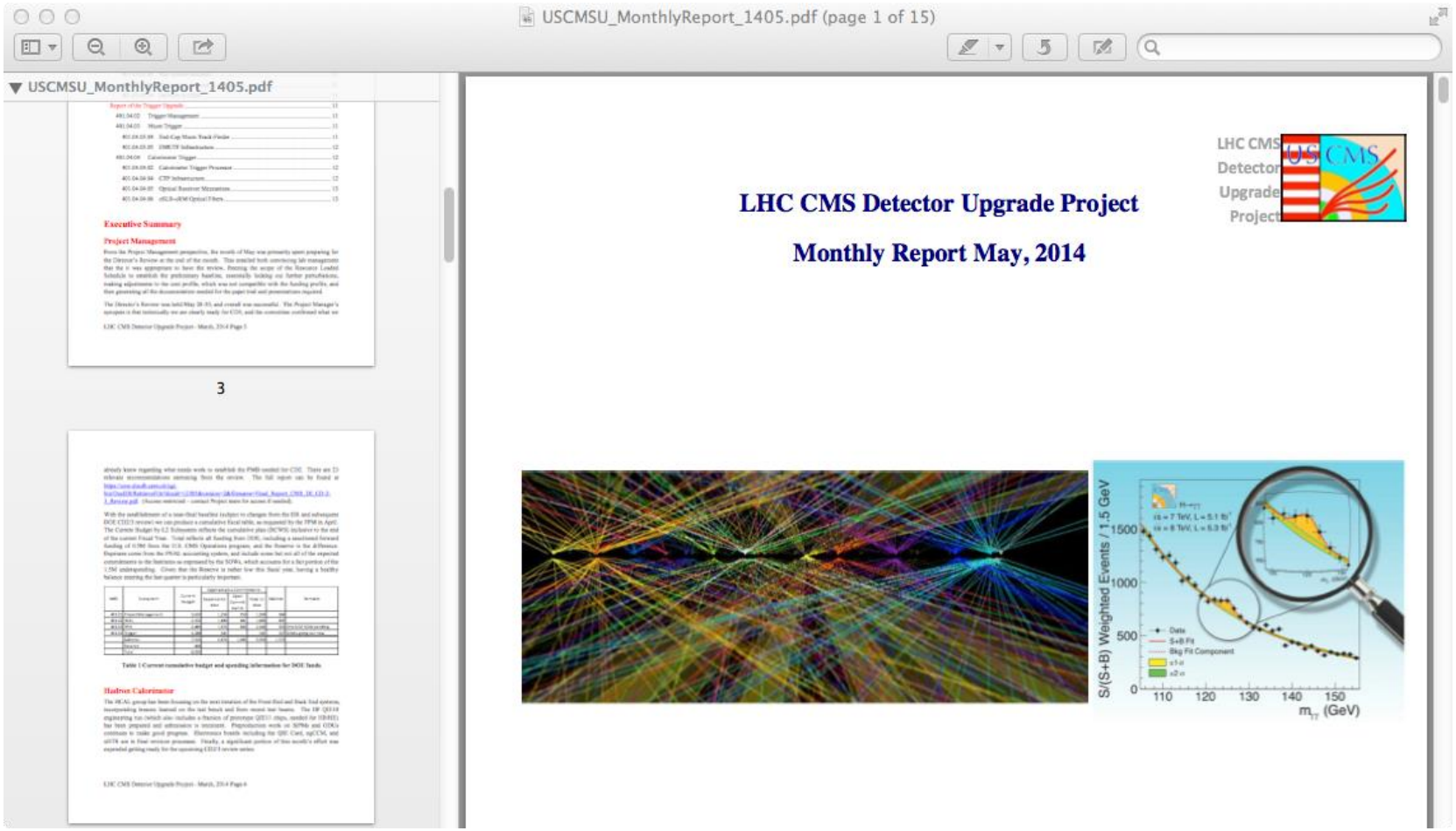
Monthly Reporting

- Monthly reports and data are stored in DocDB

CMS-doc-#	Title	Author(s)	Topic(s)	Last Updated
12521-v2	USCMS Phase 1 Upgrade -- October 2014	Steven Christopher Nahn	Monthly Reports Statusing and EVMS US Upgrades - Phase 1	01 Dec 2014
12506-v2	USCMS Phase 1 Upgrade -- September 2014	Steven Christopher Nahn	Monthly Reports Statusing and EVMS US Upgrades - Phase 1	05 Nov 2014
12458-v1	USCMS Phase 1 Upgrade -- August 2014	Steven Christopher Nahn	Monthly Reports Statusing and EVMS US Upgrades - Phase 1	17 Oct 2014
12098-v7	USCMS Phase 1 Upgrade -- Monthly Report Template	Steven Christopher Nahn	Monthly Reports Statusing and EVMS US Upgrades - Phase 1	23 Sep 2014
12413-v1	USCMS Phase 1 Upgrade -- July 2014	Steven Christopher Nahn	Monthly Reports	28 Aug 2014

Monthly Reporting

- Written report – technical progress, issues, etc.



Change Control

- Process of specifying, quantifying, approving, and implementing specific change
  - Documents reasons change is needed
  - Estimates impact on cost, scope, schedule
  - Ensures approval and notification at the appropriate level of authority
    - Thresholds specified in PEP (higher level) and Change Control document (lower level)
- Particular part of the configuration management system associated with Project Controls