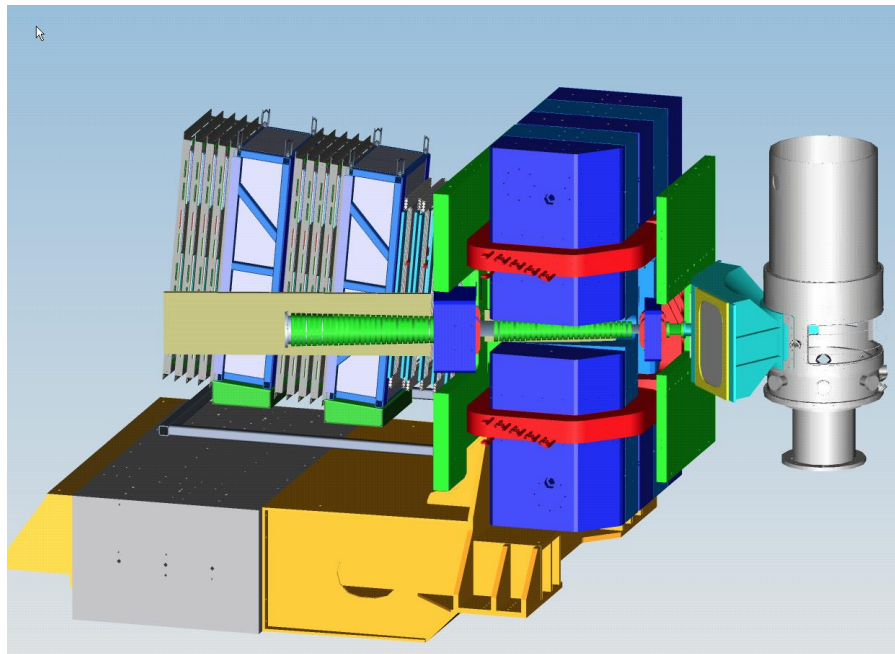


Super-Bigbite-Spectrometer (SBS)

Monthly Progress Report

February 15, 2017



Introduction:

The SBS Program consists of three separate, but interrelated Projects.

- The first Project, **SBS Basic (WBS 1)**, involves the acquisition of an existing magnet and the associated work of preparing it for use during the SBS research program. The effort includes modifications to the magnet, including machining a slot in the yoke for beam passage, field clamps, and a solenoid to reduce the transverse magnetic field on the beam line, the design and development of the infrastructure needed to run the magnet, and the construction of the platform on which it will stand.
- The second Project, **Neutron Form Factor (WBS 2)**, involves the construction of The PMT-based Coordinate Detector (CDet), trigger electronics for the Hadron Calorimeter (HCal) to meet the requirements of the approved neutron form factor measurements.
- The third and final Project, **Proton Form Factor (WBS 3)**, involves the construction of forty GEM detector modules with associated front-end and DAQ modules to meet the requirements of the approved proton form factor measurement.

Project Management Highlights:

This is the final Monthly Progress Report for the SBS Program.

The SBS Basic (WBS 1) project started in FY13 and was completed in January 2016. The SBS Neutron Form Factor (WBS 2) started at the beginning of FY14. The SBS Proton Form Factor (WBS 3) started on October 1, 2012.

- WBS 2 was completed on Jan 23rd.
- WBS 3 was completed on Feb 1st.
- Document on the Transition to Operations is being prepared and will be sent to DOE by the end of February.

WBS 1: SBS Basic

WBS 1	SBS Basic: (Hall A Infrastructure)	WBS 1.01	Milestones
		WBS 1.02	Project Oversight
		WBS 1.1	Magnet, power and construction
		WBS 1.2	Magnet/detector platforms
		WBS 1.3	Beam line

WBS1 Project was completed on January 22nd, 2016.

WBS 1 Costs:

- The budget for this WBS for FY15 is \$212K.
- The incremental budget (FY13+FY14+FY15) is \$1,694K.
- At project completion, costed and obligated: \$1738K (103%).

WBS 1.01 Milestones: (see [Appendix 1](#) for graphic view of milestones)

Level (ID#)	Milestone	Scheduled Date	Expected Date N/A	Expected Date N/A	Comment
1 (1.1-01M)	Project start	10/1/2012			Completed 10/1/2012
2 (2-01M)	Magnet delivered to JLab	4/30/2013			Completed 8/21/2013
3	Power supply received	1/4/2014			Completed 10/17/2014
3	Magnet yoke modifications Completed	4/1/2014			Completed 5/22/2014
2 (1.2-10M)	Platform parts received	6/27/2014			Completed 3/24/2015
3	Assemble magnet in Testlab	7/1/2014			Completed 9/4/2014
3	Commissioning test of magnet in Testlab completed	10/1/2014			Completed 10/29/2014
3	Beampipe solenoid correctors received	1/5/2015			Completed 12/11/2015
3	Detector supports completed	4/1/2015			Completed 3/24/2015
2 (1.2-30M)	Beam-line parts received	9/24/2015			Completed 11/30/2015
1 (1.1-10M)	Project completion	1/29/2016			Completed 1/22/2016

WBS 2: Neutron Form Factor

WBS 2	Neutron Form Factor	WBS 2.01	Milestones
		WBS 2.02	Project oversight
		WBS 2.1	Coordinate Detector (ISU)
		WBS 2.2	Electronics Hut, Lead Shielding, Lead platform, and Detector Frames (JLab)
		WBS 2.3	Pole Shims and field clamp (JLab)
		WBS 2.4	Trigger (RU)

WBS 2.02 Project Oversight:

- SBS weekly meetings, via tele and video conference, were held on Jan 5, 12 and 26th. Participants included Jefferson Lab, University of Virginia, Carnegie-Mellon University, William and Mary, Norfolk State University, University of Connecticut, University of Glasgow, Saint Mary's University, Idaho State University, Christopher Newport University and INFN Rome.
- Project is staffed appropriately for this stage, and includes Jefferson Lab (manager, scientist) and Idaho State University (one scientist).

WBS 2.1 Coordinate Detector (ISU):

- Completed

WBS 2.2 Electronics Hut, Lead Shielding & platform, and Detector Frames:

- Completed
- Spacer strips for the beamline magnetic shielding were delivered on Jan 5th. Inspection of the strips showed that not all holes were tapped properly. The spacers were returned to the vendor. The vendor fixed the problem and the spacers were officially accepted by the JLab engineers on Jan 23rd.

WBS 2.3 Pole Shims and field clamp

- Completed.

WBS 2.4 Trigger:

- Completed.

WBS 2 Costs:

- The total budget for WBS2 is \$1,372K.
- Costed and obligated as of 2/1/2017: \$1,340K (98%).

WBS 2.01 Milestones: See [Appendix 1](#) for a graphic view of the milestones .

Level	Milestone	Scheduled Date	Expected date 1/1/2016	Expected Date N/A	Comment
1	Project start	10/1/2013			Completed 10/1/2013
3	Finish testing of module prototype	8/30/2014			Completed 8/30/2014
3	Scintillator ordered	9/30/2014			Completed 9/15/2014
2	CDET module design completed	11/30/2014			Completed 11/30/2014
3	Wavelength Shifting Fibers ordered	1/15/2015			Completed 1/20/2015
3	Scintillator shipped for machining	4/30/2015			Completed 4/10/2015
2	JLab receives exit field clamp	6/2/2015			Completed 11/18/2015
3	Begin preparation of WLS fibers	6/15/2015			Completed 7/6/2015
3	Begin construction of CDET modules	9/1/2015			Completed 9/24/2015
3	Assembled one CDET module	10/1/2015			Completed 11/15/2015
2	Electronics hut parts received	10/2/2015			Completed 3/30/2016
2	Trigger completed	10/4/2015			Completed 3/15/2016
3	Assembled one CDET plane	12/1/2015			Completed 7/15/2016
2	Coordinate Detector assembled	6/30/2016			Completed 8/31/2016
1	Project completion	1/29/2017	1/29/2017		Completed 1/23/2017

WBS 3: Proton Form Factor

WBS 3	Proton Form Factor	WBS 3.01	Milestones
		WBS 3.02	Project Oversight
		WBS 3.1	GEM's (UVa)
		WBS 3.2	GEM electronics (UVa)

WBS 3.02 Project Oversight:

- SBS weekly meetings, via tele and video conference, were held on Jan 5, 12 and 26th. Participants included Jefferson Lab, University of Virginia, Carnegie-Mellon University, William and Mary, Norfolk State University, University of Connecticut, University of Glasgow, Saint Mary's University, Idaho State University, Christopher Newport University and INFN Rome.
- Project is staffed appropriately and includes Jefferson Lab (manager, scientist) and UVa (two scientists).

WBS 3.1 GEMs

- Completed.
- 40 GEM modules are completed and tested. A tabulation of the forty modules is given in Appendix III.
- Three GEM foils arrived from CERN at the end of December and they did not pass QA tests. Therefore, a prototype module that passed QA tests is module #40.

WBS 3.2 GEM electronics

- Completed.
- The 57 MPDs were tested at the vendor. Three failed the testing and were fixed by the vendor. At UVa, the 57 MPDs were tested and all passed.
- The 900 APV cards were tested at the vendor. About 10% failed the QA tests and were fixed at the vendor.

WBS 3 Costs:

- The total budget for WBS3 is \$1781K.
- Costed and obligated as of 2/1/2017: \$1753K (98%).

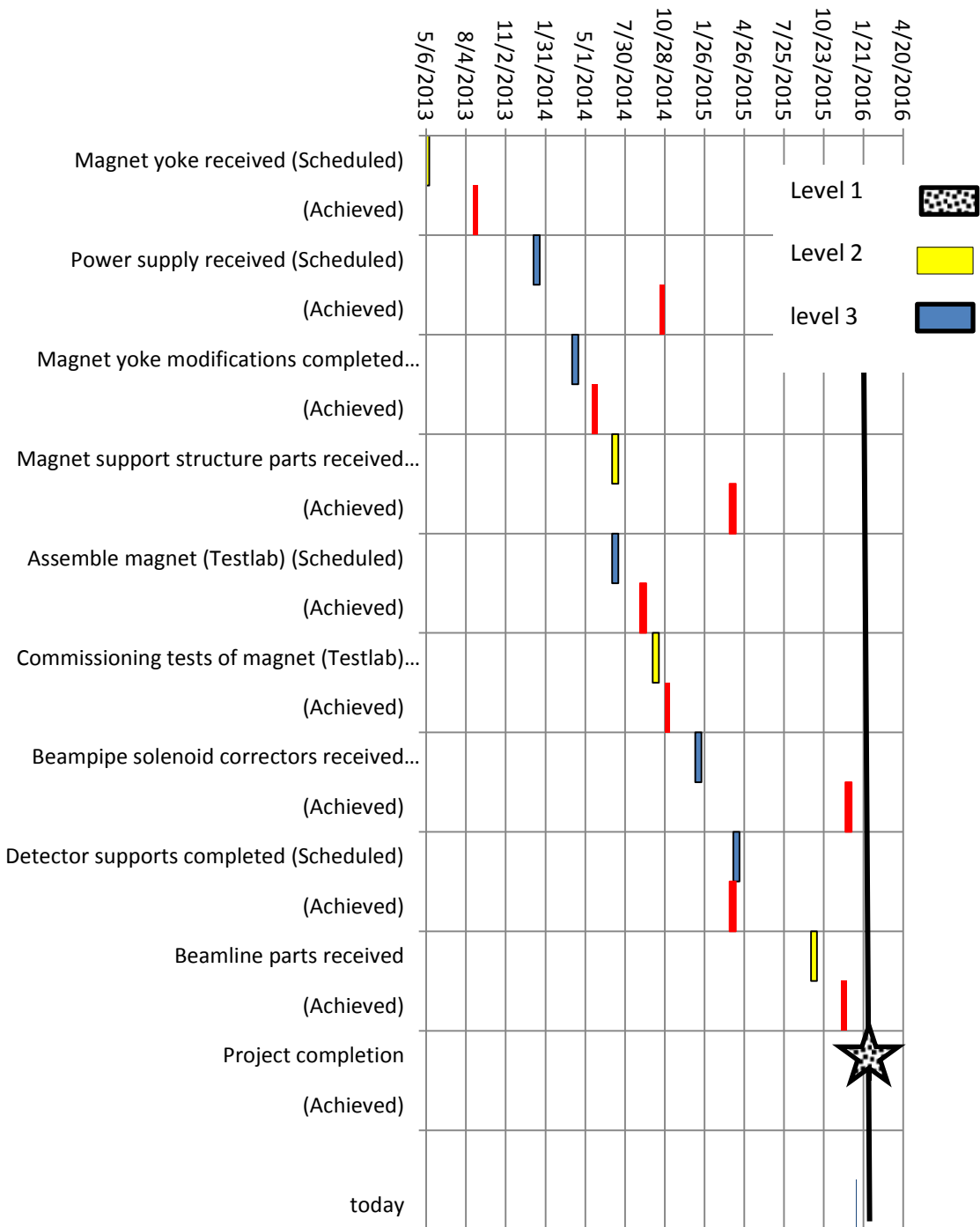
WBS 3.01 Milestones: (see [Appendix 1](#) for a graphic view of the milestones)

Level (ID#)	Milestone	Scheduled Date	Expected date 1/1/2016	Expected Date N/A	Comment
1 (3.1-01M)	Project start	10/1/2012			Completed 10/1/2012
3	Order GEM Parts	10/1/2013			Completed 10/18/2013
3	UVa receives GEM parts	2/3/2014			Completed 4/23/2014
2 (3.2-01M)	First module assembled and tested	3/3/2014			Completed 5/15/2014
2 (3.2-10M)	UVa 5 GEM modules assembled and tested	6/2/2014			Completed 12/23/2014
2 (3.2-20M)	UVa 6-16 GEM modules assembled and tested	9/30/2014			Completed 7/28/2015
2 (3.2-30M)	UVa 17-29 GEM modules assembled and tested	3/2/2015			Completed 3/30/2016
2 (3.2-40M)	UVa 30-40 GEM modules assembled and tested	7/15/2015	1/15/2017		Completed 2/1/2017
2 (3.2-50M)	1st order of Front End Electronics	10/1/2014			Completed 3/5/2015
2 (3.2-60M)	2nd order of Front End Electronics	10/1/2015			Completed 3/5/2015
1 (3.1-10M)	Project completion	2/1/2017	2/1/2017		Completed 2/1/2017

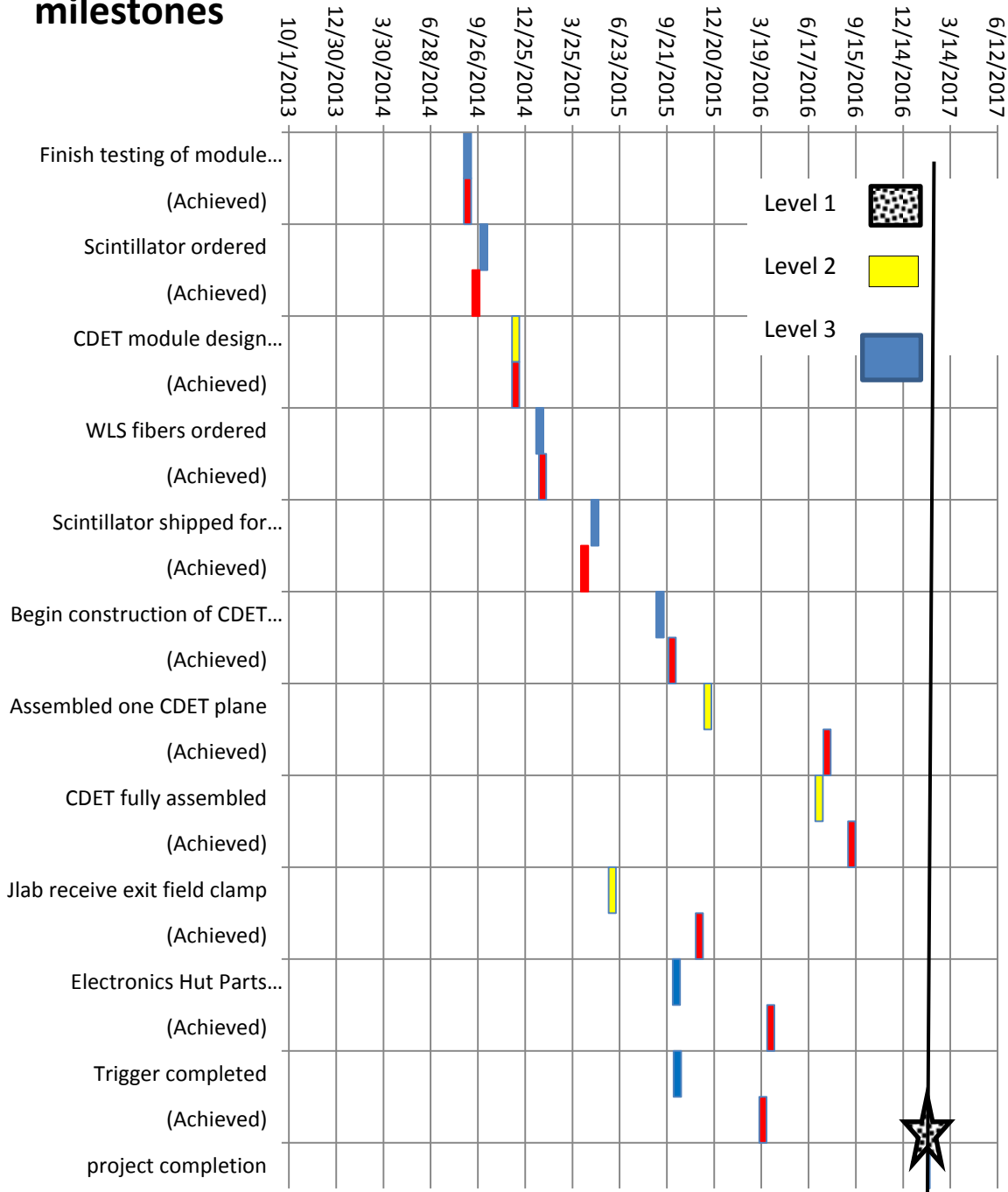
Appendix I

The following are graphical representations of the milestones for SBS Basic (WBS 1), Neutron Form Factor (WBS 2,) and Proton Form Factor (WBS 3), updated on December 1, 2013. Black represents level 1 milestones as specified in the PMP. Yellow represents level 2 milestones from the PMP. Blue represents the new level 3 milestones to allow better quarterly tracking. The black vertical line indicates the day the chart was made. The red bar indicates when the milestone was achieved (e.g. Magnet yoke received).

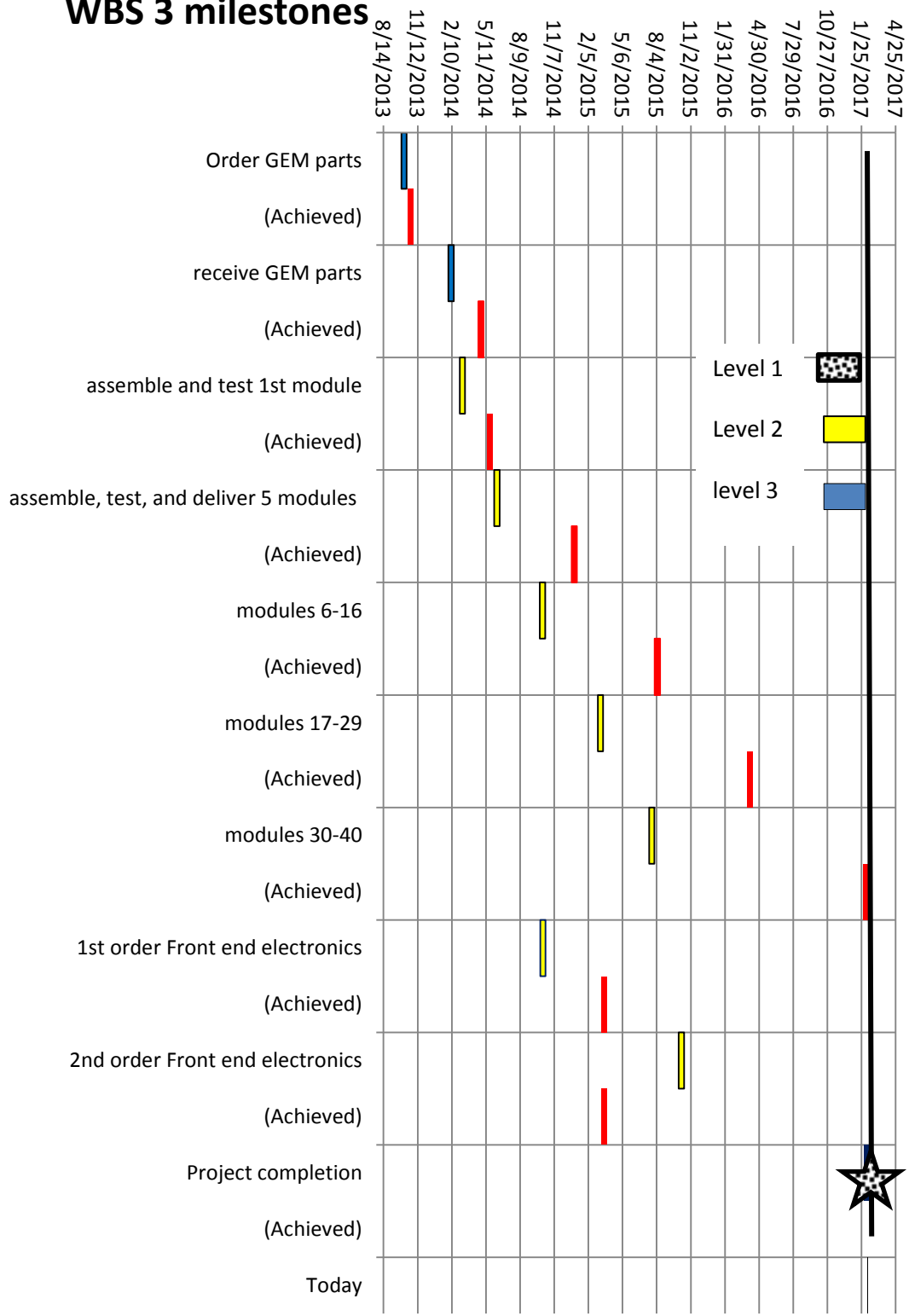
WBS 1 Milestones



WBS 2 milestones



WBS 3 milestones



Appendix II

GRINCH from W&M/NCCU/JMU (for GMN and GEN)

Milestone	Scheduled date	Comment
Design and drawings for vessel are complete	Feb 1, 2015	Completed Feb 2015
Photon Detector Array assembled and tested	Aug 1, 2015	Received by JLab in Aug 2015. Testing complete by May 2017
NINO chip front end cards system shipped to JLab	Jul 1, 2015	Completed Oct 2015
Purchase order issued for vessel	Oct 15, 2015	Completed Aug 2015
Full DAQ system ready	Dec 1, 2015	Expected June 2017
Vessel completely assembled	Mar 15, 2016	Completed Sept 2016
GRINCH ready for installation	Jun 15, 2016	Expected June 2017
Final analysis software complete	Jun 15, 2016	Expected Sept 2017

Status update:

- Installation of PMTs in the PDA and the high voltage cabling is progressing.

HCal-J from CMU/INFN-Catania (for GMN, GEN and GEP)

Milestone	Completion date	Comment
Detailed design completed	June 2014	Completed July 2014
Design review	Sept 2014	Completed Dec 2014
Module construction initiated	Mar 2015	Completed Mar 2015
Module assembly 25% complete	Sept 2015	Completed Sept 2015
Module assembly 50% complete	Mar 2016	Completed April 2016
Module assembly completed	Sept 2016	Expected in April 2017

Status update:

- Module production is ongoing. Have produced 238 modules (235 modules at JLab) of the total of 288 modules in HCal.
- Delivery of 66 modules to JLab was done in middle of December.
- Work was done to complete the remaining steel front plates and light pipe cylinders. 25 aluminum back plates were completed with 25 more to finish which should take about a week. The light guide assembly for the remaining modules has begun.
- With one CMU technician, the delivery of the final 53 modules is expected in April.

Front Tracker from INFN (for GMN, GEN and GEP)

Milestone	Completion date	Comment
Electronics in production	Sept 2014	Completed Sept 2014
GEM chambers 1 and 2 completed	Sept 2015	Completed Dec 2015
Initial Electronics QA completed	Dec 2015	Completed Dec 2015
GEM chambers 3 and 4 completed	May 2016	Expect delivery in March 2017
GEM chambers 5 and 6 completed	Dec 2016	Expect in June 2017

Status update:

- The analysis of the cosmic data for the seven chambers at Rome was completed. The following table is a summary of all modules. Further cosmic tests are ongoing.

Module	Comment
#1	Chamber 1 at JLab
#2	Chamber 1 at JLab
#3	Chamber 1 at JLab
#4	Chamber 2 at JLab
#5	Chamber 2 at JLab
#6	Chamber 2 at JLab
#7	Passed QA cosmic tests
#8	Passed QA cosmic tests
#9	Passed QA cosmic tests (but few cards unplugged so need to redo cosmic test with those cards plugged in)
#10	Passed QA cosmic tests (but few cards unplugged so need to redo cosmic test with those cards plugged in)
#11	Has low inefficiency sectors and has gotten worse. Needs more investigation.
#12	Looked good in cosmic tests but has spikes which increase with HV. Needs more investigation.
#13	HV connection was broken and now is fixed. Undergoing cosmic tests
#14	Delivered to Rome in Jan
#15	Delivered to Rome in Jan
#16	Under construction at Catania
#17	Under construction at Catania
#18	Materials on-hand

- At Rome, they received an X-ray source that will be used in an existing shielding box to be able to do similar QA tests as those done at UVa. This will speed up the QA process.
- Two modules were shipped to Rome from Catania. Two modules are under constructions at Catania.

Ecal from JLab/SBU/JMU (for GEP)

Milestone	Completion date	Comment
Light guide procurement	Jan 2017	Started Jan 2017
Mechanical design for main frame	Feb 2017	
Start gluing of light guides to leadglass blocks	Mar 2017	
Super module procurement	Apr 2017	
Main frame procurement	June 2017	
Detector assembly in main frame starts	Sept 2017	
Detector testing in the main frame starts	Oct 2017	Critical decision
Connection of Signal and HV cables	Dec 2017	
Finished first pass cosmic tests	Apr 2018	

Status update:

- The procurement for 1500 light guides was placed by NCCU in January. 200 already were purchased.
- Preparation of the lead glass blocks is underway.
- The contract for the mechanical design for the main frame was awarded in January. Weekly meetings are held to discuss the mechanical design.

Polarized ^3He target from UVa (for GEN)

Milestone	Completion date	Comment
Selection of target-cell design for high luminosity	Nov 2014	Completed Oct 2014
Conceptual design document complete	Jan 2016	Completed Mar 2016
Conceptual design review	Mar 2016	Completed Mar 2016
Start bench test of 3 liter glass convection target	April 2016	Completed Aug 2016
Conceptual design frozen	June 2016	Completed Oct 2016
Test of glass/metal technology complete	June 2016	Completed July 2016
Begin engineering and design	July 2016	Completed May 2016
Bench test of 3 liter glass/metal target	Jan 2017	Expect April 2017
Simulated beam test on the bench for full scale 6 liter cell	Sept 2017	
Begin production of full-scale cells	Nov 2017	
Engineering complete	Jan 2018	
Design of target hardware and instrumentation complete	June 2018	After CDR review updated to July 2018
Target is ready for installation	Jan 2019	

Status update:

- Planning has started for an annual internal review of the JLab work on the polarized target for March or April. The review would cover the status of the milestones set out at the polarized target meeting of March 2016.

Appendix III

Table of the University of Virginia GEM module production.

Module #	GEM foils	RO foil	Date started	Date completed	Tested
1	2,3,4	1	4/30/2014	5/30/2014	Passed
2	5,6,8	2	05/14/14	06/15/15	Passed
3	9,10,11	3	08/26/14	10/14/14	Passed
4	12,13,14	7	09/29/14	10/30/14	Passed
5	15,16,17	8	10/14/14	11/14/14	Passed
6	18,19,20	9	11/06/14	11/25/14	Passed
7	21,22,23	10	01/12/15	01/28/15	Passed
8	24,25,26	11	01/27/15	02/25/15	Passed
9	27,28,29	12	02/24/15	03/10/15	Passed
10	30,31,32	15	03/11/15	03/26/15	Passed
11	33,34,35	16	03/25/15	04/13/15	Passed
12	36,37,38	13	04/10/15	04/30/15	Passed
13	39,40,41	17	05/26/15	06/15/15	Passed
14	42,43,44	18	06/05/15	06/22/15	Passed
15	45,46,47	19	06/10/15	06/30/15	Passed
16	48,49,50	20	06/26/15	07/18/15	Passed
17	55,56,57	21	07/17/15	08/10/15	Passed
18	58,60,61	23	08/03/15	08/28/15	Passed
19	63,65,66	24	08/20/15	09/15/15	Passed
20	67,69,70	26	09/08/15	09/28/15	Passed
21	71,72,73	27	09/21/15	10/12/15	Passed
22	74,75,64	25	10/06/15	10/27/15	Passed

23	76,77,78	28	10/20/15	11/13/15	Passed
24	79,80,81	29	12/05/15	01/04/16	Passed
25	84,85,86	30	12/27/15	01/15/16	Passed
26	87,88,89	31	01/05/16	02/01/16	Passed
27	90,93,94	32	01/16/16	03/06/16	Passed
28	95,96,97	33	02/02/16	03/15/16	Passed
29	98,99,100	34	03/07/16	03/30/16	Passed
30	103, 104, 105	35	03/29/16	04/20/16	Passed
31	106, 107, 108	36	04/12/16	05/10/16	Passed
32	91,92,109	22	05/02/16	05/31/16	Passed
33	110, 111, 115	14	05/18/16	06/24/16	Passed
34	117, 118, 120	37	06/06/16	06/30/16	Passed
35	121, 122, 102	38	08/12/16	10/18/16	Passed
36	116, 114, 101	39	08/22/16	10/25/16	Passed
37	109, 83, 7	41	09/12/16	11/22/16	Passed
38	123, 52, 124	42	09/19/16	12/15/16	Passed
39	125, 126,82	43	12/05/16	01/03/17	Passed
40	P1,P2,P3	P0	09/30/13	10/30/2013	Passed