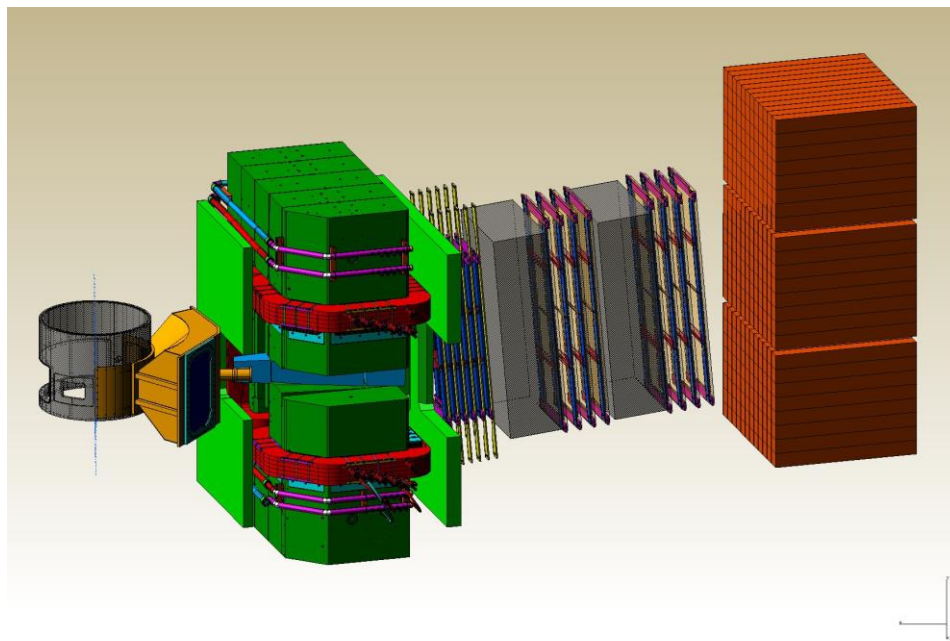


Super-Bigbite-Spectrometer *(SBS)*

Monthly Progress Report

Sept 15, 2015



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 36th Monthly Progress Report for the SBS Program.

The SBS Basic (WBS 1) project started in FY13. 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.

- All major purchases orders for the WBS1 have been submitted by Sept 4th. For WBS1, 90% of the budget has been costed or obligated.
- In Appendix III is an update on the status of the GRINCH.

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

WBS 1.02 Project Oversight:

- SBS weekly meetings, via tele and video conference, were held on Aug 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, and INFN Rome.
- Project is staffed appropriately for this stage, and includes a Jefferson Lab manager, scientist, and magnet engineer.

WBS 1.1 Magnet, Power and Construction:

- The SBS magnet is in the TestLab.
- Coils:
 - Racetrack coils: All coils are at JLab.
 - Saddle coil: The coil will be shipped in the first week of September with 4 weeks delivery time.
- The clamp supports were sent to procurement in August with a delivery date of Nov 24th.
- Installation work for the SBS power was started in August and will be finished in September.
- The sieve slit procurement will be done in September.
- Bidding for the corrector magnets contract was extended until the end of August. The conductor for the coils has already been ordered.

WBS 1.2 Magnet/Detector Platforms:

- The majority of equipment needed to move the SBS magnet to the different angle and distance settings was sent to procurement in August. This equipment was the horizontal position cylinders, the floor plates and a portable power station. A few items (< \$10K) are left to buy in September.

WBS 1.3 Beam Line:

- The beam pipe was sent to procurement on August 18th with a required delivery date of December 18th.

WBS 1 Costs:

- The budget for this WBS for FY15 is \$212K.
- The incremental budget (FY13+FY14+FY15) is \$1,694K.
- Costed and obligated as of 9/1/2015: \$1,517 (90%).

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

Level (ID#)	Milestone	Scheduled Date	Expected Date 9/1/2015	Expected Date 10/1/2015	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	9/28/2015	12/04/2015	.
3	Detector supports completed	4/1/2015			Completed 3/24/2015
2 (1.2-30M)	Beam-line parts received	9/24/2015	10/16/2015	12/18/2015	
1 (1.1-10M)	Project completion	1/29/2016	1/29/2016	1/29/2016	

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 Aug 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, 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):

- The cutting of the scintillator bars to 51 cm length has been completed at CMU and the bars have been shipped to JLab. A total of 3,068 detector elements have been cut and they arrived at JLab on August 20 including the boxes with uncut strips.
- Samples of the cut detector elements have been tested with cosmics for light output with no optical coupling of the WLS fibers to the PMT. Number of photo electrons detected per MeV was ~25; making optical contact of the WLS to the PMT will increase the n.p.e. by factor of 1.2. Test with a mirror at the end of WLS showed an increase of 1.4 in n.p.e and optical coupling of the WLS to the scintillator showed an increase of 1.8 in n.p.e.

- Mounting scheme of detector elements and WLS fibers has been finalized and a scheme for gluing of the fibers through the detector elements will be finalized by the first week of September. Sections of 14 detector elements have been assembled and tested for mechanical stability.
- The fabrication of all the parts for assembling six CDET modules by Vision Machine & Fabrication Corp. in Hampton is almost done and final machining will be completed by September 4th. Assembly of the modules will begin by the middle of September.

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

- Calculation of radiation for the small GEM electronics hut was completed.
- A design of the integrated beam line stands for lead shielding and corrector magnets has been completed. Detailed design will be done in September.

WBS 2.3 Pole Shims and field clamp:

- The shim insertion device will be sent to procurement in early September.

WBS 2.4 Trigger:

- Work continues on the DAQ test of the FASTBUS for ECal and for the VME trigger for HCAL.

WBS 2 Costs:

- Budget for this WBS for FY15 is \$710K.
- The incremental budget for FY14+FY15 is \$1,309K.
- Costed and obligated as of 9/1/2015: \$906K (69%).

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

Level	Milestone	Scheduled Date	Expected date 9/1/2015	Expected date 10/1/2015	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	10/1/2015	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	9/1/2015	9/15/2015	
3	Assembled one CDET module	10/1/2015	10/1/2015	10/15/2015	
2	Electronics hut assembled	10/2/2015	12/18/2015	12/18/2015	
2	Trigger completed	10/4/2015	10/4/2015	10/4/2015	
3	Assembled one CDET plane	12/1/2015	12/1/2015	12/15/2015	
2	Coordinate Detector assembled	6/30/2016	6/30/2016	6/30/2016	
1	Project completion	1/29/2017	1/29/2017	1/29/2017	

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 Aug 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, and INFN Rome.
- Project is staffed appropriately and includes Jefferson Lab (manager, scientist) and UVa (two scientists).

WBS 3.1 GEMs

- The construction of modules # 17 and #18 was completed.
- Cosmic and X-ray testing of modules #17 was completed. The module performed similarly to modules #13-16.
- Further tests of modules #13-16 were done. As discussed in the last report, the modules will need to be operated at slightly higher HV to have the same efficiency as modules 1-12. In discussions with Dick Majka, he pointed UVa to a GEM chamber simulation done by the TU-Munich group to study the variation gain as a function of GEM hole parameters like the diameter of the hole rim etc. It shows that only a few micron change in the rim diameter could alter the gain of a GEM foil by 15%; So with 3 foils this translates to a 50% change of total gain. Few microns is well within the accuracy of the GEM hole parameters in foil production; so the drop in gain of modules #13-17 could have been due to a small change between production batches.
- Module #18 is being tested.
- Construction of module #19 and #20 has started.

WBS 3.2 GEM electronics

- Work continues in developing CODA interface for the MPD readout.

WBS 3 Costs:

- Budget for this WBS for FY15 is \$371K.
- The incremental budget of FY13+FY14+FY15 is \$1,440K.
- With the addition of the moving the \$209K plus contingency forward from FY16 makes an incremental budget of \$1,687K.
- Costed and obligated as of 9/1/2015: \$1595K (95%).

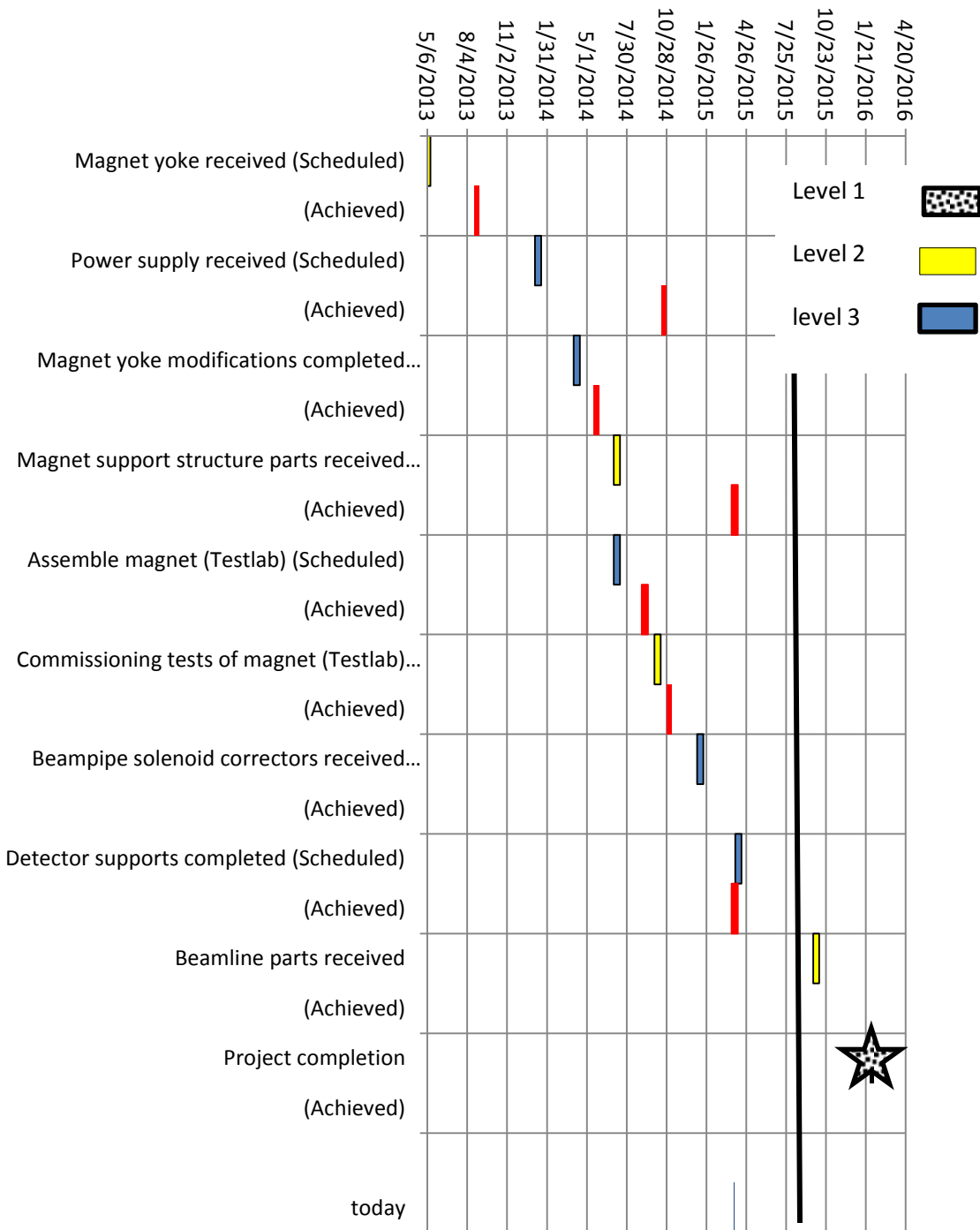
WBS 3.01 Milestones: (see [Appendix 1](#) for a graphic view of the milestones)

Level (ID#)	Milestone	Scheduled Date	Expected date 9/1/2015	Expected date 10/1/2015	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	3/15/2016	3/15/2016	
2 (3.2-40M)	UVa 30-40 GEM modules assembled and tested	7/15/2015	8/1/2016	8/1/2016	
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	7/31/2017	7/31/2017	7/31/2017	

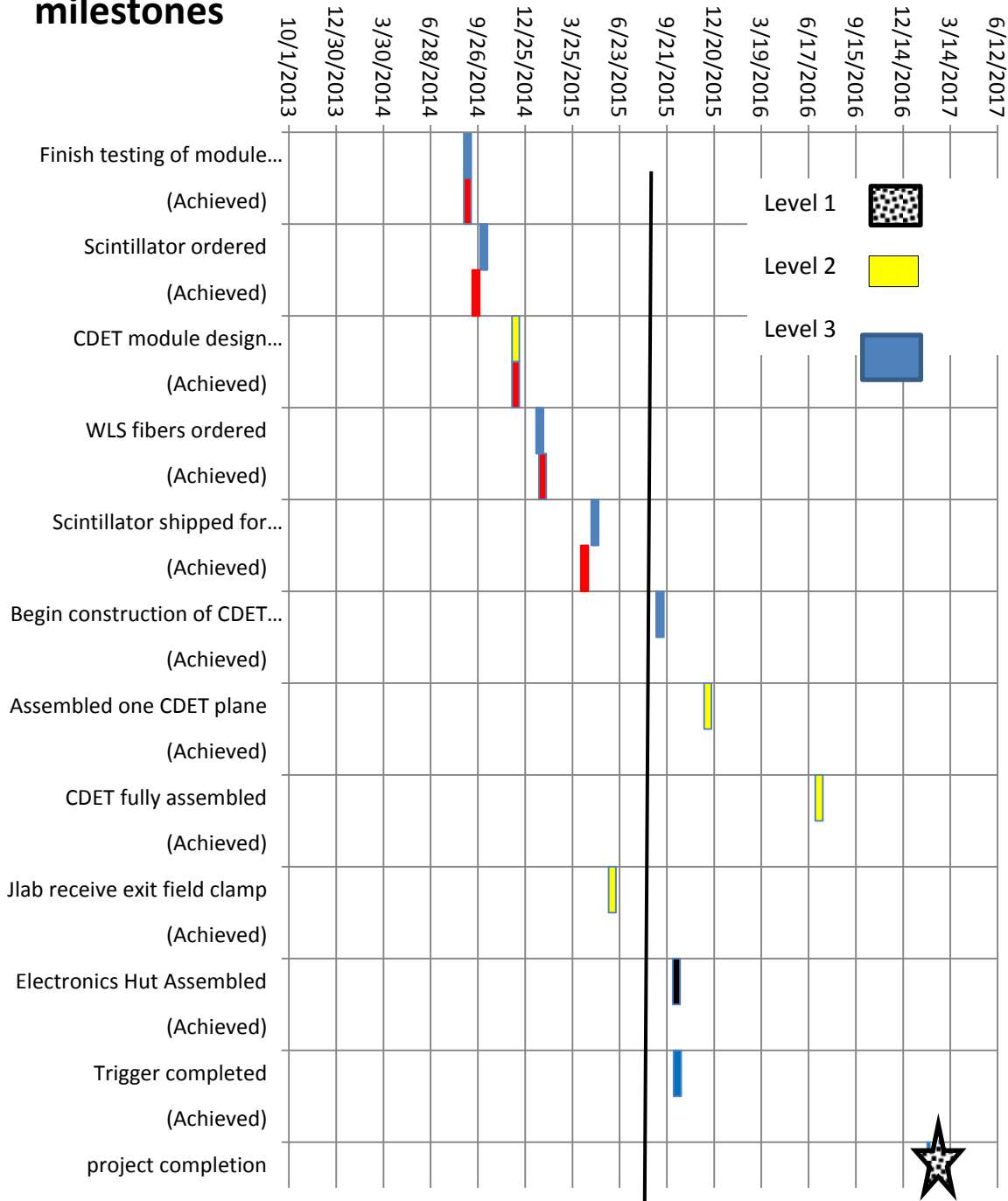
Appendix I

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).

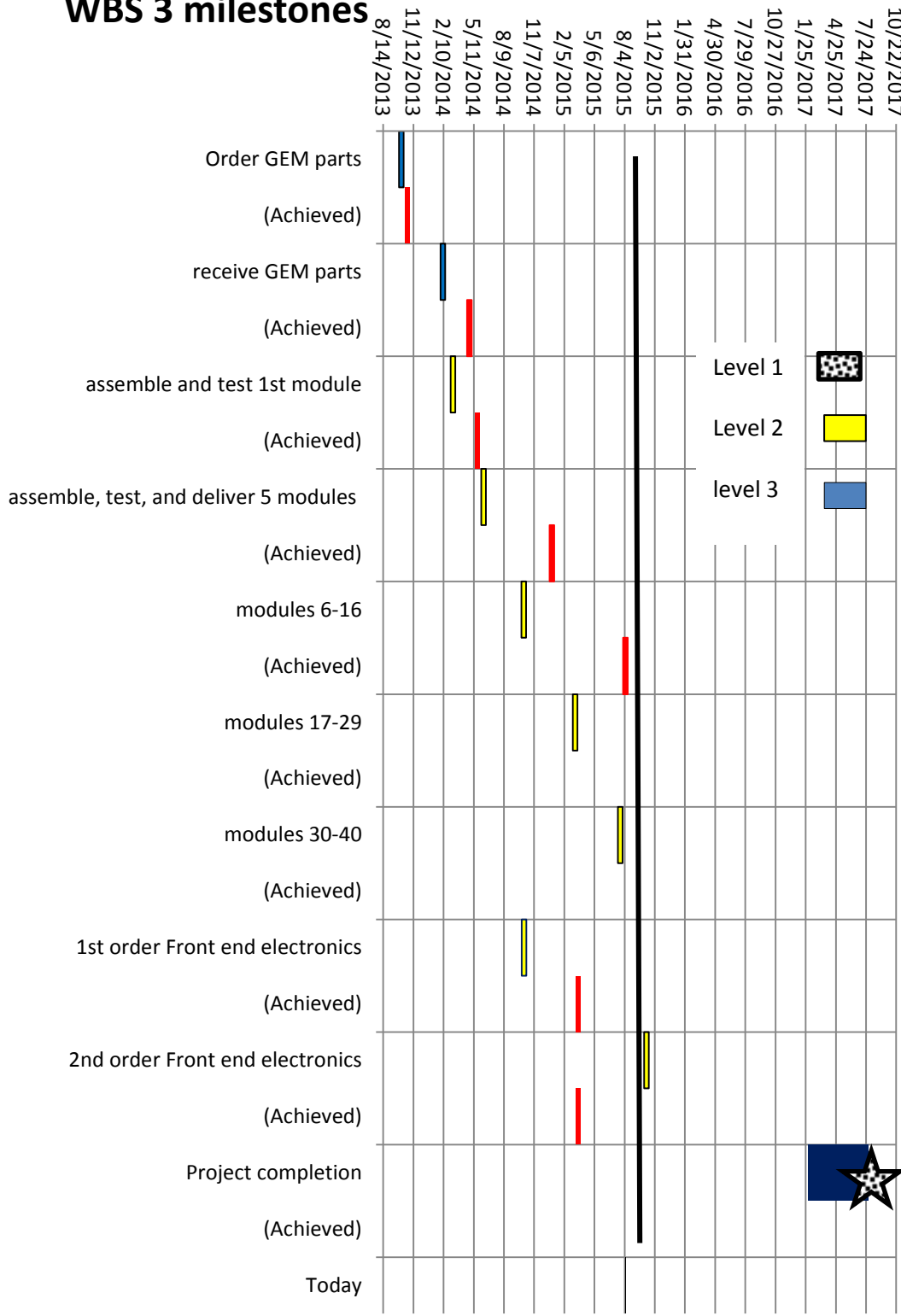
WBS 1 Milestones



WBS 2 milestones



WBS 3 milestones



Appendix II

List of milestones for all equipment off-project.

The Gas Cherenkov detector(GRINCH) from W&M (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 completed by Aug 2016
NINO chip front end cards system shipped to JLab	Jul 1, 2015	Cards and cables finished at Glasgow. Shipment in October
Purchase order issued for vessel	Oct 15, 2015	Completed Aug 2015
Full DAQ system ready	Dec 1, 2015	Expected March 2016
Vessel completely assembled	Mar 15, 2016	Expected July 2016
GRINCH ready for installation	Jun 15, 2016	Expected Sept 2016
Final analysis software complete	Jun 15, 2016	Expected Sept 2016

HCal-J from CMU (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	
Module assembly 50% complete	Mar 2016	
Module assembly completed	Sept 2016	

Status update:

- Module production is ongoing. Have produced 49 modules of the total of 288 modules in HCAL.
- All laser cutting work for all the light guides was completed.
- CMU machined an additional 24 back plates and 28 front plates. So CMU is in good shape to assemble an additional 23 modules in September to meet the next milestone.

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	Chamber 1 is at JLab Expect 2 nd chamber Oct 2015
Initial Electronics QA completed	Dec 2015	
GEM chambers 3 and 4 completed	May 2016	
GEM chambers 5 and 6 completed	Dec 2016	

Status update:

- INFN Rome is currently assembling three GEM modules into the second GEM chamber on a carbon frame. After assembly, extensive cosmic tests will be done in Rome.
- Shipment of second GEM chamber to JLab will be in late October 2015.
- GEM foils, readout planes and honeycomb for constructing GEM modules have been prepared by INFN Catania.

ECal from JLab (for GEP)

Milestone	Completion date	Comment
Develop concept of annealing	July 2014	Completed July 2014
Test of annealing with prototype	Nov 2015	Completed May 2015
Fabrication of C200 frame started	Sept 15 2015	
Design of ECAL platform modification started	Dec 1 2015	
C200 assembly completed and testing begins	Jan 15 2016	
C200 report results, recommendations completed	June 1 2016	
Design of ECAL frame/oven started	July 1 2016	
ECAL platform in testlab .	Nov 1 2016	
Installation of lead glass started	Jan 15 2017	
Lead glass installation compete and cabling started	July 15 2017	
Cabling completed and cosmic tests started	Nov 1 2017	
Finished cosmic tests and ECAL is ready to install	Jan 15 2018	

Status update:

- Stonybrook has finalized the design of the C200 which will enable starting the fabrication of the frame in September.

Polarized ^3He target from UVa (for GEN)

Milestone	Completion date	Comment
Selection of target-cell design for high luminosity	Nov 2014	Completed Oct 2014
Simulated-beam test (bench test) of selected design	Dec 2016	
Design for target hardware and instrumentation complete	July 2017	
GEn Polarized ^3He target is ready	Jan 2018	

Status update:

- UVa and JLab are updating the plan for the construction and installation of the polarized ^3He target and associated hardware for experiments in Hall A and C. From this plan, the milestones for the polarized ^3He target for the SBS experiments will be formulated and they will be ready by the end of September.

Appendix III

Status update for the GRINCH.

The mirror assembly has been completed and tested for nearly 2 years at William and Mary. The magnetic shielding box that holds over 500 PMTs arrived at Jefferson Lab around 15 Aug 2015. The PO for the main vessel was issued in August with an unexpectedly long delivery time of 6 months. This item drives the schedule for completion of the project.

Status of Milestones:

1. *Design and drawings for vessel are complete Feb 1, 2015*
Status: Completed Feb 2015
2. *Photon Detector Array assembled and tested Aug 1, 2015*
Status: Received at JLab in Aug 2015 due to manufacturing delay. Assembly and testing will be completed by April 2016 by NC A&T University group. This delay is not critical and does not affect other parts of the GRINCH construction.
3. *NINO cards complete and shipped to JLab Jul 1, 2015*
Status: Cards and cables are finished (Glasgow Univ.) Shipping to JLab by October.
4. *Purchase order issued for vessel Oct 15, 2015*
Status: Issued Aug 2015 with 6 month delivery. This is the critical path item that dictates the completion of the project.
5. *Full DAQ system ready Dec 1, 2015*
Status: Work is in progress on the new VETROC modules and on the default system of FastBUS TDCs. Expect to test prototype in Fall 2015. Full system completed by March 2016.
6. *Vessel completely assembled Mar 15, 2016*
Status: Because the delivery date for the vessel is now March 2016, full assembly will be completed by Jul 1 2016.
7. *GRINCH ready for installation Jun 15, 2016*
Status: Due to delay in delivery date, the new completion date is Sept 1 2016.
8. *Final analysis software complete Jun 15, 2016*
Status: Due to delay in delivery date, the new completion date is Sept 1 2016.