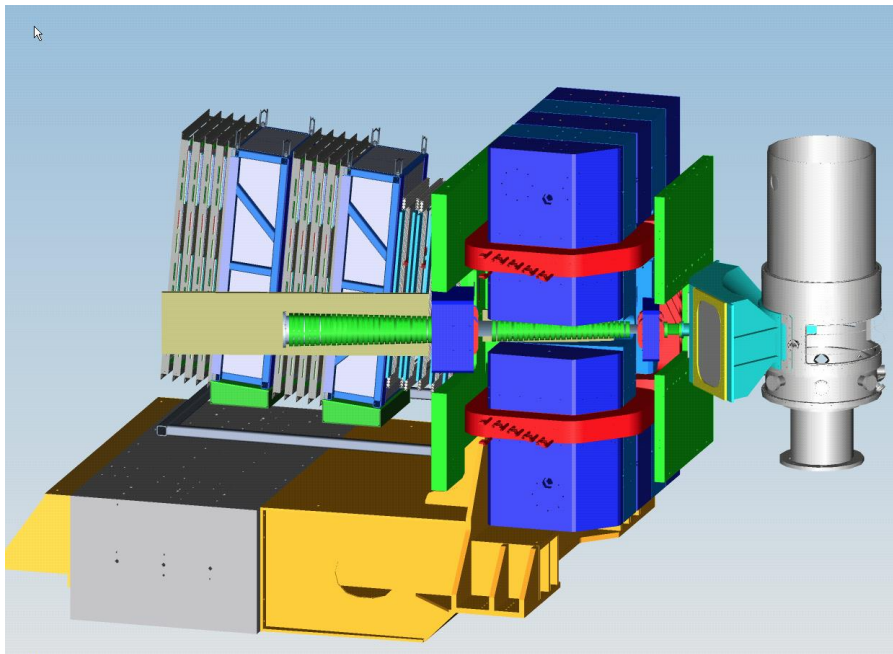


Super-Bigbite-Spectrometer (SBS)

Monthly Progress Report

November 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 37th 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.

- WBS1 is on track to be complete by Jan 2016. All expenditures have been made and monitoring remaining contracts weekly.
- In WBS2.2-50, modified title from “Electronics Hut assembled etc” to “Electronics Hut Parts Received”. Originally it was assumed that the experiment would be installed before the WBS2 completion date. It is clear that the experiment installation will not start before WBS2 completion date. Also it is not practical to assembly the electronics hut in Hall A before the WBS2 completion, since it would interfere with other experiments. Also WBS2.4 Trigger completion date was moved from 10/1/2015 to 2/1/2016. This delay has no effect on the other parts of the WBS2 project. The PMP has been updated with the change.

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 Oct 7, 14 and 21st. 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: Arrived at JLab on Oct 23rd.
- The clamp supports were ordered in September with a delivery date of Nov 24th.
- The sieve slit assembly is scheduled to arrive Nov 2nd.
- The front field clamp is scheduled to arrive Nov 4th.
- The corrector magnet coils have been wound and are in the process of being potted. Delivery of coils by Dec 4th. The iron cores are under construction and expect delivery by Nov 20th.

WBS 1.2 Magnet/Detector Platforms:

- The SBS magnet platform and counter weight were moved into the Testlab. Preparations are underway for a test of moving the platform in the spring of 2016.
- The floor plates are scheduled to be delivered by Dec 9th.

WBS 1.3 Beam Line:

- The vacuum beam pipe was ordered through the JLab machine shop. The materials have been ordered and delivery of all material by Dec 11th. Work on the beam pipe has started.

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 11/1/2015: \$1646K (97%).

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

Level (ID#)	Milestone	Scheduled Date	Expected Date 11/1/2015	Expected Date 12/1/2015	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	12/04/2015	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	12/18/2015	12/11/2015	
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 Oct 7, 14 and 21st. 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):

- Fabrication of the 14-scintillator groups has continued and so far all 28 groups for one CDet module have been completed. The fabrication accuracy of a single 14-strips group is estimated to be ~250 microns.
- Fabrication of WLS 16-fiber bundles is continuing and will be finished the first week of November. Assembly of the first module will be finished by Nov 15th. With this experience, the estimate is that it takes about 6.5 weeks to construct a module. The milestone dates have been updated for the construction of the first plane to 3/15/2016 and the completion of the CDet to 8/15/2016. This leaves 5 months float until the end of the project.

- The NINO-based A/D frontend boards (2 cards are in JLab) have been tested with a low charge input signals that correspond to the signals expected from CDet (0.6 mA with 8 ns duration pulse). The observed noise level was well below the required minimal threshold. The minimal threshold corresponds to 0.14 pC input charge at 50% efficiency and to 0.18 pC at 100% efficiency. This is close to the required minimal threshold of 0.16 pC in CDet.
- Light collection efficiency studies with cosmics have been carried out for the CDet scintillators and WLS fibers. The n.p.e. measured with straight tracks going through 0.5 cm thickness of the scintillators was ~3.5 to 4. This will correspond to ~28 to 32 n.p.e. for the 4 cm width of the scintillators.
- Studies of light collection efficiencies with the non-PMT end of WLS fibers mirrored and optical glue injected into the WLS fiber channel have been carried out. Effect of mirroring was an increase in light yield by ~40% and glue through the fiber channel increased the light yield by ~60%.
- Quality control of module components construction has been implemented.

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

- A cost estimate for the small GEM electronics hut was too high. A new design and location for the hut has been proposed and new radiation calculation will be done in November.
- Work continued on the design of the integrated beam line stands for lead shielding and corrector magnets.
- The steel for the large DAQ electronics hut has been located at BNL.

WBS 2.3 Pole Shims and field clamp:

- The shim and the shim insertion device will be delivered in the middle of November.
- The rear field clamp will be delivered in early November.

WBS 2.4 Trigger:

- Work continues on the DAQ test of the FASTBUS for ECal and for the VME trigger for HCAL.
- Idaho State University ordered the 9 CPUs that were part of their contract. They should be delivered by the end of Jan 2016.

WBS 2 Costs:

- Budget for this WBS for FY16 is \$77K.
- The incremental budget for FY14+FY15+FY16 is \$1,361K.
- Costed and obligated as of 11/1/2015: \$939K (69%).

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

Level	Milestone	Scheduled Date	Expected date 11/1/2015	Expected date 12/1/2015	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	11/18/2015	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	9/15/2015		Completed 9/24/2015
3	Assembled one CDET module	10/1/2015	10/15/2015	11/15/2015	
2	Electronics hut parts received	10/2/2015	12/18/2015	12/18/2015	
2	Trigger completed	10/4/2015	10/4/2015	2/1/2015	Delay in trigger does not affect schedule of other items
3	Assembled one CDET plane	12/1/2015	12/15/2015	3/15/2016	
2	Coordinate Detector assembled	6/30/2016	6/30/2016	8/15/2016	
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 Oct 7, 14 and 21st. 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 # 21 and #22 completed.
- X-ray testing of module # 19 completed: all sectors are operational.
- X-ray testing of module # 20 completed: all sectors are operational.
- It should be noted that when module 20 was mounted in the x-ray box for testing, it appeared to have difficulty holding high voltage at 4200 V; during ramping up to this full voltage, HV tripped a few times around 4000 V. During the subsequent inspection it was suspected that mounting of the chamber on the holding frame may be exerting a stress on the chamber, possibly leading the chamber to buckle and thereby reducing the tension on the GEM foils to the point where they come close to each other and cause electrical breakdowns. When the chamber was taken off the test stand allowed to sit on a flat surface for 24 hours, it could hold HV at 4200 V without any problem. After this the chamber was remounted on the test stand, taking care not to exert any stress on the chamber. With this the chamber held high voltage without a problem and then was completely tested. Special attention will be paid in the future during all chamber mountings to ensure that there is no stress on the chamber.

- Modules #21 and 22 are prepared for testing.
- Construction of module #23 is underway.
- The two large GEM foil shipments arrived from CERN last month contained 42 GEM foils. The inspection of these foils is currently underway.
- The contract modification for UVa to build five additional spare chambers has been signed and completed. Contingency was used to fund the materials and labor for the five modules as the comment in the 2014 DOE SBS Review suggested. The main goal of WBS3 is the construction of 40 GEM modules. If there is a problem, the money for the spare chambers can be used to finish the construction of the 40 modules.
- To mitigate risks by ensuring that GEM expertise is available at UVa, contingency has been used to support a research scientist position at UVa.

WBS 3.2 GEM electronics

- Work is continuing at Jefferson Lab for the integration of MPD-APV GEM readout system into CODA. The MPD electronics units arrived from Italy for the MPD system to be setup at UVa.

WBS 3 Costs:

- Budget for this WBS for FY16 is \$309K.
- The incremental budget of FY13+FY14+FY15+FY16 is \$1739K.
- Costed and obligated as of 11/1/2015: \$1657K (95%).

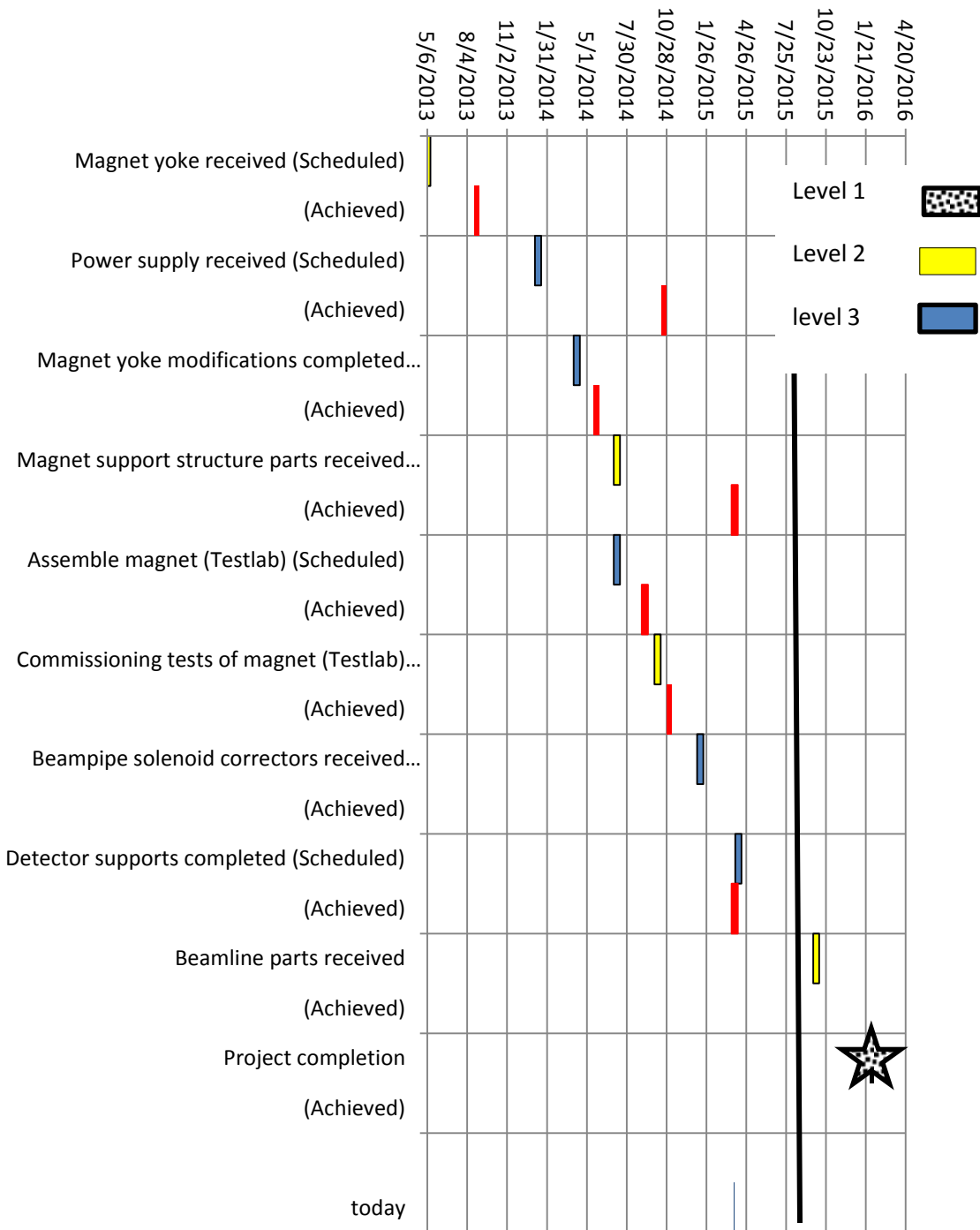
WBS 3.01 Milestones: (see [Appendix 1](#) for a graphic view of the milestones)

Level (ID#)	Milestone	Scheduled Date	Expected date 11/1/2015	Expected date 12/1/2015	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	

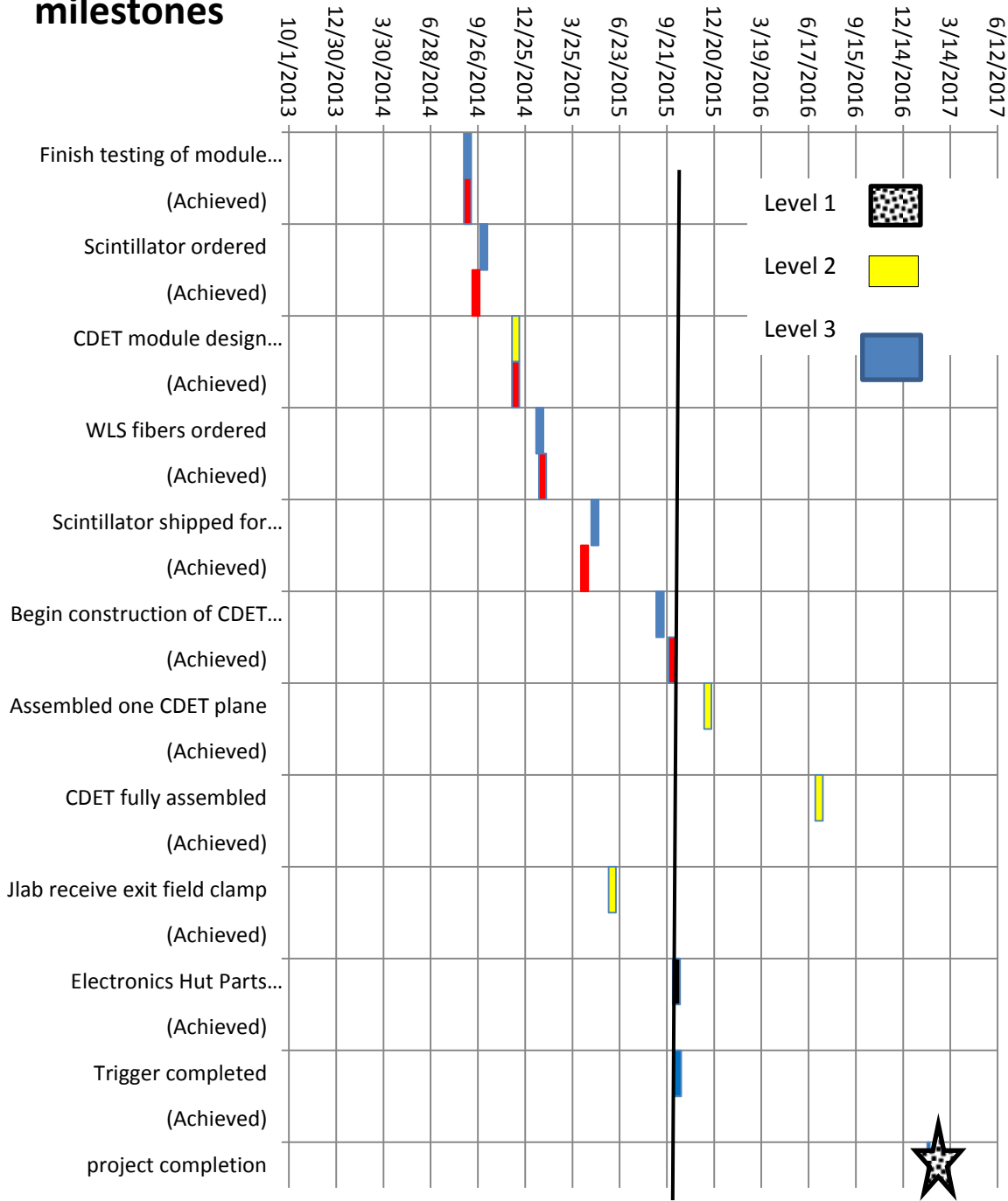
Appendix I

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).

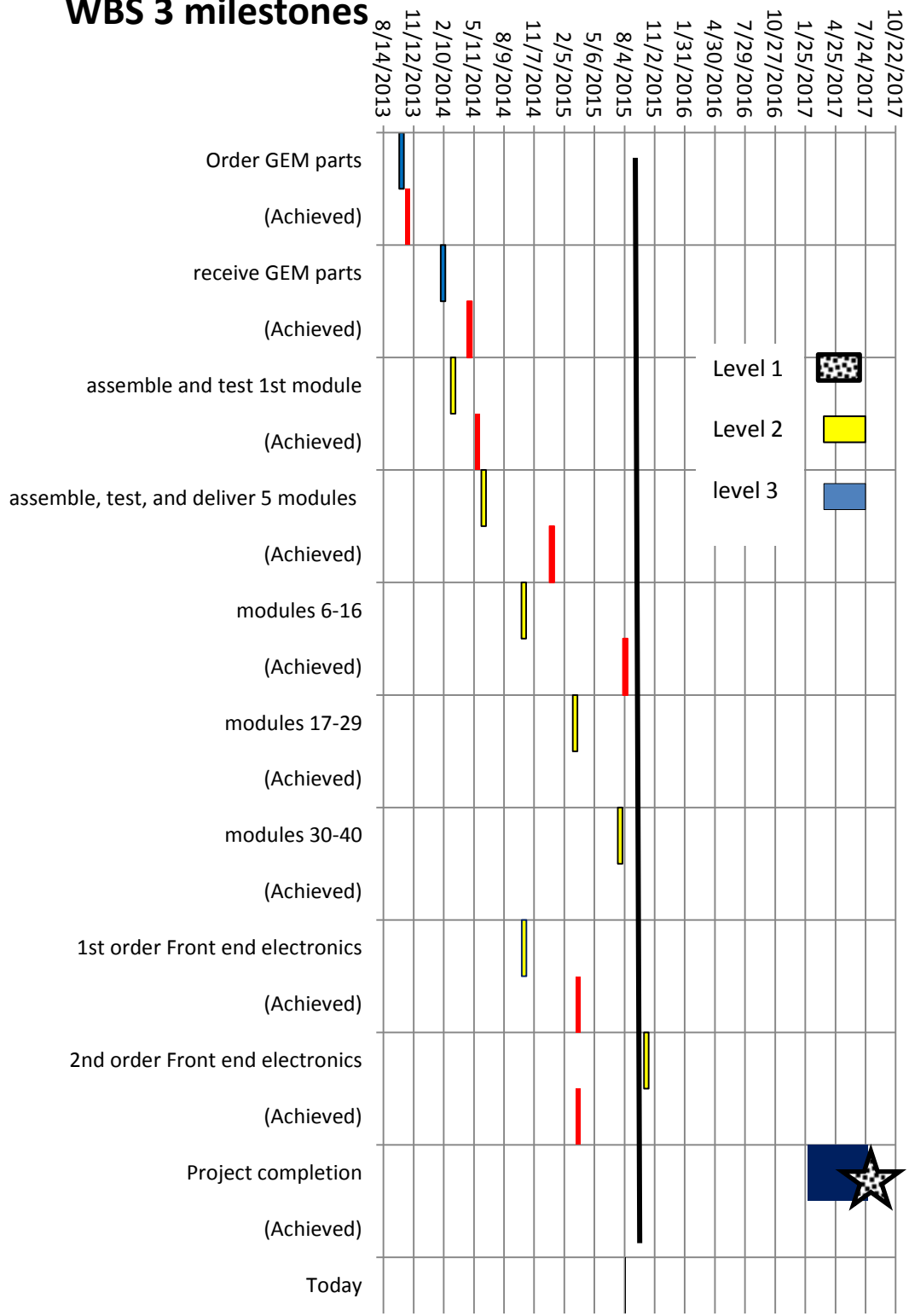
WBS 1 Milestones



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 complete 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

Status update:

- Test of the Photon Detector Array in a 15G and 30 G magnetic field using the large Helmholtz coils was successfully completed. 30G is the highest field expected in the region of the Photon Detector Array from magnetic calculations of the BigBite Spectrometer field.

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	Completed Sept 2015
Module assembly 50% complete	Mar 2016	
Module assembly completed	Sept 2016	

Status update:

- Module production is ongoing. Have produced 72 modules of the total of 288 modules in HCal.
- CMU machinist worked on completing 70 steel front plates and 70 aluminum back plates. This work should be completed by mid November.

- CMU technician has been cutting aluminized mylar pieces used to wrap the internal ribs and cutting acrylic spacers. She has also been assembly the wooden pallets used for transport.
- Once the front and back plates are completed the technician will begin to assembly the modules.
- CMU is on track for delivery on 66 modules to JLab at the end of November. 36 modules are presently at JLab.

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 end of Nov 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:

- The second chamber is expected to be delivered to JLab at the end of November.

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	Completed Sept 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	

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	
Conceptual design review	Mar 2016	
Start bench test of 3 liter glass convection target	April 2016	
Conceptual design frozen	June 2016	
Test of glass/metal technology complete	June 2016	
Begin engineering and design	July 2016	
Bench test of 3 liter glass/metal target	Jan 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	
Target is ready for installation	Jan 2019	

Status update:

- A meeting was held on Oct 8th to discuss the milestones for the polarized ^3He target. At the meeting were ^3He polarized target experts from UVa , W&M and JLab, JLab engineers with experience in past ^3He polarized target experiments and the SBS management group. The milestones were included last month's report. It was agreed that an important step forward was the completion of the conceptual design document by Jan 2016 which will detail the technical design requirements of the target. This will be followed by a review of the conceptual design in March 2016 with the goal of having the design "frozen" by June 2016.