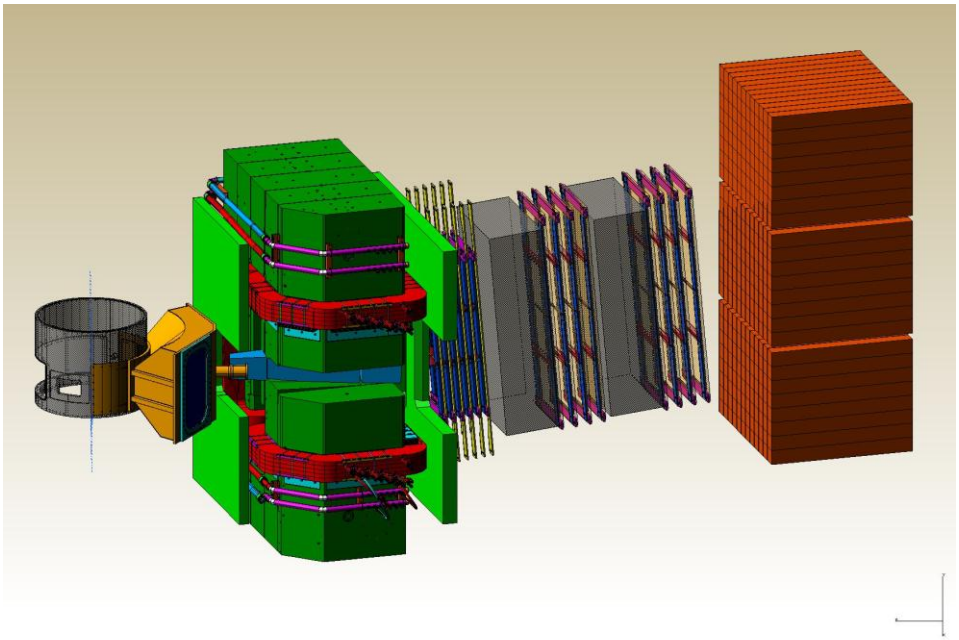
Jefferson Lab
Thomas Jefferson National Accelerator Facility

Super-BigBite-Spectrometer (SBS)

Monthly Progress Report

January 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 28th 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.

- The Program Management Plan has been updated with a new schedule for the Coordinate Detector in WBS2. The PMP is attached to this document. This meets one of the two recommendations from the DOE SBS review which was to update the schedule for the Coordinate Detector (CDET) in WBS2 by January 15, 2015.
- The updated table with the WBS2 schedule with level 3 milestones is presented on the page after the original WBS2 milestone table for the purpose of direct comparison. The table is kept with the original milestones until approval of the updated WBS2 schedule.
- An internal design review of HCAL was held in December with a committee of Hall A engineers and designers: Robin Wines, Whit Seay and Al Gavalya. The review focused on the design of the HCAL modules support structure. At the meeting, the draft design by CMU was presented. It was decided that the basic approach was sound and that JLab would take over the design. A report will be finished in January. This completes a milestone for this SBS dependency.

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 meeting, via tele and video conference was held on December 17th. 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:

- Decision was made to have the SBS magnet on beam right instead of beam left. This reduces the installation time and costs for SBS experiments and makes switching between other experiments, such as MOLLER, easier. Minor modifications are needed to the SBS magnet steel. The new drawings have been completed. The SBS magnet steel will have to be disassembled and shipped to vendor for modifications. Plan to use contingency for the modifications.
- Coils:
    - Racetrack coils: All coils are at JLab.
    - Saddle coil: Buckley contacted JLab to approve epoxy and to confirm coil drawings. Scheduled for delivery by July 31, 2015.
- Studies of the beam line corrector magnets and passive magnet shielding of exit beam pipe at all kinematic settings are ongoing. The JLab engineer still anticipates a completion date of January 23, 2015.
- After the study is completed, design of corrector magnets will start. Ordering of the magnet is expected by March 2015 and delivery by June 2015. This delay has no effect on other parts of the project and still leaves 7 months of float until project completion.

WBS 1.2 Magnet/Detector Platforms:

- JLab engineer had a site visit to the vendor. Delivery of platform is on schedule for end of January 2015.

WBS 1.3 Beam Line:

- Contacted vendor to updated snout drawings so that the SBS magnet can run on beam right. Vendor is still expecting to meet the delivery date of Feb 2015.

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 1/1/2015: $1,156K (68%).

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

Level (ID#)	Milestone	Scheduled Date	Expected Date 12/1/2014	Expected Date 1/1/2015	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	1/1/2015	1/30/2015	Expect delivery Jan 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	3/5/2015	6/1/2015	This delay has no effect on other parts of the project and still leaves 7 months of float until project completion.
3	Detector supports completed	4/1/2015			Detector supports are part of the magnet platform which will be delivered in Jan 2015
2 (1.2-30M)	Beam-line parts received	9/24/2015	9/24/2015	9/24/2015	
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 meeting, via tele and video conference were held on December 17 th. 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 scintillators bars from a test run at Fermilab arrived in mid December. Arrangements have been made to send the small sample of the test run scintillator bars to two vendors to be machined. Expect to have the machined bars back by end of January and the decision on which vendor to use will be made.
- The Program Management Plan has been updated with a new schedule for the Coordinate Detector in WBS2. This meets one of the two recommendations from the DOE SBS review which was to update the schedule for the Coordinate Detector (CDET) in WBS2 by January 15, 2015.

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

- Radiation calculations were done for the modular design of the GEM electronics hut. The radiation study was done with the GEM electronics hut near the detectors, since studies have shown that 4 meters is the maximum length of the HDMI cable before the induced noise is too large. The radiation calculations showed that this location for the hut would require a wall thickness that was impossible to accommodate. A solution of using coaxial cables instead of HDMI cables would allow the hut to be placed at 20-30 meters. At this distance, the GEM electronics can be located with the rest of the electronics. The solution of using coaxial cables is being studied.
- Plan to start design work on the detector frames in March 2015.

WBS 2.3 Pole Shims and field clamp:

- Detailed drawing for the rear clamp is ongoing.
- Drawings for the shims will begin in January. Still investigating whether on-site steel can be used for shims.

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 1/1/2015: $716K (55%).

WBS 2.01 Milestones: See Appendix 1 for a graphic view of the milestones .

Level	Milestone	Scheduled Date	Expected date 12/1/2014	Expected date 1/1/2015	Comment
1	Project start	10/1/2013			**Completed 10/1/2013**
3	Scintillator and Wavelength Shifting Fibers ordered ordered	7/30/2014	11/30/2014	12/15/2014	With test production completed, can proceed with order of WLS
3	Finish testing of module prototype	8/30/2014			**Completed 8/30/2014**
3	Scintillator shipped for machining	10/30/2014	4/30/2015	4/30/2015	With test production completed, expect full production run in Jan 2015
3	Complete plastic absorber structure design	11/15/2014	12/15/2014	12/15/2014	Delay of one month will not effect overall assembly schedule
3	Begin assembly of modules	12/15/2014	6/15/2015	6/15/2015	
3	Begin construction of plastic absorber structure	1/15/2015	2/15/2015	2/1/2015	
2	Coordinate Detector assembled	3/30/2015	9/30/2015	9/30/2015	
2	JLab receives exit field clamp	6/2/2015	6/2/2015	6/2/2015	
2	Electronics Hut Assembled	10/2/2015	10/2/2015	10/2/2015	
2	Trigger completed	10/4/2015	10/4/2015	10/4/2015	
1	Project completion	1/29/2016	1/29/2016	1/29/2016	

Updated WBS 2 milestones

Level	Milestone	Scheduled Date	Expected date 12/1/2014	Expected date 1/1/2015	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			
3	Scintillator shipped for machining	4/30/2015			
3	Begin preparation of WLS fibers	6/15/2015			
3	Begin construction of CDET modules	9/1/2015			
3	Assembled one CDET module	10/1/2015			
3	Assembled one CDET plane	12/1/2015			
2	Coordinate Detector assembled	6/30/2016			
1	Project completion	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 meeting, via tele and video conference was held on December 17th. 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 beginning stage, and includes Jefferson Lab (manager, scientist) and UVa (two scientists).

WBS 3.1 GEMs

- GEM module #6 was tested and found to have the same difficulty reaching operation high voltage at the required level of gas flow rates as GEM module #5.
- GEM modules #5 and #6 were different from the earlier modules, because they had attached the thin gas window under the readout plane used to equalize the pressure on the readout plane. This plane was under tension and caused additional pressure on the chamber side frame which increased with high gas flow rates (the window bulged more).
- This issue was remedied by using support struts attached to the two sides of each module to prevent the sides from bending in under the tension on the foils. With this fix both modules reached full high voltage at the required gas flow level. Both chambers were tested with cosmics. All sectors of both chambers work well. **This completes a WBS 3 milestone**.

- The construction of SBS module #7 is currently underway.
- The foil shipment #6 arrived at the Washington Dulles airport on December 17, but was held at customs there. Due to delays during the holidays the shipment was not cleared till January 5th. The shipment is on its way to Charlottesville now. The shipment contains 16 GEM foils and 4 readout foils. Once the new foils pass the Q&A tests, this will add to the present total of 6 readout foils and 16 GEM foils that have passed the initial QA and are on-hand to be used in module construction.
- Initial testing of the prototype chamber using a high intensity x-ray source was done. Early results show that high rates of low energy photons can be observed in the GEM chambers. Characterizing the pulse shape of the low energy photons and testing methods of rejecting high rate background in cosmic tests will be done in the next few months.
- One comment in the DOE November 2014 review was that "The provision of a complete spare plane (four modules including electronics) is strongly encouraged". Purchasing materials for 5 more GEM modules would give material for 44 modules which gives 10 planes and 1 spare plane for hot swapout. This leaves 4 spare modules which can be used replace of modules in the planes. We are investigating the purchasing of materials which seems doable within the WBS3 contingency. Purchasing materials would use about 20% of the contingency.

WBS 3.2 GEM electronics

- The purchase requisition for UVa to purchase the GEM electronics is working its way through procurement. The purchase requisition orders all electronics in this fiscal year which moved forward $209K from FY16. A small part of the WBS 3 contingency was used so that electronics for 44 modules (11 complete chambers) could be purchased along with 10% spare electronics.

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 1/1/2015: $1,422K (84%).
- The total burdened budget, including contingency, for WBS3 is $1,781K. With the purchase requisition for the GEM electronics, we expect only $82K in burdened administrative cost remaining to be spent which leaves $277K in contingency. Part of this contingency can be used for additional material and supplies for 5 GEM modules.

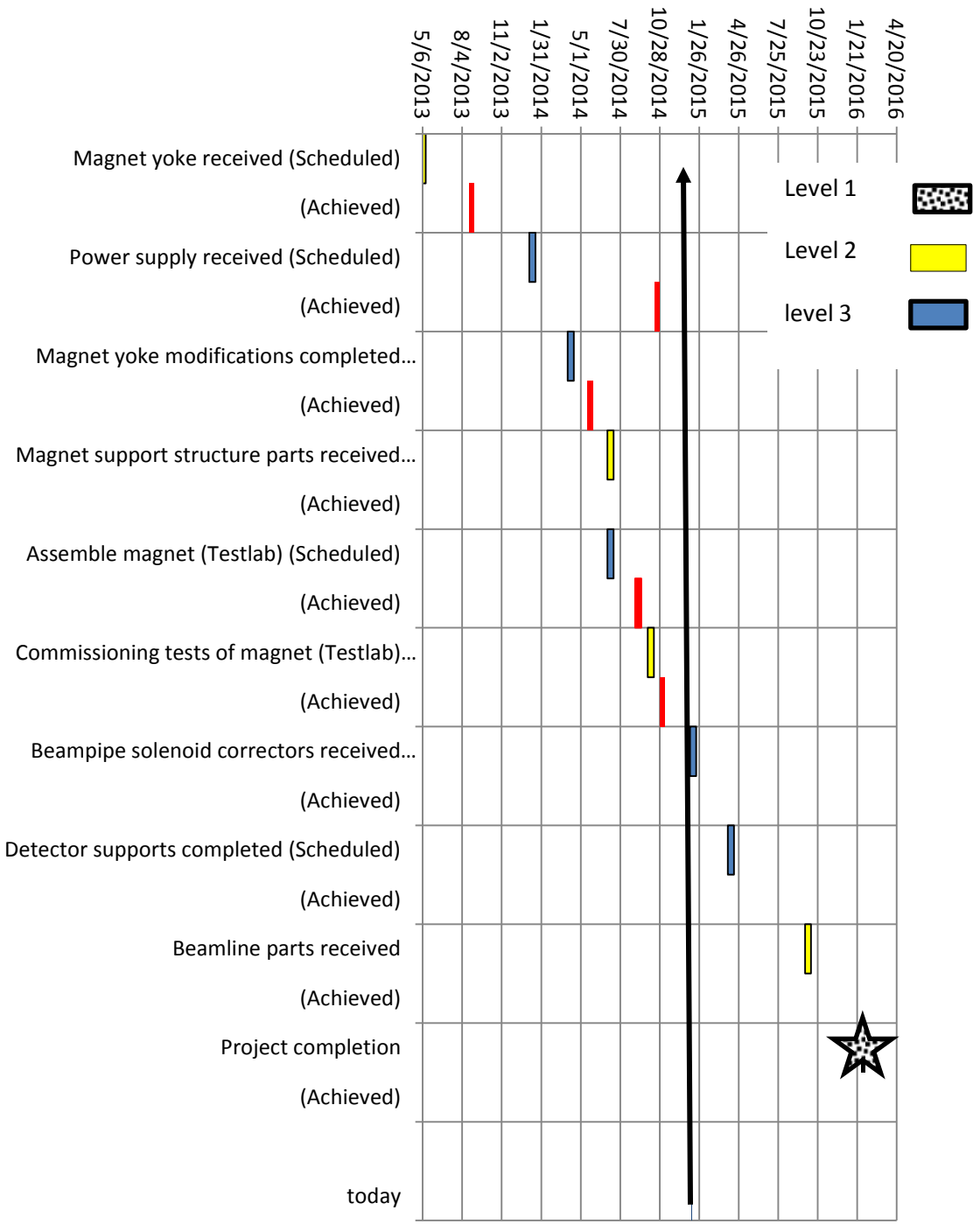
WBS 3.01 Milestones: (see Appendix 1 for a graphic view of the milestones)

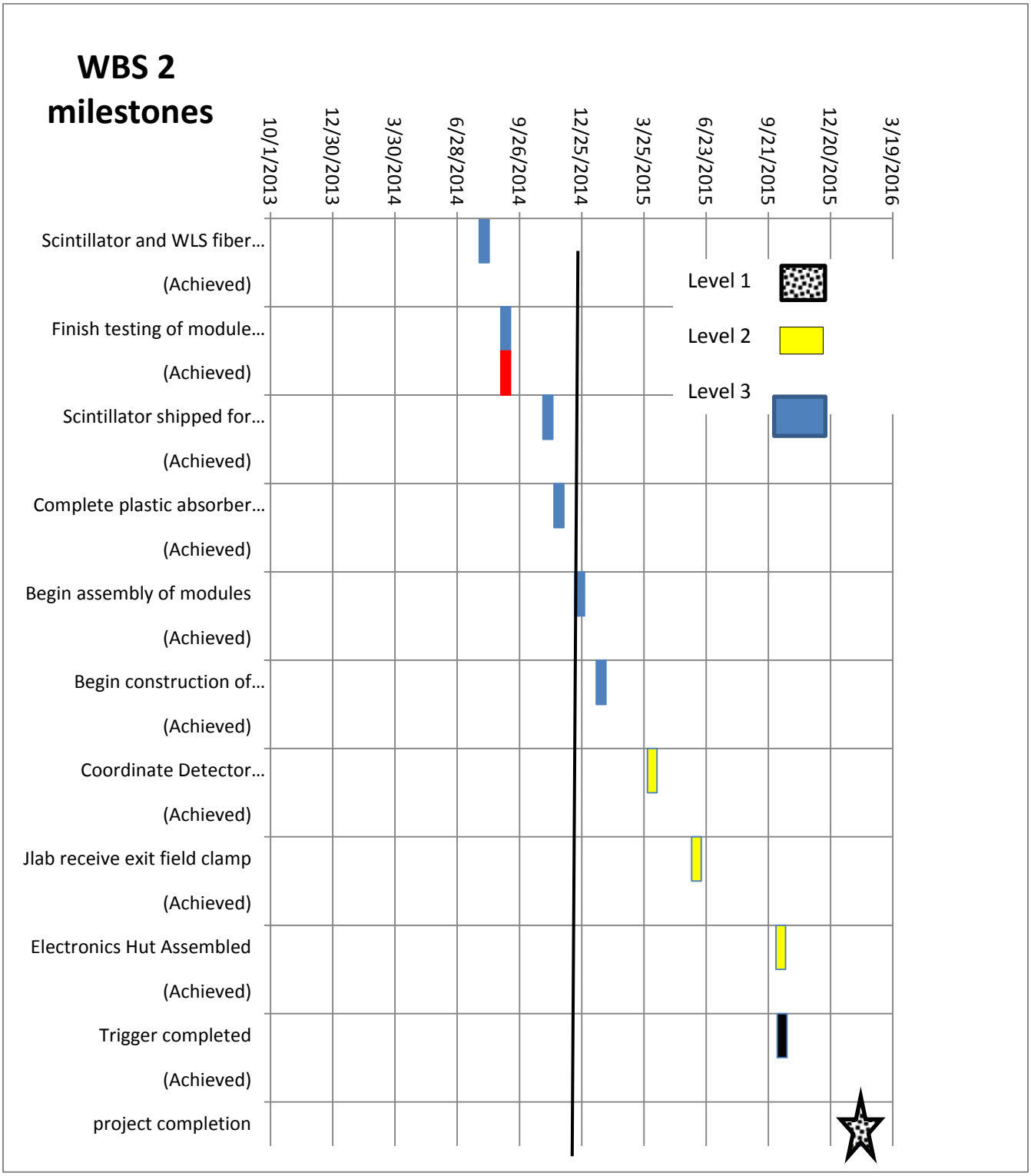
Level (ID#)	Milestone	Scheduled Date	Expected date 12/1/2014	Expected date 1/1/2015	Comment
1 (3.1-01M)	Project start	10/1/2012			**Completed 10/1/2012**
3	Order GEM Parts	10/1/2013			**Completed 10/18/2013**
3	UVa receives GEM parts	2/3/2014			**Completed 4/23/2014**
2 (3.2-01M)	First module assembled and tested	3/3/2014			**Completed 5/15/2014**
2 (3.2-10M)	UVa 5 GEM modules assembled and tested	6/2/2014	12/15/2014		**Completed 12/23/2014**
2 (3.2-20M)	UVa 6-16 GEM modules assembled and tested	9/30/2014	4/15/2015	4/15/2015	
2 (3.2-30M)	UVa 17-29 GEM modules assembled and tested	3/2/2015	11/1/2015	11/1/2015	
2 (3.2-40M)	UVa 30-40 GEM modules assembled and tested	7/15/2015	4/15/2016	4/15/2016	
2 (3.2-50M)	1st order of Front End Electronics	10/1/2014	2/1/2015	2/1/2015	
2 (3.2-60M)	2nd order of Front End Electronics	10/1/2015	10/1/2015	10/1/2015	
1 (3.1-10M)	Project completion	7/31/2017	7/31/2017	7/31/2017	

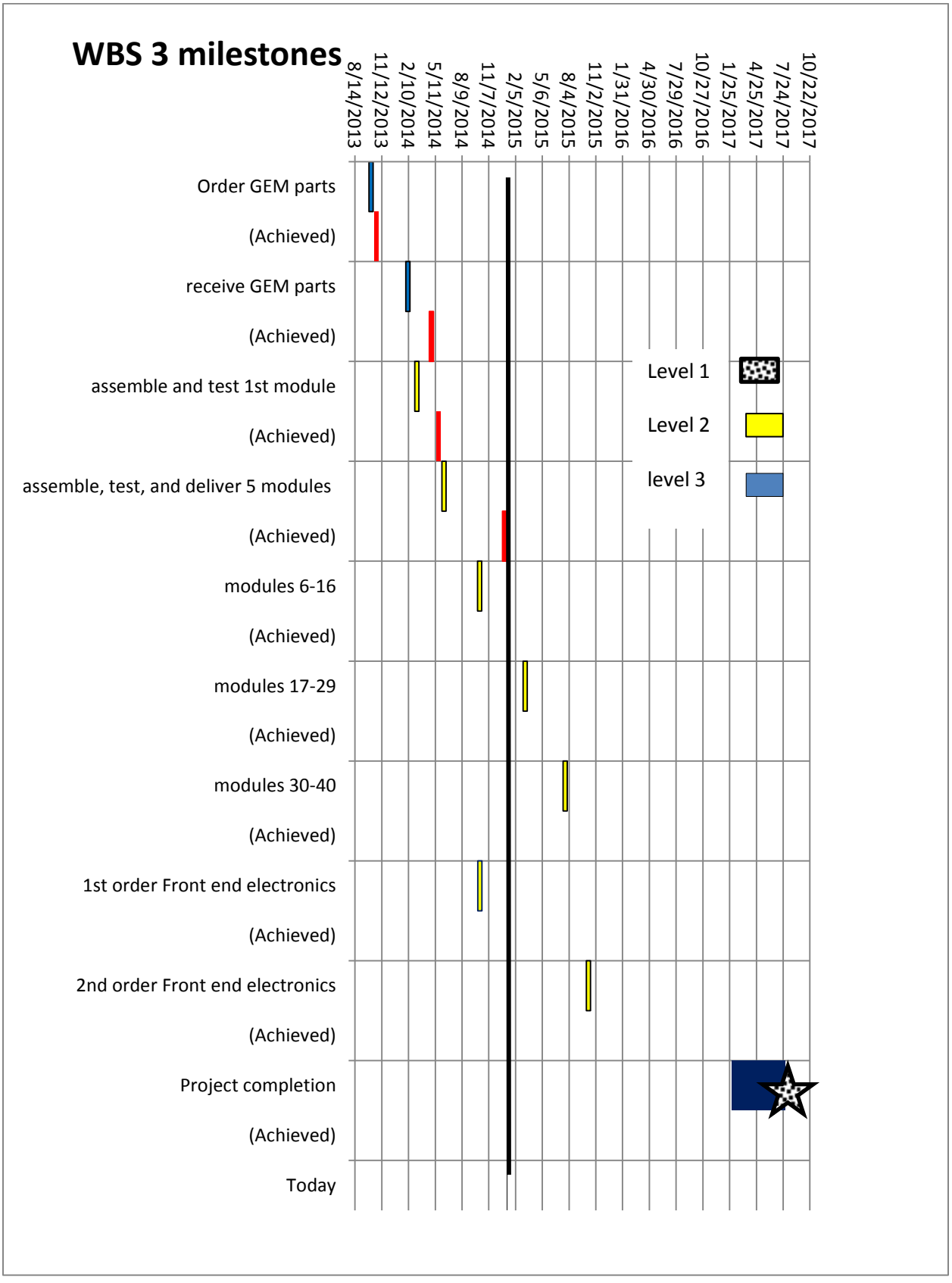
Appendix I

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
10/1/2013
12/30/2013
3/30/2014
6/28/2014
9/26/2014
12/25/2014
3/25/2015
6/23/2015
9/21/2015
12/20/2015
3/19/2016
Scintillator and WLS fiber…
(Achieved)
Finish testing of module…
(Achieved)
Scintillator shipped for…
(Achieved)
Complete plastic absorber…
(Achieved)
Begin assembly of modules
(Achieved)
Begin construction of…
(Achieved)
Coordinate Detector…
(Achieved)
Jlab receive exit field clamp
(Achieved)
Electronics Hut Assembled
(Achieved)
Trigger completed
(Achieved)
project completion
Level 1
Level 2
Level 3


WBS 3 milestones
8/14/2013
11/12/2013
2/10/2014
5/11/2014
8/9/2014
11/7/2014
2/5/2015
5/6/2015
8/4/2015
11/2/2015
1/31/2016
4/30/2016
7/29/2016
10/27/2016
1/25/2017
4/25/2017
7/24/2017
10/22/2017
Order GEM parts
(Achieved)
receive GEM parts
(Achieved)
assemble and test 1st module
(Achieved)
assemble, test, and deliver 5 modules
(Achieved)
modules 6-16
(Achieved)
modules 17-29
(Achieved)
modules 30-40
(Achieved)
1st order Front end electronics
(Achieved)
2nd order Front end electronics
(Achieved)
Project completion
(Achieved)
Today
Level 1
Level 2
level 3

Appendix II

List of integration milestones for all equipment off-project, as well as key JLab readiness and safety reviews. For each milestone the additional float is indicated.

Polarized ^{3}He target from UVa (for GEN)

1. Selection of target-cell design for high luminosity: August 2014 (+3 months float) **Completed Oct 2014**
2. Simulated-beam test (bench test) of selected design: June 2016 (+6 months float)
3. Design for target hardware and instrumentation complete: January 2017 (+6 month float).
4. GEn Polarized ^{3}He target is ready, June 2017 (+6 months float)

The Gas Cherenkov detector(GRINCH) from W&M (for GMN and GEN)

Milestone	Completion date	Comment
Design and drawings for vessel are complete	Feb 1, 2015	
Photon Detector Array assembled and tested	Aug 1 , 2015	
NINO chip front end cards system shipped to JLab	Jul 1, 2015	
Purchase order issued for vessel	Oct 15, 2015	
Full DAQ system ready	Dec 1, 2015	
Vessel completely assembled	Mar 15, 2016	
GRINCH ready for installation	Jun 15, 2016	
Final analysis software complete	Jun 15, 2016	

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

1. Electronics in production: September 2014 **Completed Sept 2014**
2. Four GEM chambers completed and available at JLab (each chamber has 3 GEM modules): Feb 2016 (+3 months float)
3. Rest of GEM chambers (Two) completed and available at JLab (each chamber has 3 GEM modules): Sep 2016 (+3 months float)

HCal-J from CMU

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

ECal from JLab

1. Develop concept of annealing: July 2014 (+2 months float) . **Completed July 2014**
2. Design review: July 2015(+4 months float)
3. ECAL electronics is ready: May 2016 (+6 months float)
4. ECAL is ready: Sept. 2017 (+9 months float)