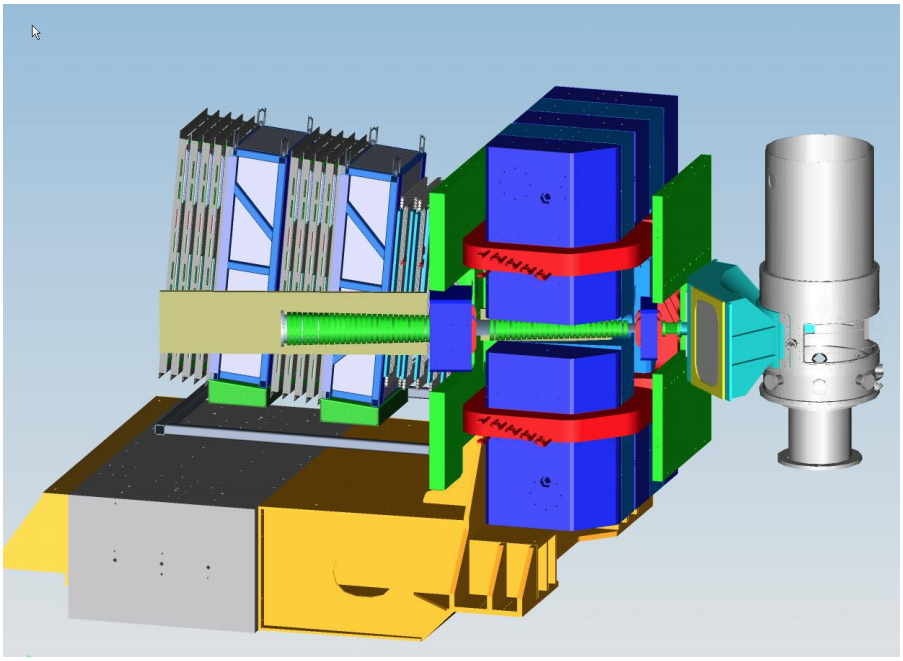
Jefferson Lab
Thomas Jefferson National Accelerator Facility

Super-Bigbite-Spectrometer (SBS)

Monthly Progress Report

November 15, 2016



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 47th 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.

- Report that describes trigger and DAQ electronics was submitted as part of the November 2016 DOE Review pre-brief materials. This fulfills a recommendation of the November 2015 DOE review.

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 Oct 6, 13, 20 and 27th. 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:

- The beam-line corrector magnet support tower was delivered at end of October. The beamline shielding assembly was delivered in middle of October.
- Delivery of the SBS detector support for the GEM frames is middle of November.
- The UVa GEM frames are being made by the JLab machine shop and completion is expected in middle of December.

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 11/1/2016: $1298K (95%).
- The only remaining item is the GEM frames which are in the JLab machine shop. The quoted cost is $60K including overhead.

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

Level	Milestone	Scheduled Date	Expected date 10/1/2016	Expected date 11/1/2016	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	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 6, 13, 20 and 27th. 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

- Present status for completion of 40 GEM modules:

GEM module #	Status
35	Constructed and passed final QA
36	Constructed and prepared for final QA
37	Constructed and prepared for final QA
38	3 GEM foils and 1 RO board at UVa
39	3 GEM foils and 1 RO board shipped week of Nov 13th
40	3 GEM foils and 1 RO board shipped week of Nov 13th

- Module #35 was constructed and tested with x-rays. Initial tests showed that all sectors are operational.
- Two RO boards were delivered in October.
- Module #36 and #37 were constructed and are prepared for final QA with test in x-ray box.
- The shipment of foils received on Nov 1st. They had major problems and had to be shipped back to CERN on Nov 3rd. CERN will send new shipment of 6 GEM foils and 2 RO boards the week of Nov 13th. This has shifted the expected completion of 40 modules from 11/30/2016 to 1/15/2016.

WBS 3.2 GEM electronics

- All electronics have been delivered to UVa.
- 140 out of ~ 900 APV cards have been tested connected to full size SBS modules and the testing will be finished by Jan 2017. The average RMS noise level for all cards has been less than 15 ADC channels.

WBS 3 Costs:

- The total budget for WBS3 is $1781K.
- Costed and obligated as of 11/1/2016: $1750K (98%).

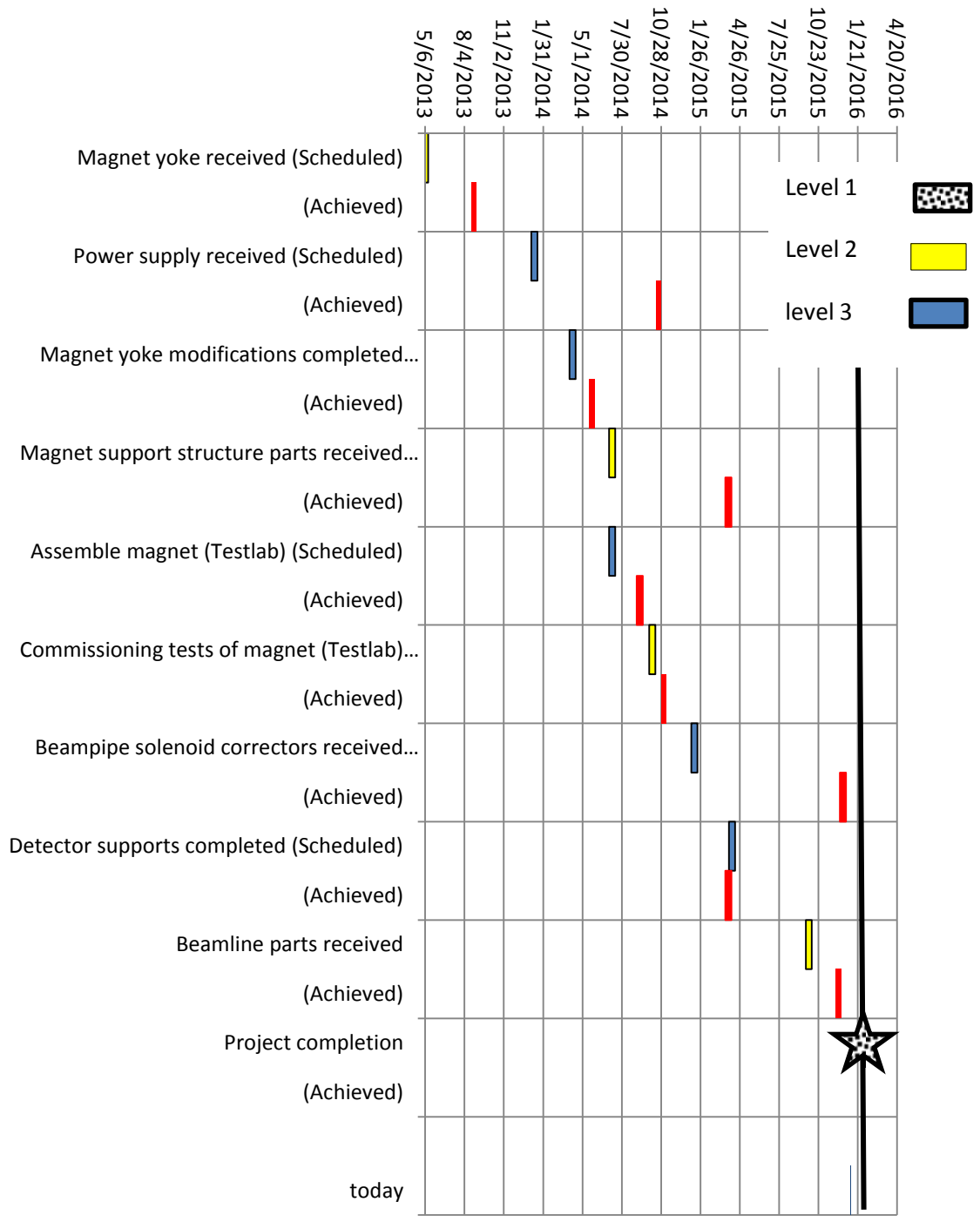
WBS 3.01 Milestones: (see Appendix 1 for a graphic view of the milestones)

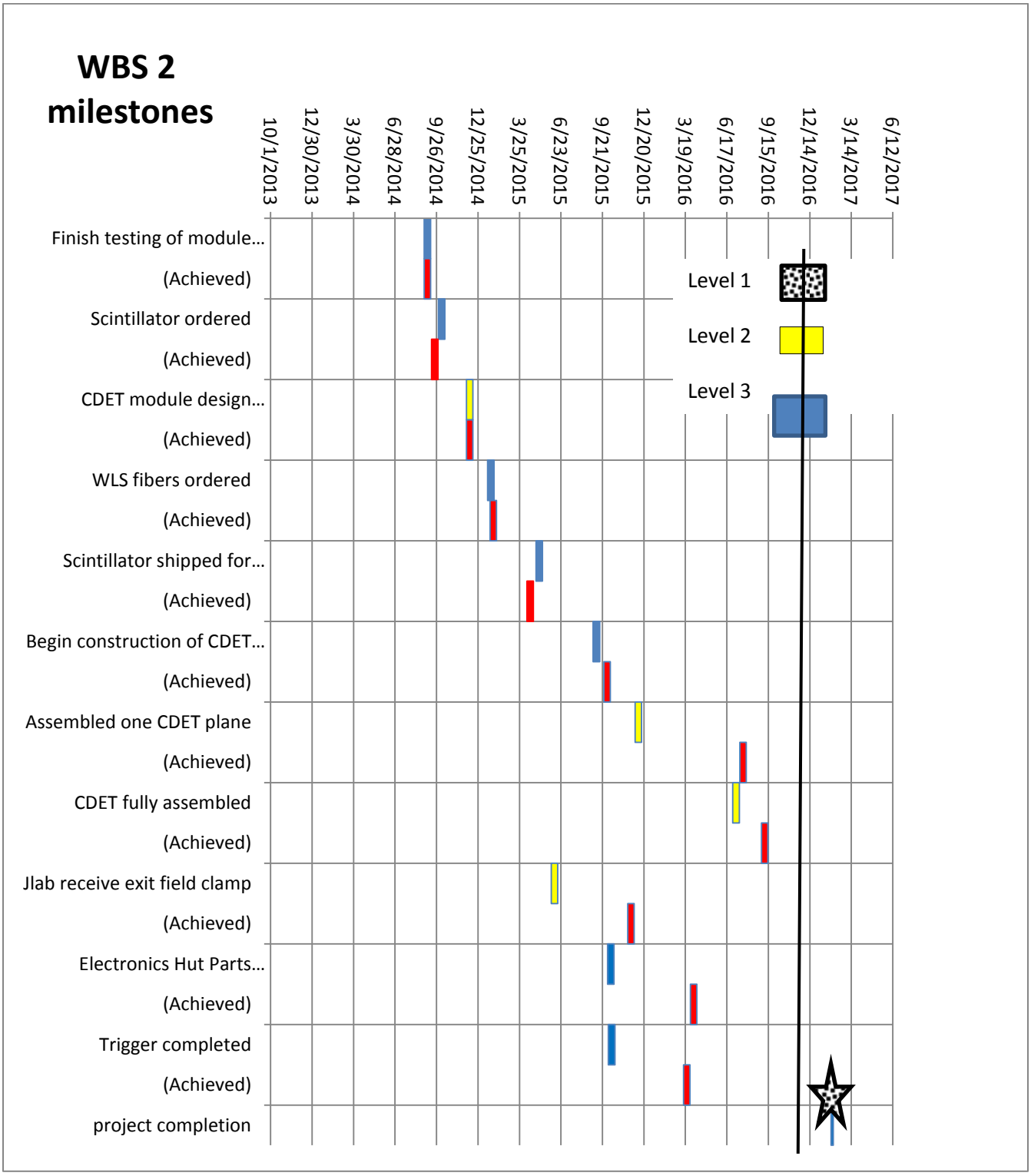
Level (ID#)	Milestone	Scheduled Date	Expected date 10/1/2016	Expected date 11/1/2016	Comment
1 (3.1-01M)	Project start	10/1/2012			**Completed 10/1/2012**
3	Order GEM Parts	10/1/2013			**Completed 10/18/2013**
3	UVa receives GEM parts	2/3/2014			**Completed 4/23/2014**
2 (3.2-01M)	First module assembled 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	11/30/2016	1/15/2017	
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	2/1/2017	

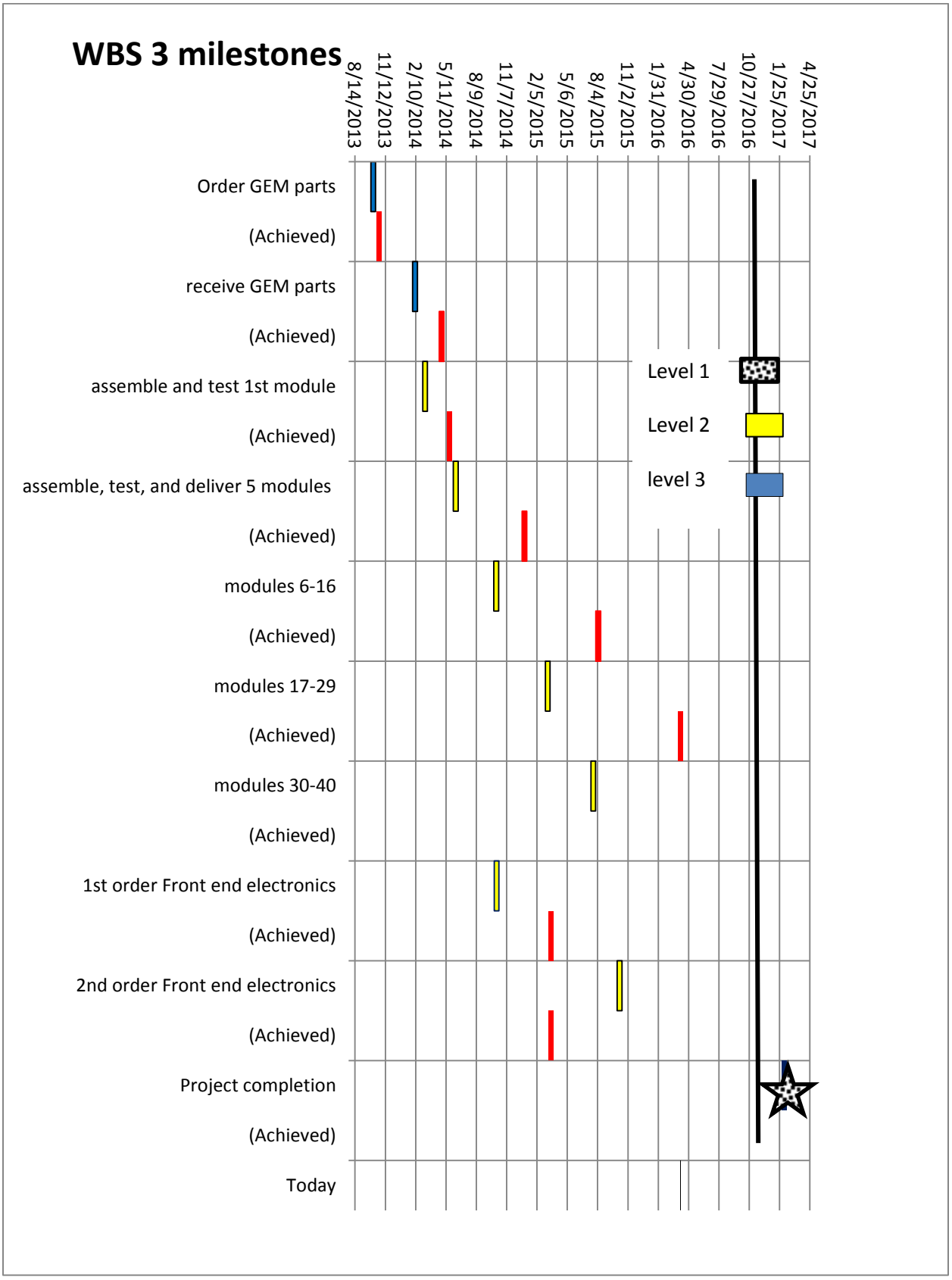
Appendix I

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
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
6/17/2016
9/15/2016
12/14/2016
3/14/2017
6/12/2017
Finish testing of module...
(Achieved)
Scintillator ordered
(Achieved)
CDET module design...
(Achieved)
WLS fibers ordered
(Achieved)
Scintillator shipped for...
(Achieved)
Begin construction of CDET...
(Achieved)
Assembled one CDET plane
(Achieved)
CDET fully assembled
(Achieved)
Jlab receive exit field clamp
(Achieved)
Electronics Hut Parts...
(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
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

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 Dec 2016
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 Dec 2016
Vessel completely assembled	Mar 15, 2016	**Completed Sept 2016**
GRINCH ready for installation	Jun 15, 2016	Expected Jan 2017
Final analysis software complete	Jun 15, 2016	Expected Mar 2017

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 Dec 2016
GEM chambers 5 and 6 completed	Dec 2016	Expect in May 2017

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 Feb 2017

Status update:

- Module production is ongoing. Have produced 220 modules (169 modules at JLab) of the total of 288 modules in HCAL.
- 20 modules were produced in October. This rate of about 1 per day is on track for completion by Feb 2017 as reported last month.

ECal from JLab/SBU/JMU (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	Delay until Jan 2017
C200 assembly completed and testing begins	Jan 15 2016	**Completed Jan 2016**
C200 report results, recommendations completed	June 1 2016	**Completed Oct 2016**
Design of ECAL frame/oven started	July 1 2016	Delay until Nov 2016
ECAL platform in testlab .	Nov 1 2016	Delay until Dec 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:

- The C200 report was written and is part of the pre-brief material for SBS November Review.
- A conceptual design report on the final ECal has been written and is part of the pre-brief material for SBS November Review.

Polarized ^{3}He 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	
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:

- The polarized target CDR is submitted as part of the pre-brief material for SBS November Review.