

sPHENIX Project Status Report – October 2020

HOST LABORATORY: BROOKHAVEN NATIONAL LAB

FEDERAL PROGRAM MANAGER: ELIZABETH BARTOSZ

BHSO POINT OF CONTACT: ROBERT CARADONNA

CONTRACTOR PROJECT DIRECTOR: EDWARD O'BRIEN

1. SCORECARD AS OF October 31, 2020

Current PD:	2/3	Date of Current CD/PD approval	September 2019	
Next PD:	4	Forecast approval:	1QFY23	Baseline: 1QFY23
% Complete:	54.7%	Planned:	57.5%	
ETC:	\$11.04M	TPC or Cost Range:	\$27.0M	
Contingency:	24.4% on ETC	Float to PD-4 in months:	11.5	
Cumulative CPI:	1.01	Cumulative SPI:	0.95	

2. NEAR TERM MILESTONES

The sPHENIX Project team will continue the monthly EVMS process, Change Control, and updating of the ETC. We will continue to place orders for detector components approved at PD-3. We are implementing a plan to mitigate COVID-19 related delays including funding certain collaborating universities that host sPHENIX fabrication and testing activities to hire additional technicians to replace a shortfall in student labor. Contract amendments are being put in the place to allow additional hires.

Most of the recent project activities are associated with production of final detector components. Remaining R&D is limited to electronics and calibration components for the detector, and will be completed in the near future.

The TPC field cage will be assembled at SBU in the coming few months. TPC Fee preproduction boards will arrive at BNL and testing will begin starting in November. Testing of TPC DAM (FELIX) preproduction electronics will be completed in the near future. Testing of production SAMPA v5 chips will be completed at Lund. Production of GEM modules will continue at collaborating universities.

Production of EMCal blocks for Sectors 13-64 will continue at UIUC. The rate of block production is already near the target production rate. The plan is to maintain the production rate given the available resources and current COVID situation. Work will also continue on module production and sector assembly at BNL. Production rates should improve as additional mechanical techs are hired that will be dedicated to EMCal module and sector production work. The production of all the remaining EMCal blocks for Sectors 1-12 should be completed and the blocks delivered to BNL by the beginning of November. Production of blocks for Sectors 13-64 will then begin at UIUC and fiber filling for Sectors 13-64 will continue. UIUC will ship the first set of 24 high rapidity blocks to BNL, and if they pass inspection, they will be installed in one of the first 12 sectors.

The final shipment of OHCAL tiles will arrive from Uniplast in November. A contract between BNL and ISU will be in place within the next 4 weeks to procure the IHCAL mechanical sectors. After the ISU contract is in place an RFQ will be released and a vendor selected. Over the next six months work on the Outer HCAL will center on production sector assemblies in the HCAL factory. We expect the parts that will allow for the mechanical assembly of the OHCAL sectors into the detector barrel will arrive at BNL in the next 4-6 weeks. The parts include the joining plates, pins and pucks.

Work on the calorimeter electronics over the next three months will include the fabrication of on-detector cable assemblies for the production HCal sectors, testing of production electronics including the EMCal SiPM boards, HCal Preamps, and HCal LED Driver board, system chain tests of the Digitizer ½-Crate system, finalization of cable lengths, orders for external cables and production of the LV power system components.

Work will continue in 1008 on the new DAQ/Trigger set-up. Work on the Global Level-1 Trigger system and the Timing system will continue. As soon as hardware becomes available, we will augment the calorimeter-type DAQ readout slice with another, FELIX card-based one for the development of the whole variety of readout hardware.

Prototype studies of the MBD Disc/Shaper (D/S) will be completed and we will schedule the Production Readiness Review for the D/S electronics. BNL scientists will continue to train grad students from Howard Univ and Florida A&M Univ on testing and operation of the MBD.

3. STATUS HIGHLIGHTS

Production components for the sPHENIX detector continue to arrive. The early completion date remains unchanged in October that indicates that the schedule has stabilized after 3.5 months of delay in the schedule over the summer due to COVID. The first milestone related to the sPHENIX 2021 PEMP notable has been met. All the OHCAL tiles, a CD-3A long-lead procurement, have been delivered by the vendor.

The EVMS processing is complete for October. The schedule contingency remains unchanged at 11.5 months and cost performance remained excellent with 24.4% contingency remaining on a project that is now 54.7% complete. Cobra and P6 monthly reports have been uploaded to IPD. We approved PCR017 in October.

The TPC Inner field cage has been completed at SBU. The TPC Outer field cage is under construction at SBU. Testing of the TPC Fee preproduction cards started at BNL. A test stand is being prepared for a 26 TPC Fee board integrated system test to take place in the next 4-8 weeks. All 11,000 SAMPA v5 chips have been tested at Lund with the shaping time set at 160 nsec with a yield of 70%. Orders continue for the TPC gas, cooling, and laser systems.

Production of the EMCal blocks for preproduction Sectors 1-12 has been completed and all the blocks have been delivered to BNL. The completion of blocks for Sectors 1-12 was a PEMP-related sPHENIX milestone for 2021. Block production at UIUC is now continuing with the remaining Sectors 13-64. Work on module production and sector assembly continued at BNL. Six EMCal sectors have been completed

and Sectors 7 and 8 are currently under assembly. All of the first six sectors passed their initial production level testing with all LEDs and test pulse calibrations working.

Work is underway by BNL to award the contract for the IHCal frame production. Iowa State University (ISU) will manage the contract. GSU has tested 94% of the total number of scintillating tiles required for the outer HCAL, with only 1.3% failing performance testing. A final shipment of OHCal tiles arrived at GSU from the vendor. The first five pre-production OHCal sectors have been fully assembled, tested and moved to storage. Nine production sectors have been moved into the assembly area for tile and electronics and cabling installation. The high-strength OHCal endplates, pucks, and pins are expected the first week of December.

Testing of the EMCAL SiPM daughter boards continues with a failure rate of less than 1%. The production of the HCAL Interface boards for the production sectors was completed and boards delivered to BNL for QA testing. The contract for the EMCAL preamp boards has been awarded, with a completion date of February 2021 due to a long lead time on a number of components. The Calorimeter Digitizer boards, XMIT modules, crates and backplanes for the 7-Crate preproduction have been received at Nevis Labs, Columbia University and have passed the initial power up tests with no failures. The first crate of digitizers was delivered to BNL at the end of October. The contract for the full production of the digitizer system was finalized in October and orders for long lead-time components are being prepared.

The purchase order for 20 PCs, a new network switch, and a "first article" file server, called a "BufferBox", were received. The data acquisition development is continuing. We are setting up for the long-awaited multiple-system test. We have received six more hardware units that can be used as a GL1 or GTM. This will allow us to have more development stations simultaneously and also expands our options for testing and diagnostics. The DAQ group has hired a new junior computer expert who is currently working from home due to the pandemic.

Scientists at Columbia University, Nevis Labs have taken data, read out from multiple MBD Disc/Shaper boards. Studies are underway to fine-tune the shaper gain, as well as to determine the effect of pile-up from high rate collisions.

WBS 1.1 Project Management (L2 Manager: Irina Sourikova)

Current Status:

- SPI is 0.95, CPI is 1.01.

Highlights:

- July Review recommendations implemented.
- PCR017 approved, \$2.1M contingency draw.
- Risk Register updated based on realized risks, risk contingency reduced.
- Estimate Uncertainty (EU) bottom up analysis completed, EU contingency reduced.
- EVMS processing complete; schedule contingency remained unchanged and cost performance remained excellent.
- Cobra and P6 monthly reports uploaded to IPD.

- October variance reports approved.

Plans for the next 2-3 month:

- Continue monthly EVMS process and Change Control.
- Place TEC orders and monitor procurements.

Issues:

- None

WBS 1.2 Time Projection Chamber (L2 Manager: Tom Hemmick, SBU)

Current Status:

Production GEM framing at GEM factories continues. The TPC Inner field cage has been completed at SBU. The TPC Outer field cage is under construction at SBU. Testing of the TPC Fee preproduction cards started at BNL. Most of the new features of the preproduction Fee board have been tested and work. These include a new JTAG over fiber programming option, new SAMPA power-on-reset, new EEPROM, new FPGA and new optical transceiver. Tests of the TPC Fee cooling structure are underway. Environmental test (radiation, magnetic field and HV discharge) are being prepared. A test stand is being prepared for a 26 TPC Fee board integrated system test. An additional 32 TPC Fee preproduction boards are being assembled and will be used for this system test. The procurement of long lead components has started for the 700-board TPC Fee production run.

All 11,000 SAMPA v5 chips have been tested at Lund with the shaping time set at 160 nsec with a yield of 70%. SAMPA v5 tests with the shaping time set to 80 nsec is in progress.

Now that all SAMPA chips are now fully delivered QA inspection at Lund is just ongoing. The first FEE card was populated at BNL instrumentation for testing and validation.

Orders continue for the gas, cooling, and laser systems.

Plans for the next 2-3 Months

The field cage will be assembled in the coming few months. Production-level GEMs are anticipated to arrive at SBU starting in November. TPC DAM preproduction testing will be completed and TPC DAM production will begin. TPC Fee preproduction board system testing will be underway. Parts order for the TPC Fee production boards will continue.

Issues:

None

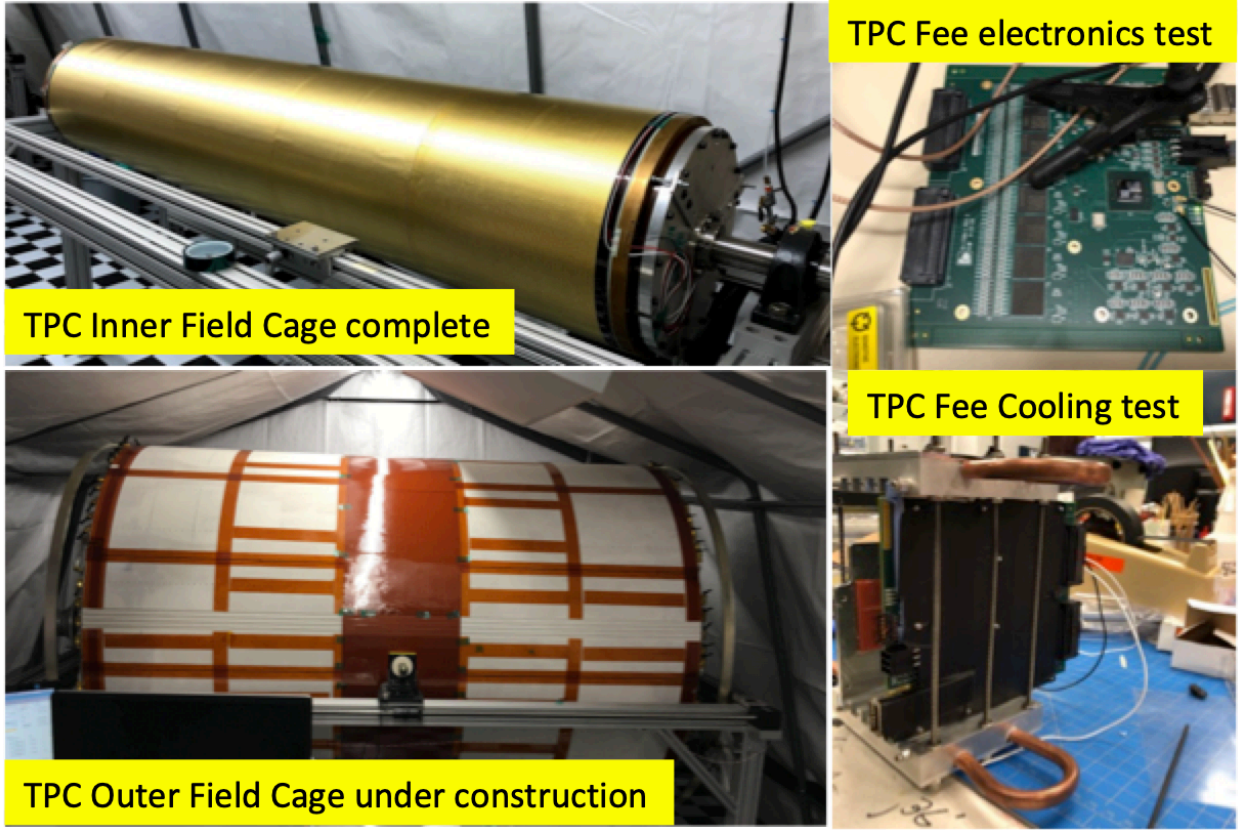


Figure 1. Clockwise from upper left: TPC Inner field cage complete at SBU. Electronic testing of TPC Fee preproduction board. TPC cooling test at BNL. Assembly of Outer field cage at SBU.

WBS 1.3 Electromagnetic Calorimeter (L2 Manager: Craig Woody, BNL)

Current Status:

Production of the blocks for preproduction Sectors 1-12 has been completed and all the blocks have been delivered to BNL. Block production at UIUC is now continuing with the remaining Sectors 13-64. Figure 2 shows the status as of the end of October. A total of 202 blocks (2.8 sectors) have been produced and 1.2 sectors have been shipped to BNL. The rejection rate for the 202 blocks was 1.5 % (3 blocks). In addition to the blocks for Sectors 13-64 that were shipped to BNL, 24 blocks that were produced at Fudan and tested at UIUC were also shipped to BNL during October.

EMCal Sectors 13-64 block construction: status

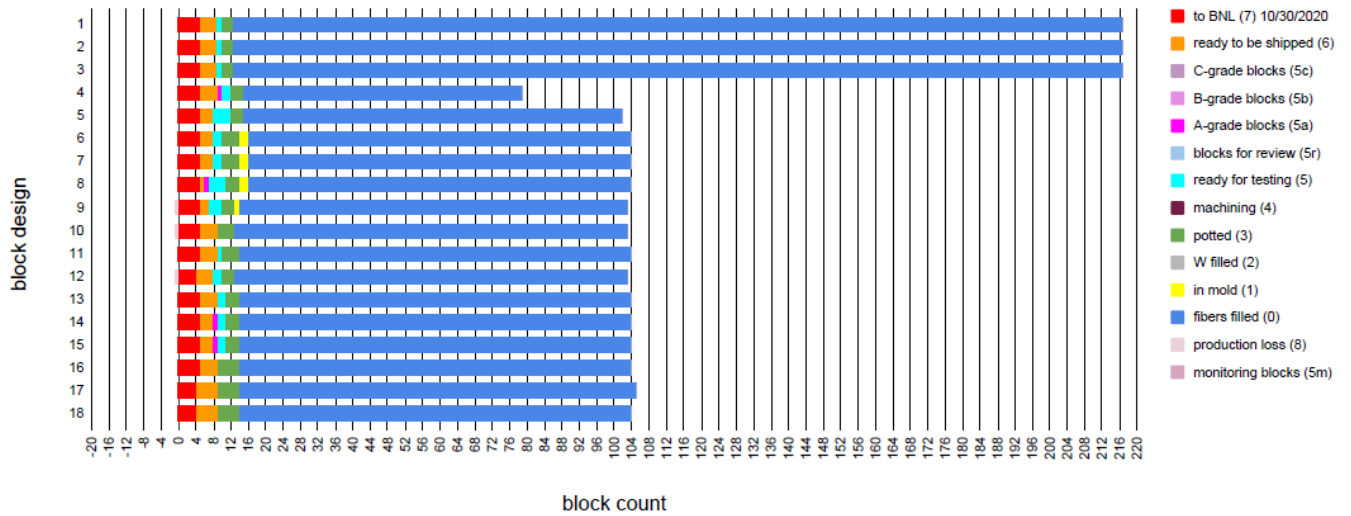


Figure 2. Progress on block production for Sectors 13-64 at UIUC as of the end of October. A total of 12 sectors worth of these blocks have been shipped to BNL.

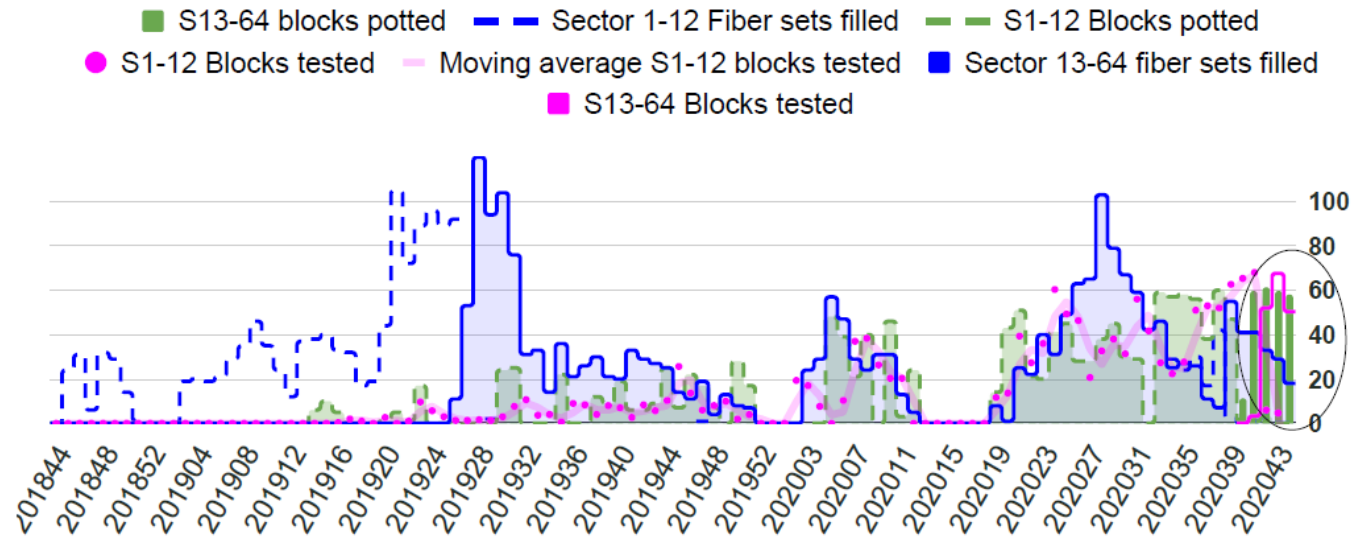


Figure 3. Weekly rate of various stages of block production at UIUC. The current rate now meets or exceeds the target rate for full-scale production of 60 blocks per week.

Figure 3 shows the weekly rate of various stages of block production at UIUC. The total rate of blocks potted and tested now meets or exceeds the final target production rate of 60 blocks per week. Fiber filling for the Sector 13-64 blocks is also proceeding ahead of schedule.

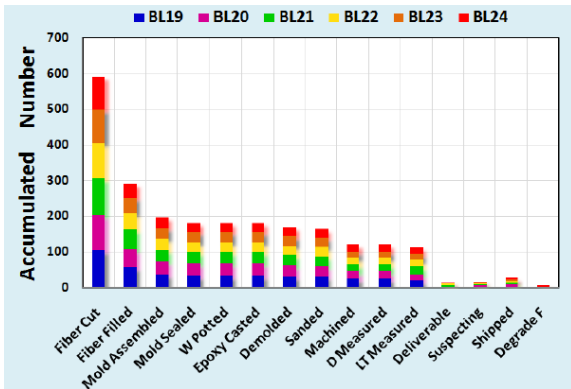


Figure 4. Block production at Fudan. Left show the total number of blocks at various stages of production. Right shows a set of blocks being prepared for shipment to BNL.

Block production also continued at Fudan. A total of 57 blocks have been machined and are undergoing testing and QA. Figure 4 shows the total number of blocks at various stages of production along with a set of finished blocks being readied for shipment to BNL.

Work on module production and sector assembly continued at BNL. A total of 25 shipments of blocks from UIUC have now been received along with one sectors worth of blocks from Fudan that underwent additional testing at UIUC. Figure 5 shows the status of the various stages of module production. All of the modules for Sectors 1-8 have been completed and light guides are being installed on Sector 9. Work is proceeding on more modules but we are waiting for delivery of additional light guides before we will be able to complete more sectors.

Figure 6 shows the status of sector assembly. Six sectors have been completed and Sectors 7 and 8 are currently under assembly. All of the first 6 sectors passed their initial production level testing with all LEDs and test pulse calibrations working. The first two sectors have completed their post production testing, which includes testing the cooling system, temperature control system, SiPM bias adjustment, etc., and Sector 3 is currently under test. A new test area is also being set up to do a long term burn-in test of each sector with the sectors biased and under cooling for several weeks. We also plan to test some limited subset of the sectors with cosmic rays which should provide an initial absolute energy calibration that can be applied to those sectors and used for other sectors as well.

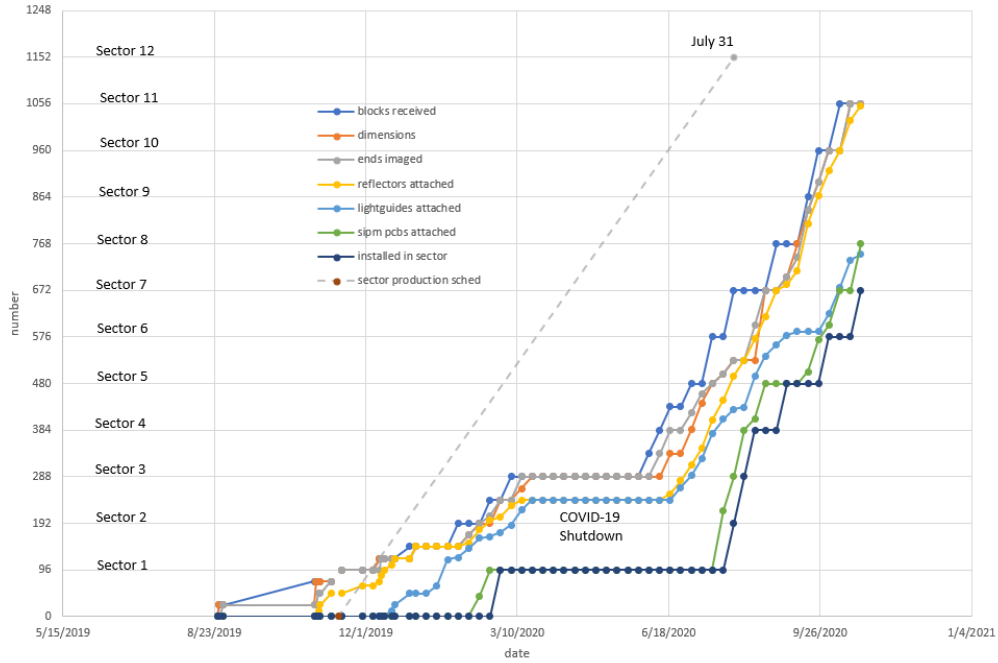


Figure 5. Status of module production at BNL.

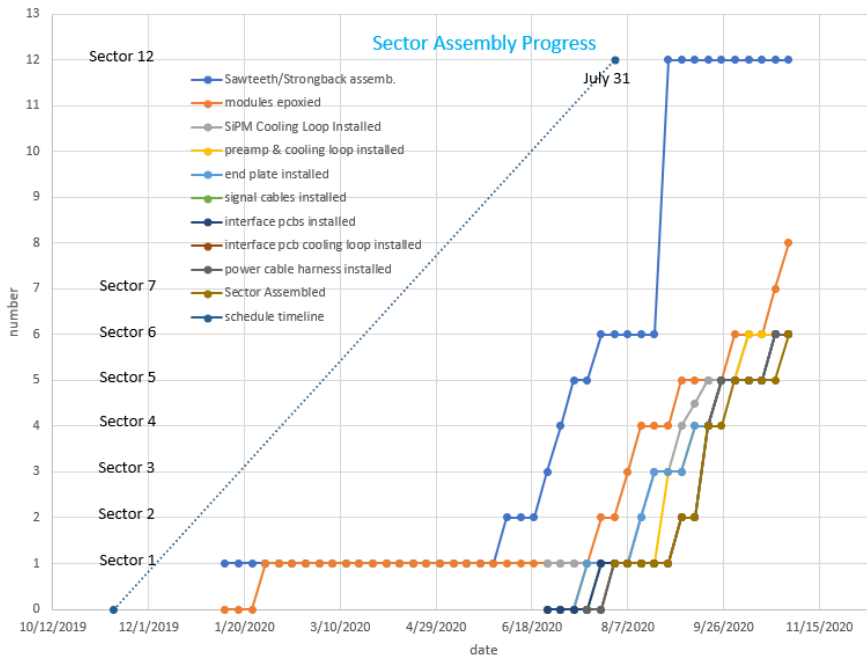


Figure 6. Status of sector assembly at BNL.

Work For the Next 2-3 Months:

Production of blocks for Sectors 13-64 will continue at UIUC. The rate of block production there is already near the target production rate and the hope is to be able to maintain this rate given the current COVID situation and other factors that could limit available manpower.

Production of the high rapidity blocks for Sectors 13-64 will also continue at Fudan. The current production rate there is sufficient to keep up with our assembly of these sectors at this time and we expect that it will increase as they gain more experience producing and testing blocks. There are also plans to start producing blocks at a second site at CIAE in Beijing which will add to the production capabilities in China.

Work will also continue on module production and sector assembly at BNL. Sector production has been running behind schedule but we have begun the process to hire two additional techs that will be dedicated to doing production work. We expect that these two new techs will become available in early December, which will improve the rate of production. We also expect that the delivery of light guides will increase during the next month to a rate that will meet our production requirements.

Issues:

We have been limited in our capabilities for module production and sector assembly at BNL due to a shortfall of technicians. However, two new techs have been hired and will start to work in early December. This should greatly improve the situation. The light guide vendor expects to overcome the delay with the delivery of the light guides. While there are still a few more issues to resolve regarding their mechanical machining, we are confident that these can be overcome during the coming weeks as well. We are still short of resources in the form of postdocs and/or students to help us test the completed sectors and prepare them for installation and commissioning.

WBS 1.4 Hadronic Calorimeter (L2 Manager: John Lajoie, Iowa State University)

WBS 1.4.2 Inner Hadronic Calorimeter

Current Status:

Work is underway to put the contract between BNL and Iowa State University (ISU) in place for the iHCAL mechanical parts – this contract is imminent, with active communication between the relevant parties at BNL and ISU. ISU and Rutgers will place the orders for the iHCAL sector parts and manage their production. The end ring supports will be procured through BNL.

Work for the Next 2-3 Months:

Contracts should be in place to procure the iHCAL sectors in the next week or so. After the ISU contract is in place, an RFQ will be released and a vendor selected.

Issues:

The COVID-19 pandemic can potentially have a negative schedule impact on the inner HCAL assembly schedule due to the availability of student labor. More will be known when we have a sector production schedule from the manufacturer.

WBS 1.4.3 Outer Hadronic Calorimeter

Current Status:

GSU has tested >95% of the total number of scintillating tiles required for the outer HCAL, with only 1.3% failing performance testing. A last shipment of the remaining ~350 tiles arrived at GSU November 16th, 2020. This completes the delivery of outer HCAL tiles from Uniplast.

Factory operations at BNL are continuing with technician labor and collaborator support from the NY state area. The first five pre-production sectors have been fully assembled, tested and moved to storage. One pre-production module remains to be completed. Nine production sectors have been moved into the assembly area for tile and electronics and cabling installation. At the present time the limiting factor in sector assembly continues to be the availability of signal cables and tested preamps. Cables from the technicians at NSLS-II have just begun to arrive as of the date of this report, and preamp testing is ramping up at Lehigh University. Additional collaboration labor resources have been identified, and ISU has added a new postdoc who resides local to the BNL area to work full-time in the outer HCAL factory. In addition, we hope to be able to bring collaborators onto the BNL site in early 2021 to ramp up OHCAL assembly and testing.

The high-strength endplates, pucks, and pins are expected the first week of December, 2020. The vendor is on track to deliver as scheduled.

Work for the Next 2-3 Months:

Over the next six months work on the outer HCAL will center on production sector assemblies in the HCAL factory will continue.

Issues:

We continue to be optimistic that we will be able to supplement OHCAL factory labor with graduate students and postdocs from beyond the NY state area in early 2021.



Figure 7: The seventh and final shipment of outer HCAL tiles from Uniplast arriving at Georgia. This marks the successful completion of a complicated international contract and the retirement of a key risk for the OHCAL portion of the sPHENIX MIE.

WBS 1.5 Calorimeter Electronics (L2 Manager: Eric Mannel, BNL)

Current Status:

Testing of the EMCal SiPM daughter boards continues with a failure rate of less than 1%. The production of the HCAL Interface boards for the production sectors was completed and boards delivered to BNL for QA testing. HCAL LED drive boards were delivered from the assembly house mid-October and the LED distribution cans and photodiodes were installed. QA testing of the boards has started, with initial testing showing >99% yield. The contract for the EMCal preamp boards was awarded, with a completion date in February of 2021 due to a long lead-time on a number of components. A number of the cables are being done in-house, taking advantage of the expertise of technicians assigned to NSLS-II, with the balance being sent out to a local vendor.

The Digitizer boards, XMIT modules, crates and backplanes for the 7-Crate preproduction have been received at Nevis Labs, Columbia University and have passed the initial power up tests with no failures.

The first crate of digitizers was delivered to BNL at the end of October and is shown in Figure 8. The Colorado group has agreed to oversee the production of front panels for all the modules, and the first panels for the digitizer boards have been delivered. In addition, the Colorado group will be doing detailed testing and documenting of the analog response of the digitizer modules. The contract for the full production of the digitizer system was finalized in October and orders for long lead time components are being prepared.

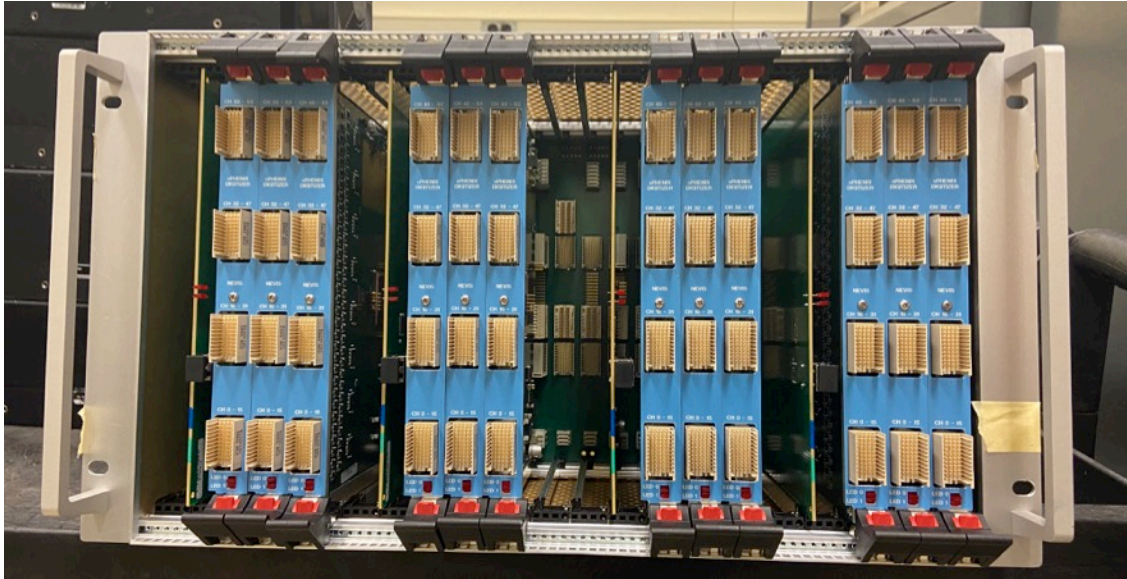


Figure 8: First digitizer crate delivered to BNL with 12 Digitizer boards and 4 XMIT. The Digitizer boards have first production front panels installed. The XMIT boards are still waiting for first production front panels that are being fabricated at Colorado University.

Work for the next 2-3 months:

Work over the next 3 months will be focused on the continued testing of preproduction sectors and procurement of production electronics. This work includes:

1. Start assembly of cable assemblies for the remaining 26 HCal modules
2. Test EMCal SiPM boards, HCal Preamps, and HCal LED Driver board.
3. Start testing of EMCal Sector 2 and HCal Module 2-6.
4. System chain test of the Digitizer ½-Crate system at BNL
5. Work with the Integration and Installation group to finalize cable lengths and rack design
6. Place orders for external cables.
7. Production of low voltage systems.

Issues:

- COVID-19 travel and work restrictions will impact the short-term schedule for testing of delivered electronics.

WBS 1.6 DAQ/Trigger (L2 Manager: Martin Purschke, BNL)

Current Status:

The purchase order for 20 PCs, a new network switch, and a “first article” file server, called a “BufferBox”, were received. The role of the latter is the interim storage of data at the experimental site to level the variable data rates, and a steady stream of data can be sent to the computing center for storage. Fig. 9 shows the two assembled racks.



Figure 9: A picture of the two newly assembled racks with the new PCs.

After the exact power requirements are now known after the delivery, we have started the first phase of re-organizing the power distribution in the rack room of the experiment. We are trying to keep a token DAQ setup powered to be able to continue the development while the main power feed is down.

At the same time, we have started to refine the initial installation of the new PCs in a way that a mass-setup is easy and can be done in about 20 minutes. In the previous PHENIX experiment, this had been the basis of the machine management that kept the required patching at a minimum – rather than having to keep a database of applied patches for each of the hundreds of PCs, we just re-installed the operating system from a fully patched reference machine, which dramatically cut down on system administration work. The current setup, while still undergoing refinements, takes this one step further, by performing all setup and installation steps remotely through IMPI (“Intelligent Platform Management Interface”) that allows us to control all aspects of the machine hardware remotely, as if one was sitting at a physical console. So far, one rack of the two has been installed in this way (Fig. 10), and in the process, the installation system has been streamlined and automated more and more.

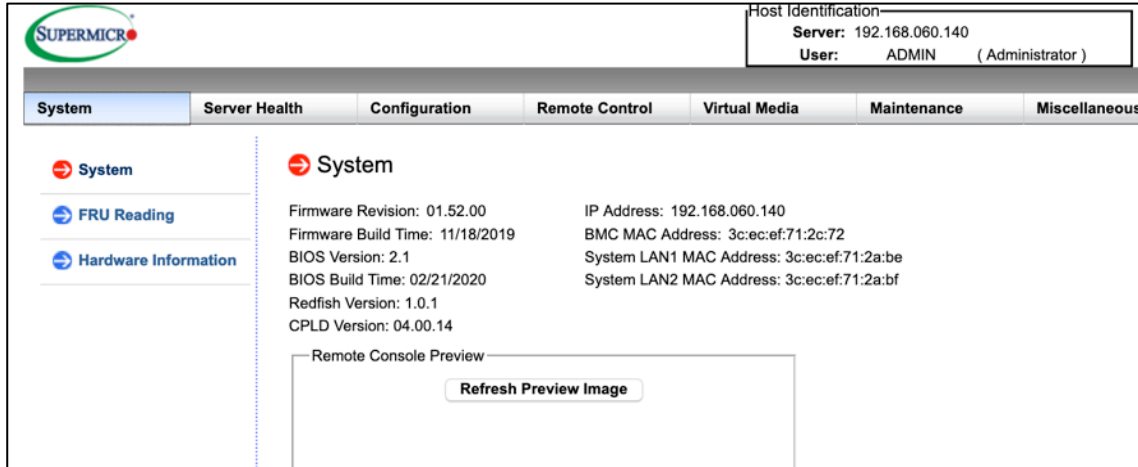


Figure 10: Setting up a machine through the IPMI interface

The data acquisition development is continuing meanwhile. We are setting up for the long-awaited multiple-system test. This, unfortunately, has seen a slight setback, as an apparent hardware failure in the currently sole prototype ADC controller currently prevents us from taking data through the GL1 (which is required to distribute a common clock to multiple systems). We are trying to fix this issue. To get some other than just pulser data, we had set up a calorimeter prototype (that was available opportunistically, and is treated here just a source of actual signals) with a cosmics trigger distributed via the Global Level 1. Before the hardware failure that is still under investigation, we took about a million events under various conditions to test the readout.

Work to clear out the old PHENIX racks in the experimental building 1008 are continuing. Drawings and designs for the new power distribution system are under development to provide the required power in a managed way (UPS and normal power). The new power distribution for the new racks that is mentioned above is part of this.

We have also received 6 more hardware units that can be used as a GL1 or GTM. This allows us to have more development stations simultaneously and also expands our options for testing and diagnostics.

The DAQ group has hired a new junior computer expert who is currently working from home due to the pandemic. This new coworker is getting up to speed and will be allowed to come on site hopefully in January 2021.

Work for the next 2-3 months :

We will continue the work in 1008 for the new setup. Work on the Global Level-1 Trigger system and the Timing system is continuing meanwhile. We will try to fix the hardware problem with the ADC controller as soon as possible. As soon as hardware is available, we will augment the calorimeter-type DAQ readout slice with another, FELIX card-based one for the development of the whole variety of readout hardware.

Issues :

None

WBS 1.7 Minimum Bias Trigger Detector (L2 Manager: Mickey Chiu, BNL)

Current Status:

Scientists at Columbia University, Nevis Labs have taken data, read out from multiple Disc/Shaper boards, and that data is currently being analyzed. The MBD was implemented in the sPHENIX simulation, and studies are underway to fine-tune the shaper gain, as well as to determine the effect of pile-up from high rate collisions.

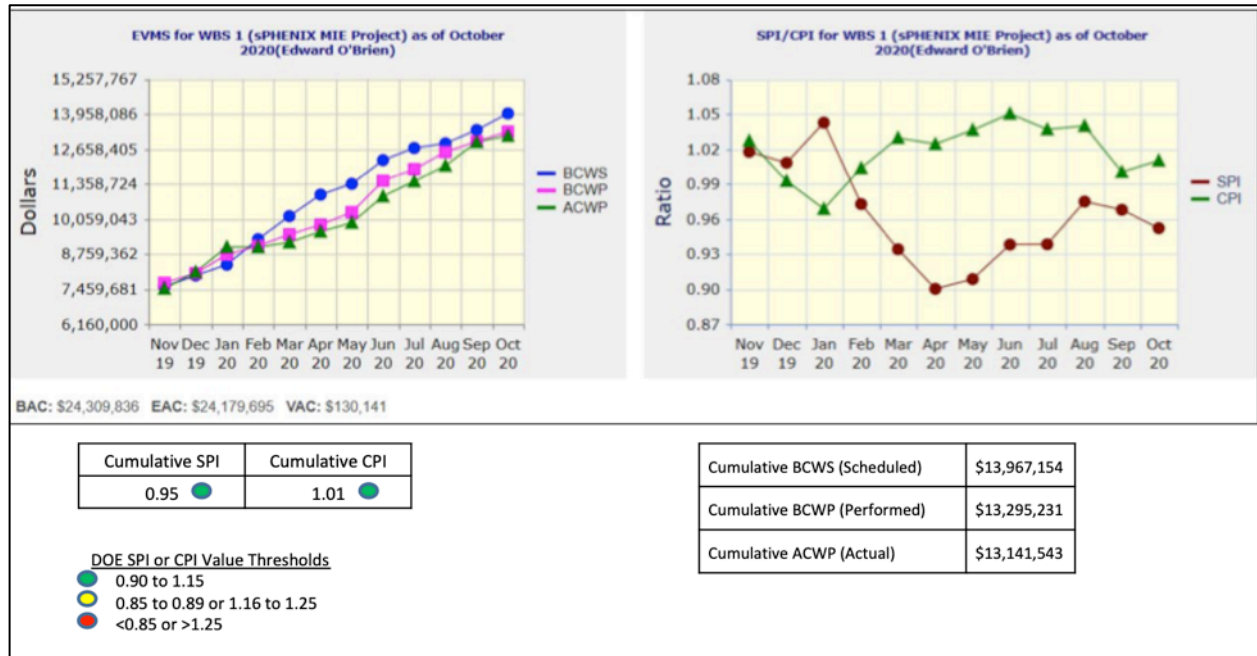
Work for Next 2-3 Months:

We will finish up the last set of Disc/Shaper prototype studies, and make plans for the final Production Readiness Review. BNL scientists continues to meet weekly with grad students from Howard and Florida A&M Univ to train them on the MBD and the skill set required for testing and eventually for operating it.

Issues:

None.

SPI and CPI Trends



October 2020 Cost Performance Report

B. PERFORMANCE DATA											
CA (3)	CUMULATIVE TO DATE					AT COMPLETION			SPI	CPI	
	BUDGETED COST		ACTUAL	VARIANCE		BUDGETED	ESTIMATED	VARIANCE			
	WORK SCHEDULED (7)	WORK PERFORMED (8)	COST WORK PERFORMED (9)	SCHEDULE (10)	COST (11)	(14)	(15)	(16)			
ITEM (1)											
1.01A Project Management	1,777,809	1,777,809	1,617,939	0	159,870	1,951,679	1,791,808	159,870	1.00	1.10	
1.02A TPC	2,599,784	2,161,620	1,827,285	-438,165	334,335	4,702,483	4,376,619	325,864	0.85	1.18	
1.03A EMCal	4,115,496	3,901,770	4,262,307	-213,726	-360,537	5,789,008	6,156,252	-367,243	0.95	0.92	
1.04A HCal	2,488,431	2,393,284	2,488,908	-95,147	-95,624	4,160,785	4,262,584	-101,799	0.96	0.96	
1.05A Calorimeter Electronics	2,644,472	2,622,629	2,599,412	-21,843	23,218	6,290,621	6,269,214	21,407	0.99	1.01	
1.06A DAQ & Trigger	242,014	338,971	266,767	96,957	72,204	1,245,090	1,173,270	71,821	1.40	1.27	
1.07A MinBias Trigger Detector	99,148	99,148	78,926	0	20,221	170,170	149,948	20,221	1.00	1.26	
b. COST OF MONEY	0	0	0	0	0	0	0	0			
c. GENERAL AND ADMINISTRATIVE	0	0	0	0	0	0	0	0			
d. UNDISTRIBUTED BUDGET						0	0	0			
e. SUBTOTAL	13,967,154	13,295,231	13,141,543	-671,923	153,688	24,309,836	24,179,695	130,141	0.95	1.01	
f. Contingency						2,690,164					
g. TOTAL	13,967,154	13,295,231	13,141,543	-671,923	153,688	27,000,000					
9. RECONCILIATION TO CONTRACT BUDGET BASELINE											
a. VARIANCE ADJUSTMENT				0	0						
b. TOTAL CONTRACT VARIANCE				-671,923	153,688						
CLASSIFICATION (When Filled In)											
					\$11,038,151	ETC					
					\$11,014,605	BCWR					
					24.37%	% Contingency on ETC					
					24.42%	% Contingency on Remaining Work					
					57.45%	% Planned					
					54.69%	% Complete					
					54.06%	% Spent					

DOE SPI or CPI Value Thresholds

- 0.90 to 1.15
- 0.85 to 0.89 or 1.16 to 1.25
- <0.85 or >1.25

*Highlights in table above takes variance \$ into consideration, not just Indices

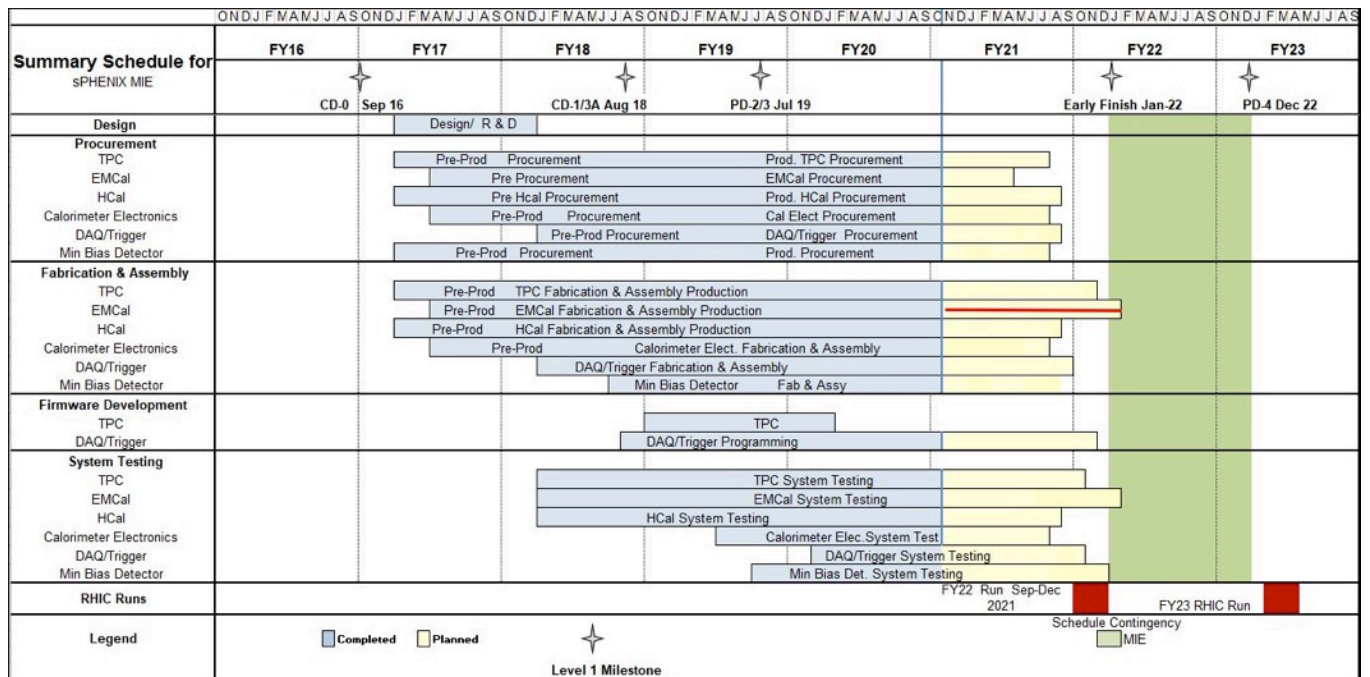
L1 & L2 Milestones

#	WBS	Milestone Name	Target Milestone Date	Forecast	Actual Finish	Variance (in work days)
	WBS Path	Activity Name	Target	Actual /	Actual Finish	Variance
1	01.01.01	Approve Project Baseline and Construction PD2/3	30-Sep-19	20-Sep-19 A	20-Sep-19	6
2	01.02.02.02	Production Readiness Review - TPC Module Factories	31-Dec-19	17-Dec-19 A	17-Dec-19	8
3	01.03.02.03.02	EMCal Preproduction Sector 0 Assembled	31-Dec-19	25-Nov-19 A	25-Nov-19	23
4	01.02.06.02	Production Readiness Review - TPC DAM	28-Feb-20	04-Feb-20 A	4-Feb-20	16
5	01.05.02.03	HCal Preproduction FEE Complete	30-Apr-20	22-Jan-20 A	22-Jan-20	70
6	01.05.02.01	EMCal Electronics Preproduction Complete	29-May-20	28-May-20 A	28-May-20	0
7	01.03.01.03.01	EMCal W Powder Acquisition Complete	30-Jun-20	15-Jun-20 A	15-Jun-20	11
8	01.03.02.03.03	EMCal Production Readiness Review Blocks/Modules/Sectors Complete	31-Jul-20	30-Jul-20 A	30-Jul-20	1
9	01.02.05.03	SAMPA ASIC Performance Accepted	30-Sep-20	29-May-20 A	29-May-20	86
10	01.05.01	EMCal/HCal SiPM Sensor Procurement Complete	30-Oct-20	28-Feb-20 A	28-Feb-20	171
11	01.05.02.04	HCal SiPM Boards Assembly Complete	30-Nov-20	22-Sep-20 A	22-Sep-20	45
12	01.02.06.03	TPC DAM Felix 2.0 Production Complete	29-Jan-21	12-Aug-21		-137
13	01.06.02.03	Trigger LL1 Preproduction complete	26-Feb-21	13-Apr-21		-33
14	01.05.02.02	EMCal SiPM Boards Production Complete	31-Mar-21	5-Feb-21		36
15	01.04.04.02	First Outer HCal Sector and Splice Plates Ready to Install	30-Apr-21	14-Dec-20		94
16	01.04.01	Inner HCal Support Structure Ready for Installation	30-Apr-21	28-May-21		-21
17	01.02.01.06	GEM Production Complete	31-May-21	15-Mar-21		54
18	01.03.01.03.01	EMCal Scintillating Fiber Acquisition Complete	31-May-21	3-Mar-21		62
19	01.06.01.03	DAQ Production: DAQ Ready for Operation	31-May-21	14-Dec-21		-135
20	01.05.02.04	HCal Electronics Complete: Production	30-Jun-21	8-Feb-21		99
21	01.02.05.04	TPC FEE Production Complete	30-Jul-21	6-Aug-21		-6
22	01.05.03.02	Calorimeter Electronics Complete	30-Jul-21	15-Jul-21		10
23	01.05.02.02	EMCal Electronics Complete	30-Jul-21	15-Jul-21		10
24	1.07	MinBias Detector Ready to Install	30-Sep-21	22-Nov-21		-36
25	01.06.03.03	GL1 Ready to Operate	30-Sep-21	4-Jan-22		-63
26	01.01.01	Early Project Completion	29-Oct-21	7-Jan-22		-45
27	01.02.01.08	TPC Ready to Install (Assembly Complete)	29-Oct-21	19-Nov-21		-15
28	01.02.06.03	TPC DAM Production Complete	29-Oct-21	8-Nov-21		-7
29	01.03.02.03.03	EMCal Ready to Install	29-Oct-21	6-Jan-22		-45
30	01.04.04.02	Last Outer HCal Sector Ready to Install	29-Oct-21	26-Aug-21		43
31	01.06.02.04	LL1 Trigger Production Complete	29-Oct-21	3-Nov-21		-4
32	01.06.02.04	LL1 Ready to Operate	29-Oct-21	3-Nov-21		-4
33	01.01.01	Approve Project Closeout PD-4	30-Dec-22	29-Dec-22*		0

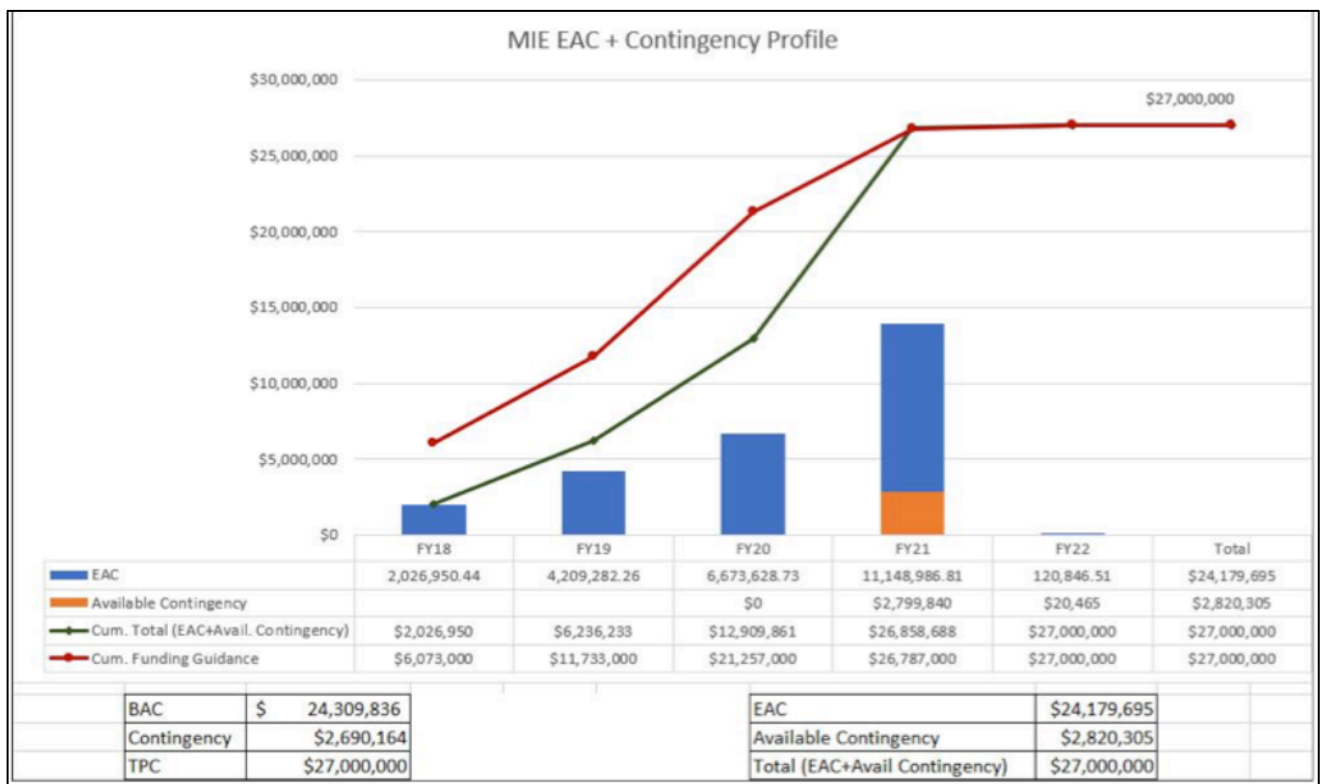
sPHENIX Budget Profile:

Funding Profile At Year k\$								
	Prior Yrs	FY17	FY18	FY19	FY20	FY21	FY22	Total
R&D		1,513	4,260	350				6,123
CDR		100	200					300
PED								
Pre-ops								
OPC (R&D+CDR)		1,613	4,460	350				6,423
TEC				5,310	9,524	5,530	213	20,577
Total Project Cost		1,613	4,460	5,660	9,524	5,530	213	27,000

Summary Schedule with critical path



Estimate at Completion Profile



Baseline/Contingency Log

Date	PCR ID	PCR Title	WBS affected	sPHENIX MIE Baseline Cost	PCR Change	Contingency	Total Project Cost
9/20/2019	Approved MIE	Setting up Baseline	all	\$22,169,490		\$4,830,510	\$27,000,000
9/24/2019	007A	Hcal Scin Tiles placed Contract delivery schedule	1.04 HCal	\$22,132,844	(\$36,646)	\$4,867,156	\$27,000,000
1/31/2020	008A	OHCal Sci.Tiles delivery schedule update	1.04 HCal	\$22,132,943	\$100	\$4,867,056	\$27,000,000
2/27/2020	009A	Extending the lead time for IHCal Support Rings	1.04 HCal	\$22,132,943	\$0	\$4,867,056	\$27,000,000
3/31/2020	011A	Added management labor for EMCal block production. EMCal Powder and TPC Sampa Cost and Delivery Schedule update	1.02 TPC and 1.03 EMCal	\$22,193,813	\$60,870	\$4,806,187	\$27,000,000
4/28/2020	013A	EMCal Block assembly contract details schedule update	1.03 EMCal	\$22,195,549	\$ 1,736	\$4,804,451	\$27,000,000
5/27/2020	014A	EMCal Light guides delivery schedule; EMCal SiPM daughterboards for Sectors 13-64 contract schedule	1.03 EMCal and 1.05 Cal E	\$22,176,963	\$ (18,586)	\$4,823,037	\$27,000,000
6/19/2020	105A	COVID-19 Schedule Adjustments	All	\$22,198,743	\$ 21,780	\$4,801,257	\$27,000,000
10/30/2020	017A	Risk Reduction and Realization	1.2; 1.3; 1.4; 1.5	\$24,309,836	\$ 2,111,093.00	\$2,690,164	\$27,000,000

Critical Path

Activity ID	Activity Name	Completion %	Total	Start	Finish	BL Project Start	BL Project Finish	Variance - BL Project Finish Date	Budgeted Labor Units	Budgeted Nonlabor Units	Budgeted Total Cost	BL Project Total Cost	2019 FY19	2020 FY20	2021 FY21	2022 FY22
S172900	Prepare fiber assemblies for final blocks	529	0	21-Jun-19 A	02-Aug-21	21-Aug-19	02-Aug-21	0	9360	0	163,757	163,757				
S171800	Procure EMCAL Epoxy for Final Blocks - Delivery Acceptance	240	0	03-Aug-20 A	19-Jul-21	15-Jun-20	14-Jun-21	-24	0	90653	104,858	104,592				
S172500	Order parts and fabricate molds for EMCal Sectors 13-64 Blocks - Deliv	240	0	03-Aug-20 A	19-Jul-21	18-May-20	17-May-21	-43	0	26230	30,340	30,218				
S173300	Fabricate final blocks sector 16	18	0	21-Oct-20 A	16-Nov-20	10-Jul-20	17-Jul-20	-83	135	0	5,163	5,012				
S173400	Fabricate final blocks sector 17	6	0	17-Nov-20	24-Nov-20	20-Jul-20	27-Jul-20	-83	135	0	5,163	5,012				
S173500	Fabricate final blocks sector 18	6	0	25-Nov-20	04-Dec-20	28-Jul-20	04-Aug-20	-83	135	0	5,163	5,012				
S173600	Fabricate final blocks sector 19	6	0	07-Dec-20	14-Dec-20	05-Aug-20	12-Aug-20	-83	135	0	5,163	5,012				
S187700	Install light guides on final blocks M&S	266	0	10-Dec-20	04-Jan-22	02-Sep-20	30-Sep-21	-62	0	1650	1,924	1,912				
S188100	Install SiPMs daughterboards on final blocks M&S	266	0	11-Dec-20	05-Jan-22	11-Sep-20	08-Oct-21	-57	0	300	350	348				
S173700	Fabricate final blocks sector 20	6	0	15-Dec-20	22-Dec-20	13-Aug-20	20-Aug-20	-83	135	0	5,163	5,012				
S173800	Fabricate final blocks sector 21	6	0	23-Dec-20	31-Dec-20	21-Aug-20	28-Aug-20	-83	135	0	5,163	5,012				
S173900	Fabricate final blocks sector 22	6	0	04-Jan-21	11-Jan-21	31-Aug-20	08-Sep-20	-83	135	0	5,163	5,012				
S174000	Fabricate final blocks sector 23	6	0	12-Jan-21	20-Jan-21	09-Sep-20	16-Sep-20	-83	135	0	5,163	5,012				
S174100	Fabricate final blocks sector 24	6	0	21-Jan-21	28-Jan-21	17-Sep-20	24-Sep-20	-83	135	0	5,163	5,012				
S174200	Fabricate final blocks sector 25	6	0	29-Jan-21	05-Feb-21	25-Sep-20	02-Oct-20	-83	135	0	5,163	5,062				
S174300	Fabricate final blocks sector 26	6	0	08-Feb-21	16-Feb-21	05-Oct-20	13-Oct-20	-83	135	0	5,163	5,163				
S174400	Fabricate final blocks sector 27	6	0	17-Feb-21	24-Feb-21	14-Oct-20	21-Oct-20	-83	135	0	5,163	5,163				
S174500	Fabricate final blocks sector 28	6	0	25-Feb-21	04-Mar-21	22-Oct-20	29-Oct-20	-83	135	0	5,163	5,163				
S174600	Fabricate final blocks sector 29	6	0	05-Mar-21	12-Mar-21	30-Oct-20	06-Nov-20	-83	135	0	5,163	5,163				
S174700	Fabricate final blocks sector 30	6	0	15-Mar-21	22-Mar-21	09-Nov-20	17-Nov-20	-83	135	0	5,163	5,163				
S174800	Fabricate final blocks sector 31	6	0	23-Mar-21	30-Mar-21	18-Nov-20	25-Nov-20	-83	135	0	5,163	5,163				
S174900	Fabricate final blocks sector 32	6	0	31-Mar-21	07-Apr-21	30-Nov-20	07-Dec-20	-83	135	0	5,163	5,163				
S175000	Fabricate final blocks sector 33	6	0	08-Apr-21	15-Apr-21	08-Dec-20	15-Dec-20	-83	135	0	5,163	5,163				
S175100	Fabricate final blocks sector 34	6	0	16-Apr-21	23-Apr-21	16-Dec-20	23-Dec-20	-83	135	0	5,163	5,163				
S175200	Fabricate final blocks sector 35	6	0	26-Apr-21	03-May-21	24-Dec-20	04-Jan-21	-83	135	0	5,163	5,163				
S175300	Fabricate final blocks sector 36	6	0	04-May-21	11-May-21	05-Jan-21	12-Jan-21	-83	135	0	5,163	5,163				
S175400	Fabricate final blocks sector 37	6	0	12-May-21	19-May-21	13-Jan-21	21-Jan-21	-83	135	0	5,163	5,163				
S175500	Fabricate final blocks sector 38	6	0	20-May-21	27-May-21	22-Jan-21	29-Jan-21	-83	135	0	5,163	5,163				
S175600	Fabricate final blocks sector 39	6	0	28-May-21	07-Jun-21	01-Feb-21	08-Feb-21	-83	135	0	5,163	5,163				
S175700	Fabricate final blocks sector 40	6	0	06-Jun-21	15-Jun-21	09-Feb-21	17-Feb-21	-83	135	0	5,163	5,163				
S175800	Fabricate final blocks sector 41	6	0	16-Jun-21	23-Jun-21	18-Feb-21	25-Feb-21	-83	135	0	5,163	5,163				
S175900	Fabricate final blocks sector 42	6	0	24-Jun-21	01-Jul-21	26-Feb-21	05-Mar-21	-83	135	0	5,163	5,163				
S176000	Fabricate final blocks sector 43	6	0	02-Jul-21	12-Jul-21	08-Mar-21	15-Mar-21	-83	135	0	5,163	5,163				
S176100	Fabricate final blocks sector 44	6	0	13-Jul-21	20-Jul-21	16-Mar-21	23-Mar-21	-83	135	0	5,163	5,163				
S176200	Fabricate final blocks sector 45	6	0	21-Jul-21	28-Jul-21	24-Mar-21	31-Mar-21	-83	135	0	5,163	5,163				
S176300	Fabricate final blocks sector 46	6	0	29-Jul-21	05-Aug-21	01-Apr-21	08-Apr-21	-83	135	0	5,163	5,163				
S176400	Fabricate final blocks sector 47	6	0	06-Aug-21	13-Aug-21	09-Apr-21	16-Apr-21	-83	135	0	5,163	5,163				
S176500	Fabricate final blocks sector 48	6	0	16-Aug-21	23-Aug-21	19-Apr-21	26-Apr-21	-83	135	0	5,163	5,163				
S176600	Fabricate final blocks sector 49	6	0	24-Aug-21	31-Aug-21	27-Apr-21	04-May-21	-83	135	0	5,163	5,163				
S176700	Fabricate final blocks sector 50	6	0	01-Sep-21	09-Sep-21	05-May-21	12-May-21	-83	135	0	5,163	5,163				
S176800	Fabricate final blocks sector 51	6	0	10-Sep-21	17-Sep-21	13-May-21	20-May-21	-83	135	0	5,163	5,163				
S176900	Fabricate final blocks sector 52	6	0	20-Sep-21	27-Sep-21	21-May-21	28-May-21	-83	135	0	5,163	5,163				
S177000	Fabricate final blocks sector 53	6	0	29-Sep-21	05-Oct-21	01-Jun-21	08-Jun-21	-83	135	0	5,240	5,163				
S177100	Fabricate final blocks sector 54	6	0	06-Oct-21	14-Oct-21	09-Jun-21	16-Jun-21	-83	135	0	5,318	5,163				
S177200	Fabricate final blocks sector 55	6	0	15-Oct-21	22-Oct-21	17-Jun-21	24-Jun-21	-83	135	0	5,318	5,163				
S177300	Fabricate final blocks sector 56	5	0	25-Oct-21	29-Oct-21	25-Jun-21	02-Jul-21	-82	135	0	5,318	5,163				
S177400	Fabricate final blocks sector 57	5	0	01-Nov-21	05-Nov-21	06-Jul-21	13-Jul-21	-81	135	0	5,318	5,163				
S177500	Fabricate final blocks sector 58	5	0	08-Nov-21	15-Nov-21	14-Jul-21	21-Jul-21	-80	135	0	5,318	5,163				
S177600	Fabricate final blocks sector 59	5	0	16-Nov-21	22-Nov-21	22-Jul-21	29-Jul-21	-79	135	0	5,318	5,163				
S177700	Fabricate final blocks sector 60	5	0	23-Nov-21	01-Dec-21	30-Jul-21	06-Aug-21	-78	135	0	5,318	5,163				
S177800	Fabricate final blocks sector 61	5	0	02-Dec-21	08-Dec-21	09-Aug-21	16-Aug-21	-77	135	0	5,318	5,163				
S177900	Fabricate final blocks sector 62	5	0	09-Dec-21	15-Dec-21	17-Aug-21	24-Aug-21	-76	135	0	5,318	5,163				
S178000	Fabricate final blocks sector 63	5	0	16-Dec-21	22-Dec-21	25-Aug-21	01-Sep-21	-75	135	0	5,318	5,163				
S178100	Fabricate final blocks sector 64	5	0	23-Dec-21	30-Dec-21	02-Sep-21	10-Sep-21	-74	135	0	5,318	5,163				
S178900	Pack and ship final blocks for sectors 57-64 to BNL - Purchased Servic	1	0	03-Jan-22	03-Jan-22	21-Sep-21	27-Sep-21	-64	41	0	2,638	2,561				
S176010	Pack and ship final blocks for sectors 57-64 to BNL - M&S	1	0	03-Jan-22	03-Jan-22	13-Sep-21	17-Sep-21	-70	0	6480	7,672	7,521				

Variance Analysis

WBS 1.02A

Reporting Period: 10/1/2020 - 10/31/2020

TPC (Thomas Hemmick [H5685])

	BCWS	BCWP	ACWP	SV in \$	SV in %	CV in \$	CV %	SPI	CPI
Current:	188,845	171,160	27,233	-17,685	-9%	143,927	84%	0.91	6.28
Cumulative:	2,599,784	2,161,620	1,827,285	-438,165	-17%	334,335	15%	0.83	1.18

BAC

At Complete: 4,702,483

Threshold(s) Exceeded: Cumulative Schedule, Cumulative Cost

Explanation of Variance/Description of Problem:

WBS 1.2.2-4.3 – TPC GEM Modules R1, R2, R3 – Procure TPC Module Parts – The Pad Planes for R3 and R2 are complete and received but those for R1 not yet built, thus R1 modules have not started construction. This leads to a -\$69K of SV. The GEM foil work at CERN has started and first foils are delivered but was delayed due to COVID thus the overall rate is behind schedule, resulting in -\$33K of SV. The v2 field cage work is behind schedule (-\$6K) but the handling cart is ahead (+\$14K) WBS 1.2.7 TPC Support System - Laser – new conceptual cost-saving design for laser optics agreed upon only in May. The implications of this had to be propagated through the balance of the laser system design. A PDR was held for the laser system and decision taken to proceed to procurement and set up of an initial system. The initial procurement of a laser has been done but most parts remain to be ordered. This leads to -\$225K of SV. We note there has now been +\$27K of progress in this area now. WBS 1.2.7 TPC Support System – Gas System – An evaluation to ascertain which existing parts from the PHENIX HBD gas system could be reused vs replaced/upgraded has delayed purchase of identical parts until the inventory is complete. This leads to -\$61K of SV. We note that there has been +\$27K of progress in this area now. WBS 1.2.7 TPC Support System – Cooling System – Bench test required for validation delayed due to COVID. This leads to -\$57K of SV.

Impact:

WBS 1.2.2-4.3 – TPC GEM Modules R1, R2, R3 – Procure TPC Module Parts – impact none. R1 pad plane has 50 days float. WBS 1.2.7 TPC Support System - Laser impact none. Completion and test of the laser system has 100 days float. WBS 1.2.7 TPC Support System – Gas System – Impact none. The system has 63 days float. WBS 1.2.7 TPC Support System – Cooling System – Impact none. The system has 31 days float.

Corrective Action:

WBS 1.2.2-4.3 – TPC GEM Modules R1, R2, R3 – Procure TPC Module Parts – New Pad Planes - R3 and R2 complete, R1 designs submitted for quote. WBS 1.2.7 TPC Support System - Laser – Design concept finalized, design review finished, prototype under construction. WBS 1.2.7 TPC Support System – Gas System – First parts now on order, design review finished, prototype under construction. WBS 1.2.7 TPC Support System – Cooling System – Tests have been completed with initial FEE cards, validate the design and demonstrate adequate cooling power; design review finished, prototype under construction.

Prepared By:

Irina Sourikova [22419]

Date:

11/24/2020

Approved By:

Edward O'Brien [18368]

Date:

11/24/2020