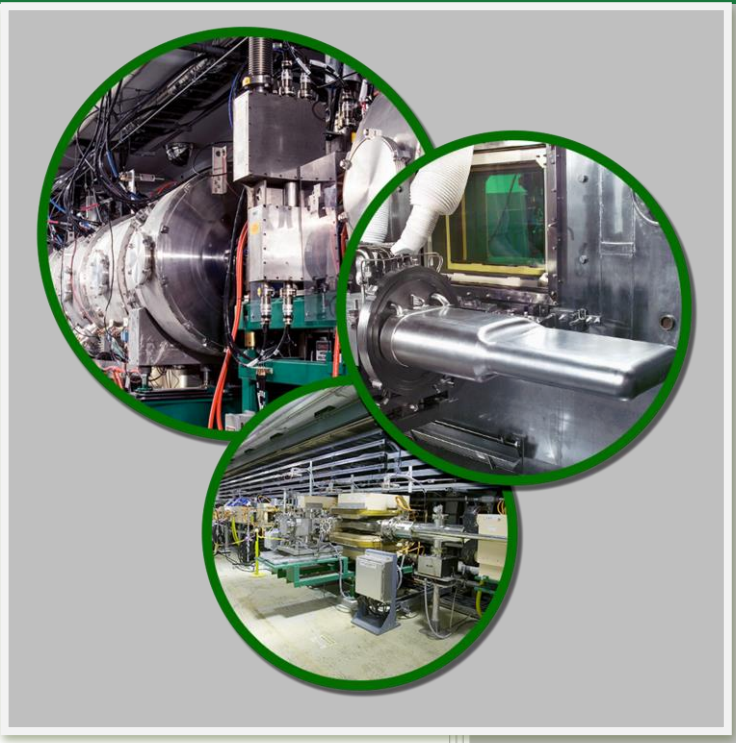
PPUP-100-PI039-R00

PROTON POWER UPGRADE (PPU) PROJECT

Monthly Progress Report



June 2021

Report Due Date: **July 31, 2021**
Project Director: **John Galambos**

OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE US DEPARTMENT OF ENERGY

PROTON POWER UPGRADE (PPU) PROJECT
Monthly Progress Report

June 2021

Approved by: Mark Champion Digitally signed by Mark Champion Date: 2021.07.28 09:50:54 -04'00'

Mark Champion, PPU Project Management Group Leader

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Overall Assessment

Proton Power Upgrade Project highlights for the month of June 2021 are as follows:

- *The project continues to proceed as planned with good earned-value performance metrics. However, it is becoming increasingly apparent that vendor schedules are being impacted by supply chain disruptions caused by the COVID-19 pandemic. The project team is working closely with the vendors to accommodate and/or mitigate these delays where feasible.*

- *The following reviews were conducted in June:*
  - *Ring personnel protection system final design review, June 10th*

- *Final design completeness is at approximately 98% (versus 92% at CD-2/3 review).*

Annual DOE Milestones

Seventeen milestones were selected by the project and DOE to monitor FY21 progress. The status of the milestones is summarized in the following table and presented in the associated technical sections. One milestone was successfully completed in June.

System		Milestone Name	Planned Finish	Actual Date	Current Forecast	Owner
P.2	**Super Conducting Linac (SCL) Systems**					
	P2319MS05	Completion of Cryomodule Shipping Tests (Jlab)	20-Jun-21	23-Feb-21		Matt Howell
	P228MS197	Award Contract for Inner Extension, Outer Extension, and Waveguide Cover	01-Aug-21	27-Apr-21		Matt Howell
P.3	**Radio Frequency (RF) Systems**					
	P362P90	Award of Remaining High Voltage Converter Modulator (HVCM) Transformers Complete	12-Apr-21	18-Dec-20		John Moss
	P333MS002	Receipt of 3MW Klystron Test Article	03-Aug-21		16-Sep-21	John Moss
	P342MS50	Fabrication of Low Level Radio Frequency (LLRF) Platform Complete	15-Sep-21		29-Oct-21	John Moss
P.4	**Ring Systems**					
	P422P175MS	Award Contract for Fabrication of Chicane 2/3 (and Spare), Injection Dump Septum Magnets and Spare Coil Sets	04-May-21	28-Apr-21		Nick Evans
	P462D384	Preliminary Design Review of Beam Power Limiting System (BPLS) Complete	04-May-21	04-Mar-21		Nick Evans
	P432DFDC	Final Design of Injection Dump Imaging System Complete	29-Jun-21	18-May-21		Nick Evans
	P462D454	Final Design of PPS Interface Complete	06-Sep-21	29-Jun-21		Nick Evans
	P432P979	Fabrication of Injection Dump Window Full Assembly for Installation Complete	30-Sep-21		20-Aug-21	Nick Evans
P.5	**First Target Station (FTS) Systems**					
	P5921MS006	Award Contract for 2MW Target	29-Nov-20	30-Oct-20		Bernie Riemer
	P5921MS140	Fabrication of PPU Front Body Development Test Article Complete	01-Mar-21	26-Feb-21		Bernie Riemer
	P5942MS145	Fabrication of PPU Test Target 1 Shroud Complete	12-Jul-21		23-Aug-21	Bernie Riemer
	P542MS230	Award Contract for Ortho/Para Converter Vessel Assembly	18-Jul-21		30-Aug-21	Bernie Riemer
	P582MS10	Fabrication of Second Carbon Delay Bed Vessel and Cartridge Complete	30-Sep-21	03-May-21		Bernie Riemer
P.10	**Long Lead Procurements (LLPs)**					
	P222MS06	Receipt of Last Five Production Cavities at Jlab	13-May-21	25-Feb-21		Matt Howell
	P621PM01	Conventional Facilities (CF) Construction of Klystron Gallery Complete	13-May-21	06-Apr-21		Mark Connell

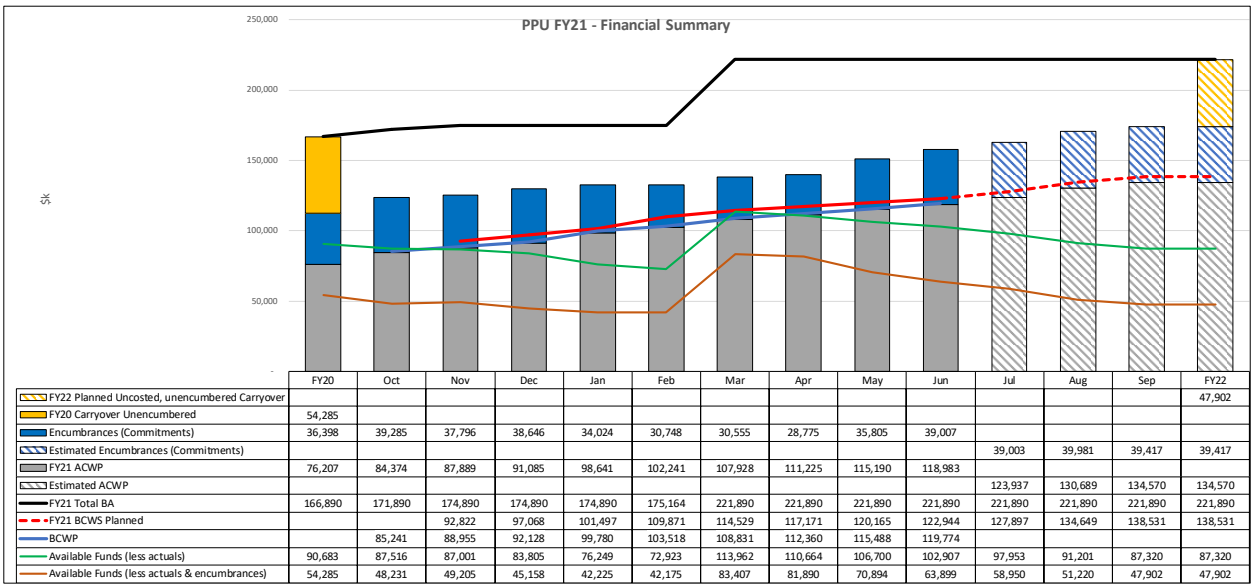
Legend: Green - On/Ahead of Schedule, Yellow - Moderately Late (<3 months), Red - Very Late (>3 months) or Critical Path (>1 month)

Project Cost Overview

Level 2 Cost Summary

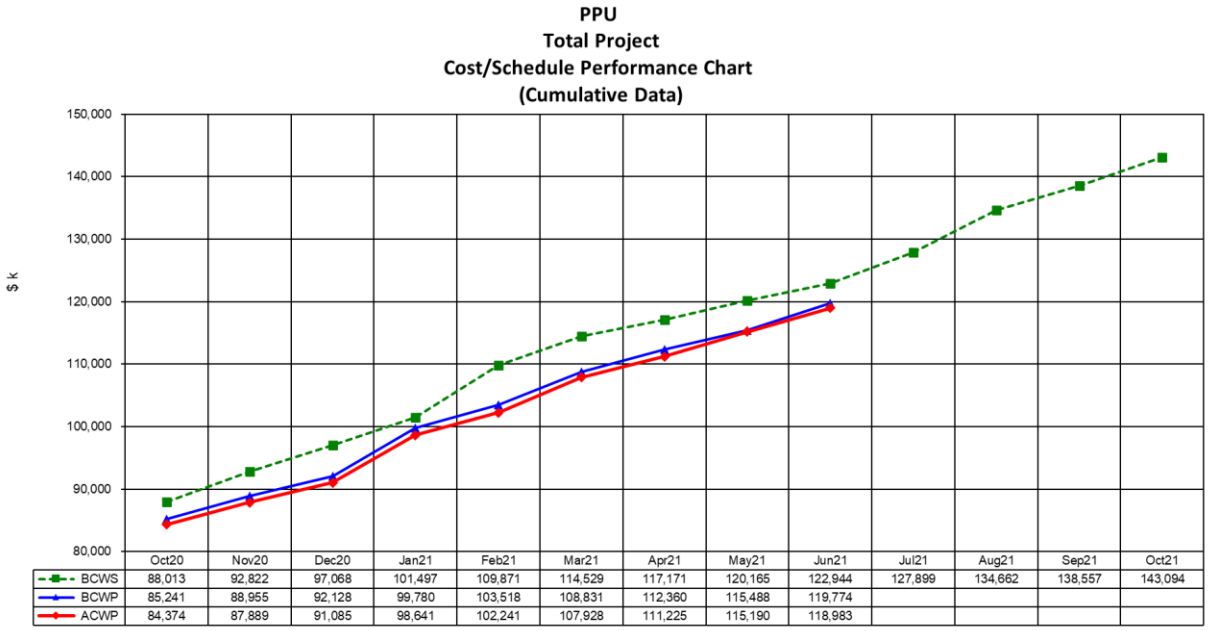
WBS Description	Prior Costs	Prior FY21 Costs	June Costs	Total FY21 Costs	Total Costs to Date	Commits (with OH)
P.1 Project Management	5,883,425	2,554,017	392,429	2,946,446	8,829,871	742,534
P.2 SCL Systems	5,924,975	2,519,223	378,703	2,897,926	8,822,902	9,248,431
P.3 RF Systems	12,347,958	7,183,942	480,201	7,664,144	20,012,101	11,082,760
P.4 Ring Systems	6,980,063	2,712,651	369,642	3,082,293	10,062,356	2,952,423
P.5 First Target Station Systems	10,224,569	6,806,296	1,764,270	8,570,566	18,795,136	5,681,074
P.6 Conventional Facilities	2,522,645	323,059	33,222	356,281	2,878,926	44,617
P.7 R&D (OPC)	2,265,525	62,492	-	62,492	2,328,017	1,070
P.8 Pre-Ops (OPC)	56,292	19,911	396	20,308	76,599	-
P.9 Pre-CD1 Activities (OPC)	7,249,768	-	-	-	7,249,768	-
P.10 Long Lead Procurements	22,751,625	16,801,967	375,460	17,177,427	39,929,053	9,254,238
Total PPU	**76,206,845**	**38,983,559**	**3,794,325**	**42,777,884**	**118,984,729**	**39,007,148**

Detailed Financial Plan



	FY20	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	FY22
FY22 Planned Uncosted, unencumbered Carryover														47,902
FY20 Carryover Unencumbered	54,285													
Encumbrances (Commitments)	36,398	39,285	37,796	38,646	34,024	30,748	30,555	28,775	35,805	39,007				
Estimated Encumbrances (Commitments)											39,003	39,981	39,417	39,417
FY21 ACWP	76,207	84,374	87,889	91,085	98,641	102,241	107,928	111,225	115,190	118,983				
Estimated ACWP											123,937	130,689	134,570	134,570
FY21 Total BA	166,890	171,890	174,890	174,890	174,890	175,164	221,890	221,890	221,890	221,890	221,890	221,890	221,890	221,890
FY21 BCWS Planned			92,822	97,068	101,497	109,871	114,529	117,171	120,165	122,944	127,897	134,649	138,531	138,531
BCWP		85,241	88,955	92,128	99,780	103,518	108,831	112,360	115,488	119,774				
Available Funds (less actuals)	90,683	87,516	87,001	83,805	76,249	72,923	113,962	110,664	106,700	102,907	97,953	91,201	87,320	87,320
Available Funds (less actuals & encumbrances)	54,285	48,231	49,205	45,158	42,225	42,175	83,407	81,890	70,894	63,899	58,950	51,220	47,902	47,902

Earned Value Performance Charts



	Oct20	Nov20	Dec20	Jan21	Feb21	Mar21	Apr21	May21	Jun21	Jul21	Aug21	Sep21	Oct21
BCWS	88,013	92,822	97,068	101,497	109,871	114,529	117,171	120,165	122,944	127,899	134,662	138,557	143,094
BCWP	85,241	88,955	92,128	99,780	103,518	108,831	112,360	115,488	119,774				
ACWP	84,374	87,889	91,085	98,641	102,241	107,928	111,225	115,190	118,983				

As shown in the following Contract Performance Report, the project performance indices are SPI = .97 and CPI = 1.01.

CONTRACT PERFORMANCE REPORT
FORMAT 1 - WORK BREAKDOWN STRUCTURE
PERFORMANCE DATA (WBS Level 2)

June ($k)	CURRENT PERIOD					CUMULATIVE TO DATE							AT COMPLETE		
	BCWS	BCWP	ACWP	VARIANCE		BCWS	BCWP	ACWP	VARIANCE				BAC	EAC	VAC
ITEM				SV	CV				SV	SPI	CV	CPI			
P.01 - PPU Project Management	382	398	392	16	5	9,213	9,213	8,830	0	1.00	384	1.04	22,169	21,786	383
P.02 - SCL Systems	368	112	379	(256)	(267)	9,609	8,986	8,823	(623)	0.94	163	1.02	23,887	23,719	168
P.03 - RF Systems	664	720	480	56	240	19,844	20,317	20,012	472	1.02	304	1.02	44,061	44,030	31
P.04 - Ring Systems	552	233	370	(319)	(136)	10,511	9,440	10,062	(1,072)	0.90	(623)	0.94	20,551	21,346	(795)
P.05 - First Target Station Systems	611	2,337	1,763	1,725	574	18,195	18,800	18,794	605	1.03	7	1.00	34,544	34,655	(111)
P.06 - Conventional Facilities	51	22	33	(28)	(11)	2,809	2,794	2,879	(15)	0.99	(85)	0.97	10,900	10,985	(86)
P.07 - R&D	54	0	0	(54)	0	2,321	2,315	2,328	(6)	1.00	(13)	0.99	2,476	2,489	(13)
P.08 - Pre-Ops	5	5	0	0	4	92	92	77	0	1.00	15	1.19	1,137	1,122	15
P.09 - Pre-CD-1 Activities	0	0	0	0	0	7,250	7,250	7,250	0	1.00	0	1.00	7,250	7,250	0
P.10 - Long Lead Procurements	92	460	375	367	84	43,099	40,567	39,929	(2,531)	0.94	638	1.02	49,785	49,503	282
TOTAL	2,779	4,286	3,793	1,507	493	122,944	119,774	118,983	-3,170	0.97	791	1.01	216,761	216,886	-125
Cumulative Thresholds:									Management Reserve				5,338	5,338	
• Red: CPI/SPI <0.85 or >+1.20 AND >$100k									Contingency				49,469	49,343	
• Yellow: CPI/SPI between 0.85-0.90 or 1.15-1.20 AND >$100k									TPC				271,567	271,567	

Project Change Requests

The project continues appropriate configuration management to incorporate PCRs to ensure the project maintains an accurate baseline against which project performance can be accurately measured. The impact of PCRs implemented this month was a net increase to the baseline of $60K.

The impacts by L2 are shown in the following table.

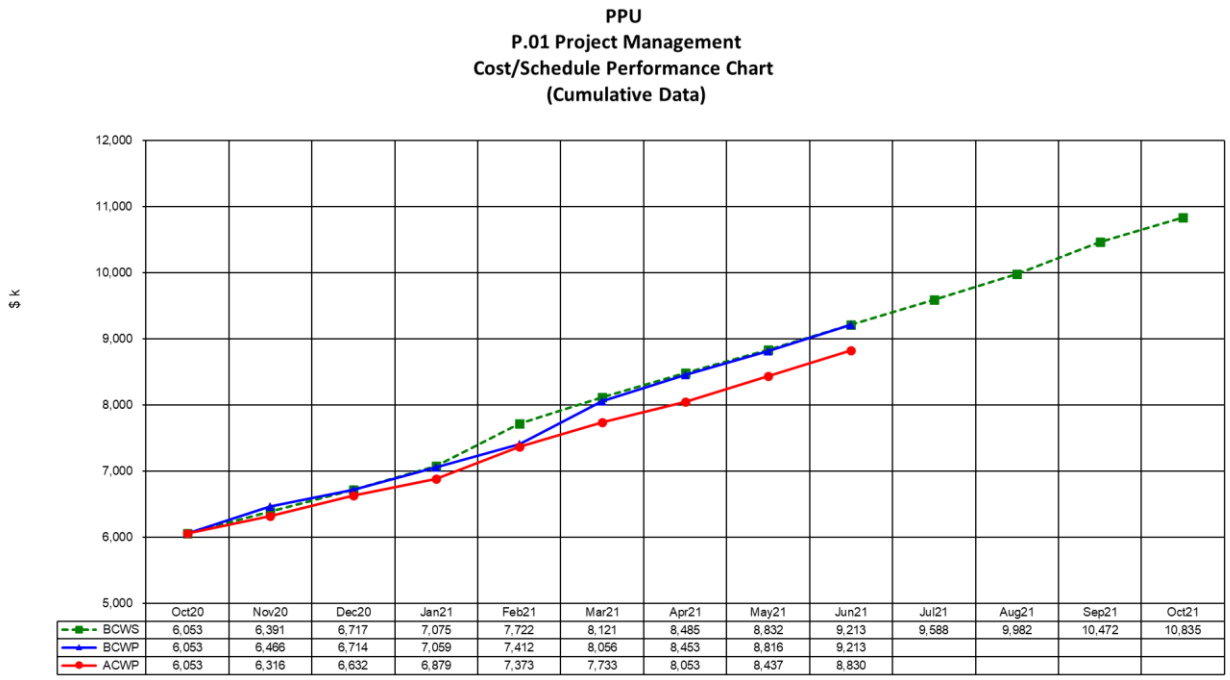
$k	May 2021 Baseline	June 2021 Baseline
P.01 Project Management	22,169	22,169
P.02 SCL Systems	24,082	23,887
P.03 RF Systems	43,696	44,061
P.04 Ring Systems	20,662	20,551
P.05 First Target Station Systems	34,544	34,544
P.06 Conventional Facilities	10,900	10,900
P.07 R&D	2,476	2,476
P.08 Pre-Ops	1,137	1,137
P.09 Pre CD-1 Activities	7,250	7,250
P.10 Long Lead Procurements	49,785	49,785
Revised Baseline	216,701	216,761
Management Reserve	5,105	5,338
Contingency	49,762	49,469
PPU - Total with Contingency	271,567	271,567

P.1 Project Management

Preparations are underway for the Director's Review that will be conducted the first week of August.

- The committee membership is complete and confirmed
- The agenda is complete and synchronized with the September Independent Project Review (IPR) draft agenda
- The charge questions are the same as those for the September IPR
- Dry run presentations are scheduled
- May cost and schedule data will be used for the Director's review and IPR

Earned Value Performance Charts



As shown in the following Contract Performance Report, the Project Management performance indices are SPI = 1.00 and CPI = 1.04.

CONTRACT PERFORMANCE REPORT
FORMAT 1 - WORK BREAKDOWN STRUCTURE
PERFORMANCE DATA (Control Account)

June ($k)	CURRENT PERIOD					CUMULATIVE TO DATE							AT COMPLETE		
				VARIANCE					VARIANCE						
ITEM	BCWS	BCWP	ACWP	SV	CV	BCWS	BCWP	ACWP	SV	SPI	CV	CPI	BAC	EAC	VAC
P.01 - PPU Project Management	**382**	**398**	**392**	**16**	**5**	**9,213**	**9,213**	**8,830**	**0**	**1.00**	**384**	**1.04**	**22,169**	**21,786**	**383**
P.01.01 - Project Management	62	78	61	16	18	2,051	2,051	2,025	0	1.00	26	1.01	4,572	4,546	26
P.01.02 - Project Support	276	276	277	0	(2)	6,037	6,037	5,661	0	1.00	376	1.07	14,778	14,402	376
P.01.03 - ESH&Q	44	44	54	0	(10)	1,125	1,125	1,144	0	1.00	(18)	0.98	2,820	2,838	(18)

Cumulative Thresholds: * Red: CPI/SPI <0.85 or >+1.20 AND >$100k * Yellow: CPI/SPI between 0.85-0.90 or 1.15-1.20 AND >$100k

P.2 Superconducting Linac (SCL) Systems

Seventeen cavities have been qualified and fourteen cavities have been installed in helium vessels. Eight cavities have been qualified for the first and second cryomodules. Testing and evaluation continues to determine the cause of field emission in the tanked cavity process.

A nineth cavity has been qualified and will be tested in the horizontal testing apparatus (HTA). The cavity was received at SNS, adapter flanges have been welded, and beam line assembly has begun. The HTA has been delivered to the radio frequency test facility to begin assembly effort.

The ¼" lines are complete for cavity string 1 with two cavities having brazed joints. The tuners are installed and the string is ready for fundamental power coupler bellows welding. Cavities and couplers are ready for cavity string 2 assembly.

Procurements are in process for the eighth cryomodule. A quote for the eighth set of end cans was received and approved.

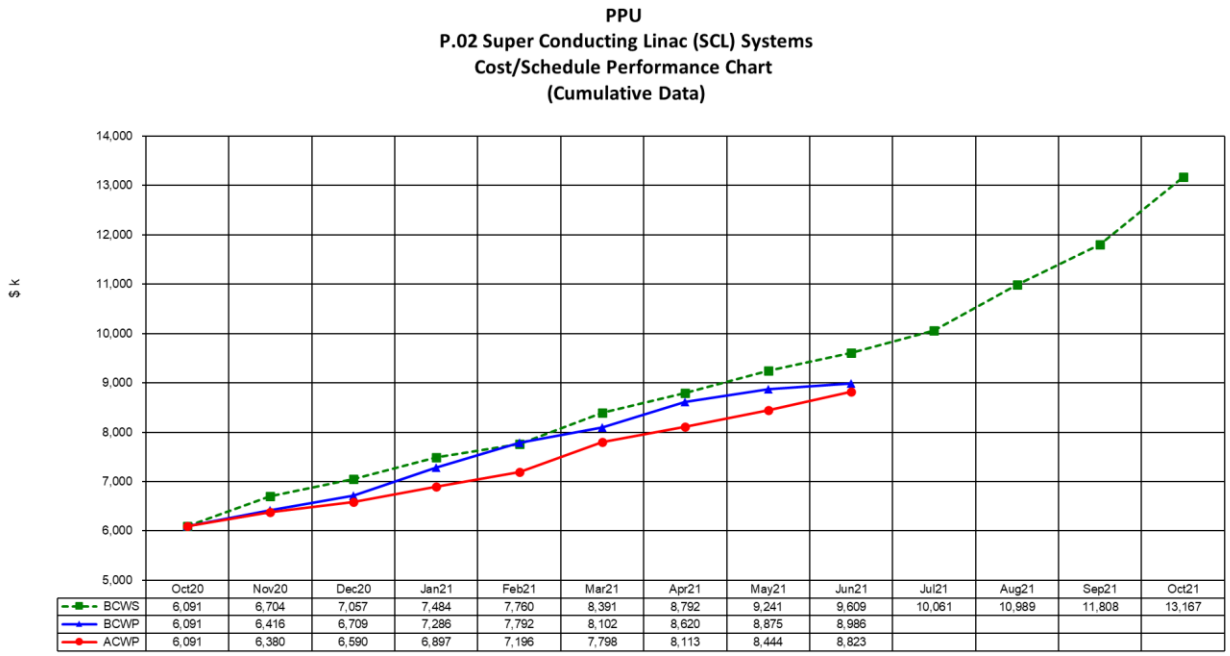
Plasma processing for SNS cryomodule 11 was completed in April and the cryomodule has been installed in the tunnel.

Fourteen couplers have been delivered to Jefferson Lab. An additional four couplers are scheduled for delivery in July.

Milestone Table

P.2 SCL Systems	Planned Finish	Actual Finish	Current Forecast	Owner
Completion of Cryomodule Shipping Tests (JLab)	20-Jun-21	23-Feb-21		Matt Howell
Award Contract for Inner Extension, Outer Extension, and Waveguide Cover	01-Aug-21	27-Apr-21		Matt Howell

Earned Value Performance Charts



As shown in the following Contract Performance Report, the Superconducting Linac Systems performance indices are SPI = .94 and CPI = 1.02.

CONTRACT PERFORMANCE REPORT
FORMAT 1 - WORK BREAKDOWN STRUCTURE
PERFORMANCE DATA (Control Account)

June ($k) ITEM	CURRENT PERIOD BCWS	BCWP	ACWP	VARIANCE SV	CV	CUMULATIVE TO DATE BCWS	BCWP	ACWP	VARIANCE SV	SPI	CV	CPI	AT COMPLETE BAC	EAC	VAC
P.02 - SCL Systems	**368**	**112**	**379**	**(256)**	**(267)**	**9,609**	**8,986**	**8,823**	**(623)**	**0.94**	**163**	**1.02**	**23,887**	**23,719**	**168**
P.02.01 - Management and System Integration	29	29	18	0	10	927	927	857	0	1.00	70	1.08	1,122	1,052	70
P.02.02 - Cavities	(12)	(91)	20	(78)	(110)	1,711	1,179	1,313	(533)	0.69	(134)	0.90	2,474	2,615	(141)
P.02.03 - Cryomodule Integration (Partner Laboratory Scope)	330	148	320	(183)	(172)	5,519	5,389	5,253	(130)	0.98	136	1.03	14,186	14,050	136
P.02.04 - Cryogenics	3	3	0	0	3	70	70	35	0	1.00	36	2.03	826	791	36
P.02.05 - Utility Systems	6	10	4	5	6	116	122	89	6	1.05	33	1.37	1,022	977	46
P.02.06 - System Integration	7	7	0	0	7	303	410	339	107	1.35	70	1.21	2,229	2,159	70
P.02.07 - SCL Controls	6	6	17	0	(11)	963	890	937	(73)	0.92	(47)	0.95	2,027	2,075	(47)

Cumulative Thresholds: * Red: CPI/SPI <0.85 or >+1.20 AND >$100k * Yellow: CPI/SPI between 0.85-0.90 or 1.15-1.20 AND >$100k

Title: P.02.02.05.05 / ORNL - Testing - Coupler Acquisition (SPI = .80)
Cause: RF Conditioning of couplers has slowed due to the availability of the RF test stand and the recovery of hardware from JLab due to slow string assembly.
Impact: There is no impact on the cryomodule string assembly at Jlab. Jlab currently has 10 conditioned RF couplers. RF coupler testing continues with delivery of couplers ahead of the Jlab string assembly schedule. Plans are to deliver 4 couplers to Jlab in July.
Recoverable: Yes.
Corrective Action: None.

Title: P.02.06.05.04 / ORNL - Installation - Plasma Process MB Cryomodule in Tunnel (SPI = 2.08)
Cause: All planned plasma processing on medium beta cryomodules was completed ahead of schedule due to the earily availability of cryomodules in the linac maintenance program.
Impact: None.
Recoverable: Yes.
Corrective Action: None.

P.3 Radio Frequency (RF) Systems

CPI submitted the production plan for the balance of the 700kW klystrons. The High-Power RF (HPRF) team returned comments which CPI will incorporate and resubmit in July.

The Utilities team continued to support technical equipment installation activities including placement of equipment racks and their associated overhead cable tray.

The Low-Level RF (LLRF) team completed testing and acceptance of all Frequency Conversion and Arc Detector chassis. All of the µTCA crates, shelf managers, and filler cards for the LLRF platform have been received and work continues on the in-situ calibration routines for the High-power Protection Module (HPM-II).

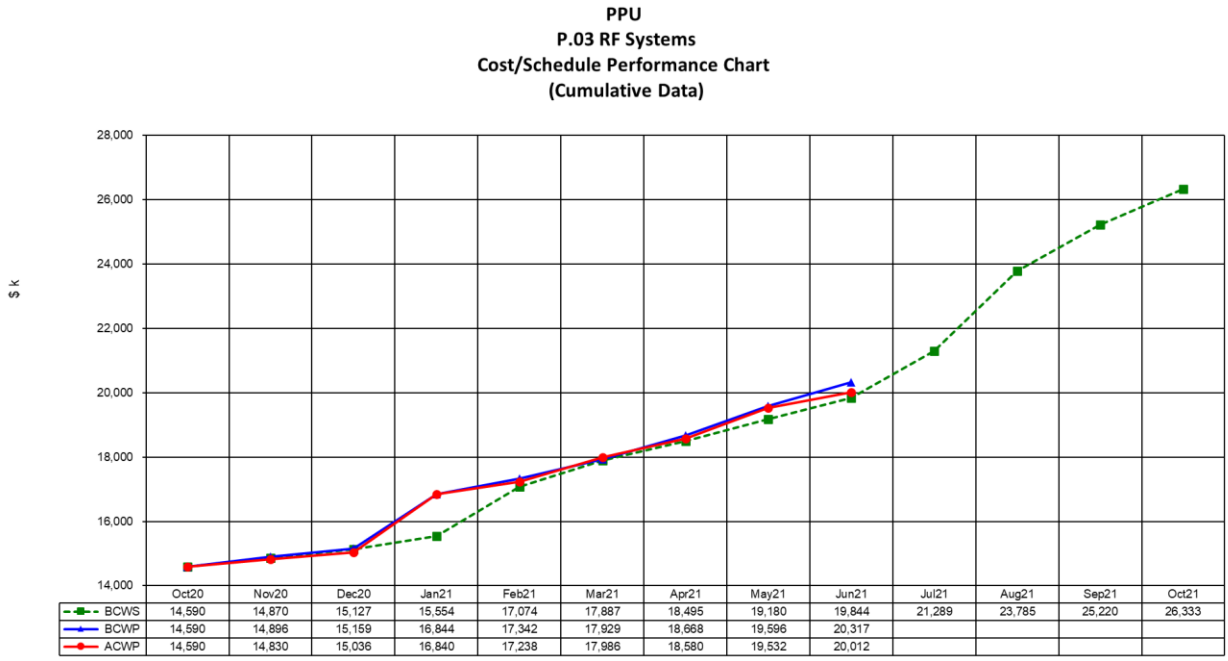
Milestone Table

P.3 RF Systems	Planned Finish	Actual Finish	Current Forecast	Owner
Award of Remaining HVCM Transformers Complete	12-Apr-21	18-Dec-20		John Moss
Receipt of 3MW Klystron Test Article	03-Aug-21		16-Sep-21*	John Moss
Fabrication of LLRF Platform Complete	15-Sep-21		29-Oct-21**	John Moss

**3MW klystron schedule delays are being caused by bottle-necking at the CPI cold test facility, a dynamic fabrication load at the factory, and a leak found in the vacuum oven at the start of the klystron processing. CPI has installed parallel cold testing lines to alleviate the bottleneck and repaired the vacuum leak. The PPU RF team is actively working with CPI to recover the lost time and will make a factory visit at the end of July during the 3MW factory acceptance testing.*

***The LLRF platform is late due to the significant increase in lead time for the electronic components needed for the printed circuit boards. The lead times have increased from approximately 16 weeks to 52. These longer lead times are being experienced across the industry and are attributed to lagging COVID-induced delays.*

Earned Value Performance Charts



As shown in the following Contract Performance Report, Radio Frequency Systems performance indices are SPI = 1.02 and CPI = 1.02.

CONTRACT PERFORMANCE REPORT
FORMAT 1 - WORK BREAKDOWN STRUCTURE
PERFORMANCE DATA (Control Account)

June ($k) ITEM	CURRENT PERIOD					CUMULATIVE TO DATE							AT COMPLETE		
	BCWS	BCWP	ACWP	VARIANCE SV	VARIANCE CV	BCWS	BCWP	ACWP	VARIANCE SV	VARIANCE SPI	VARIANCE CV	VARIANCE CPI	BAC	EAC	VAC
P.03 - RF Systems	**664**	**720**	**480**	**56**	**240**	**19,844**	**20,317**	**20,012**	**472**	**1.02**	**304**	**1.02**	**44,061**	**44,030**	**31**
P.03.01 - Management and System Integration	10	10	11	0	(1)	375	375	369	0	1.00	5	1.01	534	529	5
P.03.02 - SCL HPRF	1	0	3	(1)	(3)	4,919	4,919	4,892	(0)	1.00	27	1.01	12,965	13,072	(107)
P.03.03 - NCL HPRF	175	0	1	(175)	(1)	1,297	1,097	1,084	(200)	0.85	14	1.01	4,985	5,000	(15)
P.03.04 - LLRF	323	86	70	(237)	16	4,027	4,661	4,560	635	1.16	101	1.02	5,947	5,873	74
P.03.05 - Existing Linac Modulators	39	134	32	96	102	3,155	3,185	3,235	30	1.01	(50)	0.98	4,869	4,957	(87)
P.03.06 - New Linac Modulators	39	92	46	53	46	2,686	2,634	2,492	(52)	0.98	142	1.06	5,322	5,225	97
P.03.07 - Utilities	39	347	302	308	44	2,351	2,430	2,444	79	1.03	(14)	0.99	7,728	7,742	(14)
P.03.08 - RF Controls	22	12	13	(10)	(1)	577	565	513	(12)	0.98	52	1.10	982	930	51
P.03.09 - RF/SCL Global Controls	16	39	2	23	37	458	450	423	(8)	0.98	27	1.06	729	702	26

Cumulative Thresholds: * Red: CPI/SPI <0.85 or >+1.20 AND >$100k * Yellow: CPI/SPI between 0.85-0.90 or 1.15-1.20 AND >$100k

Title: P.03.04.02.03 / ORNL - Procure/Fab - LLRF System (SPI = 1.56)
Cause: This positive schedule variance is due to early receipt of all Frequency Conversion Chassis (FrCC) components ($88K), as well as early partial receipts of both LLRF Platform components ($144K). These positive variances are somewhat offset by later than planned receipt of some picoammeter components (-$10K).
Impact: No negative impact is expected due to early full and early partial shipments being received. The early receipt of LLRF platform components does not mitigate schedule pressure because portions of all components are needed to allow for testing.
Recoverable: Yes.
Corrective Action: None, this positive variance will go away as the scheduled receipt dates of these items occurs. The largest part, LLRF platform components, will be in August 2021 and the remaining FrCCs will be in July.

Title: P.03.04.03.03 / ORNL - Procure/Fab - LLRF System (SPI = 8.96)
Cause: This positive schedule variance is due to early receipt of all arc detectors (~$373K).
Impact: No impact due to early receipt of arc detectors since installation waits on racks to be installed.
Recoverable: Yes.
Corrective Action: None, this positive variance will go away as the scheduled receipt dates of these items occurs. The arc detectors are scheduled for receipt in August 2021.

P.4 Ring Systems

Fermilab has placed the first purchase order of the magnet fabrication scope. A contract to build the chicane winding fixture was awarded to WPA Works LLC on June 21st. Several bids were received for the injection dump quadrupole, and a meeting has been scheduled for the evaluation team to discuss the proposals and select a vendor for this magnet.

The ring injection dump vacuum windows (Figure 1) were sent to Stony Brook for coating with the luminescent material that will provide light for the measurement of the beam position on the dump window. These windows will be coated and returned to Keller Technology for final fabrication of the window assembly in July. The fiducial masks used during the coating of the windows will be shipped to ORNL for use in a mock-up of the ring injection dump line used for optical system tests.

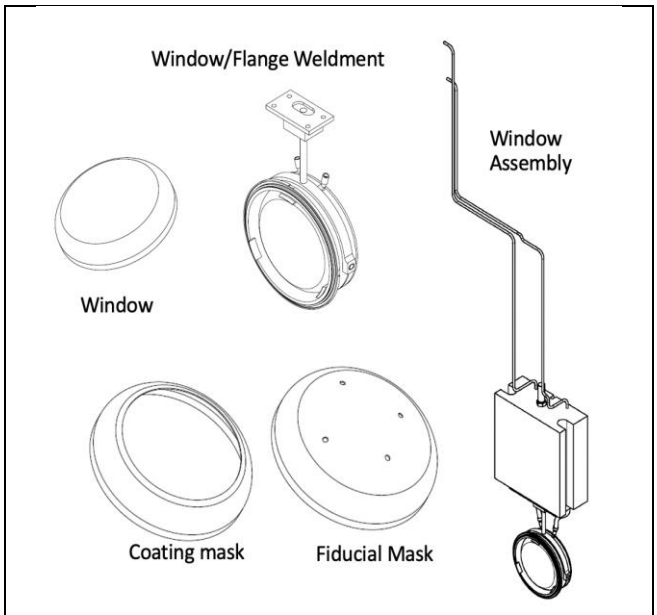


Figure 1: Window components and final assembly. The window (upper left) and coating and fiducial masks were sent to Stony Brook this month and will be returned to Keller for final assembly in July.

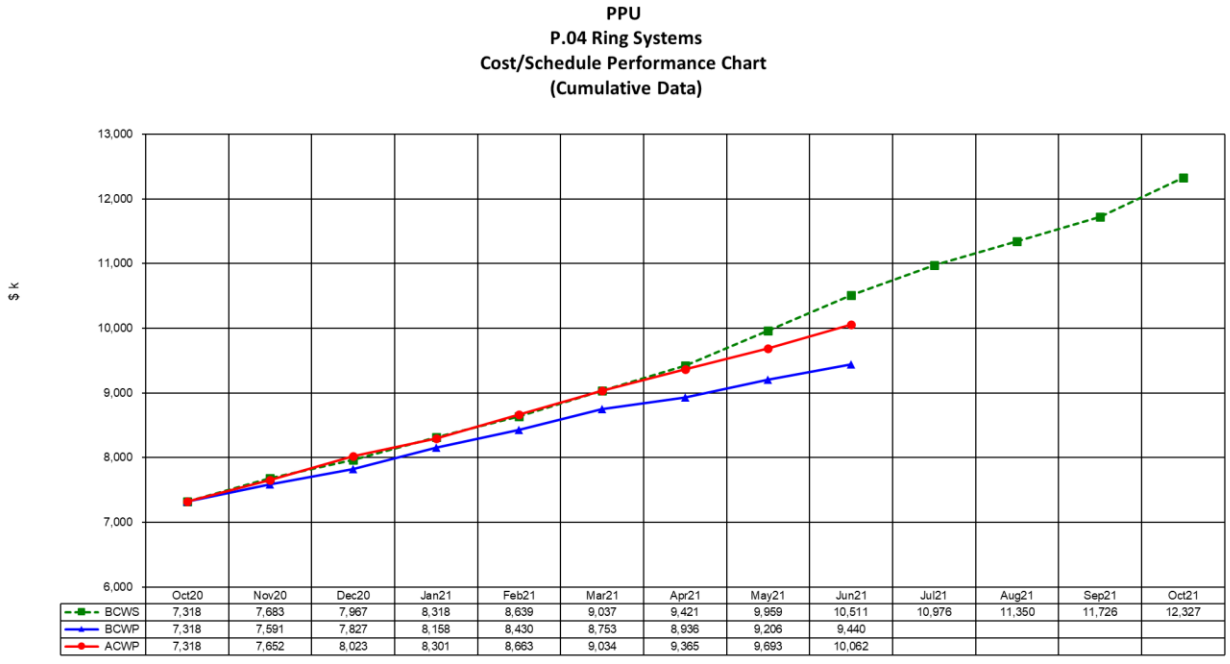
A contract was placed for the remaining fast current transformer (FCT) for the Beam Power Limit System (BPLS). A test article is currently installed in the Ring-Target Beam Transport (RTBT) line. The second device will be installed in the spring of 2022.

A final design review was held for the RTBT personnel protection system (PPS) interface. This scope includes upgraded and expanded PPS racks in the RTBT service building to modernize hardware, and accommodate new PPS connections required by the RTBT stub and BPLS. Equipment related to this work was ordered shortly after and will be installed in the next outage beginning in October 2021.

Milestone Table

P.4 Ring Systems	Planned Finish	Actual Finish	Current Forecast	Owner
Award Contract for Fabrication of Chicane 2/3 (and Spare), Injection Dump Septum Magnets and Spare Coil Sets	04-May-21	28-Apr-21		Nick Evans
Preliminary Design Review of Beam Power Limiting System (BPLS) Complete	04-May-21	04-Mar-21		Nick Evans
Final Design of Injection Dump Imaging System Complete	29-Jun-21	18-May-21		Nick Evans
Final Design of PPS Interface Complete	06-Sep-21	22-Jun-21		Nick Evans
Fabrication of Injection Dump Window Full Assembly for Installation Complete	30-Sep-21		20-Aug-21	Nick Evans

Earned Value Performance Charts



As shown in the following Contract Performance Report, Ring Systems performance indices are SPI = .90 and CPI = .94.

CONTRACT PERFORMANCE REPORT
FORMAT 1 - WORK BREAKDOWN STRUCTURE
PERFORMANCE DATA (Control Account)

June ($k)	CURRENT PERIOD					CUMULATIVE TO DATE							AT COMPLETE		
				VARIANCE					VARIANCE						
ITEM	BCWS	BCWP	ACWP	SV	CV	BCWS	BCWP	ACWP	SV	SPI	CV	CPI	BAC	EAC	VAC
P.04 - Ring Systems	**552**	**233**	**370**	**(319)**	**(136)**	**10,511**	**9,440**	**10,062**	**(1,072)**	**0.90**	**(623)**	**0.94**	**20,551**	**21,346**	**(795)**
P.04.01 - Management and System Integration	10	10	13	0	(4)	566	566	597	0	1.00	(31)	0.95	1,176	1,206	(31)
P.04.02 - Injection Region	169	112	114	(57)	(2)	3,296	3,193	3,351	(104)	0.97	(158)	0.95	7,816	8,125	(309)
P.04.03 - Injection Dump	122	38	33	(84)	6	1,104	939	935	(165)	0.85	4	1.00	1,421	1,431	(11)
P.04.04 - Extraction Region	2	2	10	(0)	(8)	1,254	1,247	1,299	(7)	0.99	(52)	0.96	2,217	2,269	(52)
P.04.05 - Utilities	3	3	2	0	2	449	448	423	(1)	1.00	25	1.06	1,767	1,742	25
P.04.06 - Ring Control Systems	245	67	198	(178)	(131)	3,757	2,962	3,380	(795)	0.79	(418)	0.88	5,883	6,308	(425)
P.04.07 - RTBT Stub	0	0	0	0	0	35	35	35	0	1.00	0	1.00	165	165	0
P.04.08 - Accelerator Physics	2	2	1	0	1	49	49	42	0	1.00	7	1.16	107	100	7

Cumulative Thresholds: * Red: CPI/SPI <0.85 or >+1.20 AND >$100k * Yellow: CPI/SPI between 0.85-0.90 or 1.15-1.20 AND >$100k

Title: P.04.06.02.02 / ORNL - Design - Beam Power Limit System (SPI = .78, CPI = .85)
Cause: The Beam Power Limit System (BPLS) scope was not identified as part of the original project scope. When the need for this system was realized, the cost and schedule was developed quickly. It became apparent that in some cases the necessary level of schedule detail and some required elements were not included in the plan at that time. Additionally, in order to address comments and recommendations from the BPLS Preliminary Design Review, the plan for the digital portion of the design was reworked, delaying planned activities.
Impact: To meet the installation schedule, work proceeded on in-scope tasks that are not currently detailed in the baseline schedule (e.g., design review documents baselined at a summary level). These are incurring cost with no earned value. In addition, the PDR-related design changes are understood and have been communicated to the review committee with positive feedback. While the re-design activity has caused a schedule delay, the new design is simplified so the meeting the original scheduled installation dates is still possible.
Recoverable: Possibly.
Corrective Action: The addition of schedule detail and the corresponding estimates to ensure a robust schedule is in process. A to-go forecast will be finalized in July and a PCR will be processed so the baseline is at a sufficient level of detail to effectively manage the BPLS scope.

P.5 First Target Station (FTS) Systems

A report was issued for tests conducted on the mercury system Overflow Tank (OFT) level sensor – a new type provided by KROHNE. The sensor is radiation hard and compatible with mercury. Tests were conducted in a mercury test apparatus at the Target Test Facility (TTF) with satisfactory results obtained for operation and data readout. A spare OFT level sensor was ordered.

Hardware for mockup testing for installation and operation of the OFT is on track for scheduled completion (Figure 2). ORNL shops are producing the hardware and all major machining steps are complete. Tests are scheduled to commence in early August.

Figure 2: Left: Mockup shield blocks for the OFT. Right: mockup mercury pump tank, shield platform and OFT (dark cylinder).

The long-lead gas compressors for target gas recirculation were received from the German vendor KNF (Figure 3). This model had been extensively tested in the TTF and provided reliable service. Four compressors were received. The project provides two recirculation trains – one for target bubblers and one for the nose injector. Each train has an active and a backup compressor. Compressors are constructed from sufficiently radiation resistant materials. The vendor recommends periodic replacement of diaphragms because of fatigue – hence, the need for secondary units.

Figure 3: KNF diaphragm gas compressors for target gas recirculation.

The Mercury Off-gas Treatment Systems (MOTS) delay bed (vessel, shielding, piping) installation began in the June outage (Figure 4) and is scheduled to complete mid-July. Authorization to operate is expected in the current run cycle.

Figure 4: PPU MOTS Delay bed in the Gold Amalgamation Room in early stage of installation.

The MOTS Cold Trap shield housing fabrication was readied for lead pouring (Figure 5-L). The copper-oxide reactor shielding is in a similar state (Figure 5-R).

Figure 5: Left: MOTS cold trap shield housing. Right: CuO shield housing.

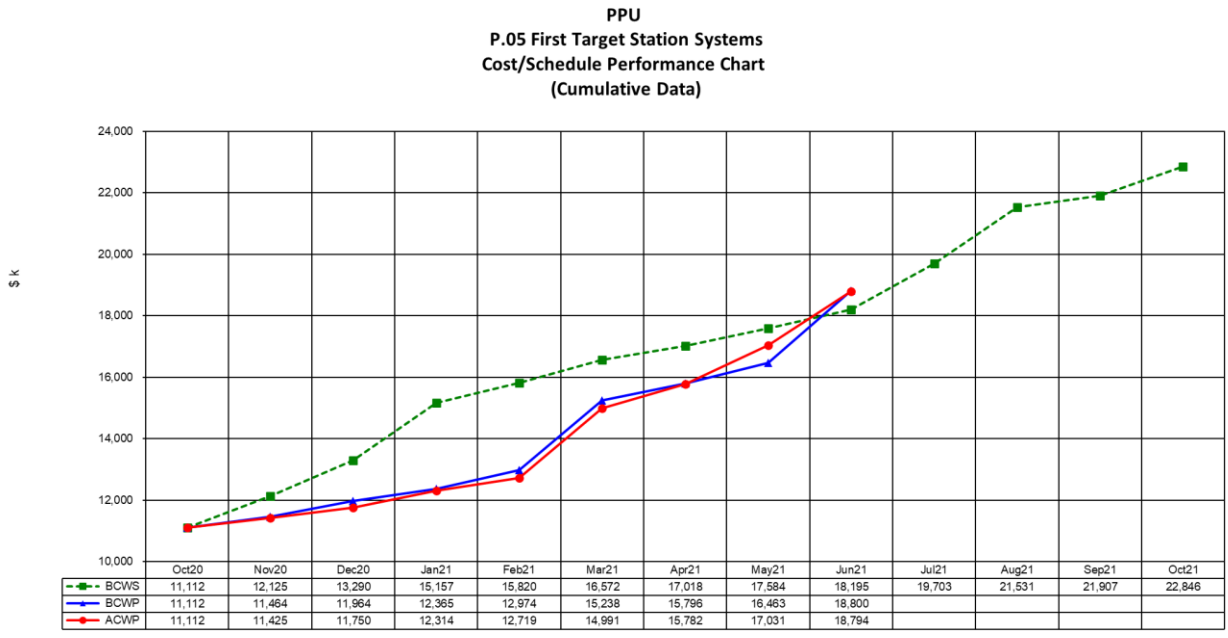
Milestone Table

P.5 First Target Station Systems	Planned Finish	Actual Finish	Current Forecast	Owner
Award Contract for 2MW Target	29-Nov-20	30-Oct-20		Bernie Riemer
Fabrication of PPU Front Body Development Test Article Complete	01-Mar-21	26-Feb-21		Bernie Riemer
Fabrication of PPU Test Target 1 Shroud Complete	12-Jul-21		23-Aug-21*	Bernie Riemer
Award Contract for Ortho/Para Converter Vessel Assembly	18-Jul-21		30-Aug-21**	Bernie Riemer
Fabrication of Second Carbon Delay Bed Vessel and Cartridge Complete	30-Sep-21	03-May-21		Bernie Riemer

**Weld defects in the final electron beam weld of PPU Test TT#1 water-cooled shroud were found by ORNL inspectors. After repair and reinspection, delivery of TT#1 is now anticipated at the end of August or beginning of September.*

***The solicitation for the Ortho/Para Converter Vessel Assembly missed being issued in May. Issues with procurement package documents were resolved and the solicitation was issued in early June. Eight companies have been approached.*

Earned Value Performance Chart



As shown in the following Contract Performance Report, First Target Station Systems performance indices are SPI = 1.03 and CPI =1.00.

CONTRACT PERFORMANCE REPORT
FORMAT 1 - WORK BREAKDOWN STRUCTURE
PERFORMANCE DATA (Control Account)

June ($k)	CURRENT PERIOD					CUMULATIVE TO DATE							AT COMPLETE		
				VARIANCE					VARIANCE						
ITEM	BCWS	BCWP	ACWP	SV	CV	BCWS	BCWP	ACWP	SV	SPI	CV	CPI	BAC	EAC	VAC
P.05 - First Target Station Systems	**611**	**2,337**	**1,763**	**1,725**	**574**	**18,195**	**18,800**	**18,794**	**605**	**1.03**	**7**	**1.00**	**34,544**	**34,655**	**(111)**
P.05.01 - Management and System Integration	39	39	36	0	3	1,122	1,122	1,120	0	1.00	2	1.00	2,798	2,796	2
P.05.02 - Neutronics	0	0	0	0	0	473	473	474	0	1.00	(1)	1.00	473	474	(1)
P.05.03 - Mercury Process Systems	24	6	54	(18)	(48)	1,852	1,726	2,007	(126)	0.93	(281)	0.86	2,496	2,777	(281)
P.05.04 - Moderator Cryogenic Systems	10	11	1	0	10	1,459	1,347	1,412	(112)	0.92	(65)	0.95	2,513	2,583	(70)
P.05.05 - Vessel and Shielding Systems	0	0	0	0	0	446	446	446	0	1.00	0	1.00	446	446	0
P.05.06 - Target Utility Systems	97	164	166	67	(2)	2,106	1,851	1,475	(256)	0.88	376	1.26	3,819	3,445	374
P.05.07 - Instrument Systems	0	0	0	0	0	40	40	40	0	1.00	0	1.00	40	40	0
P.05.08 - MOTS	271	81	49	(190)	32	966	884	817	(82)	0.92	67	1.08	2,065	1,998	67
P.05.09 - 2 MW Target	154	2,018	1,368	1,864	650	6,818	8,477	8,412	1,659	1.24	66	1.01	15,103	15,038	64
P.05.10 - Safety, Controls and Operations	16	18	88	2	(70)	1,300	842	1,138	(458)	0.65	(295)	0.74	3,180	3,583	(403)
P.05.11 - Gas Injection Development	0	0	1	0	(1)	1,613	1,591	1,454	(22)	0.99	137	1.09	1,613	1,476	137

Cumulative Thresholds: * Red: CPI/SPI <0.85 or >+1.20 AND >$100k * Yellow: CPI/SPI between 0.85-0.90 or 1.15-1.20 AND >$100k

Variance Explanations

Title: P.05.06.04.02 / ORNL - Design - Upgrades for Gas Injection (CPI = 1.30)
Cause: Subcontractor and internal staff design effort continued to progress in June, but a positive cost variance persists as resource ramp up was slower than expected.
Impact: None. The variance will likely resolve itself over time.
Recoverable: Yes.
Corrective Action: A purchase requisition was processed in June for additional subcontractor work in July. This is expected to alleviate the cost variance over time. The control account manager will continue to closely monitor the cost of design.

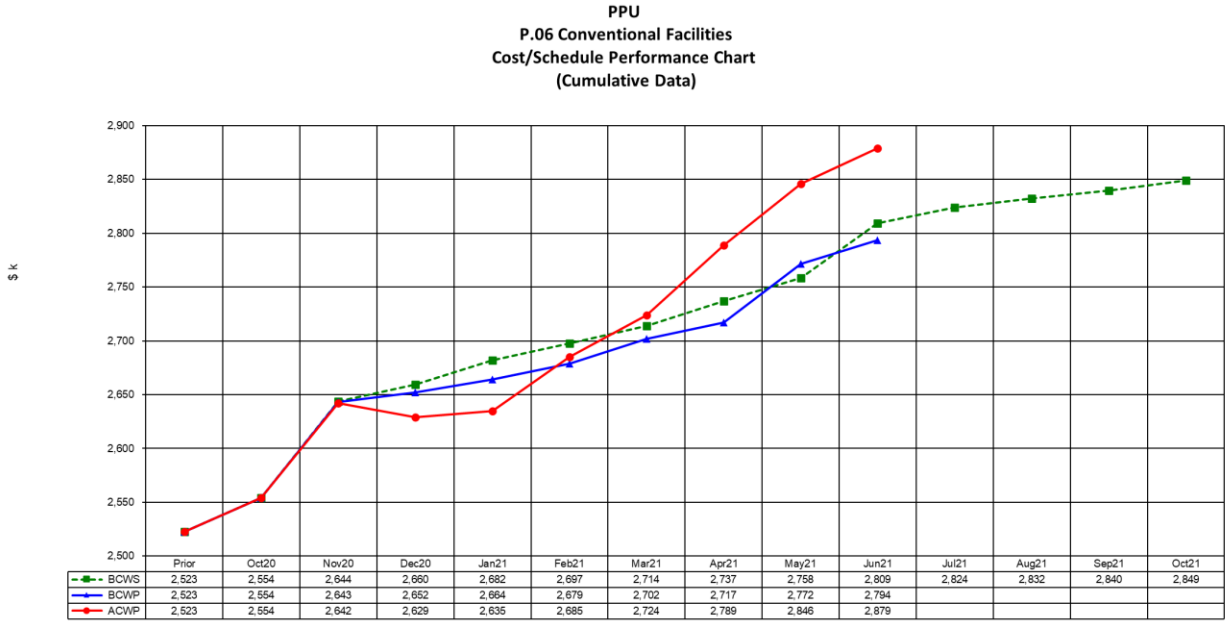
Title: P.05.09.02.03.03 / ORNL - Procure/Fab - Target Module Assembly (SPI = 1.91)
Cause: The completion of water cooled shroud front sleeves was completed early by the vendor.
Impact: None. The completion of the milestone occurred early and will resolve itself.
Recoverable: Yes.
Corrective Action: Regular communication will be kept with the vendor to track completion of milestones.

Title: P.05.10.03.02 / ORNL - Design - Controls Integration (SPI = .44; CPI = .53)
Cause: Target Controls design work is behind schedule due to late completion of requirements (P&ID, PCD) from other target subsystems. In particular, there is a resource shortage to provide mechanical information which needs to be resolved for parts of the Controls Design. The cost has increased due to design changes which increased the number of I/O points to be controlled.
Impact: Delays in starting design work could lead to delays in implementation and installation.
Recoverable:
Corrective Action: Two additional engineers will begin working part-time on Target Controls scope in mid-August to accelerate progress versus the schedule. A PCR will be needed due to the increased cost for additional scope.

P.6 Conventional Facilities

The focus of Conventional Facilities team has been preparation for the DOE status review.

Earned Value Performance Chart



As shown in the following Contract Performance Report, Conventional Facilities performance indices are SPI = .99 and CPI = .97.

CONTRACT PERFORMANCE REPORT
FORMAT 1 - WORK BREAKDOWN STRUCTURE
PERFORMANCE DATA (Control Account)

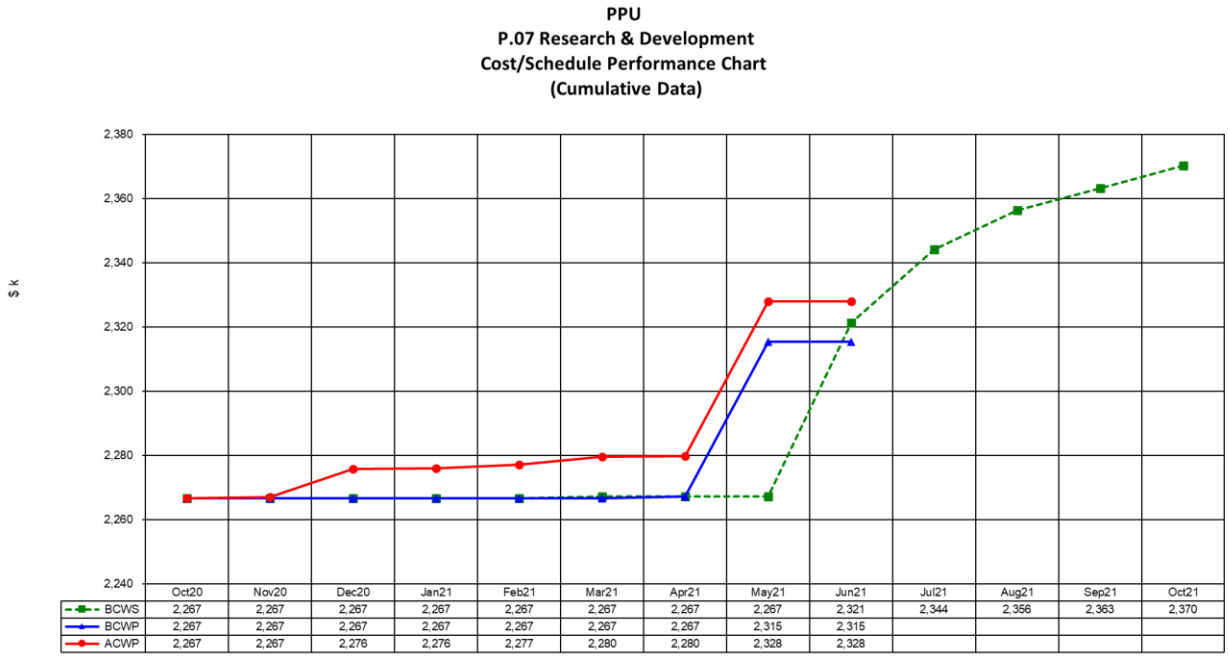
June ($k)	CURRENT PERIOD			VARIANCE		CUMULATIVE TO DATE			VARIANCE				AT COMPLETE		
ITEM	BCWS	BCWP	ACWP	SV	CV	BCWS	BCWP	ACWP	SV	SPI	CV	CPI	BAC	EAC	VAC
P.06 - Conventional Facilities	**51**	**22**	**33**	**(28)**	**(11)**	**2,809**	**2,794**	**2,879**	**(15)**	**0.99**	**(85)**	**0.97**	**10,900**	**10,985**	**(86)**
P.06.01 - Management and System Integration	6	6	4	0	2	179	179	165	0	1.00	14	1.08	309	295	14
P.06.02 - Building Modifications	44	16	29	(28)	(13)	2,630	2,615	2,714	(15)	0.99	(99)	0.96	10,591	10,691	(100)

Cumulative Thresholds: * Red: CPI/SPI <0.85 or >+1.20 AND >$100k * Yellow: CPI/SPI between 0.85-0.90 or 1.15-1.20 AND >$100k

P.7 R&D

No update.

Earned Value Performance Chart



As shown in the following Contract Performance Report, R&D performance indices are SPI = 1.00 and CPI = .99.

CONTRACT PERFORMANCE REPORT
FORMAT 1 - WORK BREAKDOWN STRUCTURE
PERFORMANCE DATA (Control Account)

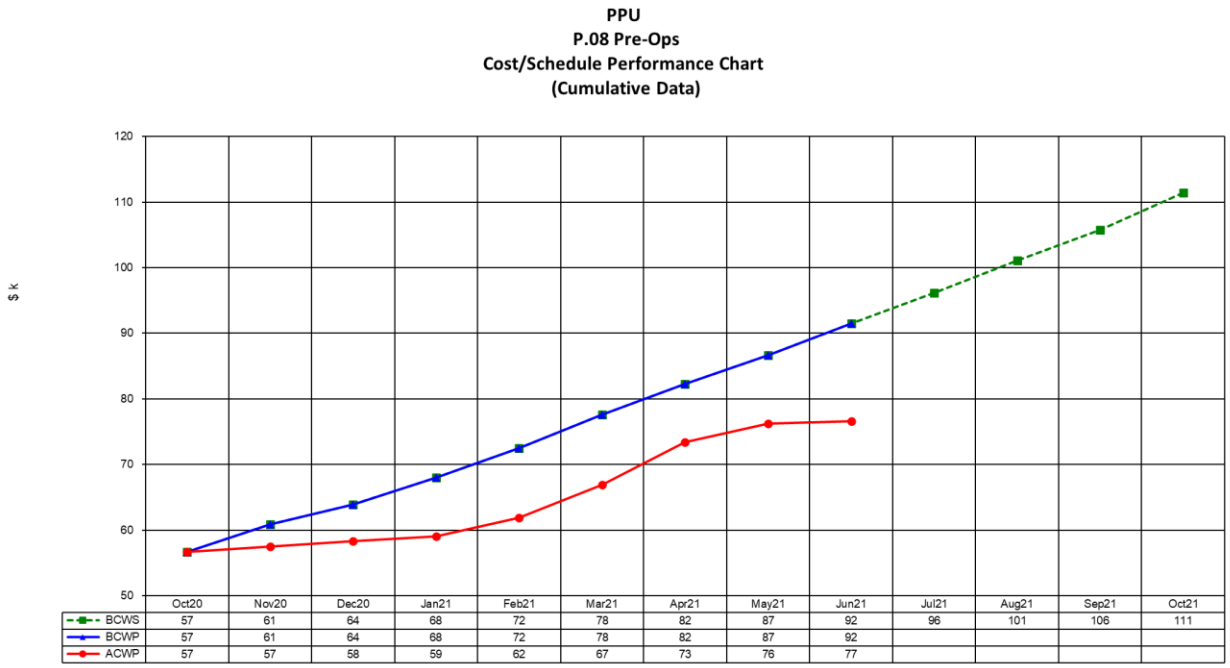
June ($k)	CURRENT PERIOD					CUMULATIVE TO DATE							AT COMPLETE		
				VARIANCE					VARIANCE						
ITEM	BCWS	BCWP	ACWP	SV	CV	BCWS	BCWP	ACWP	SV	SPI	CV	CPI	BAC	EAC	VAC
P.07 - R&D	**54**	**0**	**0**	**(54)**	**0**	**2,321**	**2,315**	**2,328**	**(6)**	**1.00**	**(13)**	**0.99**	**2,476**	**2,489**	**(13)**
P.07.01 - Gas Injection Development	0	0	0	0	0	1,992	1,992	1,992	0	1.00	0	1.00	1,992	1,992	0
P.07.02 - Foil Development	54	0	0	(54)	0	330	324	336	(6)	0.98	(13)	0.96	484	497	(13)

Cumulative Thresholds: * Red: CPI/SPI <0.85 or >+1.20 AND >$100k * Yellow: CPI/SPI between 0.85-0.90 or 1.15-1.20 AND >$100k

P.8 Pre-Ops

The Pre-Ops team participated in final design review for the Ring-Target Beam Transport personnel protection system final upgrade. The team also began preparing for the upcoming Directors Review.

Earned Value Performance Chart



As shown in the following Contract Performance Report, Pre-Ops performance indices are SPI = 1.00 and CPI = 1.19.

CONTRACT PERFORMANCE REPORT
FORMAT 1 - WORK BREAKDOWN STRUCTURE
PERFORMANCE DATA (Control Account)

June ($k) ITEM	CURRENT PERIOD BCWS	BCWP	ACWP	VARIANCE SV	CV	CUMULATIVE TO DATE BCWS	BCWP	ACWP	VARIANCE SV	SPI	CV	CPI	AT COMPLETE BAC	EAC	VAC
P.08 - Pre-Ops	**5**	**5**	**0**	**0**	**4**	**92**	**92**	**77**	**0**	**1.00**	**15**	**1.19**	**1,137**	**1,122**	**15**
P.08.01 - Commissioning	0	0	0	0	0	0	0	0	0		0		933	934	(0)
P.08.03 - Regulatory Compliance	5	5	0	0	4	92	92	77	0	1.00	15	1.19	204	189	15

Cumulative Thresholds: * Red: CPI/SPI <0.85 or >+1.20 AND >$100k * Yellow: CPI/SPI between 0.85-0.90 or 1.15-1.20 AND >$100k

P.10 Long Lead Procurements (LLP)

P.10.2 SCL Systems

- Supply end can #1 was returned to the vendor for rework. Supply end cans #2 passed the pressure and leak test and is awaiting further alignment tests. Supply end can #3 is at JLab and is awaiting leak check and inspection.
- Return end can #1 has been pressure tested and leak checked. Return end can #2 is ready for pressure and leak test.
- Vacuum vessel #1 has been received at JLab. Vacuum vessel #2 awaiting a third party dimensional inspection and is due to ship at the end of June. Vacuum vessel #3 is undergoing final post weld machining. Vacuum vessels #4 is awaiting first post weld machining. Vacuum vessels #5, #6, and #7 are progressing.

P.10.3 RF Systems

- The repaired first article circulator arrived at SNS and the HPRF team completed low power measurements. The return loss and insertion loss were -42 dB and -0.05 dB respectively. Both measurements exceeded specification. High power testing is scheduled to start in early July.
- L3Harris continued fabrication of the HPRF transmitters. They completed the weldments of all five control consoles and have started populating the consoles with chassis, feedthroughs, and the associated wiring. L3 completed the fit-up of the first transmitter cooling cart (TRCC) and started assembling the transmitter programming logic controllers.
- The HVCM Team traveled to Alpha-Omega to support the fabrication and testing of the first article alternate-topology high-voltage converter modulators (AT-HVCM) switch plate. The testing was successful.

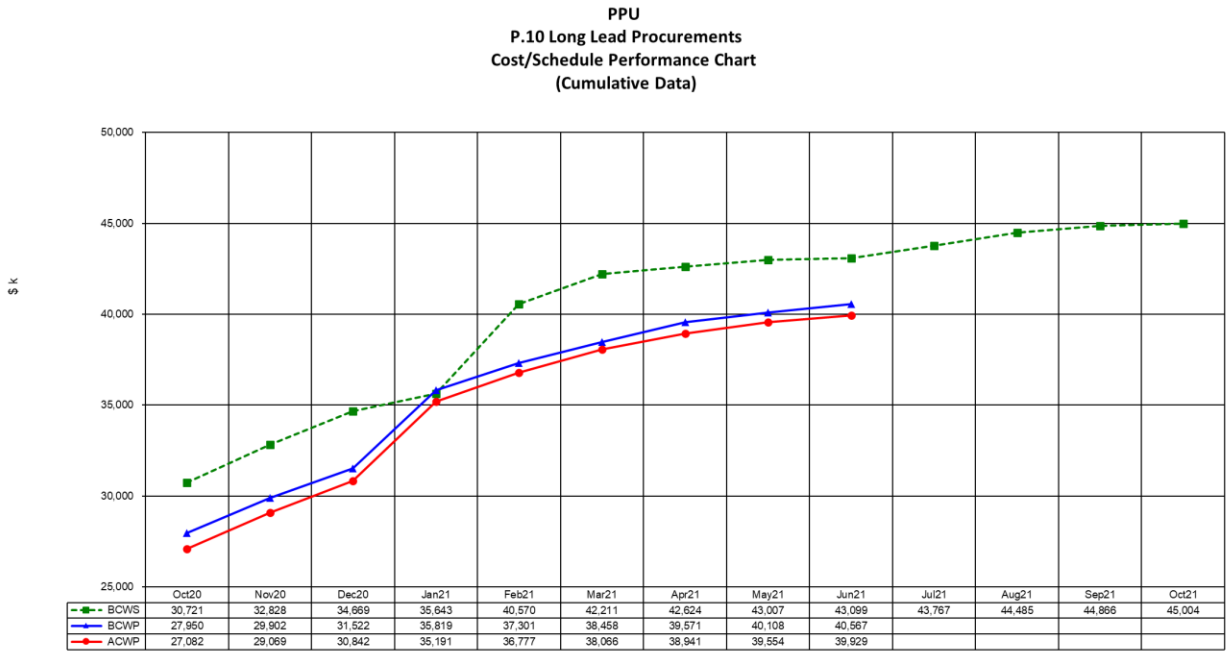
P.10.6 Conventional Facilities

- All field work complete.
- As-builts, operation and maintenance manuals, and warranty submittals are in progress.
- Multiple change orders were negotiated, accepted and are awaiting subcontract modification.
- The technical installation subcontractor has control of the Klystron Gallery area.
- Preparations for the DOE status review have begun.

Milestone Table

P.10 LLPs	Planned Finish	Actual Finish	Current Forecast	Owner
Receipt of Last Five Production Cavities at JLab	13-May-21	25-Feb-21		Matt Howell
CF Construction of Klystron Gallery Complete	13-May-21	06-Apr-21		Mark Connell

Earned Value Performance Chart



As shown in the following Contract Performance Report, Long Lead Procurements performance indices are SPI = .94 and CPI = 1.02.

CONTRACT PERFORMANCE REPORT
FORMAT 1 - WORK BREAKDOWN STRUCTURE
PERFORMANCE DATA (Control Account)

June ($k)	CURRENT PERIOD					CUMULATIVE TO DATE							AT COMPLETE		
				VARIANCE					VARIANCE						
ITEM	BCWS	BCWP	ACWP	SV	CV	BCWS	BCWP	ACWP	SV	SPI	CV	CPI	BAC	EAC	VAC
P.10 - Long Lead Procurements	**92**	**460**	**375**	**367**	**84**	**43,099**	**40,567**	**39,929**	**(2,531)**	**0.94**	**638**	**1.02**	**49,785**	**49,503**	**282**
P.10.02 - SCL Systems	17	147	111	129	35	19,754	18,441	18,092	(1,313)	0.93	349	1.02	19,848	19,500	349
P.10.03 - RF Systems	21	151	165	129	(15)	15,196	13,978	13,537	(1,218)	0.92	441	1.03	21,748	21,277	471
P.10.06 - Conventional Facilities	53	162	99	109	63	8,148	8,148	8,300	(0)	1.00	(152)	0.98	8,189	8,727	(538)

Cumulative Thresholds: * Red: CPI/SPI <0.85 or >+1.20 AND >$100k * Yellow: CPI/SPI between 0.85-0.90 or 1.15-1.20 AND >$100k

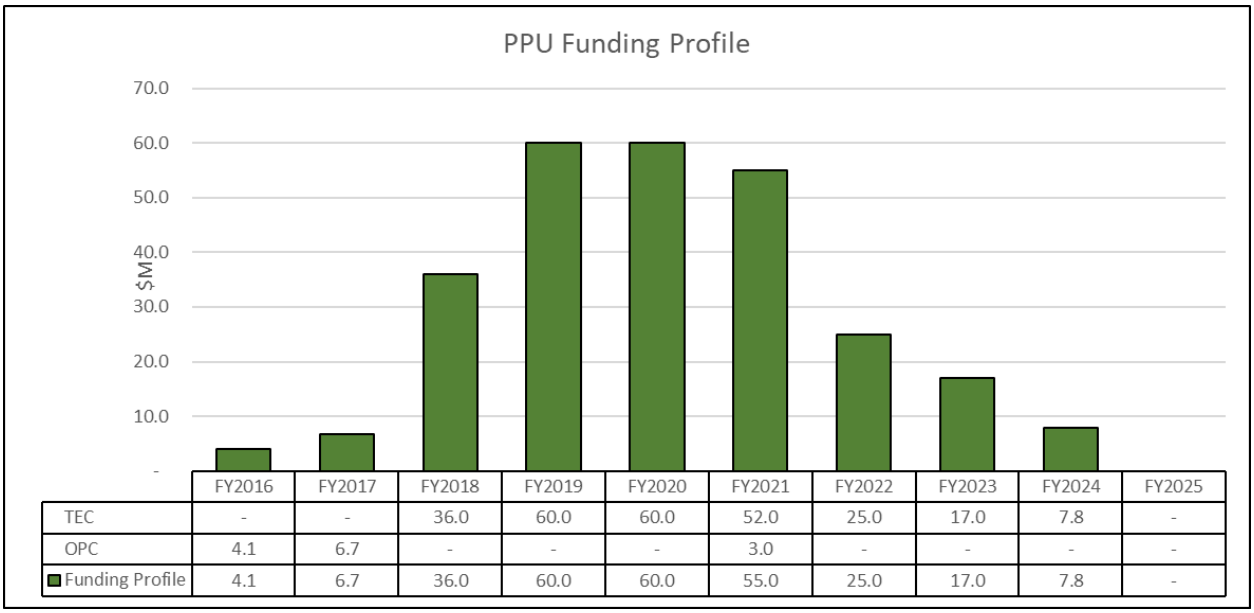
Appendices

PPU – Cost Report (thru June 2021)

WBS Description	Prior Costs	June Costs	Total Costs to Date	Commits (with OH)	Costs plus Commits
P Proton Power Upgrade	115,190,404	3,794,325	118,984,729	39,007,148	157,991,876
P.1 Project Management	8,437,441	392,429	8,829,871	742,534	9,572,404
P.2 Super-Conducting Linac Systems	8,444,199	378,703	8,822,902	9,248,431	18,071,333
P.02.01 Management & Systems Integration	838,892	18,224	857,115		857,115
P.02.02 Cavities	1,294,953	19,689	1,314,642	659,849	1,974,491
P.02.03 Cryomodule Integration (JLab Scope)	4,933,502	319,789	5,253,291	8,290,294	13,543,585
P.02.04 Cryogenics	34,619	-	34,619		34,619
P.02.05 Utility Systems	84,791	4,151	88,942	298,289	387,231
P.02.06 System Integration	337,495	-	337,495		337,495
P.02.07 SCL Controls	919,946	16,851	936,797		936,797
P.3 RF Systems	19,531,900	480,201	20,012,101	11,082,760	31,094,862
P.03.01 Management and System Integration	358,361	11,124	369,485		369,485
P.03.02 SCL HPRF	4,889,151	2,976	4,892,128	6,528,565	11,420,693
P.03.03 NCL HPRF	1,082,800	858	1,083,659	625,219	1,708,878
P.03.04 LLRF	4,490,182	69,769	4,559,951	620,962	5,180,912
P.03.05 Existing Linac Modulators	3,203,725	31,754	3,235,479	48,471	3,283,951
P.03.06 New Linac Modulators	2,445,434	46,238	2,491,672	1,692,028	4,183,700
P.03.07 Utilities	2,141,650	302,137	2,443,787	1,458,513	3,902,299
P.03.08 RF Controls	500,187	12,943	513,130	49,812	562,942
P.03.09 Global Controls	420,409	2,403	422,812	59,190	482,001
P.4 Ring Systems	9,692,714	369,642	10,062,356	2,952,423	13,014,779
P.04.01 Management and System Integration	583,679	13,175	596,853		596,853
P.04.02 Injection region	3,237,015	113,990	3,351,005	2,226,458	5,577,463
P.04.03 Injection Dump	902,917	32,581	935,498	209,945	1,145,443
P.04.04 Extraction region	1,289,361	9,546	1,298,907	20,082	1,318,989
P.04.05 Utilities	421,106	1,655	422,761	21,545	444,306
P.04.06 Ring Control Systems	3,181,760	197,973	3,379,733	474,393	3,854,127
P.04.07 RTBT Stub	35,481	-	35,481		35,481
P.04.08 Accelerator Physics	41,395	722	42,117		42,117
P.5 First Target Station Systems	17,030,865	1,764,270	18,795,136	5,681,074	24,476,209
P.05.01 Management and System Integration	1,083,844	36,098	1,119,943		1,119,943
P.05.02 Neutronics	482,984	-	482,984		482,984
P.05.03 Mercury Process Systems	2,011,213	53,747	2,064,960	10,125	2,075,085
P.05.04 Moderator Cryogenic Systems	1,410,495	1,080	1,411,575	7,310	1,418,885
P.05.05 Vessel and Shielding Systems	436,756	-	436,756		436,756
P.05.06 Target Utility Systems	1,308,593	165,990	1,474,583	431,258	1,905,841
P.05.07 Instrument Systems	40,315	-	40,315		40,315
P.05.08 MOTS	768,298	48,690	816,987	299,056	1,116,043
P.05.09 2 MW Target	6,985,317	1,369,699	8,355,016	4,921,141	13,276,156
P.05.10 Safety, Controls and Operations	1,049,958	87,797	1,137,755	77	1,137,832
P.05.11 Gas Injection Development	1,453,092	1,169	1,454,261	12,107	1,466,369
P.6 Conventional Facilities	2,845,704	33,222	2,878,926	44,617	2,923,543
P.06.01 Management and System Integration	160,923	4,137	165,060	419	165,479
P.06.02 Building Modifications	2,684,781	29,085	2,713,866	44,198	2,758,064
P.7 R&D (OPC)	2,328,017	-	2,328,017	1,070	2,329,087
P.07.01 Gas Injection Development	1,991,752	-	1,991,752		1,991,752

WBS Description	Prior Costs	June Costs	Total Costs to Date	Commits (with OH)	Costs plus Commits
P.07.02 Foil Development	336,265	-	336,265	1,070	337,335
P.8 Pre-Ops (OPC)	76,203	396	76,599	-	76,599
P.08.03 Commissioning	76,203	396	76,599		76,599
P.9 Pre-CD1 Activities (OPC)	7,249,768	-	7,249,768	-	7,249,768
P.09.01 Pre-CD-1 Activities	7,249,768	-	7,249,768		7,249,768
P.10 Long Lead Procurements	39,553,592	375,460	39,929,053	9,254,238	49,183,291
P.10.02 SCL Systems	17,980,508	111,436	18,091,944	1,768,788	19,860,732
P.10.03 RF Systems	13,371,937	165,059	13,536,996	7,459,237	20,996,233
P.10.06 CF Systems	8,201,148	98,965	8,300,113	26,213	8,326,326

PPU – Funding Profile



	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025
TEC	-	-	36.0	60.0	60.0	52.0	25.0	17.0	7.8	-
OPC	4.1	6.7	-	-	-	3.0	-	-	-	-
Funding Profile	4.1	6.7	36.0	60.0	60.0	55.0	25.0	17.0	7.8	-

Note: This profile includes FY2021 actual funding, which is $10M higher than documented in the Project Execution Plan. The outyears have been reduced accordingly to maintain a total project cost of $271.6M.

PPU – Critical Decision Schedule

Level 1 Milestones	Schedule
CD-0, Approve Mission Need	Jan 2009 (A)
CD-1, Approve Alternative Selection and Cost Range	Apr 2018 (A)
CD-3A, Approve Long Lead Procurement	Oct 2018 (A)
CD-3B, Approve Long Lead Procurement	Sep 2019 (A)
CD-2, Approve Performance Baseline and Long Lead Procurement	Oct 2021 (A)
CD-3, Approve Start of Construction	Oct 2021 (A)
CD-4, Approve Project Completion (Level 0 Milestone)	Q4 FY2028