PPUP-100-PI041-R00

PROTON POWER UPGRADE (PPU) PROJECT

Monthly Progress Report

July 2021

Report Due Date: **August 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
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July 2021

Approved by: Galambos, John D. 2021.08.27 14:40:33 -04'00'

John Galambos, PPU Project Director

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Overall Assessment

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

- *The project continues to proceed as planned with good earned-value performance metrics. However, 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 CD-3A long lead procurements were completed in July with the delivery of the final two cavities to Jefferson Lab.*

- *The PPU Project planned early finish is February 12, 2025.*

- *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. No milestones were completed in July.

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		01-Dec-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		21-Sep-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

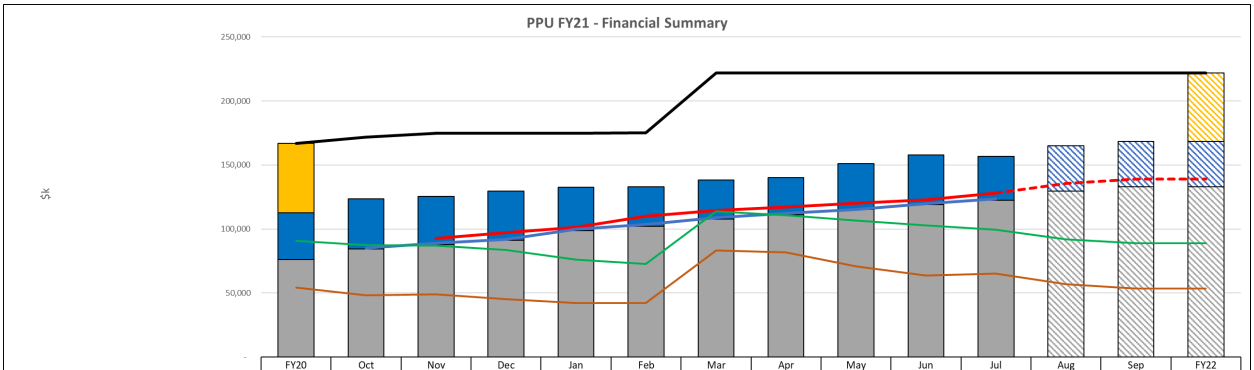
Legend: Green - On/Ahead of Schedule, Yellow - Moderately Late (<3 months), Red - Very Late (>3 months) or Critical Path (>1 month)

Project Cost Overview

Level 2 Cost Summary

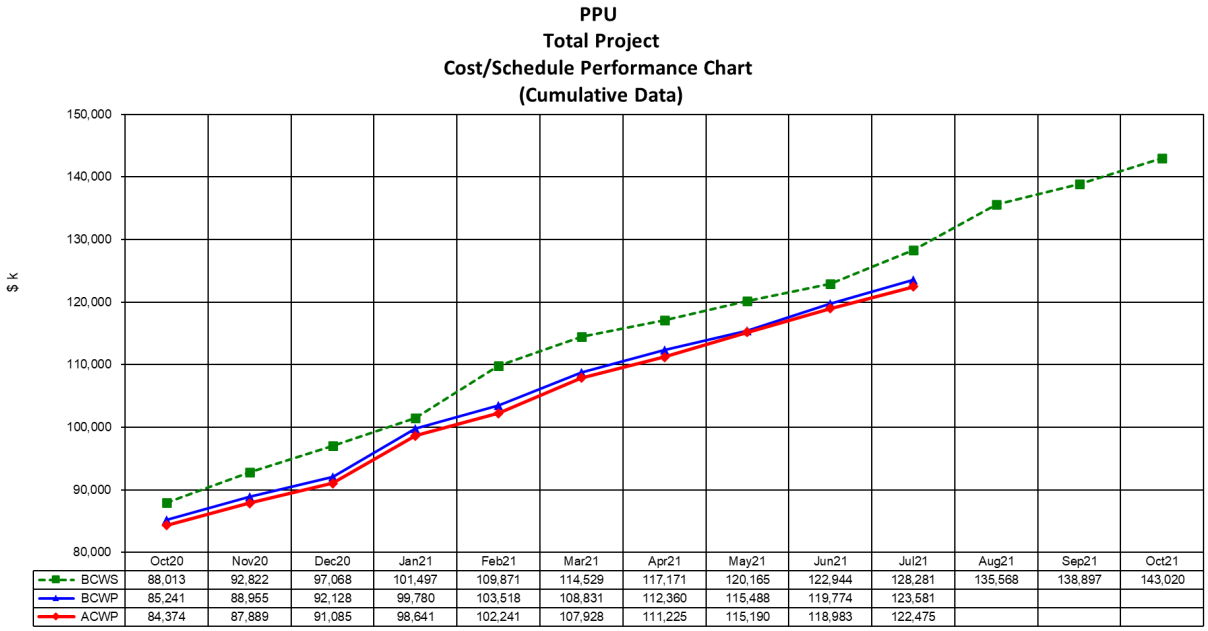
WBS Description	Prior Costs	Prior FY21 Costs	July Costs	Total FY21 Costs	Total Costs to Date	Commits (with OH)
P.1 Project Management	5,883,425	2,946,446	315,872	3,262,318	9,145,742	725,031
P.2 SCL Systems	5,924,975	2,897,926	319,102	3,217,029	9,142,004	9,094,207
P.3 RF Systems	12,347,958	7,664,144	998,930	8,663,074	21,011,031	10,515,157
P.4 Ring Systems	6,980,063	3,082,293	319,311	3,401,604	10,381,667	3,286,087
P.5 First Target Station Systems	10,224,569	8,570,566	342,582	8,913,148	19,137,717	5,609,786
P.6 Conventional Facilities	2,522,645	356,281	14,780	371,061	2,893,706	44,617
P.7 R&D (OPC)	2,265,525	62,492	1,070	63,562	2,329,087	
P.8 Pre-Ops (OPC)	56,292	20,308	6,142	26,449	82,741	-
P.9 Pre-CD1 Activities (OPC)	7,249,768	-	-	-	7,249,768	-
P.10 Long Lead Procurements	22,751,625	17,177,427	1,173,891	18,351,318	41,102,943	8,423,683
Total PPU	**76,206,845**	**42,777,884**	**3,491,678**	**46,269,562**	**122,476,407**	**37,698,567**

Detailed Financial Plan



	FY20	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	FY22
FY22 Planned Uncosted, unencumbered Carryover														53,496
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	34,138			
Estimated Encumbrances (Commitments)												35,116	35,327	35,327
FY21 ACWP	76,207	84,374	87,889	91,085	98,641	102,241	107,928	111,225	115,190	118,983	122,475			
Estimated ACWP												129,752	133,066	133,066
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	128,281	135,558	138,873	138,873
BCWP		85,241	88,955	92,128	99,780	103,518	108,831	112,360	115,488	119,774	123,581			
Available Funds (less actuals)	90,683	87,516	87,001	83,805	76,249	72,923	113,962	110,664	106,700	102,907	99,415	92,138	88,823	88,823
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	65,277	57,022	53,496	53,496

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	128,281	135,568	138,897	143,020
BCWP	85,241	88,955	92,128	99,780	103,518	108,831	112,360	115,488	119,774	123,581			
ACWP	84,374	87,889	91,085	98,641	102,241	107,928	111,225	115,190	118,983	122,475			

As shown in the following Contract Performance Report, the project performance indices are SPI = .96 and CPI = 1.01.

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

July 2021 ($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	375	183	316	(192)	(133)	9,588	9,397	9,146	(192)	0.98	251	1.03	21,869	21,794	75
P.02 - SCL Systems	452	361	319	(91)	42	10,061	9,347	9,142	(714)	0.93	205	1.02	23,887	23,680	207
P.03 - RF Systems	1,441	1,337	999	(104)	338	21,285	21,653	21,011	369	1.02	642	1.03	43,995	43,539	456
P.04 - Ring Systems	465	694	319	229	375	10,976	10,134	10,382	(843)	0.92	(248)	0.98	20,800	21,101	(301)
P.05 - First Target Station Systems	1,507	381	343	(1,127)	38	19,703	19,181	19,136	(522)	0.97	45	1.00	34,646	34,603	43
P.06 - Conventional Facilities	15	17	15	1	2	2,824	2,810	2,894	(14)	1.00	(83)	0.97	10,900	10,996	(97)
P.07 - R&D	23	10	1	(12)	9	2,344	2,326	2,329	(18)	0.99	(3)	1.00	2,476	2,481	(5)
P.08 - Pre-Ops	5	5	6	0	(1)	96	96	83	0	1.00	13	1.16	1,137	1,124	13
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	1,054	819	1,174	(235)	(355)	44,153	41,386	41,103	(2,767)	0.94	284	1.01	50,171	49,691	480
TOTAL	**5,338**	**3,807**	**3,492**	**-1,531**	**315**	**128,281**	**123,581**	**122,475**	**-4,701**	**0.96**	**1,106**	**1.01**	**217,130**	**216,260**	**870**
Cumulative Thresholds:									Management Reserve				5,338	5,338	
• Red: CPI/SPI <0.85 or >+1.20 AND >$100k (or > 1/2 of BAC)									Contingency				49,099	49,969	
• Yellow: CPI/SPI between 0.85-0.90 or 1.15-1.20 AND >$100k (or > 1/2 of BAC)									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 $370K.

The impacts by L2 are shown in the following table.

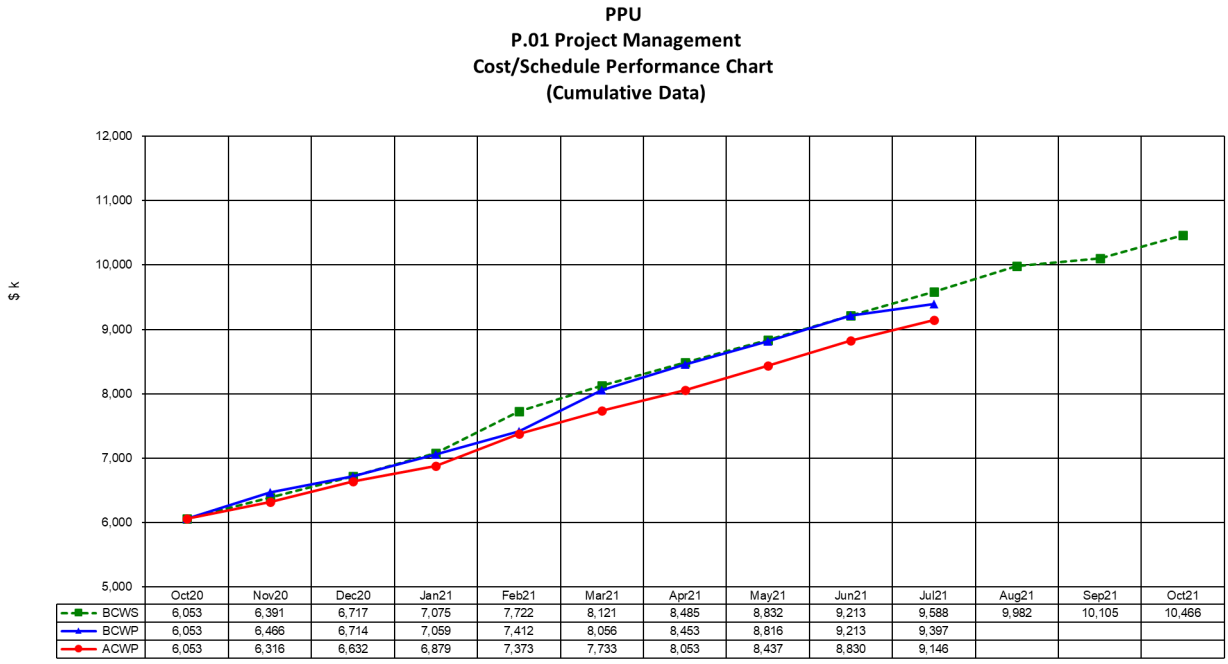
$k	June 2021 Baseline	July 2021 Baseline
P.01 Project Management	22,169	21,869
P.02 SCL Systems	23,887	23,887
P.03 RF Systems	44,061	43,995
P.04 Ring Systems	20,551	20,800
P.05 First Target Station Systems	34,544	34,646
P.06 Conventional Facilities	10,900	10,900
P.07 R&D	2,476	2,476
P.08 Pre-Ops	1,137	1,137
P.09 Pre CD-1 Activities	7,250	7,250
P.10 Long Lead Procurements	49,785	50,171
Revised Baseline	216,761	217,130
Management Reserve	5,338	5,354
Contingency	49,469	49,082
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



	Oct20	Nov20	Dec20	Jan21	Feb21	Mar21	Apr21	May21	Jun21	Jul21	Aug21	Sep21	Oct21
BCWS	6,053	6,391	6,717	7,075	7,722	8,121	8,485	8,832	9,213	9,588	9,982	10,105	10,466
BCWP	6,053	6,466	6,714	7,059	7,412	8,056	8,453	8,816	9,213	9,397			
ACWP	6,053	6,316	6,632	6,879	7,373	7,733	8,053	8,437	8,830	9,146			

As shown in the following Contract Performance Report, the Project Management performance indices are SPI = .98 and CPI = 1.03.

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

July 2021 ($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	**375**	**183**	**316**	**(192)**	**(133)**	**9,588**	**9,397**	**9,146**	**(192)**	**0.98**	**251**	**1.03**	**21,869**	**21,794**	**75**
P.01.01 - Project Management	70	70	55	0	15	2,121	2,121	2,080	0	1.00	41	1.02	4,572	4,531	41
P.01.02 - Project Support	263	71	216	(192)	(145)	6,300	6,108	5,878	(192)	0.97	231	1.04	14,477	14,421	56
P.01.03 - ESH&Q	42	42	45	0	(3)	1,167	1,167	1,188	0	1.00	(21)	0.98	2,820	2,842	(22)

Cumulative Thresholds: * Red: CPI/SPI <0.85 or >+1.20 AND >$100k (or > 1/2 of BAC) * Yellow: CPI/SPI between 0.85-0.90 or 1.15-1.20 AND >$100k (or > 1/2 of BAC)

P.2 Superconducting Linac (SCL) Systems

Eighteen cavities have been qualified and sixteen cavities have been installed in helium vessels. Eight cavities have been qualified for the first and second cryomodules. Two cavities have been qualified for the third cryomodule. All cavities have been delivered to JLab.

A nineth cavity has been qualified and will be tested in the horizontal testing apparatus (HTA). Testing is scheduled for August, contingent on the radio frequency test facility availability.

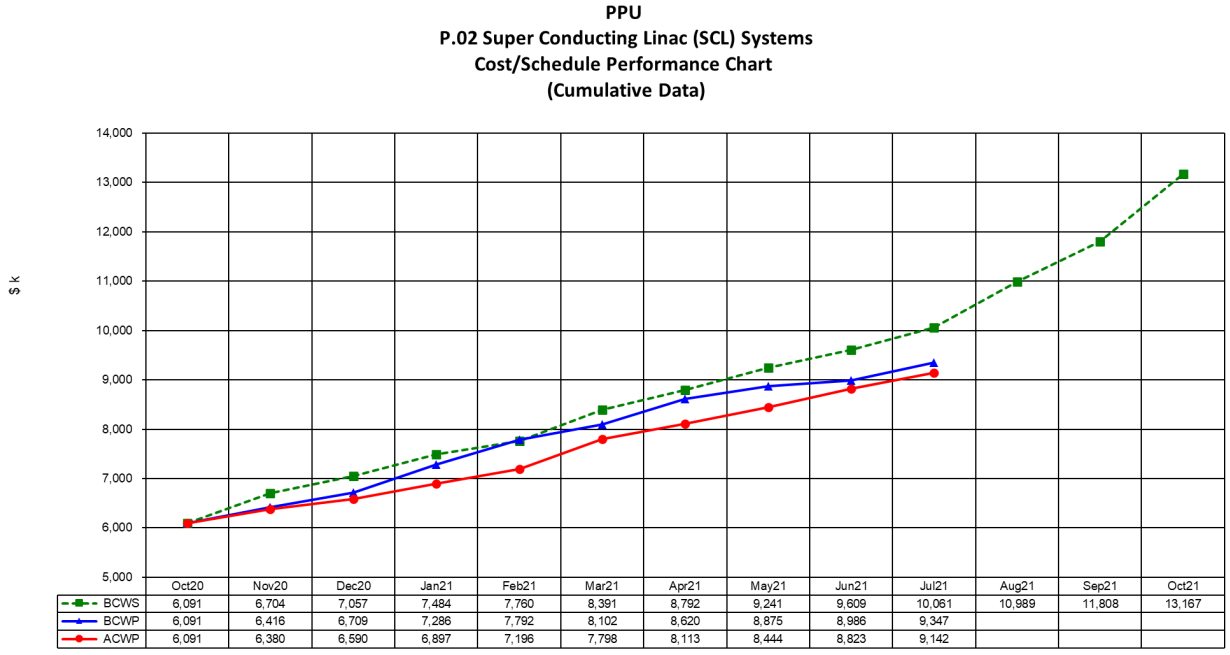
In a meeting at Jefferson Laboratory between SNS and JLab personnel, additional processing steps were identified and agreed upon for preparing tanked cavities for vertical testing. The initial results look favorable. For cryomodule 1, the cavity string has undergone test fits into the spaceframe and thermal shield to ensure no mechanical interfaces are present. For cryomodule 2, a leak in the cavity string was present. Cavity PPU-08 was replaced with PPU-09 and leak checking will follow.

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

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 = .93 and CPI = 1.02.

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

July 2021 ($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.02 - SCL Systems	**452**	**361**	**319**	**(91)**	**42**	**10,061**	**9,347**	**9,142**	**(714)**	**0.93**	**205**	**1.02**	**23,887**	**23,680**	**207**
P.02.01 - Management and System Integration	27	27	14	0	14	955	955	871	0	1.00	84	1.10	1,122	1,039	84
P.02.02 - Cavities	23	57	38	34	18	1,734	1,236	1,351	(499)	0.71	(115)	0.91	2,474	2,596	(122)
P.02.03 - Cryomodule Integration (Partner Laboratory Scope)	382	241	241	(141)	(0)	5,901	5,630	5,494	(271)	0.95	135	1.02	14,186	14,050	135
P.02.04 - Cryogenics	3	3	0	0	2	73	73	35	0	1.00	38	2.08	826	789	38
P.02.05 - Utility Systems	5	6	3	0	2	121	128	92	6	1.05	35	1.38	1,022	975	47
P.02.06 - System Integration	6	6	0	0	6	309	416	339	107	1.35	76	1.22	2,229	2,154	75
P.02.07 - SCL Controls	6	22	22	16	(1)	969	912	959	(57)	0.94	(48)	0.95	2,027	2,078	(51)

Cumulative Thresholds: * Red: CPI/SPI <0.85 or >+1.20 AND >$100k (or > 1/2 of BAC) * Yellow: CPI/SPI between 0.85-0.90 or 1.15-1.20 AND >$100k (or > 1/2 of BAC)

Note: Although the L3 WBS element P.02.06 (System Integration) is highlighted, the underlying control account creating the variance is complete and therefore no longer requires a variance explanation.

Title: P.02.02.05.05 / ORNL - Testing - Coupler Acquisition (SPI = .79, CPI = .84)
Cause: Schedule - Radio frequency (RF) Conditioning of couplers has slowed due to the availability if the RF test stand and the recovery of hadware from JLab due to slow string assembly. Plans are to complete 3 sets of coupler conditioning by end of August and deliver the couplers to Jefferson Lab in early September. Cost - some additional labor charges were charged to the coupler conditioning effort in error and are currently being corrected.
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 deliiver 3 sets in September.
Recoverable: Yes.
Corrective Action: The control account manager will continue to closely monitor the RF availability and labor charges.

Title: P.02.02.07.05 / ORNL - Testing - HTA Testing (SPI = .16)
Cause: The cavity was delivered later than planned by Jefferson Lab, it was received recently and is now assembled into the cryostat and waiting for high power radio frequesncy availability to complete the testing of PPU05. The test is planned for late August.
Impact: None. Does not impact downstream activities. The variance will resolve itself upon completion of testing.
Recoverable: Yes.
Corrective Action: None.

P.3 Radio Frequency (RF) Systems

The 3MW klystron has been prepped for factory acceptance testing. A single solenoid coild was returned to the manufacturer for rework after CPI discovered a physical interference.

Testing of the radio frequency quadrupole / drift tube linac high voltage converter modulator (RFQ/DTL HVCM) prototype continued.

The Low-Level RF (LLRF) team completed integration of the timing card into LLRF. The 23D witness testing was re-initiated in preparation of full control testing. LLRF racks were mocked-up in preparation for installation activities.

The KL-04 pump upgrade installation contract has been released for bid with a plan to award by September. The KL-04 pumps and variable frequency drives are scheduled to arrive in mid September. The 15kV switchgear has been tied into the alternate topography high voltage converter modulators. The AC-power cable pulls to the equipment racks have been initiated. The transmitter 31 waveguide installation has begun.

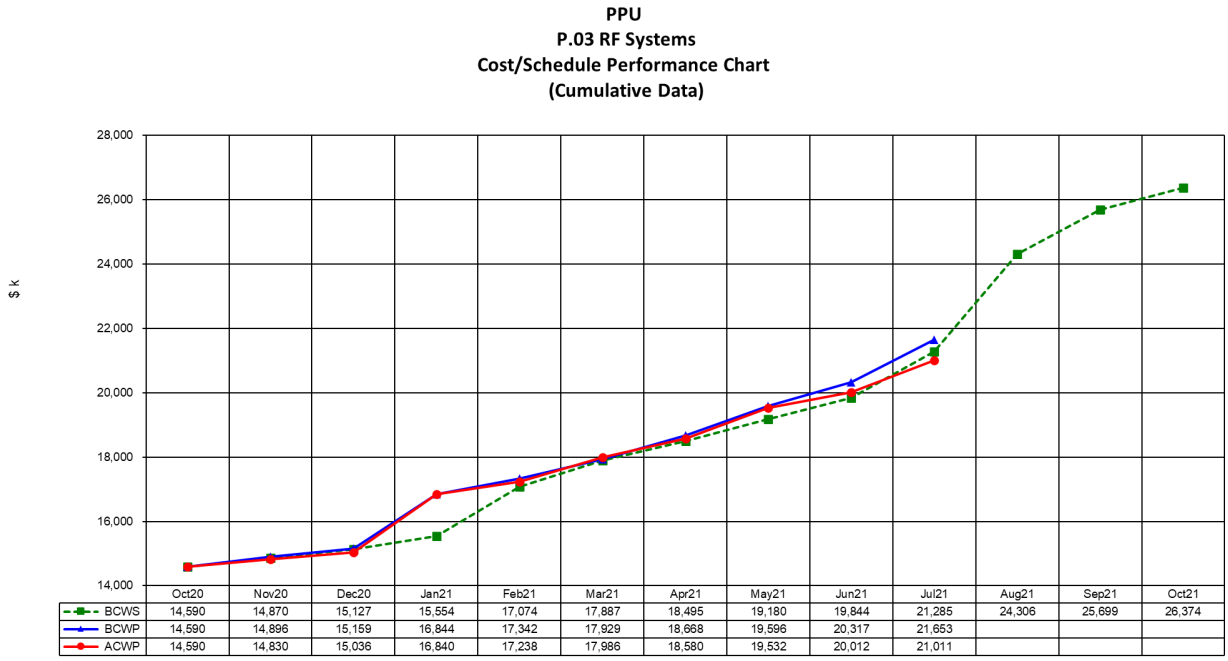
Milestone Table

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		01-Dec-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 = 1.03.

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

July 2021 ($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.03 - RF Systems	**1,441**	**1,337**	**999**	**(104)**	**338**	**21,285**	**21,653**	**21,011**	**369**	**1.02**	**642**	**1.03**	**43,995**	**43,539**	**456**
P.03.01 - Management and System Integration	9	9	11	0	(2)	384	384	381	0	1.00	3	1.01	534	531	3
P.03.02 - SCL HPRF	0	474	472	474	2	4,919	5,394	5,364	474	1.10	29	1.01	12,906	12,927	(21)
P.03.03 - NCL HPRF	478	0	0	(478)	0	1,775	1,097	1,084	(677)	0.62	14	1.01	4,997	4,984	13
P.03.04 - LLRF	166	73	69	(94)	3	4,193	4,734	4,629	541	1.13	105	1.02	5,947	5,874	73
P.03.05 - Existing Linac Modulators	55	40	58	(15)	(18)	3,211	3,225	3,293	15	1.00	(68)	0.98	4,869	4,978	(109)
P.03.06 - New Linac Modulators	101	546	140	445	406	2,786	3,180	2,631	393	1.14	548	1.21	5,302	4,818	484
P.03.07 - Utilities	528	170	221	(359)	(51)	2,879	2,600	2,665	(280)	0.90	(65)	0.98	7,729	7,792	(63)
P.03.08 - RF Controls	80	13	24	(67)	(11)	657	578	538	(80)	0.88	40	1.07	982	942	40
P.03.09 - RF/SCL Global Controls	23	12	4	(10)	9	481	463	427	(18)	0.96	36	1.08	729	694	35

Cumulative Thresholds: * Red: CPI/SPI <0.85 or >+1.20 AND >$100k (or > 1/2 of BAC) * Yellow: CPI/SPI between 0.85-0.90 or 1.15-1.20 AND >$100k (or > 1/2 of BAC)

Title: P.03.03.03.02 / ORNL - Design - Klystrons (NCL) (SPI = .60)
Cause: The vendor has delayed the delivery of the first article due to several fabrication problems including dimensional errors on the 3rd cavity, a braze-induced crack in the 5th cavity, a vacuum leak in the 1st cavity, and dimensional errors in the solenoid pole piece. In addition, the vendor had to add fabrication space to their facility to alleviate a bottleneck in the cold test portion of cavity fabrication.
Impact: Ultimately, the delay in delivery has caused a subsequent delay in the site acceptance testing at the SNS.
Recoverable: Yes.
Corrective Action: The SNS RF Systems team meets with the vendor biweekly to discuss the ongoing fabrication effort and address problems as they arise. In addition, the SNS RF team will be making a site visit in October to witness portions of the factory acceptance testing.

Title: P.03.06.02.03 / ORNL - Procure/Fab - Transformer (SPI = 1.45)
Cause: The positive schedule variance is due to partial early completion of PO 4000184643 MS#2 "Satisfactory completion of Factory Accepance Test" for 1 unit out of 4 (25% of $359K = $90K) and early completion of PO 4000188748 MS#1 "Completion and Approval of Drawings for SCR" ($55K).
Impact: Early delivery of the first SCR unit will not directly affect subsequent activities.
Recoverable: Yes.
Corrective Action: None required, the positive variance will go away in August when the milestones were originally scheduled to happen.

Title: P.03.06.04.03 / ORNL - Procure/Fab - Modulator System (SPI = 1.82, CPI = 3.13)
Cause: SPI: The positive schedule variance is mainly due to early completion of PO 4000178812 Item 2 Milestone 2 "Receipt of 50% of purchased and/or fabricated" ($222K) as well as partial completions of milestone 3 "Successful completion of energy storage cap racks assembly, water panel, oil tank assemblies" (80% of $59K = $47K) and milestone 4 "IGBT board assemblies including full peak power testing on single phase test stand and documentation" (50% of $88K = $44K). This positive variance is offset somewhat by later than planned receipt of the CO2 Systems (-$41K) and procurements mainly related to the oil cooling systems (-$19K). CPI: The positive cost variance is mostly due to having taken credit for completion of PO 4000178812 Item 2 Milestone 2 "Receipt of 50% of purchased and/or fabricated" ($222K), partial completion of milestones 3 "Successful completion of energy storage cap racks assembly, water panel, oil tank assemblies" (80% of $59K = $47K) and partial completion of milestone 4 "IGBT board assemblies including full peak power testing on single phase test stand and documentation" (50% of $88K = $44) without making accruals for these items. Completion status for these items were determined in a meeting late in the month after accruals had already been submitted. An additional ~$20K positive CV is due to the less than planned utilization of the Albuquerque-local AT-HVCM fabrication onsite support contractor (this may get used in the following months during fabrication of the remaining units). The additional positive variance (~$50K) is due to less oversight and effort associated with the items completed earlier.
Impact: SPI: Because the milestones are not delivery milestones, they will have no impact on downstream schedule activities. CPI: The portion of the positive cost variance not related to either the missed accruals, or the Albuquerque-local AT-HVCM fabrication onsite support contractor (which may be expended in the next few months) will result in a cost savings to the project.
Recoverable: Yes.
Corrective Action: SPI: None Required, the variance related to these early items will go away next month when the items were scheduled to have been completed. A PCR is planned for the late CO2 system activities now that the procurement had been awarded. CPI: In August, accruals (or actual invoicing) will be applied for the items for which an accrual was missed in July.

P.4 Ring Systems

A fabrication contract for the Injection Dump Quadupole and Dipole Corrector shown in Figure 1 was awarded to Buckely Systems of New Zealand after evaluation of five proposals. The two magnets will be build-to-print copies of existing magnets used throughout the SNS ring. Delivery is expected by the third quarter of 2022.

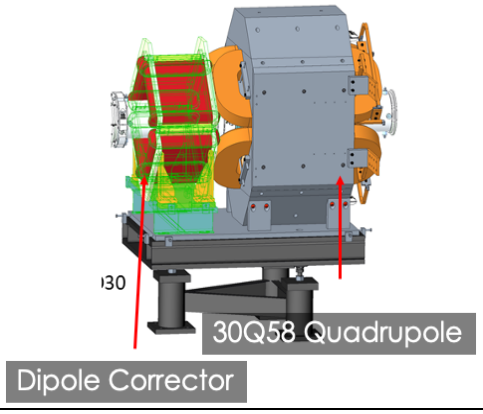


Figure 1: 30Q58 Quadrupole and dipole correct that will be built by Buckley Systems for the injection dump line.

Analysis of the injection region vacuum chambers (Figure 2) has resumed following the departure of the lead engineer. Buckling analysis for several chambers has been conducted. Two contractors have been brought on board to help with the remaining design and analysis activities.

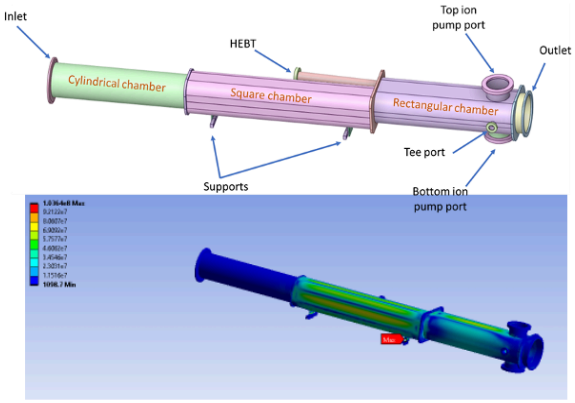


Figure 2: Chicane 1 vacuum chamber design (top) and buckling analysis of same (bottom).

The Ring Injection Dump Imaging System (RID-IS) vacuum window coating was completed at Stony Brook and the windows were sent to Keller technologies to be integrated into the final assembly. Figure 3 shows one of the windows at several stages during the process of applying the luminescent coating and removal of said coating in several small areas that will act as fiducial markers for alignment of images taken with the system.

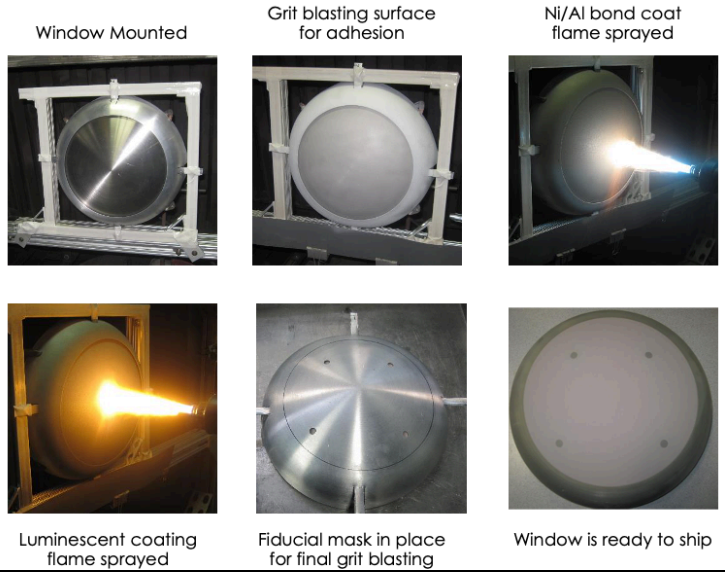


Figure 3: The injection dump vacuum window being prepared with luminescent coating at Stony Brook. The coated window with fiducials for image alignment is shown in the bottom right.

The Beam Power Limiting System (BPLS) team has been preparing for a digital-processing-unit-specific Preliminary Design Review (PDR) to be held in early September. This is in response to a recommendation made at the system-wide PDR to take a closer look at the digital processing design prior to the Final Design Review. A new layout for the current transformers used to measure the current of magnet DH13 has also been implemented. This scheme, shown in Figure 4, left, has three transformers, each measuring the total current of all six cables supplying current to DH13. Work also continues to finalize drawings of system components that will be installed in the Ring-Target Beam Transport (RTBT) service building, such as the Analog Front End (AFE) chassis shown in Figure 4, right.

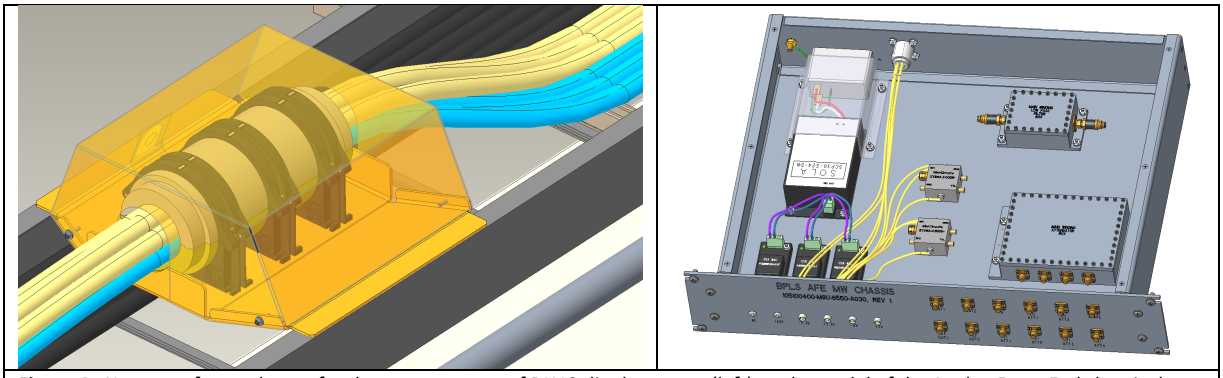
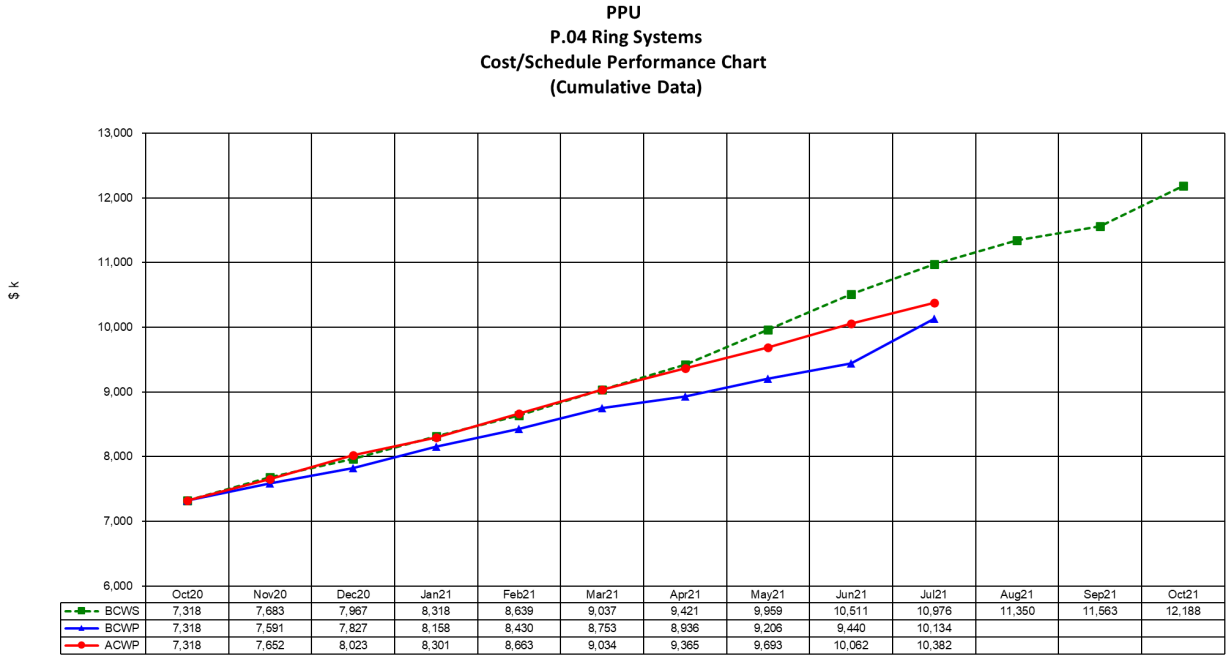


Figure 4: New transformer layout for the measurement of DH13 dipole current (left), and a model of the Analog Front End chassis that will be installed in the RTBT service building (right).

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 = .92 and CPI = .98.

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

July 2021 ($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	**465**	**694**	**319**	**229**	**375**	**10,976**	**10,134**	**10,382**	**(843)**	**0.92**	**(248)**	**0.98**	**20,800**	**21,101**	**(301)**
P.04.01 - Management and System Integration	9	9	14	0	(5)	575	575	611	0	1.00	(36)	0.94	1,176	1,212	(36)
P.04.02 - Injection Region	178	29	78	(149)	(49)	3,474	3,222	3,429	(252)	0.93	(207)	0.94	7,816	8,037	(221)
P.04.03 - Injection Dump	93	35	14	(58)	21	1,197	974	950	(223)	0.81	25	1.03	1,421	1,397	24
P.04.04 - Extraction Region	2	2	4	0	(3)	1,256	1,249	1,303	(7)	0.99	(54)	0.96	2,217	2,271	(55)
P.04.05 - Utilities	25	3	0	(22)	3	474	451	423	(23)	0.95	28	1.07	1,767	1,739	28
P.04.06 - Ring Control Systems	157	614	207	457	407	3,914	3,576	3,586	(338)	0.91	(10)	1.00	6,132	6,181	(49)
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	51	51	44	0	1.00	7	1.17	107	100	7

Cumulative Thresholds: * Red: CPI/SPI <0.85 or >+1.20 AND >$100k (or > 1/2 of BAC) * Yellow: CPI/SPI between 0.85-0.90 or 1.15-1.20 AND >$100k (or > 1/2 of BAC)

Title: P.04.03.02.03 / ORNL - Procure/Fab - Injection Dump Imaging System (SPI = .21)
Cause: Fabrication and delivery of the Injection Dump window assembly and spare flange weldment has been delayed. The RID window assemblies were initially delayed when Keller's spin-forming subcontractor took an additional three weeks complete the domed window pieces and the associated masks used to apply the luminescent coating and create fiducials. When the window pieces were received at Keller one of the coordinate measuring machines went down during incoming receipt inspection. Shipment for coating was delayed by another three weeks.
Impact: None. The windows have been coated by Stonybrook, returned to Keller and final fabrication of the window assemblies is underway. The current forecast for receipt is late September 2021. The Injection Dump Imaging System will be installed during the FY22B outage (start date 21 Mar 22).
Recoverable: Yes.
Corrective Action: None.

P.5 First Target Station (FTS) Systems

Fabrication of hardware for mockup testing for installation and operation of the overflow tank (OFT) completed and the equipment was delivered to the SNS high-bay (Figure 5). Testing with the telemanipultor (simulant for the in-cell servomanipulator) is scheduled to commence by mid August.

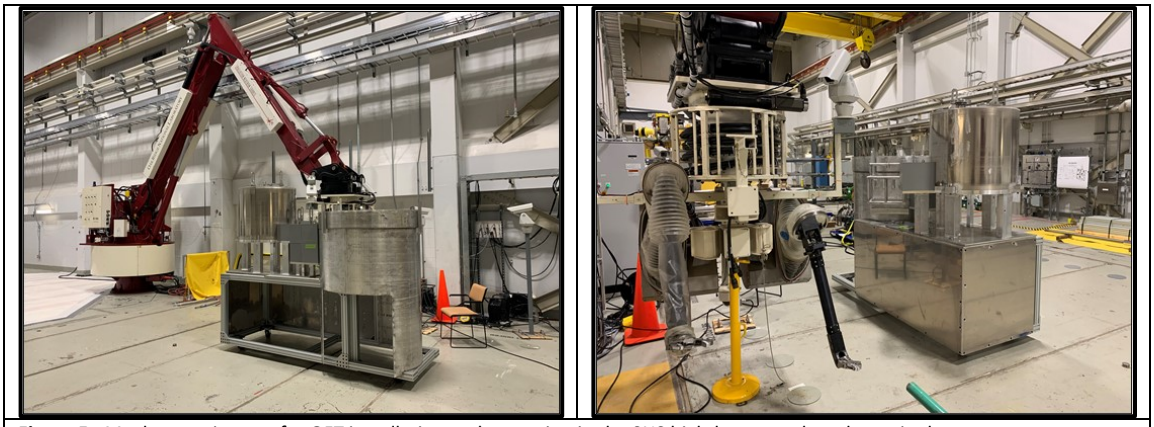


Figure 5: Mockup equipment for OFT installation and operation in the SNS high-bay near the telemanipulator.

A revised estimate of hydrogen mass added by the ortho/parahydrogen catalyst assembly to the Cryogenic Moderator Systems has been prepared (Figure 6). The mass value is need to confirm that the Hydrogen Refill System upgrade has adequate capacity, and for facility safety updates that will be captured in a future release of the Facility Safety Assessment Document – Neutron Facility (FSAD-NF). A thorough evaluation of the final dsign of the catalyst beds and all piping was prepared, independently reviewed and issued (PPUP-504-CA0006-R00). The final added mass was about twice that estimated in the preliminary design stage.

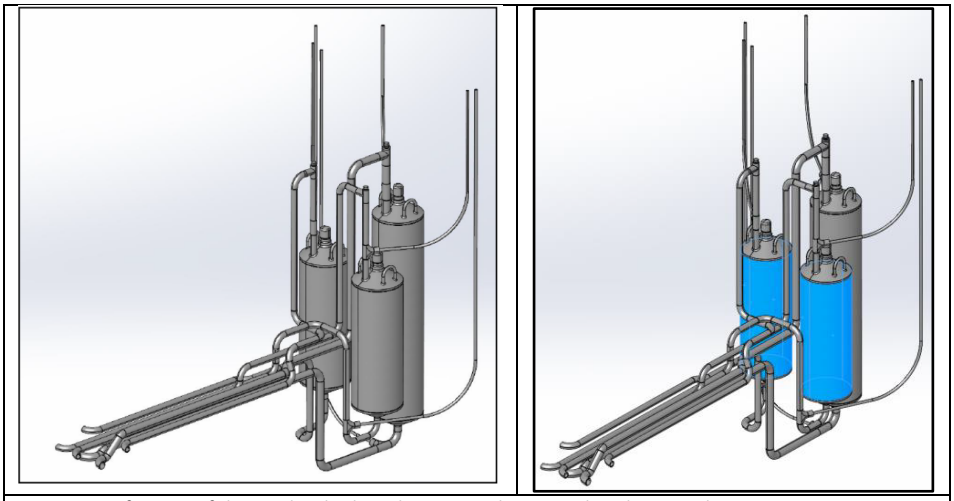


Figure 6: Left: View of the catalyst beds and piping. Right: Example volume evaluation.

An internal review of gas injection control interlocks was conducted. The review scope included gas recirculation equipment, mol sieves, and the mercury OFT. There was participation from Mercury Process Systems, Target, Safety, Operations, Controls and an advising subcontractor. The review identified some interlocks to be deleted. Updates to the Process and Instrumentation Diagram and Process Control Description now reflect these changes.

Test Target #1 is nearing completion (Figure 7). Water-cooled shroud issues are resolved and its assembly is complete. The mercury vessel assembly is also complete. Strain sensors and leak detectors are being installed in August. Delivery is expected by early September with operation scheduled for January 2022.

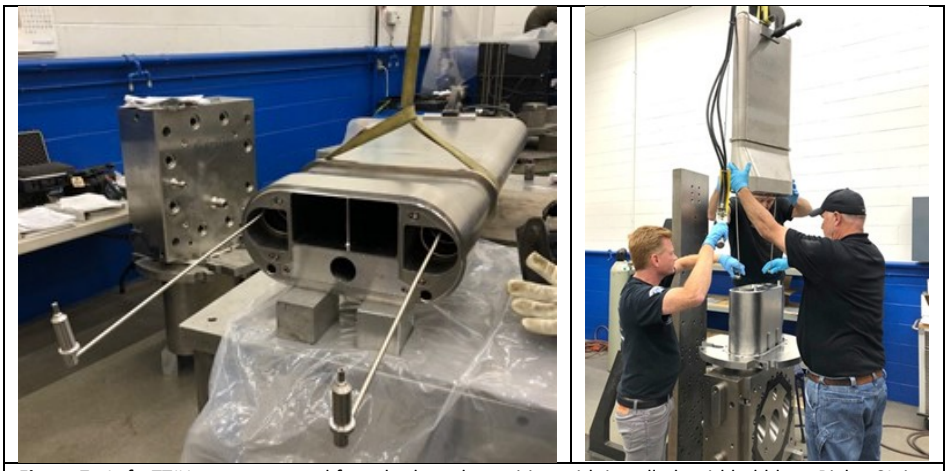


Figure 7: Left: TT#1 mercury vessel front body and transition with installed swirl bubblers Right: CJoing of the front body / transition to the manifold block.

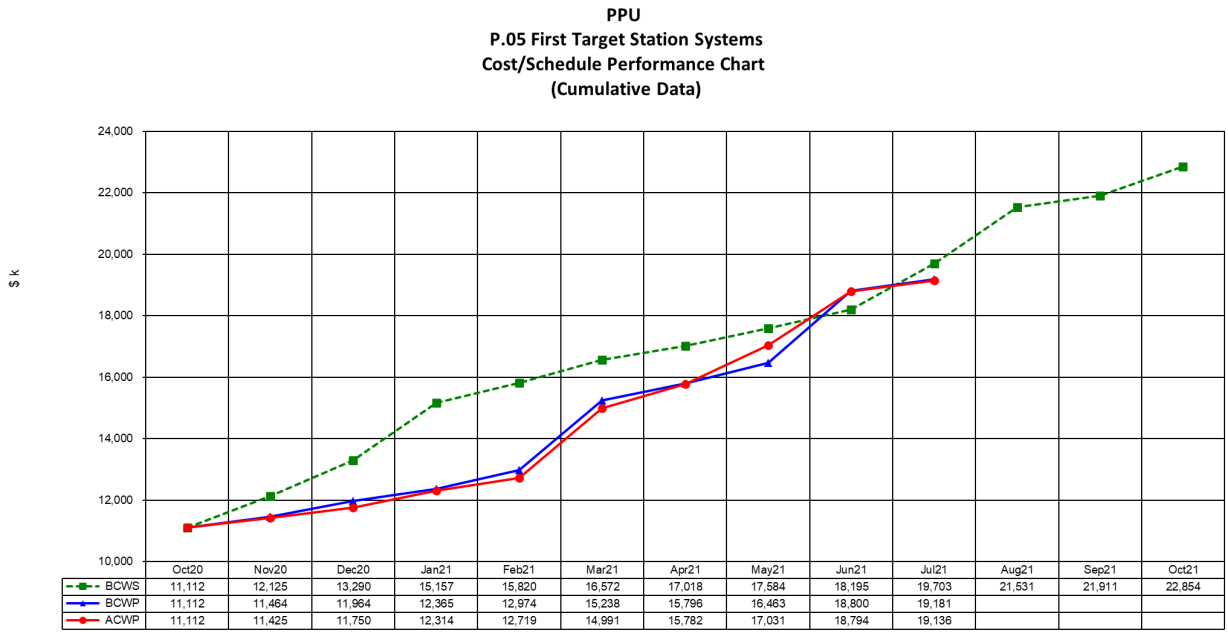
Milestone Table

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		21-Sep-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 = .97 and CPI =1.00.

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

July 2021 ($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	**1,507**	**381**	**343**	**(1,127)**	**38**	**19,703**	**19,181**	**19,136**	**(522)**	**0.97**	**45**	**1.00**	**34,646**	**34,603**	**43**
P.05.01 - Management and System Integration	38	38	16	0	21	1,160	1,160	1,136	0	1.00	24	1.02	2,798	2,774	24
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	49	87	41	38	46	1,901	1,813	2,048	(88)	0.95	(235)	0.89	2,496	2,732	(237)
P.05.04 - Moderator Cryogenic Systems	10	10	1	0	10	1,469	1,357	1,412	(112)	0.92	(55)	0.96	2,513	2,574	(61)
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	43	75	124	32	(48)	2,150	1,926	1,598	(223)	0.90	328	1.21	3,819	3,490	328
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	13	40	42	26	(2)	979	924	859	(55)	0.94	64	1.07	2,065	1,986	79
P.05.09 - 2 MW Target	1,300	118	33	(1,182)	85	8,118	8,595	8,445	477	1.06	150	1.02	15,103	14,954	149
P.05.10 - Safety, Controls and Operations	55	13	80	(41)	(66)	1,355	856	1,217	(499)	0.63	(362)	0.70	3,281	3,652	(370)
P.05.11 - Gas Injection Development	0	0	6	0	(6)	1,613	1,591	1,460	(22)	0.99	131	1.09	1,613	1,482	131

Cumulative Thresholds: * Red: CPI/SPI <0.85 or >+1.20 AND >$100k (or > 1/2 of BAC) * Yellow: CPI/SPI between 0.85-0.90 or 1.15-1.20 AND >$100k (or > 1/2 of BAC)

Variance Explanations

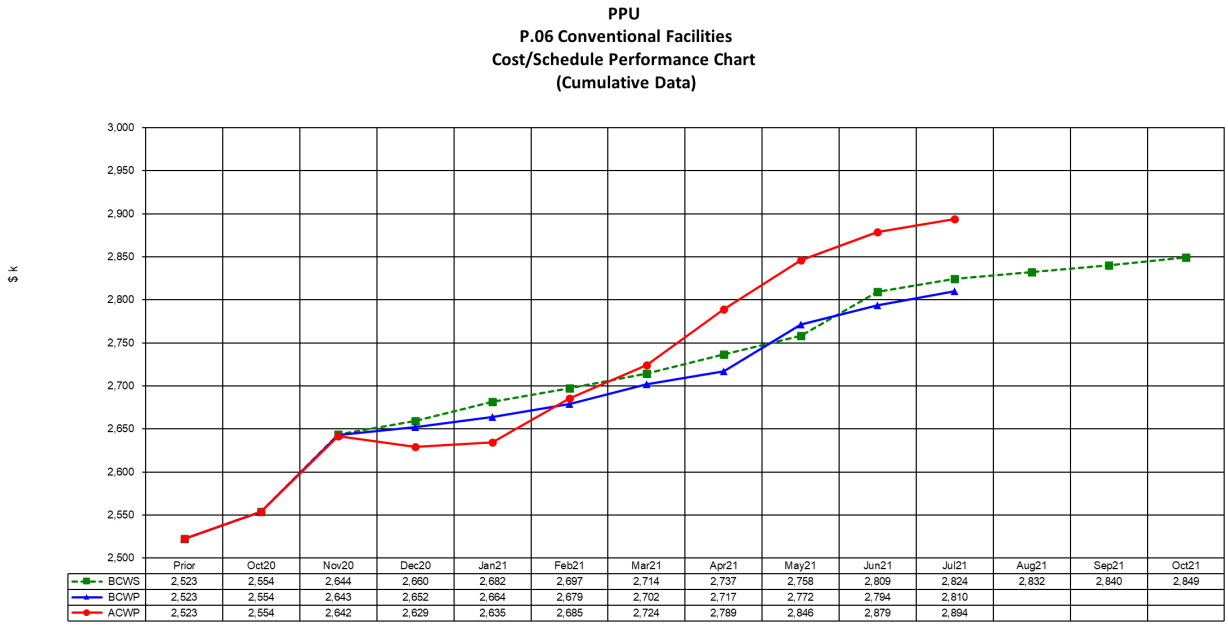
Title: P.05.06.04.02 / ORNL - Design - Upgrades for Gas Injection (CPI = 1.25)
Cause: Subcontractor and internal staff design effort continued to progress in July, but a positive cost variance persists. Subcontrctor progress was slightly impacted due to SNS resources preparing for the upcoming OPA reviews. SNS resources were not able to provide critical feedback to subcontractors.
Impact: None. The variance is slowly resolving itself.
Recoverable: Yes.
Corrective Action: None.

Title: P.05.10.03.02 / ORNL - Design - Controls Integration (SPI = .44; CPI = .49)
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 to continue. The cost has increased due to design changes which increased the number of I/O points to be controlled and multiple iterations as design details evolve.
Impact: Delays in starting design work could lead to delays in implementation and installation.
Recoverable: Partially.
Corrective Action: Two additional part-time engineers have been added for Target Controls programming. This will allow more work to proceed in parallel and accelerate progress versus the schedule. A PCR will be needed due to the increased cost for additional scope and to adjust the schedule.

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 = 1.00 and CPI = .97.

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

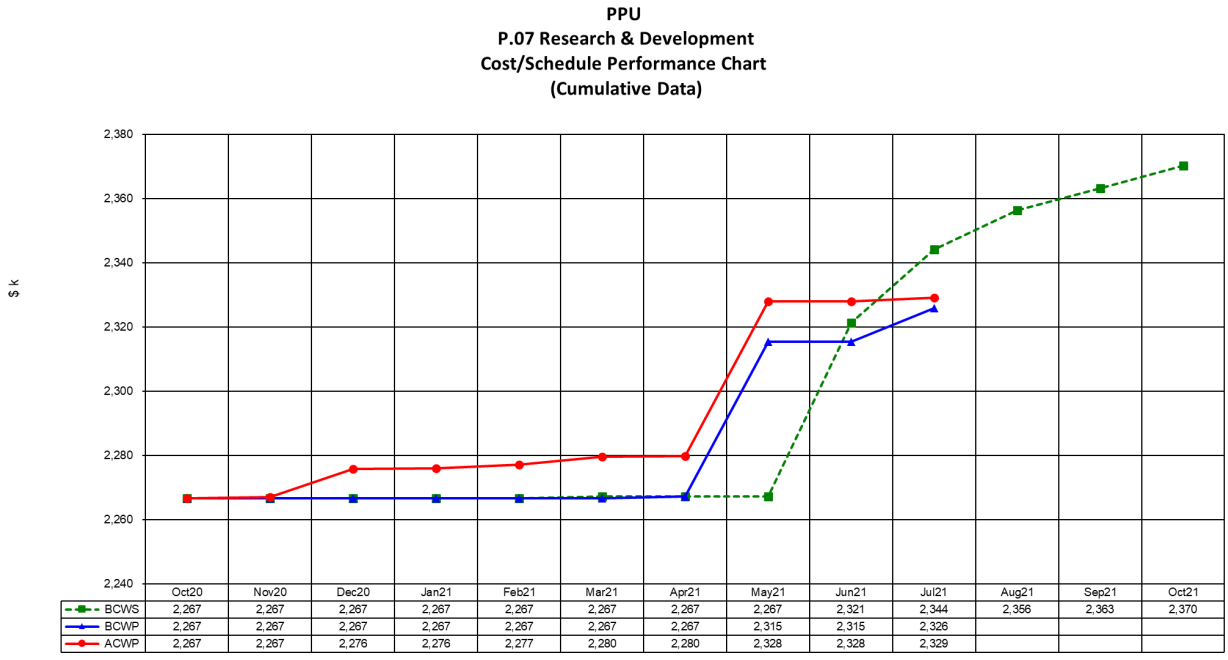
July 2021 ($k)	CURRENT PERIOD					CUMULATIVE TO DATE							AT COMPLETE		
				VARIANCE					VARIANCE						
ITEM	BCWS	BCWP	ACWP	SV	CV	BCWS	BCWP	ACWP	SV	SPI	CV	CPI	BAC	EAC	VAC
P.06 - Conventional Facilities	**15**	**17**	**15**	**1**	**2**	**2,824**	**2,810**	**2,894**	**(14)**	**1.00**	**(83)**	**0.97**	**10,900**	**10,996**	**(97)**
P.06.01 - Management and System Integration	6	6	5	0	1	185	185	170	0	1.00	15	1.09	309	293	15
P.06.02 - Building Modifications	9	11	10	1	0	2,639	2,625	2,724	(14)	0.99	(99)	0.96	10,591	10,703	(112)

Cumulative Thresholds: * Red: CPI/SPI <0.85 or >+1.20 AND >$100k (or > 1/2 of BAC) * Yellow: CPI/SPI between 0.85-0.90 or 1.15-1.20 AND >$100k (or > 1/2 of BAC)

P.7 R&D

No update.

Earned Value Performance Chart



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

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

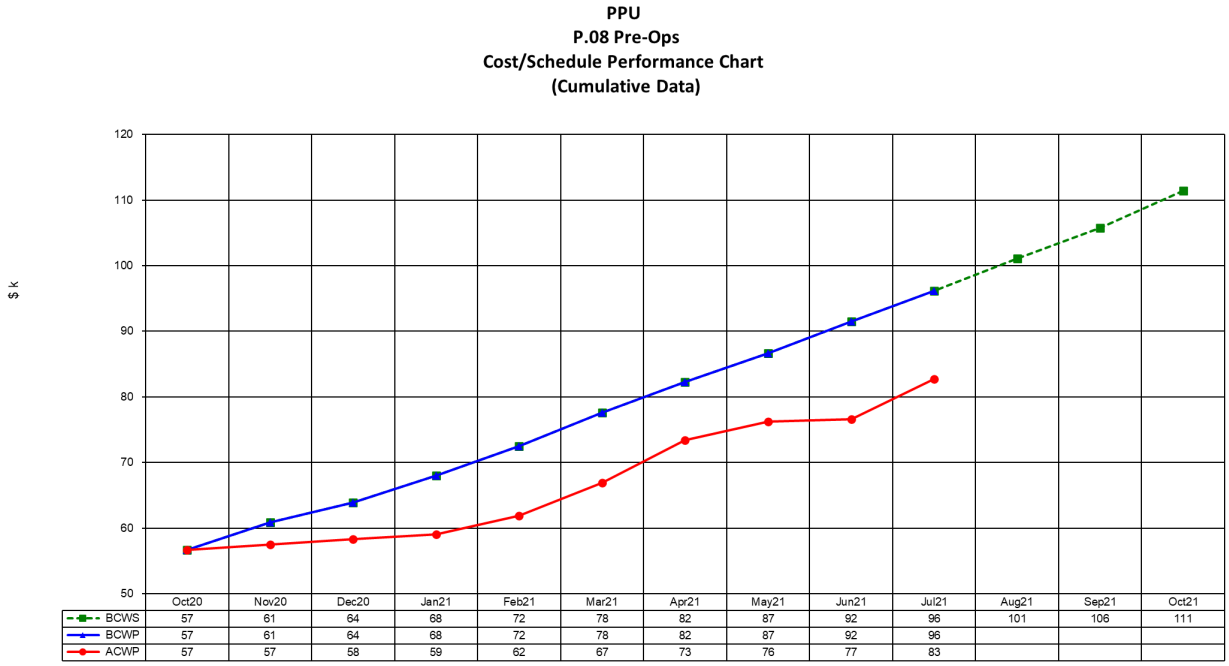
July 2021 ($k)	CURRENT PERIOD					CUMULATIVE TO DATE							AT COMPLETE		
				VARIANCE					VARIANCE						
ITEM	BCWS	BCWP	ACWP	SV	CV	BCWS	BCWP	ACWP	SV	SPI	CV	CPI	BAC	EAC	VAC
P.07 - R&D	**23**	**10**	**1**	**(12)**	**9**	**2,344**	**2,326**	**2,329**	**(18)**	**0.99**	**(3)**	**1.00**	**2,476**	**2,481**	**(5)**
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	23	10	1	(12)	9	352	334	337	(18)	0.95	(3)	0.99	484	490	(5)

Cumulative Thresholds: * Red: CPI/SPI <0.85 or >+1.20 AND >$100k (or > 1/2 of BAC) * Yellow: CPI/SPI between 0.85-0.90 or 1.15-1.20 AND >$100k (or > 1/2 of BAC)

P.8 Pre-Ops

The Pre-Ops team revised the Transition to Operations plan to reflect the updated 5-year plan. The team also focused on preparing for the upcoming DOE status review.

Earned Value Performance Chart



	Oct20	Nov20	Dec20	Jan21	Feb21	Mar21	Apr21	May21	Jun21	Jul21	Aug21	Sep21	Oct21
BCWS	57	61	64	68	72	78	82	87	92	96	101	106	111
BCWP	57	61	64	68	72	78	82	87	92	96			
ACWP	57	57	58	59	62	67	73	76	77	83			

As shown in the following Contract Performance Report, Pre-Ops performance indices are SPI = 1.00 and CPI = 1.16.

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

July 2021 ($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.08 - Pre-Ops	**5**	**5**	**6**	**0**	**(1)**	**96**	**96**	**83**	**0**	**1.00**	**13**	**1.16**	**1,137**	**1,124**	**13**
P.08.01 - Commissioning	0	0	0	0	0	0	0	0	0		0		933	934	(0)
P.08.03 - Regulatory Compliance	5	5	6	0	(1)	96	96	83	0	1.00	13	1.16	204	190	13

Cumulative Thresholds: * Red: CPI/SPI <0.85 or >+1.20 AND >$100k (or > 1/2 of BAC) * Yellow: CPI/SPI between 0.85-0.90 or 1.15-1.20 AND >$100k (or > 1/2 of BAC)

P.10 Long Lead Procurements (LLP)

P.10.2 SCL Systems

- Supply end cans #1 and #2 were returned to the vendor for rework. Supply end can #3 is in fit up testing (Figure 8). Supply end cans #4-#7 are being checked on critical dimensions per Request for Information 18. Long lead materials for supply end can #8 are being ordered.
- Return end can #1 has completed fit up testing (Figure 8). Return end can #2 is onsite at JLab. Inspections are being implemented as defined by Request for Information 18.
- Vacuum vessel #3 has been received at JLab. Vacuum vessel #4 is through final machining and is due to be shipped in September. Vacuum vessels #5, #6, and #7 are in various stages and scheduled to be shipped at one per month.

P.10.3 RF Systems

- SCL klystron 5 (of 12) completed factory acceptance testing. Klystron 6 factory acceptance testing is underway. SCL klystrons 7 through 11 are in the vacuum sealing and exhaust process.
- Site high power testing of the SCL circulator revealed incorrect tuning. The unit was returned to Microwave Techniques for re-tuning at the SNS operating temperature.
- L3Harris continued fabrication of the HPRF transmitters. The first transmitter cooling cart (TRCC) is complete pending wiring. The printed circuit boards have been installed in the main control chassis (Figure 9).
- The HVCM team participated in the factory acceptance testing of the new silicon-controlled rectifier unit (SCR). The SCR has been received by Alpha-Omega for the alternate-topology high-voltage converter modulators (AT-HVCM) factory acceptance testing. Wiring of the AT-HVCM safety enclosure is complete.

P.10.6 Conventional Facilities

- All field work is complete.
- As-builts, operation and maintenance manuals, and warranty submittals are in progress.
- Subcontract modifications are complete for all changes.
- The final invoice has been received and subcontract closure has started.
- Preparations for the DOE status review have begun.

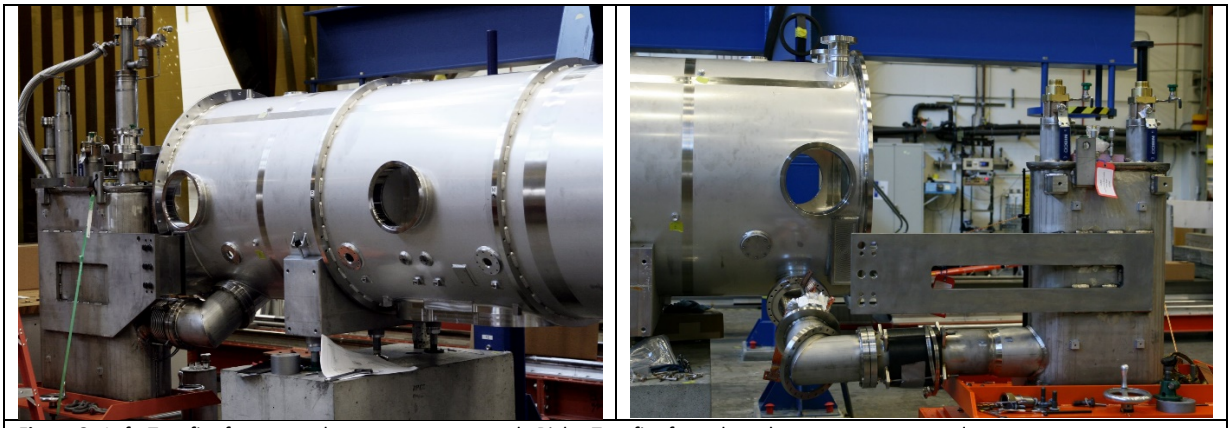


Figure 8: Left: Test fit of return end can on vacuum vessel. Right: Test fit of supply end can on vacuum vessel.

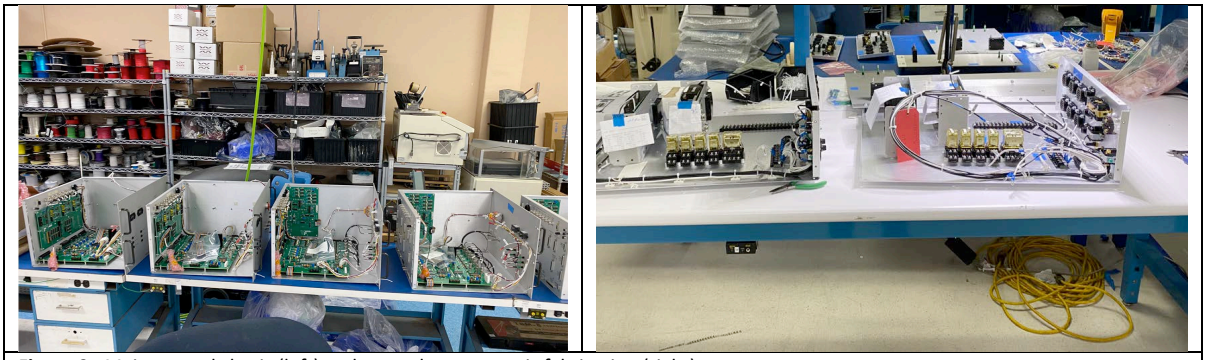
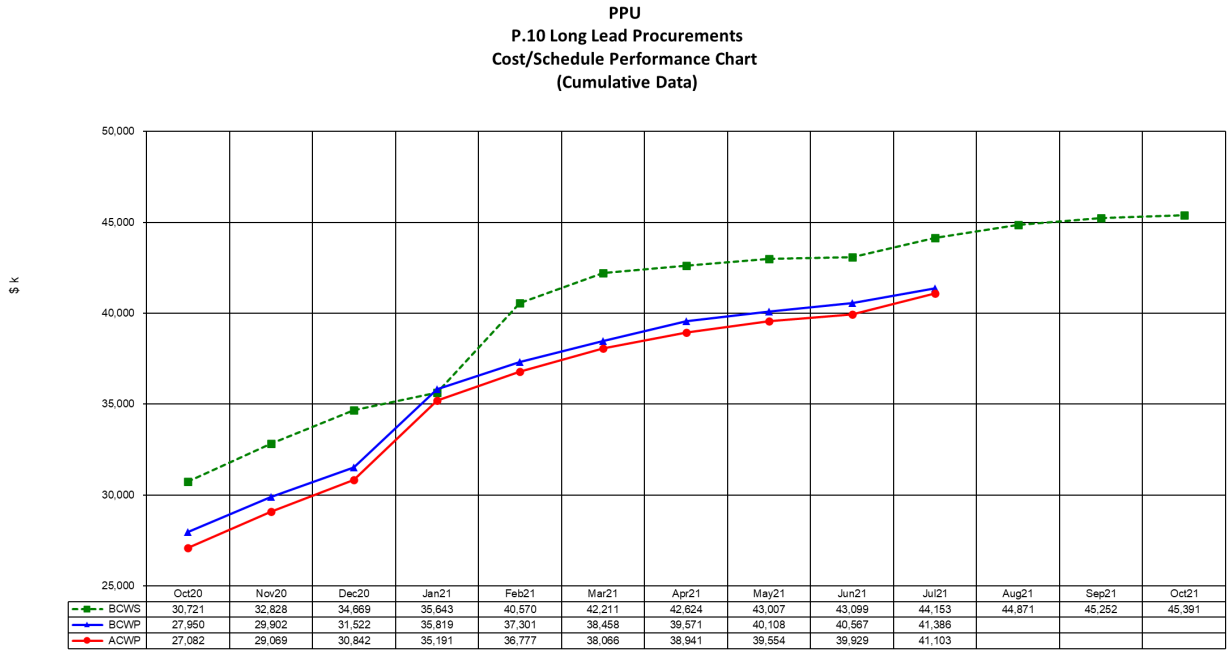


Figure 9: Main control chasis (left) and control power cassis fabrication (right).

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 = 1.01.

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

July 2021 ($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	**1,054**	**819**	**1,174**	**(235)**	**(355)**	**44,153**	**41,386**	**41,103**	**(2,767)**	**0.94**	**284**	**1.01**	**50,171**	**49,691**	**480**
P.10.02 - SCL Systems	26	162	489	135	(328)	19,781	18,603	18,581	(1,178)	0.94	21	1.00	19,848	19,828	21
P.10.03 - RF Systems	602	231	282	(371)	(52)	15,798	14,209	13,819	(1,589)	0.90	389	1.03	21,748	21,162	586
P.10.06 - Conventional Facilities	427	427	402	0	25	8,575	8,575	8,702	0	1.00	(127)	0.99	8,575	8,702	(127)

Cumulative Thresholds: * Red: CPI/SPI <0.85 or >+1.20 AND >$100k (or > 1/2 of BAC) * Yellow: CPI/SPI between 0.85-0.90 or 1.15-1.20 AND >$100k (or > 1/2 of BAC)

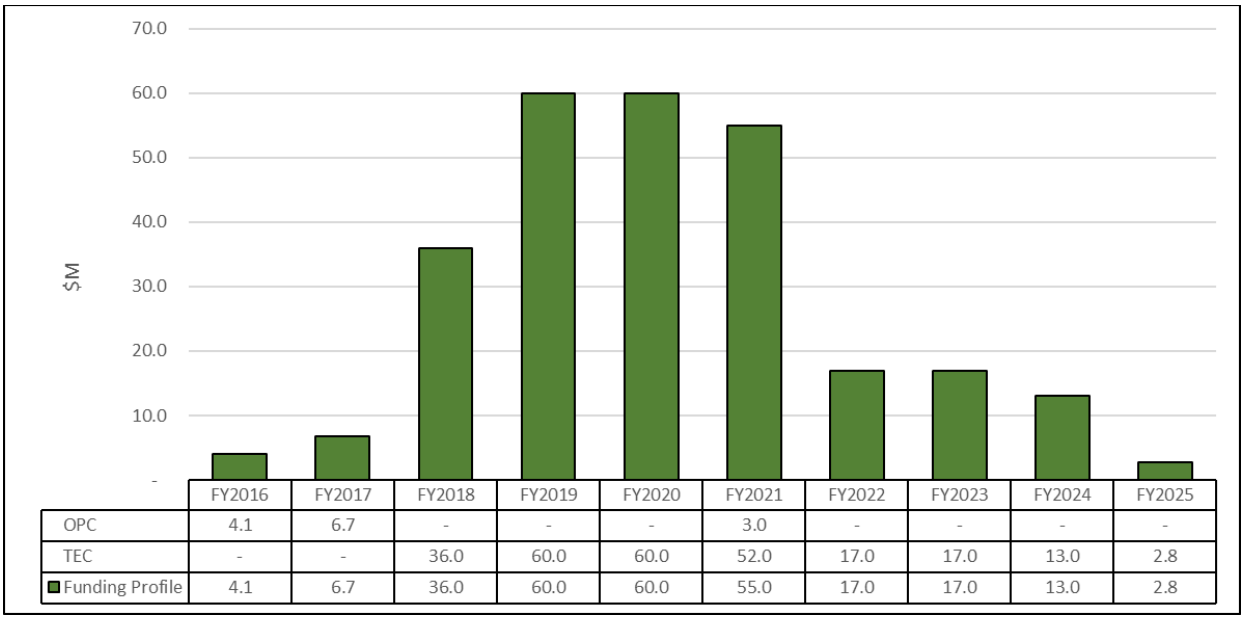
Appendices

PPU – Cost Report (thru July 2021)

WBS Description	Prior Costs	July Costs	Total Costs to Date	Commits (with OH)	Costs plus Commits
P Proton Power Upgrade	118,984,729	3,491,678	122,476,407	37,698,567	160,174,974
P.1 Project Management	8,829,871	315,872	9,145,742	725,031	9,870,773
P.2 Super-Conducting Linac SZstems	8,822,902	319,102	9,142,004	9,094,207	18,236,211
P.02.01 Management and System Integration	857,115	13,671	870,786		870,786
P.02.02 Cavities	1,314,642	38,328	1,352,970	659,586	2,012,556
P.02.03 Cryomodule Integration (JLab Scope)	5,253,291	240,855	5,494,146	7,997,072	13,491,218
P.02.04 Cryogenics	34,619	440	35,059		35,059
P.02.05 Utility Systems	88,942	3,328	92,270	437,550	529,820
P.02.06 System Integration	337,495	-	337,495		337,495
P.02.07 SCL Controls	936,797	22,479	959,276		959,276
P.3 RF Systems	20,012,101	998,930	21,011,031	10,515,157	31,526,188
P.03.01 Management and System Integration	369,485	11,028	380,513		380,513
P.03.02 SCL HPRF	4,892,128	472,232	5,364,359	6,056,333	11,420,693
P.03.03 NCL HPRF	1,083,659	-	1,083,659	625,219	1,708,878
P.03.04 LLRF	4,559,951	69,051	4,629,002	577,242	5,206,243
P.03.05 Existing Linac Modulators	3,235,479	57,884	3,293,363	65,050	3,358,413
P.03.06 New Linac Modulators	2,491,672	139,600	2,631,271	1,699,058	4,330,329
P.03.07 Utilities	2,443,787	220,810	2,664,597	1,383,253	4,047,850
P.03.08 RF Controls	513,130	24,485	537,614	49,812	587,427
P.03.09 Global Controls	422,812	3,841	426,652	59,190	485,842
P.4 Ring Systems	10,062,356	319,311	10,381,667	3,286,087	13,667,753
P.04.01 Management and System Integration	596,853	14,438	611,291		611,291
P.04.02 Injection region	3,351,005	77,702	3,428,708	2,441,374	5,870,082
P.04.03 Injection Dump	935,498	14,054	949,552	208,393	1,157,945
P.04.04 Extraction region	1,298,907	4,499	1,303,406	31,541	1,334,947
P.04.05 Utilities	422,761	420	423,181	21,545	444,726
P.04.06 Ring Control Systems	3,379,733	206,753	3,586,486	583,234	4,169,720
P.04.07 RTBT Stub	35,481	-	35,481		35,481
P.04.08 Accelerator Physics	42,117	1,444	43,560		43,560
P.5 First Target Station Systems	18,795,136	342,582	19,137,717	5,609,786	24,747,503
P.05.01 Management and System Integration	1,119,943	16,234	1,136,176		1,136,176
P.05.02 Neutronics	482,984	-	482,984		482,984
P.05.03 Mercury Process Systems	2,064,960	41,066	2,106,026	10,109	2,116,135
P.05.04 Moderator Cryogenic Systems	1,411,575	583	1,412,158	7,310	1,419,468
P.05.05 Vessel and Shielding Systems	436,756	-	436,756		436,756
P.05.06 Target Utility Systems	1,474,583	123,701	1,598,284	374,176	1,972,460
P.05.07 Instrument Systems	40,315	-	40,315		40,315
P.05.08 MOTS	816,987	42,126	859,114	283,456	1,142,570
P.05.09 2 MW Target	8,355,016	33,403	8,388,419	4,922,570	13,310,989
P.05.10 Safety, Controls and Operations	1,137,755	79,601	1,217,356	77	1,217,433
P.05.11 Gas Injection Development	1,454,261	5,867	1,460,128	12,087	1,472,215
P.6 Conventional Facilities	2,878,926	14,780	2,893,706	44,617	2,938,323
P.06.01 Management and System Integration	165,060	4,654	169,714	419	170,133
P.06.02 Building Modifications	2,713,866	10,126	2,723,992	44,198	2,768,190
P.7 R&D (OPC)	2,328,017	1,070	2,329,087	-	2,329,087
P.07.01 Gas Injection Development	1,991,752	-	1,991,752		1,991,752

WBS Description	Prior Costs	July Costs	Total Costs to Date	Commits (with OH)	Costs plus Commits
P.07.02 Foil Development	336,265	1,070	337,335		337,335
P.8 Pre-Ops (OPC)	76,599	6,142	82,741	-	82,741
P.08.03 Commissioning	76,599	6,142	82,741		82,741
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	39,929,053	1,173,891	41,102,943	8,423,683	49,526,626
P.10.02 SCL Systems	18,091,944	489,427	18,581,370	1,399,040	19,980,411
P.10.03 RF Systems	13,536,996	282,417	13,819,413	7,006,219	20,825,632
P.10.06 CF Systems	8,300,113	402,047	8,702,160	18,423	8,720,584

PPU – Funding Profile



	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025
OPC	4.1	6.7	-	-	-	3.0	-	-	-	-
TEC	-	-	36.0	60.0	60.0	52.0	17.0	17.0	13.0	2.8
Funding Profile	4.1	6.7	36.0	60.0	60.0	55.0	17.0	17.0	13.0	2.8

PPU – Project Execution Plan Milestones

Level 1 Milestone	DOE Dates	Status Date (Juy21)
CD-0, Approve Mission Need	Jan 2009 (A)	07-Jan-09 (A)
CD-1, Approve Alternative Selection and Cost Range	Apr 2018 (A)	04-Apr-18 (A)
CD-3A, Approve Long Lead Procurement	Oct 2018 (A)	05-Oct-18 (A)
CD-3B, Approve Long Lead Procurement	Sep 2019 (A)	03-Sep-19 (A)
CD-2, Approve Performance Baseline and Long Lead Procurement	Q1 FY21	06-Oct-20 (A)
CD-3, Approve Start of Construction	Q1 FY21	06-Oct-20 (A)
CD-4, Approve Project Completion (Level 0 Milestone)	Q4 FY28	31-Jul-28

Level 2 Milestone	DOE Dates	Status Date (Juy21)
P.1 Project Management		
Proton Facility (PF) and Neutron Facility (NF) - Facility Safety Assessment Document (FSAD) updates complete	Q3 FY26	10-Nov-22
P.2 SCL Systems		
Contract for superconducting cavities awarded	Dec 2018 (A)	21-Dec-18 (A)
Contract for cryomodule fabrication awarded	Sep 2019 (A)	23-Sep-19 (A)
First 5 production cavities received on site and successfully passed factory acceptance and receiving inspections	Q2FY24	24-Sept-20 (A)
First cryomodule on site and successfully passed factory acceptance and receiving inspections	Q3FY25	17-Feb-22
Last 5 production cavities received on site and successfully passed factory acceptance and receiving inspections	Q4FY24	26-Feb-21 (A)
Cryomodules 31 & 32 installed and system test completed	Q3FY26	5-Oct-22
Cryomodules 28, 29 & 30 installed and system test completed	Q4FY26	3-May-23
Cryomodules 25 & 27 installed and system test completed	Q4FY27	10-May-24
P.3 RF Systems		
Contract for transmitters awarded	Oct 2019 (A)	31-Oct-19 (A)
Installation and successful functional testing of KL-06 deionized water system completed	Q4FY25	4-May-23
Installation and successful functional testing of first SCL HVCM system completed	Q4FY25	1-Jul-22
Installation and successful functional testing of Superconducting Linac High Power Radio Frequency systems completed	Q3FY26	27-Nov-23
Installation of chase inserts and firestop/shield blocks completed	Q4FY27	17-May-24
P.4 Ring Systems		
Injection region magnets on site and successfully passed functional testing	Q1FY26	13-Dec-22
Installation of extraction kicker power supply upgrade completed	Q1FY27	22-Jun-23
P.5 First Target Station Systems		
Contract for 2MW target awarded	Q3FY24	30-Oct-20 (A)
Mercury process loop and MOTS modifications complete and successfully passed functional testing	Q4FY26	7-Aug-23
P.6 Conventional Facilities		
Klystron gallery CF construction complete	Q4FY24	06-Apr-21 (A)
Ring-to-Target Beam Transport (RTBT) stub construction complete	Q1FY27	1-Aug-23
P.8 Pre-Operations		
SNS power ramp up to 1.7MW complete	Q1FY28	24-Jul-24