## HEP Project Status Report – June 2019 Large Synoptic Survey Telescope (LSST) Camera Commissioning

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### 1. SCORECARD AS OF May 2019

Forecast Commissioning Completion:		June 24, 2022			
Percent Complete:	15.0%	Start of Operation Baseline:	Oct 1, 2022		
ETC:	\$16.9	Total Cost Estimate:	\$23.2M		
Contingency:	\$3.3M (EAC)	Float to Start of operation:	71 Days		
Cumulative CPI:	0.93	Cumulative SPI:	0.87		

#### 2. NEAR-TERM MILESTONES

Jan 2019 Forecast Finish	Activity Name	Float <sup>1</sup>	Comment
28-Jun-19	Refrigeration pathfinder ready to ship	301	This is delayed by about a month to accommodate manufacturing complexity. All parts are in hand and integration of the two cold heat exchanger is complete. The integration of the 2 cryo heat exchanger is under way.
8-Aug-19	Summit Facility Camera Utility Room Ready	233	DOE scope is complete for this milestone. Some electrical work still needed from the telescope and site to complete this in August.
13-Sep-19	Ship Mass Simulator SLAC to Chile	79	This is the new effort added to the baseline to reduce shipping risks to the camera by shipping a Camera mass simulator as an exercise run. This is on track currently although will be possibly delayed depending on readiness to receive.
3-Jan-20	Need telescope refrigeration cabinet in Chile	215	Refrigeration cabinets are MIE deliverables and are expected to be completed in July 2019; this milestone is on track from the MIE project with completion of all 4 cabinet in June and acceptance testing underway at SLAC.
14-Jan-20	Transport container final design review	79	The preliminary design review was successfully completed in March 2019. This activity in on track.
30-Oct-20	ComCam Ready to Start Early System AI&T	-19	ComCam was shipped by the DOE commissioning team in June. ComCam is now being integrated in Tucson with shutter and optics.
24-May-21	Camera Ready for Full System AI&T	1	This milestone is reflecting the current camera MIE forecast. It has slipped to accommodate MIE delays from the refrigeration testing and expected to slip an additional 2 weeks due to the safety stand down on MIE. This DOE commissioning Milestone will have ~2 months of schedule float to the project need date based on the re-plan done in the June schedule.

<sup>1</sup> float is computed to the current LSST Observatory Project completion date of 4/1/2022 as approved by the NSF MREFC project. The current Commissioning completion date of June 2022 is 61 days beyond this date, driven by the telescope mount assembly and dome, and is being assessed by the integrated project for incorporation in the June baseline.

## 3. STATUS HIGHLIGHTS

#### **Camera Summit Servicing Area Preparation**

A summit sprint at the end of March completed all infrastructure work that is required prior to turning-on and certifying the cleanrooms. The team conducted a second sprint the first week in May to verify the readiness of the utility room to receive the refrigeration pathfinder and refrigeration cabinet in July 2019.

The trip in May 2019 was not as successful as expected, because of delays in having the refrigeration lines available from the site and some additional equipment delivered. The delay was reflected in the cost variance

for last month, which captured the inefficiency. Additional scope was added to the plan to provide additional support to accommodate preparation of the items that were not ready yet.

Clean room turn on, inspection, and certification were completed in the June/July 2019 summit trip as well as build out of the refrigeration infrastructure in the Camera servicing area.

#### Shipping, Receiving and Logistics

The Commissioning team completed a review of the pathfinder shipping plan in early June at SLAC. The review resulted in several Tier 1 action items that are currently being addressed. The team is working on the shipping plan for the refrigeration cabinets to be used for the pathfinder and nearing completion at SLAC under the project scope. A review is planned for mid-July to evaluate the shipping approach ahead of the cabinets shipping in late July 2019.

### **Commissioning Camera (ComCam)**

ComCam work is supported by MIE and MREFC projects per the respective baselines. The completed ComCam main assembly was shipped from SLAC to Tucson in early June (Figures 1 through 4). The delivery of the ComCam assembly to Tucson accomplished a major goal of the MIE project.

Prior to shipment, final testing of the ComCam assembly was done with ComRaft installed. ComRaft is the schedule mitigation raft funded from the commissioning budget. ComRaft was used for final ComCam testing, because ETU2 (MIE deliverable ComCam raft), was being used by I&T for Camera early testing at IR2. Per a request by the Commissioning team, ComRaft remained in the ComCam cryostat during shipment to Tucson.

The quadrant box portion of the utility trunk that will support ComCam will remain at SLAC for a few more months to allow work on the commissioning refrigeration pathfinder portions of the quadrant box. ETU2 will also remain at SLAC for several months, because ComRaft is the preferred raft at the moment to continue work in Tucson.

#### **Refrigeration Pathfinder**

The MIE project forecasts that compressor cabinets to be used by the pathfinder will be available by July 2019. The two cold and two cryo refrigeration cabinets have been assembled and verification testing is underway. Storage tanks for pathfinder cryo-system refrigeration have been filled at SLAC and have arrived at the summit.

Also, at SLAC, all internal components of the pathfinder refrigeration system are completed and are being integrated with the vacuum canister (Figures 5 through 8).

#### Camera Control System and Camera Data Acquisition system support

All of the MIE deliverables of the commissioning camera CCS and DAQ systems were found to be ready to ship by the ComCam Pre-Ship Review committee. The ComCam was shipped to Tucson early June. For subsequent ComCam support, the CCS and DAQ teams will now be supported by DOE commissioning as the ComCam is finished in Tucson and then at the summit in Chile.

#### Management

As reported last month, the commissioning completion has been delayed due to delays in completion of the dome and disassembly/shipping of the Telescope Mount Assembly (TMA). The integrated project has generated a revised plan incorporating an optimized commissioning plan and contained the schedule delays to a three-month delay.

This delay has impacted Camera commissioning efforts to date, as well as upcoming activities, which is reflected in the EAC update reported this month.

The Cost Performance Index is still showing some over-spending which is due to the partial completion of the work expected to be done in the May preparation trip to Chile as well as additional effort needed to complete

the pathfinder heat-exchanger coil repairs and cleaning (which was anticipated based on the MIE similar effort for the I&T heat exchangers).

# 4. COMMISSIONING COST AND SCHEDULE SUMMARY (\$M)

	WBS	BAC	CTG	EAC	Contingency	Actuals
Project Office and Support	01C.01.01	\$4.9	\$4.9	\$5.7		\$0.8
Commng Management	06C.02.01	\$2.4	\$2.1	\$2.1		\$0.0
Commng Plng, Prep, Tooling, & Simulations	06C.02.02	\$4.7	\$3.8	\$4.9		\$1.1
Early System AI&T	06C.02.03	\$3.3	\$2.5	\$3.6		\$1.1
Full System AI&T	06C.02.04	\$2.4	\$2.5	\$2.5		\$0.0
Science Verification	06C.02.05	\$1.1	\$1.1	\$1.1		\$0.0
OPC		\$18.8	\$16.9	\$19.9	\$3.3	\$3.0
Cost Range		\$23.2		\$23.2		

#### 5. Schedule summary:

Level	Milestone	Actual & Forecast	Baseline Finish
L2	COMP: C_CDR - Pathfinder	18-Jan-18 A	03/31/18
L2	COMP: C_PDR - Pathfinder	31-Jul-18 A	07/31/18
L2	COMP: C_FDR - Pathfinder	26-Oct-18 A	11/28/18
L2	AVAIL: Refrigeration Pathfinder to ship	06/28/19	04/02/19
L2	NEED: Refrigeration Pathfinder on summit	09/17/19	05/07/19
L2	NEED: MIE Chile (TMA) Compressors	01/03/20	08/08/19
L2	NEED: Access to TMA Refrigeration Lines	05/04/20	08/08/19
L2	AVAIL: White Room Refrigeration System Ready for LSSTCam	05/12/20	11/09/19
L2	AVAIL: Pathfinder for ComCam	05/12/20	11/09/19
L2	COMP: Calibration Telescope Ready for Operations	09/10/20	03/23/20
L2	COMP: ComCam re-Verification Complete	10/23/20	07/01/20
L2	NEED: Pathfinder in ComCam on TMA	11/16/20	11/09/19
L2	COMP: L1/L2 received at summit	01/12/21	01/17/21
L2	COMP: TMA Refrigeration Tests Complete	03/09/21	03/20/20
L2	COMP: ComCam Ready for Bulk Data Production	05/14/21	03/28/21
L2	COMP: Camera Reverification Complete	08/03/21	07/22/21
L2	COMP: DMS: Pipeline Testing w/ComCam Complete	08/04/21	07/13/21
L2	COMP: Engineering Tests w/ComCam Complete	05/24/21	07/14/21
L2	COMP: LSSTCam-Tel Integration Complete	01/26/22	03/29/22
L2	COMP: DMS- Integration Complete	02/07/22	04/06/22
L2	COMP: mini-Survey 1 Data Release Complete	05/26/22	08/22/22
L2	COMP: Calibration Products Production Verified	05/26/22	08/22/22
L2	COMP: Data Release Production Verified	05/26/22	08/22/22
L2	COMP: mini-Survey 2 Data Release Complete	05/26/22	08/22/22
L2	Operation Readiness Review Complete	06/24/22	09/30/22

# 6. FIGURES

Figure 1: ComCam assembly packaged for shipment to Tucson at the SLAC Cleanroom Facility in early June.





Figure 2: The ComCam assembly unpackaged at Tucson after delivery by SLAC.

Figure 3: A view of the front of the ComCam cryostat at Tucson. The front glass cover of the cryostat is behind a protective metal plate.



<u>Figure 4:</u> A view of the ComRaft focal plane array within ComCam. The metal plate covering the glass has been removed, and you can see an image of the technician taking the photo reflected in the glass.



Figure 5: A 3-D rendering of the pathfinder heat-exchanger vacuum chamber assembly. The assembly is under construction at Building 33 at SLAC.



<u>Figure 6:</u>.The cold refrigeration coils and load mass installed in the heat-exchanger vacuum canister. The top of the canister is at lower-left.



Figure 7: A view from the bottom of the heat-exchanger canister. The load mass for cold refrigeration coils is at top center.



Figure 8: The empty heat-exchanger canister as delivered by the vendor in early June.

