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

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1. SCORECARD AS OF March 2019

Forecast Commissioning Completion:		June 21, 2022	
Percent Complete:	12.6%	Start of Operation Baseline:	Oct 1, 2022
ETC:	$16.1	Total Cost Estimate:	$23.2M
Contingency:	$4.9M (EAC)	Float to Start of operation:	74 Days
Cumulative CPI:	1.06	Cumulative SPI:	0.79

2. NEAR-TERM MILESTONES

Jan 2019 Forecast Finish	Activity Name	Float[1]	Comment
6-Jun-19	Ship ComCam Cryostat to Tucson	134	The ComCam acceptance review is scheduled for May 29th, 2019. Effort in on track despite resource prioritization impeding the Quad Box effort.
19-Jun-19	Summit Facility White Room ready	80	This is on track with completion of the March sprint in Chile and a currently ongoing sprint first week of May.
30-Aug-19	Ship Mass Simulator SLAC to Chile	47	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. Tis is on track currently.
11-Dec-19	Need telescope refrigeration cabinet in Chile	232	Refrigeration cabinets are MIE deliverables and are expected to be completed in June 2019; this milestone is on track.
20-Jan-20	Transport container final design review	47	The preliminary design review was successfully completed in March 2019. This activity in on track, although scheduling was updated this month to align with changes at the project level.
4-Sep-20	ComCam Ready to Start Early System AI&T	20	This effort is currently holding with the acceptance of the ComCam Dewar planned at SLAC for end of May 2019, before shipping to Tucson for further integration by the telescope team.
29-Apr-21	Camera Ready for Full System AI&T	18	This milestone is the current camera MIE forecast and has not been impacted.

[1] float is computed to the current LSST Observatory Project completion date of 4/1/2022 as recently approved by the NSF MREFC project. The current Commissioning completion date of June 2022 is 34 days beyond this date and is being assessed by the integrated project.

3. STATUS HIGHLIGHTS

Camera Summit Servicing Area Preparation

All hardware and tools are in place at the Camera utility room, except oxygen-deficiency monitors (ODMs), which will remain on shelves in Chile until June. A summit sprint at the end of March has completed all infrastructure work prior to turning-on and certifying the cleanrooms. The team conducted a second sprint first week of May to verify the readiness of the room to receive the refrigeration pathfinder and refrigeration cabinet in July 2019.

Shipping, Receiving and Logistics

As reported, the team completed a successful equipment procurement review for the Camera saddle stand late last year; final approval of saddle stand drawings is underway. The saddle stand will serve two purposes: 1) I&T will use it at the SLAC IR2 Cleanroom Facility during Camera construction to cradle the Camera in a stationary horizontal position; and 2) the Commissioning team will use it to cradle the Camera in the interior of the Camera shipping container.

The team completed a successful preliminary design review (PDR) for the shipping container in early March. As reported, the team will develop a prototype to prove out design concepts. The prototype effort covers construction of a vibration-isolation portion of the container. Combined with the saddle stand, the prototype will be used to ship the Camera mass simulator from SLAC to Chile this summer.

Full instrumentation will be included in the shipment to allow the team to confirm that the safety system meets design requirements. The mass simulator was provided to the Camera I&T team by the Telescope and Site team. The simulator was used previously for hexapod and rotator testing and will be needed in Chile for telescope testing.

The commissioning team has started 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 being planned to evaluate the shipping approach ahead of the cabinets shipping in July 2019.

Commissioning Camera (ComCam)

ComCam work is supported by MIE and MREFC projects per the respective baselines. As reported, the ComCam main assembly was completed at IR2 late last year. The ComCam raft is expected to be one of the two engineering test units (ETUs) which are currently reserved by I&T for Bench for Optical Testing (BOT) operations at IR2. BNL constructed a schedule-mitigation raft (ComRaft) that was delivered to SLAC in mid-February. The team successfully installed ComRaft in preparation for final testing of the ComCam cryostat configuration.

ComCam testing with ComRaft is well-underway and expected to be finished in May. When an ETU becomes available, it will also be delivered as part of ComCam to complete the scope. Currently, the team is trying to improve the schedule for the ComCam pre-ship review to complete by end of May 2019. The ComCam Quad box assembly used to manage the support electronics needed by ComCam and the refrigeration pathfinder has experienced delays due to resource prioritization towards support of the camera construction.

Refrigeration Pathfinder

The MIE project forecasts that Pathfinder compressor cabinets will be available by June 2019. The two cold refrigeration cabinets have been assembled and are under verification (Figure 1). Storage tanks for Pathfinder cryo-system refrigeration have been filled at SLAC and prepared for shipment to the summit.

Also, at SLAC, the cold-system heat exchangers are cleaned and work is continuing on the cryo-system heat exchangers. The one cryo coil needing repair was fixed successfully by SLAC technicians. Pathfinder heat loads are now designed and are in manufacture at SLAC (Figure 2 and 3). Construction of the vacuum vessel that will contain the heat exchangers has started at the vendor and is expected to be completed by late April.

Camera Control System and Camera Data Acquisition system support

As reported, a series of software pathfinders was initiated in FY18. The pathfinders integrate the MREFC funded data management (DM), observatory control system (OCS) and telescope control system (TCS) with the MIE-funded data acquisition system (DAQ) and Camera Control System (CCS).

Recent pathfinders focused on the MREFC-delivered auxiliary telescope. FY19 funds provide support for the final integration of CCS and DAQ systems with MREFC software systems prior to summit deployment.

Management

The commissioning completion has been delayed in the forecast presented this month by nearly two months due to delays on completion of the dome and dis-assembly/shipping of the Telescope Mount Assembly (TMA). The integrated project is reviewing opportunities to recover some of these schedule delays by optimizing all the assembly, integration and validation efforts going forward. A re-plan is expected to be completed in July 2019. This delay is potentially impacting camera commissioning efforts for ComCam use and the refrigeration pathfinder but both are still important to the overall strategy.

The Cost Performance Index is showing some underspending due to higher efficiency gained in work performed to date. The underspending has allowed the camera commissioning effort to stay on budget and accommodate the cost of the past delays from the MIE and MREFC construction project with reduced impact on commissioning contingency.

4. COMMISSIONING COST AND SCHEDULE SUMMARY ($M)

	WBS	BAC	CTG	EAC	Contingency	Actuals
Project Office and Support	01C.01.01	$4.9	$4.1	$4.8		$0.7
Commissioning Management	06C.02.01	$2.4	$2.2	$2.2		$0.0
Commissioning Planning, Prep, Tooling, & Simulations	06C.02.02	$4.5	$3.8	$4.7		$0.9
Early System AI&T	06C.02.03	$3.0	$2.4	$3.0		$0.6
Full System AI&T	06C.02.04	$2.5	$2.5	$2.5		$0.0
Science Verification	06C.02.05	$1.1	$1.1	$1.1		$0.0
OPC		$18.4	$16.1	$18.3	$4.9	$2.2
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	07/08/19	04/02/19
L2	NEED: Refrigeration Pathfinder on summit	08/05/19	05/07/19
L2	NEED: MIE Chile (TMA) Compressors	12/11/19	08/08/19
L2	AVAIL: White Room Refrigeration System Ready for LSSTCam	03/05/20	11/09/19
L2	NEED: Access to TMA Refrigeration Lines	03/19/20	08/08/19
L2	AVAIL: Pathfinder for ComCam	05/29/20	11/09/19
L2	COMP: Calibration Telescope Ready for Operations	09/04/20	03/23/20
L2	COMP: L1/L2 recevied at summit	12/15/20	01/17/21
L2	COMP: ComCam re-Verification Complete	12/22/20	07/01/20
L2	NEED: Pathfinder in ComCam on TMA	01/15/21	11/09/19
L2	COMP: TMA Refrigeration Tests Complete	04/29/21	03/20/20
L2	COMP: Camera Reverification Complete	04/29/21	07/22/21
L2	COMP: ComCam Ready for Bulk Data Production	07/29/21	03/28/21
L2	COMP: DMS: Pipeline Testing w/ComCam Complete	07/30/21	07/13/21
L2	COMP: Engineering Tests w/ComCam Complete	05/11/21	07/14/21
L2	COMP: LSSTCam-Tel Integration Complete	01/21/22	03/29/22
L2	COMP: DMS- Integration Complete	02/02/22	04/06/22
L2	COMP: mini-Survey 1 Data Release Complete	05/23/22	08/22/22
L2	COMP: Calibration Products Production Verified	05/23/22	08/22/22
L2	COMP: Data Release Production Verified	05/23/22	08/22/22
L2	COMP: mini-Survey 2 Data Release Complete	05/23/22	08/22/22
L2	Operation Readiness Review Complete	06/21/22	09/30/22

6. FIGURES

Figure 1: One of the two cold-system refrigeration cabinets for the on-summit telescope completed at SLAC. The on-summit refrigeration system is also called the telescope mount assembly (TMA) refrigeration system and will be used for the refrigeration pathfinder.

Figure 2: The prototype cold-plate heat load for the Pathfinder refrigeration system.

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Figure 3: The prototype cryoplate heat load for the Pathfinder refrigeration system.