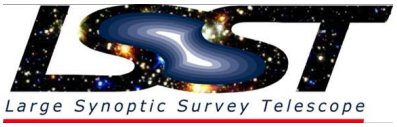

Camera Report

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Subsystem

Project Management

Document Title

LSST Camera Responses to DOE CD-3 Review Recommendations (August 2015)

1 DOE CD-3 Recommendations

The following table lists recommendations of the DOE CD-3 Review side-by-side with responses by the LSST Camera Project. All recommendations have been addressed.

DOE CD-3 Recommendation	LSSTCAM Project Response
1. (Sensors, Electronics, Control System, and DAQ): Analyze and document the number of sensor spares and the associated procurement plan required for a high probability of successfully populating the focal plane array, as well as spare rafts and the commissioning camera.	"Option 2" contracts will be awarded to both vendors in 4QFY16, which will reflect appropriate purchase quantities including spares. The quantities chosen for each contract will reflect an appropriate number of single-sensor spares as well as sensors for spare rafts and the commissioning camera (ComCam).
2. (Optics, Mechanics, Cryostat, Integration and Test): Use captured fasteners on the on-telescope serviceable camera components wherever possible.	In the camera body, all access ports and panels are attached using captured fasteners since these are intended to be removable on the telescope for servicing. The shutter is not intended to be serviced while on the telescope, so fasteners within the shutter assembly are not captive. The shutter will be removed and replaced by a second unit, so all servicing will occur on the bench in a clean room. Most mounting hardware that holds the shutter is captive, although it may not be possible to use captive hardware everywhere. This will be worked out in the full shutter prototype.
3. (Optics, Mechanics, Cryostat, Integration and Test): Review the Ball/AOS plans for handling and shipping lens blanks and finished lenses to mitigate risks during shipping between vendors (shock and vibration hazards).	Ball/AOS presented plans for handling and shipping the lens blanks and handling of the finished lenses at the Manufacturing Readiness Review in January 2016. No actions were identified pertaining to handling/shipping. The finished lenses shipping containers design is part of the Phase 4b work scope and is planned to be complete in December 2016, consistent with the coating schedule. Two milestones currently address these deliverables, P4B-11, Shipping and Packaging Plan per SOW section 7.6 and P4B-12, L1 and L2 Shipping Container suitable for the AR Coating. We will review as part of closing these milestones.

DOE CD-3 Recommendation	LSSTCAM Project Response
4. (Optics, Mechanics, Cryostat, Integration and Test): Use coarse and electrically grounded screens at the ion pump ports into the cryostat.	We are planning to modify the 3 ion pump housings to have apertures that are as large as possible consistent with the pump body itself, and will include on each a stainless steel electrically-grounded coarse-mesh screen, as recommended.
5. (Optics, Mechanics, Cryostat, Integration and Test): Procure electro-static discharge (ESD) event monitoring systems for the camera cleanroom facilities (e.g. the "EM Aware" product from 3M). See http://documents.staticcontrol.com/pdf/EMAwareTNG.pdf	BNL: "WS Aware" was installed in the cleanroom at the time of CD3 but may not have been obvious to the reviewers since they didn't enter the cleanroom. At the moment, all cleanroom work-stations that require ESD monitoring have the "WS Aware" in place (or an equivalent monitoring system). SLAC: The LSST Camera project will implement industry standard ESD controls (see LCA-10032 and LCA-13484 (in prep)). I&T's plan has been and remains focused on prevention of electrostatic discharge. However, corner raft subsystem will be performing sensor level and corner raft level testing in the LSST camera clean room. I&T will be performing raft-level testing and installation of rafts into the cryostat. For these activities, having ESD monitoring equipment in addition to ESD prevention equipment could be beneficial to the project. Working with the project we are considering purchasing two EM Aware monitors, one for use during sensor and raft-level testing in the auxiliary clean room and one for raft integration into the cryostat.
6. (Optics, Mechanics, Cryostat, Integration and Test): *In the integration frame, the camera can be rotated about two different points, neither of which is located near the camera center of gravity (see Integration and Test comments).* Consider revising the design of the camera integration frame to avoid unbalanced conditions.	The Camera body is designed to be held only by the telescope rotator attached to the back flange. Allowing attachment at other locations would levy significant requirements on the Camera body subsystem. Careful analysis of Camera mass properties in multiple stages of assembly and multiple configurations has been performed. See the PowerPoint presentation "Conceptual Designs - Camera Integration Stand" by Margaux Lopez from the I&T Integration Planning Review, March 23-24, 2016, available upon request. Also available on request is supplemental analysis of center of gravity as the Camera is built up on the Camera Integration stand.

DOE CD-3 Recommendation	LSSTCAM Project Response
7. (Optics, Mechanics, Cryostat, Integration and Test): *The camera integration frame design (with rotator) is currently unpowered and will require a crane to re-position the camera during integration (see Integration and Test comments)*. Consider motorizing the camera integration frame to improve safety and ease of use.	I&T has moved towards a commercial solution (Pandjiris) that has powered rotation around two axes. A detailed cost analysis of this solution is provided upon request.
8. (Environment, Safety, and Health): Ensure adequate oversight and assistance is provided to supervisory staff establishing qualifications and authorization basis for external personnel working on I&T operations at SLAC.	The LSST-Camera safety officer has in place a training and certification program for all (SLAC and non-SLAC) Camera personnel using SLAC facilities. This training covers • Orientation and Emergency Procedures • Area Hazards and Mitigations • Safe Work Practices • Work Planning and Control (WPC) Processes • Area Access and Control • Contamination Prevention • Clean Room Rules • ESD Control The barring of access by untrained workers is effected via keycard locks. Non-SLAC personnel at SLAC work only through designated points of contact who provide work authorization for SLAC WPC program compliance. For Camera purposes, these points-of-contact are the various subsystem managers. Work release for SLAC WPC is granted by the various SLAC area managers.
9. (Environment, Safety, and Health): Verify an integrated configuration management system is established and implemented for critical safety systems (e.g., oxygen deficiency monitors, other sensors, interlocks) that support the Camera Hardware Protection Protocols (LCA-140) prior to commencing early operations.	The Camera team, with corresponding Telescope personnel, continues to address configuration management to assure compliance with LCA-140. To this end, Camera and Telescope safety personnel have analyzed specific design considerations to prevent oxygen deficiency in the dome and in tighter spaces on summit. Auxiliary Electronics subsystem personnel are compiling a list of required certifications for the Master Protection Module (see LCA-13494).

DOE CD-3 Recommendation	LSSTCAM Project Response
10. (Environment, Safety, and Health): Refine camera and non-camera interface ES&H program provisions prior to commencing early operations.	Camera safety personnel will continue to work closely with Telescope and Camera personnel involved in subsystem, I&T, and Observatory design. Ensuring safety through an open and robust work interface has prompted the creation of the Summit Site Safety Health and Environmental Plan (LPM-114), written by the LSST safety officer and reviewed and approved by the Camera safety officer, the LSST Safety Council, and the LSST Change Control Board. The plan sets detailed rules for facility operations, including, but not limited to: emergency protocols, work planning and control, safety inspections, access control, and stop work authority.