Large Synoptic Survey Telescope System Plan	Document # **LCA-398-C** Author(s) Nadine Kurita	Status LSST Camera APPROVED Effective Date 4 Oct 2017
	Subsystem/Office System Engineering	

Document Title

LSST Camera Auxiliary Units and Overage Plan

1. Change History Log

Revision	Effective Date	Description of Change
A	01 Sept 2011	Initial Draft for Response to NSF PDR. Status set to "Review".
B	21 Oct 2014	Revision for CD-2. Released per LCN-1364.
C	4 Oct 2017	Revision for FY17. Released per LCN-1937.

2. Contents

3. Definitions

3.1. Acronyms

ADC	Analog-to-Digital Converter
ASIC	Application Specific Integrated Circuit
ATCA	Advanced Telecommunications Computing Architecture
COB	Cluster On Board
DAQ	Data Acquisition
IC	Integrated Circuit
LSST	Large Synoptic Survey Telescope
MIE	Major Item of Equipment
OTM	Optical Transition Module
RTM	(1) Raft Tower Module, (2) For DAQ, Rear Transition Module

4. Introduction

This document captures the assumptions of the camera project for Auxiliary Units, Overage and Lifetime Buys during the MIE project. The project scope includes "Auxiliary" items, in order to meet the stringent up-time requirements. The camera is the only instrument for LSST and must be reliable and easy to maintain. Therefore, some hardware will have auxiliary units that will be exchanged during downtimes, allowing the other unit to be serviced during operations. The term overage refers to extra units that are commonly purchased to cover losses during manufacturing and assembly. Also, overage is sometimes used to cover Lifetime Buys; and therefore, it is cost favorable to purchase extra units. Lifetime buys are often required for electronics because items become obsolete and the equipment cannot be maintained.

The appropriate amount of spares or overage required to successfully build and maintain an instrument needs to be individually analyzed for impacts to cost, project schedule, operations schedule, ability to obtain the items in the future and other manufacturing considerations.

5. Auxiliary Units

QTY	Auxiliary Units	Comment
1	Science Raft	full replacement unit for summit facility swap-out
1	Corner Raft	full maintenance unit for summit facility swap-out, also used in I&T
1	Shutter	full replacement unit for on-telescope swap-out
1	Auto Filter Exchanger	full replacement unit for on-telescope swap-out
1	Filter Loader	duplicate loader for allowing quick swap-out of filters
4	OTM Assembly	6 OTM needed and 10 built
2	Power supplies for the ATCA shelves	The design calls out for a single shelf and a redundant (hot swap) P/S is built into the shelf. Therefore two cold spares are sufficient. This will be an overage + lifetime buy.
1	DAQ system	I&T DAQ Test Stands could be turned into spares for the summit
1	Refrigeration System	Second unit in the camera facility for maintenance is the I&T unit retrofitted for the summit

6. Special Units

Filters: There are dummy aluminum filter that are being fabricated for testing of the filter exchange system. The real filters will be installed only at the end of I&T and removed for shipping.

L3 Assembly: There will be a non-optical quality (flat glass) L3 fabricated for testing purposes and meeting pressure operational needs.

L1-L2 assembly: there will be a set of aluminum L1 and L2 lens fabricated at vendor for assembly load testing purposes. A spare boule suitable for L1 or L2 will be held at Corning for 6 months covering the

time period until the rough polishing is complete. This is only an option and will not belong to the project unless the option to purchase the boule is executed.

Science Rafts: 2 engineering grade rafts will be made for integration testing. One of them is the ComCam deliverable. One maintenance unit listed as maintenance spare is planned.

Corner Rafts: 1 fully functional raft, identical to installed rafts, will be made for integration testing and is listed as a maintenance spare in previous section (It is shared and should not be double counted here).

CCS Computer servers in summit computer room: At the observatory level the project is planning to standardize on a small set of computer server types, with the intention that spares can be provided at the observatory level and quickly installed and configured in the event of failure. For this reason the camera does not intend to purchase or provide any spares

7. Overage & Custom Buys

%	Item Description	Comment
	Science Raft	
0.4%	4Kx4K CCD Sensors (1)	Vendor 1: 92 Vendor 2: 117 This provides 1 spare. Additional reserve sensors not part of this count are expected to be available
14%	Science Raft Baseplate (3)	2 extra for ITL and 1 extra for e2v. 2 first articles were used for ETU1 and ETU2. 22 baseplates were procured for the 21+1 maintenance
22%	Science Raft cage hardware (5)	22 rafts + 5 mechanical rafts for I7T. mechanical set of 5 can be used as spares but would need to be plated.
13%	Science Raft Electronics Boards (9)	75 assembled production REBs 21 raft + 1 maintenance plus 9 spare boards
	Corner Raft	
60%	Wavefront Sensors (6)	16 first article wavefornt sensor total ordered This leaves 6 spares
50%	Corner Raft Baseplate (2)	1 first article, 4 production, 1 maintenance and 1 overage.
75%	Corner Raft electronics boards (3)	8 boards of each kind are fully assembled. (5 are integrated)
	Filter Exchange System	
100%	Auto Changer trucks and swing arms assembly	Overage + Lifetime buy (1 set X+ and 1 set X-)
1400%	Auto Changer Latches actuators X+ and X-	Overage + Lifetime buy (28 units, change 2 every year)
100 %	Auto Changer HE sensors	Overage + Lifetime buy (custom units, 1 of

%	Item Description	Comment
		each)
300%	Auto changer Driving Motor combination	Lifetime buy (6 combinations, change 2 every 4 years)
50%	Auto Changer transmission device	Lifetime buy (1 set, 2 pulleys and 1 belt)
100%	Auto Changer Online clamp motor combination	Lifetime buy (3 combinations, change every 7.5 years)
100%	Auto Changer Safety PLC	Lifetime Buy (2 units)
25%	Autochanger Relay	Overage + Lifetime buy (4 units : 1xBT 51 + 2xRB 121 + 1x09Z)
100%	Auto Changer linkage	Lifetime Buy (1unit)
50%	Auto Changer Electrical Components (controller, …)	Overage + lifetime buy (1 of each)
100%	Auto Changer Interfaces keys and flexible supports	Overage + Lifetime buy (1 of each)
50%	Auto Changer Baffle and Power chain	Overage + Lifetime buy (1 chain + 1set of guide with rollers)
100%	Auto Changer Lubricant	Overage + Lifetime buy (6 x 57g)
100%	Carousel clamp actuator cable assembly	Overage + Lifetime buy
100%	Carousel clamp actuator rotary magnetic coupler	Overage + Lifetime buy
25%	Induction proximity switches	Overage + Lifetime buy
100%	Carousel driving motor assembly (motor + gear box without pinion)	Overage (1 set)
33%	Carousel brake assembly (brake + gear box withou pinion)	Overage (1 set)
25%	Carousel driving pinion	Overage (1 unit)
	Carousel THK rail grease	Lifetime buy (THK AFE-CA)
	Carousel gear grease	Lifetime buy (KLUBER Kluberplex AG 11-462)
	Carousel gear box grease	Lifetime buy (Harmonic Drive Flexolub A1)
100%	Carousel brake only	Lifetime buy (3 units)
100%	Carousel Encoder head	Overage (1 unit)
100%	Carousel Driving control assembly	Overage (1 unit)
100%	Carousel clamp actuator assembly	Overage (2 sets)
100%	Carousel clamp control assembly	Overage (2 sets)
100%	Carousel Brake telemetry assembly	Overage (1 set)
100%	Carousel Temperature telemetry assembly	Overage (1 set)
100%	Carousel Brakes relay assembly	Overage (1 set)
100%	Carousel Brakes power assembly	Overage (1 set)
100%	Carousel Standby socket target assembly	Overage (1 set)

%	Item Description	Comment
100%	Carousel backflange cables (all cables)	Overage (1 set)
100%	Carousel X- clamp system (with sensors and clamp unclamping assembly)	Overage (5 sets)
100%	Carousel X+ clamp system (with sensors and clamp unclamping assembly)	Overage (5 sets)
100%	Carousel unclamping reducer	Overage (2 sets)
40%	Carousel Z+ Vguide clamp assembly	Overage (2 sets)
20%	Carousel Clamp I/O assembly	Overage (1 set)
100%	Carousel Filter socket sensor assembly	Overage (5 sets)
100%	Carousel Slip-ring collectors	Overage + Lifetime buy (5 sets)
40%	Carousel filter cables assembly	Overage (2 sets)
100%	Carousel control/command device (Safety PLC + shunt regulator + Safety relays)	Overage + Lifetime buy (1 set)
15%	Filter support key, —X+,X-, Y-, Y+ custom fabricated and heat-treated with hard surfaces, etc	Lifetime Buy (1 set + 12 filter pins)
100%	PC 104 for the FCS	Lifetime Buy (1 units)
	Shutter Blade Assembly	
33%	Capstan	Overage: 1
17%	Idler pulley assembly	Overage: 1
33%	Hardware	
25%	Shutter motor	Overage: 1
	Camera Body and Purge	
100%	Camera Volume Purge filters	Overage + Lifetime Buy
100%	Camera Volume Purge VOC filters	Overage + Lifetime Buy
100%	Mechanism Purge filters	Overage + Lifetime Buy
	DAQ	
0%	OTM transceivers	2 needed per OTMs. 20 budgeted which accounts for the 4 auxiliary units.
25%	DAQ side transceivers	24 are needed and 30 are budgeted
42%	COB Boards	14 are needed and 20 are budgeted
66%	FPA/RTMs	3 are needed and 5 are budgeted
36% 13%	SSD/RTMs FLASH drives	11 are needed and 15 are budgeted 11x24 = 264 drives needed. 300 are budgeted

%	Item Description	Comment
	Cryostat	
15%	Refrigeration parts	
100%	CeSic grid material	
15%	Vacuum pumps, gauges, etc	or at least 1 unit
20%	Custom Vacuum feedthroughs-cryogenic	
20%	Custom Vacuum feedthroughs-signal/power	
	Electronics	
70%	ASPIC (CCD readout Custom ASIC)	Production lot: 1000 90 REBs (540), 8 corner raft boards (48)
25%	Commercial ICs with short design lifetimes	e.g. ADCs, amplifiers
15%	Commercial ICs of generic form	e.g. buffers, logic gates, regulators
10%	resistors, capacitors, connectors	Note, there could be large minimum buys
200%	Board assemblies (when not listed higher), low quantity	Lifetime Buy
15%	Board assemblies (when not listed higher), large quantity	Lifetime Buy
100%+	For commercial assemblies - e.g. power converters or network switches	