

Rubin Observatory

Vera C. Rubin Observatory
Data Management

Vera C. Rubin Observatory DM Science Verification Document

Jeff Carlin

LDM-752

Latest Revision: 2020-12-02

Draft Revision NOT YET Approved - This Rubin Observatory document has been approved as a Content-Controlled Document by the Rubin Observatory DM Change Control Board. If this document is changed or superseded, the new document will retain the Handle designation shown above. The control is on the most recent digital document with this Handle in the Rubin Observatory digital archive and not printed versions. Additional information may be found in the corresponding DM RFC. - **Draft Revision NOT YET Approved**



Abstract

Data Management infrastructure Verification Elements Baseline.

Draft

Change Record

Version	Date	Description	Owner name
	2020-08-11	First draft	

Document source location: <https://github.com/lsst/lm-752>

Version from source repository: 233f038

Draft

Contents

1	Introduction	1
1.1	Scope	1
1.2	Specification Flow-down	1
1.3	LSST Verification and Validation JIRA Project (LVV)	1
1.4	Verification and Validation Schedule and Resources	1
1.5	Applicable Documents	2
2	DM Science Verification Elements	3
2.1	[LVV-3] DMS-REQ-0002-V-01: Transient Alert Distribution	3
2.2	[LVV-6] DMS-REQ-0009-V-01: Simulated Data	5
2.3	[LVV-7] DMS-REQ-0010-V-01: Difference Exposures	6
2.4	[LVV-8] DMS-REQ-0018-V-01: Raw Science Image Data Acquisition	8
2.5	[LVV-9] DMS-REQ-0020-V-01: Wavefront Sensor Data Acquisition	11
2.6	[LVV-11] DMS-REQ-0024-V-01: Raw Image Assembly	14
2.7	[LVV-12] DMS-REQ-0029-V-01: Generate Photometric Zeropoint for Visit Image	17
2.8	[LVV-13] DMS-REQ-0030-V-01: Absolute accuracy of WCS	19
2.9	[LVV-14] DMS-REQ-0032-V-01: Image Differencing	22
2.10	[LVV-15] DMS-REQ-0033-V-01: Provide Source Detection Software	23
2.11	[LVV-16] DMS-REQ-0034-V-01: Associate Sources to Objects	25
2.12	[LVV-17] DMS-REQ-0042-V-01: Provide Astrometric Model	26
2.13	[LVV-18] DMS-REQ-0043-V-01: Provide Calibrated Photometry	27
2.14	[LVV-19] DMS-REQ-0046-V-01: Provide Photometric Redshifts of Galaxies	29
2.15	[LVV-20] DMS-REQ-0047-V-01: Provide PSF for Coadded Images	30
2.16	[LVV-21] DMS-REQ-0052-V-01: Enable a Range of Shape Measurement Approaches	32
2.17	[LVV-22] DMS-REQ-0059-V-01: Bad Pixel Map	33
2.18	[LVV-23] DMS-REQ-0060-V-01: Bias Residual Image	34
2.19	[LVV-24] DMS-REQ-0061-V-01: Crosstalk Correction Matrix	36
2.20	[LVV-25] DMS-REQ-0062-V-01: Illumination Correction Frame	37

2.21	[LVV-26] DMS-REQ-0063-V-01: Monochromatic Flatfield Data Cube	38
2.22	[LVV-27] DMS-REQ-0065-V-01: Provide Image Access Services	39
2.23	[LVV-28] DMS-REQ-0068-V-01: Raw Science Image Metadata	41
2.24	[LVV-29] DMS-REQ-0069-V-01: Processed Visit Images	45
2.25	[LVV-30] DMS-REQ-0070-V-01: Generate PSF for Visit Images	48
2.26	[LVV-31] DMS-REQ-0072-V-01: Processed Visit Image Content	50
2.27	[LVV-33] DMS-REQ-0075-V-01: Catalog Queries	52
2.28	[LVV-38] DMS-REQ-0096-V-01: Generate Data Quality Report Within Specified Time	54
2.29	[LVV-39] DMS-REQ-0097-V-01: Level 1 Data Quality Report Definition	55
2.30	[LVV-41] DMS-REQ-0099-V-01: Level 1 Performance Report Definition	57
2.31	[LVV-43] DMS-REQ-0101-V-01: Level 1 Calibration Report Definition	59
2.32	[LVV-46] DMS-REQ-0106-V-01: Coadded Image Provenance	60
2.33	[LVV-48] DMS-REQ-0120-V-01: Level 3 Data Product Self Consistency	62
2.34	[LVV-49] DMS-REQ-0121-V-01: Provenance for Level 3 processing at DACs	63
2.35	[LVV-52] DMS-REQ-0124-V-01: Federation with external catalogs	64
2.36	[LVV-57] DMS-REQ-0130-V-01: Calibration Data Products	65
2.37	[LVV-59] DMS-REQ-0132-V-01: Calibration Image Provenance	66
2.38	[LVV-62] DMS-REQ-0158-V-01: Provide Pipeline Construction Services	67
2.39	[LVV-64] DMS-REQ-0161-V-01: Optimization of Cost, Reliability and Availability in Order	69
2.40	[LVV-96] DMS-REQ-0265-V-01: Guider Calibration Data Acquisition	70
2.41	[LVV-97] DMS-REQ-0266-V-01: Exposure Catalog	72
2.42	[LVV-98] DMS-REQ-0267-V-01: Source Catalog	73
2.43	[LVV-99] DMS-REQ-0268-V-01: Forced-Source Catalog	76
2.44	[LVV-100] DMS-REQ-0269-V-01: DIASource Catalog	78
2.45	[LVV-101] DMS-REQ-0270-V-01: Faint DIASource Measurements	81
2.46	[LVV-102] DMS-REQ-0271-V-01: Max nearby galaxies associated with DIASource	83
2.47	[LVV-103] DMS-REQ-0272-V-01: DIAObject Attributes	86

2.48	[LVV-104] DMS-REQ-0273-V-01: SSOBJECT Catalog	88
2.49	[LVV-105] DMS-REQ-0274-V-01: Alert Content	89
2.50	[LVV-106] DMS-REQ-0275-V-01: Object Catalog	91
2.51	[LVV-107] DMS-REQ-0276-V-01: Object Characterization	93
2.52	[LVV-108] DMS-REQ-0277-V-01: Coadd Source Catalog	94
2.53	[LVV-109] DMS-REQ-0278-V-01: Coadd Image Method Constraints	95
2.54	[LVV-110] DMS-REQ-0279-V-01: Deep Detection Coadds	97
2.55	[LVV-111] DMS-REQ-0280-V-01: Template Coadds	99
2.56	[LVV-112] DMS-REQ-0281-V-01: Multi-band Coadds	100
2.57	[LVV-113] DMS-REQ-0282-V-01: Dark Current Correction Frame Creation	101
2.58	[LVV-114] DMS-REQ-0283-V-01: Fringe Correction Frame	102
2.59	[LVV-116] DMS-REQ-0285-V-01: Level 1 Source Association	103
2.60	[LVV-117] DMS-REQ-0286-V-01: SSOBJECT Precoverly	105
2.61	[LVV-118] DMS-REQ-0287-V-01: Max look-back time for precovery	106
2.62	[LVV-119] DMS-REQ-0288-V-01: Use of External Orbit Catalogs	108
2.63	[LVV-120] DMS-REQ-0289-V-01: Calibration Production Processing	109
2.64	[LVV-121] DMS-REQ-0290-V-01: Level 3 Data Import	110
2.65	[LVV-122] DMS-REQ-0291-V-01: Query Repeatability	111
2.66	[LVV-123] DMS-REQ-0292-V-01: Uniqueness of IDs Across Data Releases	112
2.67	[LVV-124] DMS-REQ-0293-V-01: Selection of Datasets	113
2.68	[LVV-125] DMS-REQ-0294-V-01: Processing of Datasets	115
2.69	[LVV-127] DMS-REQ-0296-V-01: Pre-cursor, and Real Data	117
2.70	[LVV-130] DMS-REQ-0299-V-01: Data Product Ingest	119
2.71	[LVV-132] DMS-REQ-0301-V-01: Control of Level-1 Production	121
2.72	[LVV-138] DMS-REQ-0307-V-01: Unique Processing Coverage	122
2.73	[LVV-142] DMS-REQ-0311-V-01: Regenerate Un-archived Data Products	123
2.74	[LVV-148] DMS-REQ-0317-V-01: DIAForcedSource Catalog	124
2.75	[LVV-150] DMS-REQ-0319-V-01: Characterizing Variability	125
2.76	[LVV-152] DMS-REQ-0321-V-01: Level 1 Processing of Special Programs Data	126
2.77	[LVV-154] DMS-REQ-0323-V-01: Calculating SSOBJECT Parameters	127

2.78	[LVV-155] DMS-REQ-0324-V-01: Matching DIASources to Objects	128
2.79	[LVV-156] DMS-REQ-0325-V-01: Regenerating L1 Data Products During Data Release Processing	129
2.80	[LVV-157] DMS-REQ-0326-V-01: Storing Approximations of Per-pixel Metadata	130
2.81	[LVV-158] DMS-REQ-0327-V-01: Background Model Calculation	131
2.82	[LVV-159] DMS-REQ-0328-V-01: Documenting Image Characterization	133
2.83	[LVV-160] DMS-REQ-0329-V-01: All-Sky Visualization of Data Releases	134
2.84	[LVV-161] DMS-REQ-0330-V-01: Best Seeing Coadds	135
2.85	[LVV-162] DMS-REQ-0331-V-01: Computing Derived Quantities	136
2.86	[LVV-163] DMS-REQ-0332-V-01: Denormalizing Database Tables	140
2.87	[LVV-164] DMS-REQ-0333-V-01: Maximum Likelihood Values and Covariances	141
2.88	[LVV-166] DMS-REQ-0335-V-01: PSF-Matched Coadds	142
2.89	[LVV-167] DMS-REQ-0336-V-01: Regenerating Data Products from Previous Data Releases	143
2.90	[LVV-168] DMS-REQ-0337-V-01: Detecting faint variable objects	144
2.91	[LVV-169] DMS-REQ-0338-V-01: Targeted Coadds	145
2.92	[LVV-170] DMS-REQ-0339-V-01: Tracking Characterization Changes Between Data Releases	146
2.93	[LVV-178] DMS-REQ-0347-V-01: Measurements in catalogs	147
2.94	[LVV-179] DMS-REQ-0348-V-01: Pre-defined alert filters	151
2.95	[LVV-180] DMS-REQ-0349-V-01: Detecting extended low surface brightness objects	153
2.96	[LVV-181] DMS-REQ-0350-V-01: Associating Objects across data releases . . .	154
2.97	[LVV-182] DMS-REQ-0351-V-01: Provide Beam Projector Coordinate Calculation Software	155
2.98	[LVV-3399] DMS-REQ-0378-V-01: Simultaneous Image Access Performance . .	156
2.99	[LVV-3401] DMS-REQ-0359-V-01: RMS photometric repeatability in uzy	157
2.100	[LVV-3402] DMS-REQ-0360-V-01: Median astrometric error on 20 arcmin scales	161
2.101	[LVV-3404] DMS-REQ-0362-V-01: Median residual PSF ellipticity correlations on 5 arcmin scales	164

2.102 [LVV-5640] DM-TS-CON-ICD-0011-V-01: Data Format_DM_1	166
2.103 [LVV-5641] DM-TS-CON-ICD-0011-V-02: Data Format_DM_2	167
2.104 [LVV-5646] DM-TS-CON-ICD-0002-V-01: Timing_DM_1	168
2.105 [LVV-5647] DM-TS-CON-ICD-0002-V-02: Timing_DM_2	169
2.106 [LVV-9741] DMS-REQ-0030-V-02: Minimum astrometric standards per CCD . .	170
2.107 [LVV-9743] DMS-REQ-0271-V-03: Radius considered nearby	172
2.108 [LVV-9745] DMS-REQ-0131-V-02: Max number of calibs to be processed . . .	173
2.109 [LVV-9746] DMS-REQ-0287-V-02: Max time from acquisition to L1 data release	174
2.110 [LVV-9747] DMS-REQ-0287-V-03: Lifetime of archived L1 data products	175
2.111 [LVV-9751] DMS-REQ-0359-V-02: Max fraction of sensors with excess unusable pixels	176
2.112 [LVV-9752] DMS-REQ-0359-V-03: Max fraction of outliers among non-saturated sources	180
2.113 [LVV-9753] DMS-REQ-0359-V-04: Accuracy of zero point for colors with u-band	184
2.114 [LVV-9754] DMS-REQ-0359-V-05: Repeatability outlier limit in gri	188
2.115 [LVV-9755] DMS-REQ-0359-V-06: Accuracy of photometric transformation . .	192
2.116 [LVV-9756] DMS-REQ-0359-V-07: RMS width of zero point in u-band	196
2.117 [LVV-9757] DMS-REQ-0359-V-08: Max cross-talk imperfections	200
2.118 [LVV-9758] DMS-REQ-0359-V-09: Repeatability outlier limit in uzy	204
2.119 [LVV-9759] DMS-REQ-0359-V-10: RMS photometric repeatability in gri	208
2.120 [LVV-9760] DMS-REQ-0359-V-11: Fraction of zero point outliers	212
2.121 [LVV-9761] DMS-REQ-0359-V-12: Max fraction of unusable pixels per sensor .	216
2.122 [LVV-9762] DMS-REQ-0359-V-13: Max sky brightness error	220
2.123 [LVV-9763] DMS-REQ-0359-V-14: RMS width of zero point in all bands except u	224
2.124 [LVV-9764] DMS-REQ-0359-V-15: Percentage of image area with ghosts	228
2.125 [LVV-9765] DMS-REQ-0359-V-16: Accuracy of zero point for colors without u- band	232
2.126 [LVV-9766] DMS-REQ-0359-V-17: Max RMS of resolved/unresolved flux ratio .	236
2.127 [LVV-9767] DMS-REQ-0360-V-02: Max fraction exceeding limit on 5 arcmin scales	240

2.128 [LVV-9768] DMS-REQ-0360-V-03: Median astrometric error on 5 arcmin scales	243
2.129 [LVV-9769] DMS-REQ-0360-V-04: Median absolute error in RA, Dec	246
2.130 [LVV-9770] DMS-REQ-0360-V-05: Outlier limit on 20 arcmin scales	249
2.131 [LVV-9771] DMS-REQ-0360-V-06: Color difference outlier limit relative to r-band	252
2.132 [LVV-9773] DMS-REQ-0360-V-07: Outlier limit on 5 arcmin scales	255
2.133 [LVV-9774] DMS-REQ-0360-V-08: Median astrometric error on 200 arcmin scales	258
2.134 [LVV-9775] DMS-REQ-0360-V-09: Outlier limit on 200 arcmin scales	261
2.135 [LVV-9776] DMS-REQ-0360-V-10: Max fraction exceeding limit on 20 arcmin scales	264
2.136 [LVV-9777] DMS-REQ-0360-V-11: Max fraction of r-band color difference out- liers	267
2.137 [LVV-9778] DMS-REQ-0360-V-12: RMS difference between r-band and other fil- ter separation	270
2.138 [LVV-9779] DMS-REQ-0360-V-13: Max fraction exceeding limit on 200 arcmin scales	273
2.139 [LVV-9780] DMS-REQ-0362-V-02: Max fraction of excess ellipticity residuals on 1 and 5 arcmin scales	276
2.140 [LVV-9781] DMS-REQ-0362-V-03: Outlier limit on 5 arcmin scales - ellipticity .	278
2.141 [LVV-9782] DMS-REQ-0362-V-04: Median residual PSF ellipticity correlations on 1 arcmin scales	280
2.142 [LVV-9783] DMS-REQ-0362-V-05: Outlier limit on 1 arcmin scales	282
2.143 [LVV-9867] DMS-PRTL-REQ-0025-V-01: Positional Query: Solar System Object Names_1	284
2.144 [LVV-9869] DMS-PRTL-REQ-0026-V-01: Positional Query by Region: Cone-Search_1	286
2.145 [LVV-9926] DMS-PRTL-REQ-0085-V-01: Distance Measurement Tool_1	288
2.146 [LVV-9937] DMS-PRTL-REQ-0097-V-01: Statistical Measurements on Image Data_1	290
2.147 [LVV-18225] DMS-REQ-0382-V-01: HiPS Visualization_1	291

2.148 [LVV-18227] DMS-REQ-0379-V-01: Produce All-Sky HiPS Map_1	292
2.149 [LVV-18228] DMS-REQ-0383-V-01: Produce MOC Maps_1	295
2.150 [LVV-18229] DMS-REQ-0344-V-01: Time to L1 public release	297
2.151 [LVV-18233] DMS-REQ-0390-V-01: Re-Runs on Other Systems_1	299
2.152 [LVV-18234] DMS-REQ-0389-V-01: Re-Runs on Similar Systems_1	300
2.153 [LVV-18295] DMS-REQ-0394-V-01: Data Management Nightly Reporting_1 . .	301
2.154 [LVV-18298] DMS-REQ-0392-V-01: Alert Delay and Failure Tolerances_1	302
2.155 [LVV-18299] DMS-REQ-0393-V-01: Performance Requirements for Transient Alert Distribution_1	303
2.156 [LVV-18339] DMS-REQ-0359-V-18: Outlier limit on zero points	304
2.157 [LVV-18465] DMS-REQ-0395-V-01: Scientific Visualization of Camera Image Data_1	306
2.158 [LVV-18881] DMS-REQ-0282-V-02: Dark Current Correction Frame Effectiveness	307
A Traceability	308
B References	317
C Acronyms	318

Vera C. Rubin Observatory DM Science Verification Document

1 Introduction

1.1 Scope

The scope of this document is to capture the content and details of all DM Verification Elements categorized in the **Science** sub-component. This will make it possible to:

- provide to users and stakeholders the verification elements details, without the need to access Jira
- approve changes to the verification elements

1.2 Specification Flow-down

1.3 LSST Verification and Validation JIRA Project (LVV)

The LSST Verification and Validation JIRA Project contains the detailed specifications within or derived from, and traceable to, the DMSR specifications, in Verification Elements. Verification Elements also specify the verification methods, the responsible parties, and additional notes regarding verification, as per the LSE-160 LSST Verification and Validation Process.

The Verification Elements have one or more Test Cases associated with them that describe the implementation of the verification activities in terms of specific tests to be executed. Those Test Cases are then scheduled via Test Plans and Campaigns, and executed with results reported in Test Cycles.

1.4 Verification and Validation Schedule and Resources

The schedule and resources required for the verification are defined in the LSST Project Management Control System (PMCS).

1.5 Applicable Documents

- LSE-61 LSST DM Subsystem Requirements
- LSE-160 Verification and Validation Process

Draft

2 DM Science Verification Elements

The following is the list of verification elements defined in the context of the Science component of the DM subsystem.

2.1 [LVV-3] DMS-REQ-0002-V-01: Transient Alert Distribution

Jira Link	Assignee	Status	Test Cases
LVV-3	Eric Bellm	Not Covered	LVV-T101 LVV-T217

Verification Element Description:

With precursor data, do L1 processing and issue alerts to a standards-based broker.

Requirement Details	
Requirement ID	DMS-REQ-0002
Requirement Description	Specification: Identified transient events shall be made available to end-users in the form of alerts, which shall be published to community alert distribution networks using community-standard protocols, to be determined during the LSST construction phase as community standards evolve.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0184 Transient Alert Publication OSS-REQ-0127 Level 1 Data Product Availability

2.1.1 Test Cases Summary

LVV-T101	Verify implementation of Transient Alert Distribution			
Owner	Status	Version	Critical Event	Verification Type
Kian-Tat Lim	Draft	1	false	Test

Objective:

Precursor or simulated data, execute AP, observe distribution to simulated clients using standard protocols

LVV-T217	Full Stream Alert Distribution			
Owner	Status	Version	Critical Event	Verification Type

Eric Bellm	Approved	1	false	Test
------------	----------	---	-------	------

Objective:

This test will check that the full stream of LSST alerts can be distributed to end users.

Specifically, this will demonstrate that:

- Serialized alert packets can be loaded into the alert distribution system at LSST-relevant scales (10,000 alerts every 39 seconds);
- Alert packets can be retrieved from the queue system at LSST-relevant scales.

2.2 [LVV-6] DMS-REQ-0009-V-01: Simulated Data

Jira Link	Assignee	Status	Test Cases
LVV-6	Jim Bosch	Not Covered	LVV-T125

Verification Element Description:

Show that artificial sources can be injected into data streams and recovered. Show that processing of simulated data recovers sources to the completeness required.

Requirement Details	
Requirement ID	DMS-REQ-0009
Requirement Description	Specification: The DMS shall provide the ability to inject artificial or simulated data into data products to assess the functional and temporal performance of the production processing software.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0353 Difference Source Spuriousness Threshold - Transients DMS-REQ-0007 Pipeline Infrastructure OSS-REQ-0351 Difference Source Spurious Probability Metric OSS-REQ-0354 Difference Source Spuriousness Threshold - MOPS

2.2.1 Test Cases Summary

LVV-T125	Verify implementation of Simulated Data			
Owner	Status	Version	Critical Event	Verification Type
Robert Lupton	Draft	1	false	Test

Objective:

Verify that the DMS can inject simulated data into data products for testing.

2.3 [LVV-7] DMS-REQ-0010-V-01: Difference Exposures

Jira Link	Assignee	Status	Test Cases
LVV-7	Eric Bellm	Not Covered	LVV-T18 LVV-T20 LVV-T36

Verification Element Description:

No requirement for quality of difference processing. No requirement this is tested as part of a full L1 end to end test. Just requires a processed image and a template: demonstrate that a difference exposure is created.

Requirement Details	
Requirement ID	DMS-REQ-0010
Requirement Description	Specification: The DMS shall create a Difference Exposure from each Processed Visit Image by subtracting a re-projected, scaled, PSF-matched Template Image in the same passband.
Requirement Discussion	Discussion: Difference Exposures are not archived, and are retained for only a limited time to facilitate Alert processing. They can be re-generated for users on-demand.
Requirement Priority	1b
Upper Level Requirement	DMS-REQ-0011 Produce Difference Sources DMS-REQ-0033 Provide Source Detection Software OSS-REQ-0129 Exposures (Level 1)

2.3.1 Test Cases Summary

LVV-T18	AG-00-05: Alert Generation Produces Required Data Products			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Approved	1	false	Test

Objective:

This test will check that the basic data products produced by Alert Generation are generated by execution of the science payload. These products will include:

- Processed visit images (PVIs; DMS-REQ-0069);
- Difference Exposures (DMS-REQ-0010);
- DIASource catalogs (DMS-REQ-0269);

- DIAObject catalogs (DMS-REQ-0271);

LVV-T20	AG-00-15: Scientific Verification of Difference Images			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Approved	1	false	Test

Objective:

This test will check that the difference images delivered by the Alert Generation science payload meet the requirements laid down by LSE-61.

Specifically, this will demonstrate that:

- Difference images have been generated and persisted during payload execution;
- Each difference image includes information about the identity of the input exposures, and metadata such as a representation of the PSF matching kernel (DMS-REQ-0074);
- Masks are correctly propagated from the input images.

This test does not include quantitative targets for the science quality criteria.

LVV-T36	Verify implementation of Difference Exposures			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Draft	1	false	Test

Objective:

Verify successful creation of a

1. PSF-matched template image for a given Processed Visit Image
2. Difference Exposure from each Processed Visit Image

2.4 [LVV-8] DMS-REQ-0018-V-01: Raw Science Image Data Acquisition

Jira Link	Assignee	Status	Test Cases
LVV-8	Robert Gruendl	Not Covered	LVV-T29
			LVV-T283
			LVV-T284
			LVV-T1549
			LVV-T1550
			LVV-T1556

Verification Element Description:

This requires a DAQ and OCS. We test in all known operating, calibration, and engineering modes. We verify that the pixels are the same as provided by the DAQ client library. We do not take responsibility for corruption between the DAQ and the client. Set up lab to simulate the summit.

Requirement Details	
Requirement ID	DMS-REQ-0018
Requirement Description	Specification: The DMS shall acquire raw Exposure data from the Camera science sensors during normal operations, calibration data collection, and in any other required engineering modes.
Requirement Discussion	Discussion: The manner of data acquisition is a matter for the DM-Camera ICDs, LSE-69 and LSE-68, in this area.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0114 Acquisition of Science Sensor data

2.4.1 Test Cases Summary

LVV-T29	Verify implementation of Raw Science Image Data Acquisition			
Owner	Status	Version	Critical Event	Verification Type
Kian-Tat Lim	Defined	1	false	Test

Objective:

Verify acquisition of raw data from L1 Test Stand DAQ while simulating all modes

LVV-T283	RAS-00-00: Writing well-formed raw image			
Owner	Status	Version	Critical Event	Verification Type
Michelle Butler	Approved	1	false	Test

Objective:

This test will check:

- The successful integration of the Pathfinder components with the DM Header Service and the Level 1 Archiver;
- That the raw images are well-formed and meet specifications in change-controlled documents LSE-61;

This Test Case shall be repeated for each of the different cameras (ATScam, LSSTCam) and sensors (Science, Wavefront, and Guider) combination.

LVV-T284	RAS-00-05: (LDM-503-8b) Writing data from CCOB to the DBB for further data processing			
Owner	Status	Version	Critical Event	Verification Type
Michelle Butler	Draft	1	false	Test

Objective:

This test will check:

- The successful integration of the DAQ archiver components with the CCOB
- That the file can then be ingested into the DBB and be retrieved for further analysis

LVV-T1549	LDM-503-6 Comcam verification readiness			
Owner	Status	Version	Critical Event	Verification Type
Michelle Butler	Draft	1	false	Demonstration

Objective:

Verify that Comcam has all the services running and verified working for retrieving an image from the comcam DAQ and store it on file systems at the LDF for viewing by LSP.

LVV-T1550	LDM-503-10 DAQ Validation			
Owner	Status	Version	Critical Event	Verification Type
Michelle Butler	Draft	1	false	Demonstration

Objective:

Verify that the DAQ can talk to test machines at the BDC through the DWDM network.

LVV-T1556	LDM-503-10B Large Scale CCOB Data Access			
Owner	Status	Version	Critical Event	Verification Type
Michelle Butler	Draft	1	false	Demonstration

Objective:

Demonstrate the ability to transfer data from the SLAC test stand or CCOB with 21 rafts from SLAC and ingested at NCSA and make available through an instance of the LSP

2.5 [LVV-9] DMS-REQ-0020-V-01: Wavefront Sensor Data Acquisition

Jira Link	Assignee	Status	Test Cases
LVV-9	Gregory Dubois-Felsmann	Not Covered	LVV-T30
			LVV-T283
			LVV-T284
			LVV-T1549
			LVV-T1556

Verification Element Description:

Simulated camera DAQ acquiring wavefront data. Data backbone archiving the data. The final sentence in the discussion is negated by DMS-REQ-0265.

Requirement Details	
Requirement ID	DMS-REQ-0020
Requirement Description	Specification: The DMS shall acquire raw exposure data from the Camera wavefront sensors, during normal survey operations and in any other required operating modes.
Requirement Discussion	Discussion: The details of this are a matter for the DM-Camera ICD in this area. However, these data should be identical in format and in mode of acquisition to the raw science sensor data. There is no currently established requirement for the acquisition or archiving of any raw guider sensor data.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0316 Wavefront Sensor Data

2.5.1 Test Cases Summary

LVV-T30	Verify implementation of Wavefront Sensor Data Acquisition			
Owner	Status	Version	Critical Event	Verification Type
Kian-Tat Lim	Defined	1	false	Test

Objective:

Verify successful ingestion of wavefront sensor data from L1 Test Stand DAQ while simulating all modes.

LVV-T283	RAS-00-00: Writing well-formed raw image			
Owner	Status	Version	Critical Event	Verification Type
Michelle Butler	Approved	1	false	Test

Objective:

This test will check:

- The successful integration of the Pathfinder components with the DM Header Service and the Level 1 Archiver;
- That the raw images are well-formed and meet specifications in change-controlled documents LSE-61;

This Test Case shall be repeated for each of the different cameras (ATScam, LSSTCam) and sensors (Science, Wavefront, and Guider) combination.

LVV-T284	RAS-00-05: (LDM-503-8b) Writing data from CCOB to the DBB for further data processing			
Owner	Status	Version	Critical Event	Verification Type
Michelle Butler	Draft	1	false	Test

Objective:

This test will check:

- The successful integration of the DAQ archiver components with the CCOB
- That the file can then be ingested into the DBB and be retrieved for further analysis

LVV-T1549	LDM-503-6 Comcam verification readiness			
Owner	Status	Version	Critical Event	Verification Type
Michelle Butler	Draft	1	false	Demonstration

Objective:

Verify that Comcam has all the services running and verified working for retrieving an image from the comcam DAQ and store

it on file systems at the LDF for viewing by LSP.

LVV-T1556	LDM-503-10B Large Scale CCOB Data Access			
Owner	Status	Version	Critical Event	Verification Type
Michelle Butler	Draft	1	false	Demonstration

Objective:

Demonstrate the ability to transfer data from the SLAC test stand or CCOB with 21 rafts from SLAC and ingested at NCSA and make available through an instance of the LSP

Draft

2.6 [LVV-11] DMS-REQ-0024-V-01: Raw Image Assembly

Jira Link	Assignee	Status	Test Cases
LVV-11	Gregory Dubois-Felsmann	Not Covered	LVV-T32
			LVV-T283
			LVV-T284
			LVV-T1549
			LVV-T1550
			LVV-T1556

Verification Element Description:

Requires a simulated DAQ and OCS. Files are verified against the relevant DM specification for raw metadata content and pixel values.

Requirement Details	
Requirement ID	DMS-REQ-0024
Requirement Description	Specification: The DMS shall assemble the combination of raw exposure data from all the readout channels from a single Sensor to form a single image for that sensor. The image data and relevant exposure metadata shall be integrated into a standard format suitable for down-stream processing, archiving, and distribution to the user community.
Requirement Discussion	Discussion: Relevant exposure metadata are those that define the observing context, telescope and instrument configuration, and provenance.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0114 Acquisition of Science Sensor data OSS-REQ-0129 Exposures (Level 1)

2.6.1 Test Cases Summary

LVV-T32	Verify implementation of Raw Image Assembly			
Owner	Status	Version	Critical Event	Verification Type
Kian-Tat Lim	Defined	1	false	Test

Objective:

Verify that the raw exposure data from all readout channels in a sensor can be assembled into a single image, and that all required/relevant metadata are associated with the image data.

LVV-T283	RAS-00-00: Writing well-formed raw image			
Owner	Status	Version	Critical Event	Verification Type
Michelle Butler	Approved	1	false	Test

Objective:

This test will check:

- The successful integration of the Pathfinder components with the DM Header Service and the Level 1 Archiver;
- That the raw images are well-formed and meet specifications in change-controlled documents LSE-61;

This Test Case shall be repeated for each of the different cameras (ATScam, LSSTCam) and sensors (Science, Wavefront, and Guider) combination.

LVV-T284	RAS-00-05: (LDM-503-8b) Writing data from CCOB to the DBB for further data processing			
Owner	Status	Version	Critical Event	Verification Type
Michelle Butler	Draft	1	false	Test

Objective:

This test will check:

- The successful integration of the DAQ archiver components with the CCOB
- That the file can then be ingested into the DBB and be retrieved for further analysis

LVV-T1549	LDM-503-6 Comcam verification readiness			
Owner	Status	Version	Critical Event	Verification Type
Michelle Butler	Draft	1	false	Demonstration

Objective:

Verify that Comcam has all the services running and verified working for retrieving an image from the comcam DAQ and store it on file systems at the LDF for viewing by LSP.

LVV-T1550	LDM-503-10 DAQ Validation			
Owner	Status	Version	Critical Event	Verification Type
Michelle Butler	Draft	1	false	Demonstration

Objective:

Verify that the DAQ can talk to test machines at the BDC through the DWDM network.

LVV-T1556	LDM-503-10B Large Scale CCOB Data Access			
Owner	Status	Version	Critical Event	Verification Type
Michelle Butler	Draft	1	false	Demonstration

Objective:

Demonstrate the ability to transfer data from the SLAC test stand or CCOB with 21 rafts from SLAC and ingested at NCSA and make available through an instance of the LSP

2.7 [LVV-12] DMS-REQ-0029-V-01: Generate Photometric Zeropoint for Visit Image

Jira Link	Assignee	Status	Test Cases
			LVV-T15
LVV-12	Jim Bosch	Not Covered	LVV-T19
			LVV-T39

Verification Element Description:

Check that a zeropoint is present in output data files from DMS-REQ-0069. Does not check that the value is reasonable.

Requirement Details	
Requirement ID	DMS-REQ-0029
Requirement Description	Specification: The DMS shall derive and persist a photometric zeropoint for each visit image, per CCD.
Requirement Priority	1b
Upper Level Requirement	DMS-REQ-0090 Generate Alerts OSS-REQ-0056 System Monitoring & Diagnostics OSS-REQ-0152 Level 1 Photometric Zero Point Error

2.7.1 Test Cases Summary

LVV-T15	DRP-00-30: Scientific Verification of Processed Visit Images			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	1	false	Test

Objective:

This test will check that the Processed Visit Images (PVIs) delivered by the DRP science payload meet the requirements laid down by LSE-61.

Specifically, this will demonstrate that:

- Processed visit images have been generated and persisted during payload execution;
- Each PVI includes a background model (DMS-REQ-0327), photometric zero-point (DMS-REQ-0029), spatially-varying PSF (DMS-REQ-0070) and WCS (DMS-REQ-0030).
- Saturated pixels are correctly masked.
- Pixels affected by cosmic rays are correctly masked.

- The background is not oversubtracted around bright objects.

This test does not include quantitative targets for the science quality criteria; we instead require for each test that we be able to quickly construct a plot or display summary images that allow such a target can be visualized.

LVV-T19	AG-00-10: Scientific Verification of Processed Visit Images			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Approved	1	false	Test

Objective:

This test will check that the Processed Visit Images (PVIs) delivered by the alert generation science payload meet the requirements laid down by LSE-61.

Specifically, this will demonstrate that:

- Processed visit images have been generated and persisted during payload execution;
- Each PVI includes a science pixel array, a mask array, and a variance array. (DMS-REQ-0072).
- Each PVI includes a background model (DMS-REQ-0327), photometric zero-point (DMS-REQ-0029), spatially-varying PSF (DMS-REQ-0070) and WCS (DMS-REQ-0030).
- Saturated pixels are correctly masked.
- Pixels affected by cosmic rays are correctly masked.
- The background is not oversubtracted around bright objects.

This test does not include quantitative targets for the science quality criteria.

LVV-T39	Verify implementation of Generate Photometric Zeropoint for Visit Image			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Draft	1	false	Test

Objective:

Verify that Processed Visit Image data products produced by the DRP and AP pipelines include the parameters of a model that relates the observed flux on the image to physical flux units.

2.8 [LVV-13] DMS-REQ-0030-V-01: Absolute accuracy of WCS

Jira Link	Assignee	Status	Test Cases
			LVV-T15
LVV-13	Jim Bosch	Not Covered	LVV-T19
			LVV-T40

Verification Element Description:

See Nidever/Economou document Section 3.2. Note terminology in this requirement is not consistent with LSR. Can be tested with existing survey data. Also needs to be tested with real LSST data.

Associated element (LVV-9741) satisfies the minimum number of available astrometric standards per CCD.

Requirement Details	
Requirement ID	DMS-REQ-0030
Requirement Description	Specification: The DMS shall generate and persist a WCS for each visit image. The absolute accuracy of the WCS shall be at least astrometricAccuracy in all areas of the image, provided that there are at least astrometricMinStandards astrometric standards available in each CCD.
Requirement Parameters	[astrometricAccuracy = 50[milliarcsecond]] Absolute accuracy of the WCS across the focal plane (approximately one-quarter of a pixel), astrometricMinStandards = 5[integer] Minimum number of astrometric standards per CCD.]
Requirement Discussion	Discussion: The World Coordinate System for visits will be expressed in terms of a FITS Standard representation, which provides for named metadata to be interpreted as coefficients of one of a finite set of coordinate transformations.
Requirement Priority	1a
Upper Level Requirement	DMS-REQ-0090 Generate Alerts DMS-REQ-0104 Produce Co-Added Exposures OSS-REQ-0149 Level 1 Catalog Precision OSS-REQ-0162 Level 2 Catalog Accuracy

2.8.1 Test Cases Summary

Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	1	false	Test

Objective:

This test will check that the Processed Visit Images (PVI) delivered by the DRP science payload meet the requirements laid down by LSE-61.

Specifically, this will demonstrate that:

- Processed visit images have been generated and persisted during payload execution;
- Each PVI includes a background model (DMS-REQ-0327), photometric zero-point (DMS- REQ-0029), spatially-varying PSF (DMS-REQ-0070) and WCS (DMS-REQ-0030).
- Saturated pixels are correctly masked.
- Pixels affected by cosmic rays are correctly masked.
- The background is not oversubtracted around bright objects.

This test does not include quantitative targets for the science quality criteria; we instead re- quire for each test that we be able to quickly construct a plot or display summary images that allow such a target can be visualized.

LVV-T19	AG-00-10: Scientific Verification of Processed Visit Images			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Approved	1	false	Test

Objective:

This test will check that the Processed Visit Images (PVI) delivered by the alert generation science payload meet the requirements laid down by LSE-61.

Specifically, this will demonstrate that:

- Processed visit images have been generated and persisted during payload execution;
- Each PVI includes a science pixel array, a mask array, and a variance array. (DMS-REQ-0072).
- Each PVI includes a background model (DMS-REQ-0327), photometric zero-point (DMS- REQ-0029), spatially-varying PSF (DMS-REQ-0070) and WCS (DMS-REQ-0030).
- Saturated pixels are correctly masked.
- Pixels affected by cosmic rays are correctly masked.
- The background is not oversubtracted around bright objects.

This test does not include quantitative targets for the science quality criteria.

LVV-T40	Verify implementation of Generate WCS for Visit Images			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	1	false	Test

Objective:

Verify that Processed Visit Images produced by the AP and DRP pipelines include FITS WCS accurate to specified **astrometric Accuracy** over the bounds of the image.

Draft

2.9 [LVV-14] DMS-REQ-0032-V-01: Image Differencing

Jira Link	Assignee	Status	Test Cases
LVV-14	Eric Bellm	Not Covered	LVV-T126

Verification Element Description:

Verified as part of L1 processing.

Requirement Details	
Requirement ID	DMS-REQ-0032
Requirement Description	Specification: The DMS shall provide software to perform image differencing, generating Difference Exposures from the comparison of single exposures and/or coadded images.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0121 Open Source, Open Configuration OSS-REQ-0129 Exposures (Level 1)

2.9.1 Test Cases Summary

LVV-T126	Verify implementation of Image Differencing			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Draft	1	false	Test

Objective:

Verify that the DMS can performance image differencing from single exposures and coadds.

2.10 [LVV-15] DMS-REQ-0033-V-01: Provide Source Detection Software

Jira Link	Assignee	Status	Test Cases
LWV-15	Jim Bosch	Not Covered	LWV-T127 LWV-T362

Verification Element Description:

Given reference (possible simulated) difference images and coadd images, generate catalog and compare with known values.

Requirement Details	
Requirement ID	DMS-REQ-0033
Requirement Description	Specification: The DMS shall provide software for the detection of sources in a calibrated image, which may be a Difference Image or a Co-Add image.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0130 Catalogs (Level 1) OSS-REQ-0137 Catalogs (Level 2) OSS-REQ-0121 Open Source, Open Configuration DMS-REQ-0080 Difference Sources Available within 24 hours

2.10.1 Test Cases Summary

LWV-T127	Verify implementation of Provide Source Detection Software			
Owner	Status	Version	Critical Event	Verification Type
Robert Lupton	Defined	1	false	Test

Objective:

Verify that the DMS provides source detection software that can be applied to calibrated images, including both difference images and coadds. This will be verified using simulated data, but could also be done by inserting artificial sources into existing datasets.

LWV-T362	Installation of the LSST Science Pipelines Payloads			
Owner	Status	Version	Critical Event	Verification Type
John Swinbank	Draft	1	false	Test

Objective:

This test will check that:

- The Alert Production Pipeline payload is available for installation from documented channels;
- The Data Release Production Pipeline payload is available for installation from documented channels;
- The Calibration Products Production Pipeline payload is available for installation from documented channels;
- These payloads can be installed on systems at the LSST Data Facility following available documentation;
- The installed pipeline payloads are capable of successfully executing basic integration tests.

Note that this test assumes a 2018-era packaging of the Science Pipelines software, in which all the above payloads are represented by a single “meta-package”, `lsst_distrib`.

Draft

2.11 [LVV-16] DMS-REQ-0034-V-01: Associate Sources to Objects

Jira Link	Assignee	Status	Test Cases
LVV-16	Jim Bosch	Not Covered	LVV-T61

Verification Element Description:

Precursor data. Different filters, sky positions and epochs. L2 processing. Verify object association.

Requirement Details	
Requirement ID	DMS-REQ-0034
Requirement Description	Specification: The DMS shall associate Sources measured at different times and in different passbands with entries in the Object catalog.
Requirement Discussion	Discussion: The task of association is to relate Sources from different times, filters, and sky positions, to the corresponding Objects. Having made these associations, further measurements can be made on the full object data to generate astronomically useful quantities.
Requirement Priority	1a
Upper Level Requirement	DMS-REQ-0081 Produce Object Catalog OSS-REQ-0339 Level 2 Source-Object Association Quality

2.11.1 Test Cases Summary

LVV-T61	Verify implementation of Associate Sources to Objects			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Defined	1	false	Test

Objective:

Verify that each Source record contains an ID that associates it with a best guess at the Object it corresponds to.

2.12 [LVV-17] DMS-REQ-0042-V-01: Provide Astrometric Model

Jira Link	Assignee	Status	Test Cases
LVV-17	Jim Bosch	Not Covered	LVV-T128

Verification Element Description:

Precursor data covering a range of epochs and show that proper motion and parallax has been calculated. The requirement does not specify an accuracy for these calculations.

Requirement Details	
Requirement ID	DMS-REQ-0042
Requirement Description	Specification: An astrometric model shall be provided for every Object and DIAObject which specifies at least the proper motion and parallax, and the estimated uncertainties on these quantities.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0153 World Coordinate System Accuracy OSS-REQ-0149 Level 1 Catalog Precision OSS-REQ-0160 Level 1 Difference Source - Difference Object Association Quality OSS-REQ-0162 Level 2 Catalog Accuracy

2.12.1 Test Cases Summary

LVV-T128	Verify implementation Provide Astrometric Model			
Owner	Status	Version	Critical Event	Verification Type
Colin Slater	Draft	1	false	Test

Objective:

Verify that an astrometric model is available for Objects and DIAObjects.

2.13 [LVV-18] DMS-REQ-0043-V-01: Provide Calibrated Photometry

Jira Link	Assignee	Status	Test Cases
LVV-18	Jim Bosch	Not Covered	LWV-T21 LWV-T22 LWV-T129

Verification Element Description:

Test with precursor data and show that AB magnitudes are calculated. This functional requirement does not include a test that these magnitudes are accurate.

Requirement Details	
Requirement ID	DMS-REQ-0043
Requirement Description	Specification: The DMS shall provide calibrated photometry in each observed passband for all measured entities (e.g., DIASources, Sources, Objects), measuring the AB magnitude of the equivalent flat-SED source, above the atmosphere. Fluxes, possibly in jansky, shall be calculated for all measured entities.
Requirement Discussion	Discussion: Note that the SED is only assumed to be flat within the passband of the measurement.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0130 Catalogs (Level 1) OSS-REQ-0275 Calibration Processing Performance Allocations OSS-REQ-0137 Catalogs (Level 2)

2.13.1 Test Cases Summary

Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Approved	1	false	Test

Objective:

This test will check that the difference image source catalogs delivered by the Alert Generation science payload meet the requirements laid down by LSE-61.

- Specifically, this will demonstrate that:
- Measurements in the catalog are presented in flux units (DMS-REQ-0347);
- Each DIASource record contains an appropriate subset of the attributes required by DMS-REQ-0269. In particular, the LDM-503-3-era pipeline is expected to provide DIASource positions (sky and focal plane), fluxes, and flags indicative of

issues encountered during processing.

- Faint DIASources satisfying additional criteria are stored (DMS-REQ-0270).
- Derived quantities are provided in pre-computed columns (DMS-REQ-0331);

This test does not include quantitative targets for the science quality criteria.

LVV-T22	AG-00-25: Scientific Verification of DIAObject Catalog			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Approved	1	false	Test

Objective:

This test will check that the DIAObject catalogs delivered by the Alert Generation science payload meet the requirements laid down by LSE-61.

Specifically, this will demonstrate that:

- DIAObjects are recorded with unique identifiers (DMS-REQ-0271);
- Measurements in the catalog are presented in flux units (DMS-REQ-0347);
- Each DIAObject record contains an appropriate set of summary attributes (DMS-REQ-0271 and DMS-REQ-0272). Note:
 - This test is executed independently of the Data Release Production system. Hence, DIAObjects are not associated to Objects, and the association metadata specified by DMS-REQ-0271 is not expected to be available.
 - The LDM-503-3era pipeline is not expected to calculate or persist all attributes specified by DMS-REQ-0272 requirement.
- Relevant derived quantities are provided in pre-computed columns (DMS-REQ-0331);

This test does not include quantitative targets for the science quality criteria.

LVV-T129	Verify implementation of Provide Calibrated Photometry			
Owner	Status	Version	Critical Event	Verification Type
Robert Lupton	Defined	1	false	Test

Objective:

Verify that the DMS provides photometry calibrated in AB mags and fluxes (in nJy) for all measured objects and sources. Must be tested for both DRP and AP products.

2.14 [LVV-19] DMS-REQ-0046-V-01: Provide Photometric Redshifts of Galaxies

Jira Link	Assignee	Status	Test Cases
LVV-19	Jim Bosch	Not Covered	LVV-T68

Verification Element Description:

Verify that the Object table has a photometric redshift for each object.

Requirement Details	
Requirement ID	DMS-REQ-0046
Requirement Description	Specification: The DMS shall compute a photometric redshift for all detected Objects.
Requirement Priority	2
Upper Level Requirement	OSS-REQ-0133 Level 2 Data Products DMS-REQ-0040 Enable BAO Analysis

2.14.1 Test Cases Summary

LVV-T68	Verify implementation of Provide Photometric Redshifts of Galaxies			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Draft	1	false	Test

Objective:

Verify that Object catalogs produced by the DRP Pipeline include photometric redshift information.

2.15 [LVV-20] DMS-REQ-0047-V-01: Provide PSF for Coadded Images

Jira Link	Assignee	Status	Test Cases
			LVV-T16
LVV-20	Jim Bosch	Not Covered	LVV-T62
			LVV-T62

Verification Element Description:

From a coadd, request the PSF from every pixel. Does not require that the PSF varies.

Requirement Details	
Requirement ID	DMS-REQ-0047
Requirement Description	Specification: The DMS shall determine a characterization of the PSF for any specified location in coadded images.
Requirement Discussion	Discussion: The PSF model will be primarily used to perform initial object characterization and bootstrapping of multi-epoch object characterization (e.g., Multifit).
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0153 World Coordinate System Accuracy DMS-REQ-0041 Measure Intrinsic Ellipticities of Small Galaxies OSS-REQ-0136 Co-added Exposures OSS-REQ-0316 Wavefront Sensor Data

2.15.1 Test Cases Summary

LVV-T16	DRP-00-35: Scientific Verification of Coadd Images			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	1	false	Test

Objective:

This test will check that the coadded images delivered by the DRP science payload meet the requirements laid down by LSE-61. Specifically, this will demonstrate that:

- Coadds have been generated and persisted during payload execution;
- Each coadd provides a spatially varying PSF model (DMS-REQ-0047).
- Saturated pixels are correctly masked.
- Pixels affected by satellite trails and ghosts are rejected from the coadd.
- The background is not oversubtracted around bright objects.

This test does not include quantitative targets for the science quality criteria; we instead require for each test that we be able to quickly construct a plot or display summary images that allow such a target can be visualized.

LVV-T62	Verify implementation of Provide PSF for Coadded Images			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	2	false	Test

Objective:

Verify that all coadd images produced by the DRP pipelines include a model from which an image of the PSF at any point on the coadd can be obtained.

LVV-T62	Verify implementation of Provide PSF for Coadded Images			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	2	false	Test

Objective:

Verify that all coadd images produced by the DRP pipelines include a model from which an image of the PSF at any point on the coadd can be obtained.

2.16 [LVV-21] DMS-REQ-0052-V-01: Enable a Range of Shape Measurement Approaches

Jira Link	Assignee	Status	Test Cases
LVV-21	Jim Bosch	Not Covered	LVV-T130

Verification Element Description:

Demonstrate that the results of multiple shape models are available from Sources, Objects and ForcedSources and that this information can be obtained simultaneously using data from multiple exposures.

Requirement Details	
Requirement ID	DMS-REQ-0052
Requirement Description	Specification: The DMS shall provide for the use of a variety of shape models on multiple kinds of input data to measure sources: measurement on coadds; measurement on coadds using information (e.g., PSFs) extracted from the individual exposures; measurement based on all the information from the individual Exposures simultaneously.
Requirement Discussion	Discussion: The most appropriate measurement model to apply depends upon the nature of the composite source.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0137 Catalogs (Level 2)

2.16.1 Test Cases Summary

LVV-T130	Verify implementation of Enable a Range of Shape Measurement Approaches			
Owner	Status	Version	Critical Event	Verification Type
Colin Slater	Draft	1	false	Test

Objective:

Verify that multiple shape measurement algorithms can be used.

2.17 [LVV-22] DMS-REQ-0059-V-01: Bad Pixel Map

Jira Link	Assignee	Status	Test Cases
LVV-22	Jim Bosch	Not Covered	LVV-T83

Verification Element Description:

32bits is a minimum requirement. To verify we need to check that it is at least 32-bit. The product is an image file in unspecified format. (May want an additional requirement that these data can also be visualized directly on a web page as part of SUIT). Request the map for any date, compare with camera team understanding.

Requirement Details	
Requirement ID	DMS-REQ-0059
Requirement Description	Specification: The DMS shall produce on an as-needed basis a map of detector pixels that are affected by one or more pathologies, such as non-responsive pixels, charge traps, and hot pixels. The particular pathologies shall be bit-encoded in, at least, 32-bit pixel values, so that additional pathologies may also be recorded in down-stream processing software.
Requirement Discussion	Discussion: The fraction of bad pixels is expected to be small. Therefore the Reference Map, while logically equivalent to an image, may be stored in a more compressible form.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0271 Supported Image Types DMS-REQ-0058 Correct for Instrument Sensitivity Variation OSS-REQ-0129 Exposures (Level 1)

2.17.1 Test Cases Summary

LVV-T83	Verify implementation of Bad Pixel Map			
Owner	Status	Version	Critical Event	Verification Type
Robert Lupton	Defined	1	false	Test

Objective:

Verify that the DMS can produce a map of detector pixels that suffer from pathologies, and that these pathologies are encoded in at least 32-bit values.

2.18 [LVV-23] DMS-REQ-0060-V-01: Bias Residual Image

Jira Link	Assignee	Status	Test Cases
			LVV-T84
LVV-23	Jim Bosch	Not Covered	LVV-T368
			LVV-T368

Verification Element Description:

Can be done with simulated raw calibration data. Need to define whether “as-needed” is manual trigger or automation. Can this be done with the camera in the lab?

Requirement Details	
Requirement ID	DMS-REQ-0060
Requirement Description	Specification: The DMS shall construct on an as-needed basis an image that corrects for any temporally stable bias structure that remains after overscan correction. The Bias Residual shall be constructed from multiple, zero-second exposures where the overscan correction has been applied.
Requirement Priority	1a
Upper Level Requirement	DMS-REQ-0055 Correct for Camera Bias Structure OSS-REQ-0271 Supported Image Types OSS-REQ-0046 Calibration

2.18.1 Test Cases Summary

LVV-T84	Verify implementation of Bias Residual Image			
Owner	Status	Version	Critical Event	Verification Type
Robert Lupton	Defined	1	false	Test

Objective:

Verify that DMS can construct a bias residual image that corrects for temporally-stable bias structures.

Verify that DMS can do this on demand.

LVV-T368	Loading and processing Camera test data			
Owner	Status	Version	Critical Event	Verification Type
John Swinbank	Approved	2	false	Test

Objective:

This test will check:

- That Camera test data is available for processing in the LSST Data Facility, and accessible through the LSST Science Platform;
- That the Data Management I/O abstraction (the “Data Butler”) can load that data into the Science Platform environment;
- That Data Management algorithmic “tasks” can be executed to process that data;
- That results can be displayed in the Firefly display tool.

LVV-T368	Loading and processing Camera test data			
Owner	Status	Version	Critical Event	Verification Type
John Swinbank	Approved	2	false	Test

Objective:

This test will check:

- That Camera test data is available for processing in the LSST Data Facility, and accessible through the LSST Science Platform;
- That the Data Management I/O abstraction (the “Data Butler”) can load that data into the Science Platform environment;
- That Data Management algorithmic “tasks” can be executed to process that data;
- That results can be displayed in the Firefly display tool.

2.19 [LVV-24] DMS-REQ-0061-V-01: Crosstalk Correction Matrix

Jira Link	Assignee	Status	Test Cases
LVV-24	Jim Bosch	Not Covered	LVV-T85

Verification Element Description:

Needs commissioning data to determine “as-needed” timeline. Can demonstrate algorithms prior to commissioning by taking darks in the lab.

Requirement Details	
Requirement ID	DMS-REQ-0061
Requirement Description	Specification: The DMS shall, on an as-needed basis, determine from appropriate calibration data what fraction of the signal detected in any given amplifier on each sensor in the focal plane appears in any other amplifier, and shall record that fraction in a correction matrix. The applicability of the correction matrix shall be verified in production processing on science data.
Requirement Discussion	Discussion: The frequency with which the Cross-talk Correction Matrix must be computed will be determined during Commissioning and monitored during operations.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0329 Crosstalk Accuracy OSS-REQ-0330 Crosstalk Measureability DMS-REQ-0056 Correct for Camera Crosstalk OSS-REQ-0349 Data Release Production Crosstalk Correction

2.19.1 Test Cases Summary

LVV-T85	Verify implementation of Crosstalk Correction Matrix			
Owner	Status	Version	Critical Event	Verification Type
Robert Lupton	Defined	1	false	Test

Objective:

Verify that the DMS can generate a cross-talk correction matrix from appropriate calibration data.

Verify that the DMS can measure the effectiveness of the cross-talk correction matrix.

2.20 [LVV-25] DMS-REQ-0062-V-01: Illumination Correction Frame

Jira Link	Assignee	Status	Test Cases
LVV-25	Jim Bosch	Not Covered	LVV-T86

Verification Element Description:

Needs a real camera during commissioning and data taken in the correct mode. Can possibly be done prior to commissioning with simulated data.

Requirement Details	
Requirement ID	DMS-REQ-0062
Requirement Description	Specification: The DMS shall produce on an as-needed basis an image that corrects for the non-uniform illumination of the flat-field calibration apparatus on the focal plane. The effectiveness of the Illumination Correction shall be verified in production processing on science data.
Requirement Discussion	Discussion: The Illumination correction is anticipated to be quite stable. Updates to the correction should be no more frequent than monthly.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0271 Supported Image Types OSS-REQ-0046 Calibration DMS-REQ-0058 Correct for Instrument Sensitivity Variation

2.20.1 Test Cases Summary

LVV-T86	Verify implementation of Illumination Correction Frame			
Owner	Status	Version	Critical Event	Verification Type
Robert Lupton	Draft	1	false	Test

Objective:

Verify that the DMS can produce an illumination correction frame calibration product.

Verify that the DMS can determine the effectiveness of an illumination correction and determine how often it should be updated.

2.21 [LVV-26] DMS-REQ-0063-V-01: Monochromatic Flatfield Data Cube

Jira Link	Assignee	Status	Test Cases
LVV-26	Jim Bosch	Not Covered	LVV-T87

Verification Element Description:

Needs a real camera during commissioning and data taken in the correct mode. Possibly can be done with simulated data and lab measurements.

Requirement Details	
Requirement ID	DMS-REQ-0063
Requirement Description	Specification: The DMS shall produce on an as-needed basis an image that corrects for the color-dependent, pixel-to-pixel non-uniformity in the detector response. The images in the cube shall be constructed from exposures at multiple wavelengths of a uniformly illuminated source. The effectiveness of the flat-field shall be verified in production processing on science data.
Requirement Discussion	Discussion: Monochromatic flat-fields are expected to be produced no more frequently than monthly, owing to the time required to obtain the exposures.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0271 Supported Image Types OSS-REQ-0046 Calibration DMS-REQ-0058 Correct for Instrument Sensitivity Variation DMS-REQ-0057 Correct for Detector Fringing

2.21.1 Test Cases Summary

LVV-T87	Verify implementation of Monochromatic Flatfield Data Cube			
Owner	Status	Version	Critical Event	Verification Type
Robert Lupton	Draft	1	false	Test

Objective:

Verify that the DMS can generate a calibration image/cube that corrects for pixel-to-pixel wavelength-dependent detector response.

Verify that the DMS can measure the effectiveness of this monochromatic flatfield data cube.

2.22 [LVV-27] DMS-REQ-0065-V-01: Provide Image Access Services

Jira Link	Assignee	Status	Test Cases
LVV-27	Gregory Dubois-Felsmann	Not Covered	LVV-T134

Verification Element Description:

Could be verified by DMS-REQ-0298. Demonstrate that SIA can be used to retrieve image data.

Requirement Details									
Requirement ID	DMS-REQ-0065								
Requirement Description	Specification: The DMS shall provide a service for Image Access through community data access protocols, to support programmatic search and retrieval of images or image cutouts. The service shall support one or more community standard formats, including the LSST pipeline input format.								
Requirement Discussion	Discussion: At least the FITS image format will be supported though an IVOA-standard service such as SIAP. Other image formats such as JPG may be more compatible with education/public outreach needs.								
Requirement Priority	1b								
Upper Level Requirement	<table border="0"> <tr> <td>OSS-REQ-0180</td> <td>Data Products Query and Download Availability</td> </tr> <tr> <td>OSS-REQ-0176</td> <td>Data Access</td> </tr> <tr> <td>OSS-REQ-0181</td> <td>Data Products Query and Download Infrastructure</td> </tr> <tr> <td>DMS-REQ-0066</td> <td>Keep Exposure Archive</td> </tr> </table>	OSS-REQ-0180	Data Products Query and Download Availability	OSS-REQ-0176	Data Access	OSS-REQ-0181	Data Products Query and Download Infrastructure	DMS-REQ-0066	Keep Exposure Archive
OSS-REQ-0180	Data Products Query and Download Availability								
OSS-REQ-0176	Data Access								
OSS-REQ-0181	Data Products Query and Download Infrastructure								
DMS-REQ-0066	Keep Exposure Archive								

2.22.1 Verified By

- . LVV-10004 (??) DMS-API-REQ-0028-V-01: Access to Image Data in FITS Format_1
- . LVV-10016 (??) DMS-API-REQ-0016-V-01: SIA Service for Image Availability_1
- . LVV-10017 (??) DMS-API-REQ-0018-V-01: Cutout Service_1
- . LVV-10018 (??) DMS-API-REQ-0017-V-01: SODA Service for Image Data_1

2.22.2 Test Cases Summary

LVV-T134	Verify implementation of Provide Image Access Services			
Owner	Status	Version	Critical Event	Verification Type

Gregory Dubois- Felsmann	Draft	1	false	Inspection
-----------------------------	-------	---	-------	------------

Objective:

Verify that images can be identified and that images and image cut-outs can be retrieved using the network interfaces - primarily IVOA standards-based - and Python APIs provided for image access by science users.

Draft

2.23 [LVV-28] DMS-REQ-0068-V-01: Raw Science Image Metadata

Jira Link	Assignee	Status	Test Cases
LVV-28	Gregory Dubois-Felsmann	Not Covered	LWV-T33
			LWV-T283
			LWV-T284
			LWV-T286
			LWV-T1549
			LWV-T1550
			LWV-T1556

Verification Element Description:

This is a more specific restatement of DMS-REQ-0024. Can be done with simulated camera DAQ and OCS. Compare against ICD. Test that the metadata placed on the OCS middleware by the simulated OCS is the same as that stored in the image metadata.

Requirement Details	
Requirement ID	DMS-REQ-0068
Requirement Description	<p>Specification: For each raw science image, the DMS shall store image metadata including at least:</p> <ul style="list-style-type: none"> • Time of exposure start and end, referenced to TAI, and DUT1 • Site metadata (site seeing, transparency, weather, observatory location) • Telescope metadata (telescope pointing, active optics state, environmental state) • Camera metadata (shutter trajectory, wavefront sensors, environmental state) • Program metadata (identifier for main survey, deep drilling, etc.) • Scheduler metadata (visitID, intended number of exposures in the visit)
Requirement Discussion	<p>Discussion: The program metadata should be sufficient to associate an image with a specific Special Program so that DMS-REQ-0320 and DMS-REQ-0397 can be satisfied. The scheduler metadata should sufficiently inform the processing pipelines regarding e.g., deviations from 2-snap 30 second visits, so that computational resources can be appropriately allocated, and so that DMS-REQ-0320 can be satisfied.</p>
Requirement Priority	1a
Upper Level Requirement	<p>OSS-REQ-0122 Provenance</p> <p>DMS-REQ-0320 Processing of Data From Special Programs</p> <p>DMS-REQ-0066 Keep Exposure Archive</p> <p>OSS-REQ-0171 Engineering and Facilities Data</p>

2.23.1 Test Cases Summary

LVV-T33	Verify implementation of Raw Science Image Metadata			
Owner	Status	Version	Critical Event	Verification Type
Kian-Tat Lim	Defined	1	false	Test

Objective:

Verify successful ingestion of raw data from L1 Test Stand DAQ and that image metadata is present and queryable.

LVV-T283	RAS-00-00: Writing well-formed raw image			
Owner	Status	Version	Critical Event	Verification Type
Michelle Butler	Approved	1	false	Test

Objective:

This test will check:

- The successful integration of the Pathfinder components with the DM Header Service and the Level 1 Archiver;
- That the raw images are well-formed and meet specifications in change-controlled documents LSE-61;

This Test Case shall be repeated for each of the different cameras (ATScam, LSSTCam) and sensors (Science, Wavefront, and Guider) combination.

LVV-T284	RAS-00-05: (LDM-503-8b) Writing data from CCOB to the DBB for further data processing			
Owner	Status	Version	Critical Event	Verification Type
Michelle Butler	Draft	1	false	Test

Objective:

This test will check:

- The successful integration of the DAQ archiver components with the CCOB
- That the file can then be ingested into the DBB and be retrieved for further analysis

LVV-T286	RAS-00-20: Raw image are part of the permanent record of survey via DBB			
----------	---	--	--	--

Owner	Status	Version	Critical Event	Verification Type
Michelle Butler	Approved	1	false	Test

Objective:

This test will check:

- That the handoff of a raw image from the Level 1 Archiver Service to the DBB buffer manager is successful;
- That the raw image is ingested into the Data Backbone successfully;
- That the monitoring of the above items is successful;

This Test Case shall be repeated for each of the different cameras (ATScam, LSSTCam) and sensors (Science, Wavefront, and Guider) combination.

Note: For a complete check of the various aspects of what it means for a raw image to be in the Data Backbone, see the tests for the Data Backbone.

LVV-T1549	LDM-503-6 Comcam verification readiness			
Owner	Status	Version	Critical Event	Verification Type
Michelle Butler	Draft	1	false	Demonstration

Objective:

Verify that Comcam has all the services running and verified working for retrieving an image from the comcam DAQ and store it on file systems at the LDF for viewing by LSP.

LVV-T1550	LDM-503-10 DAQ Validation			
Owner	Status	Version	Critical Event	Verification Type
Michelle Butler	Draft	1	false	Demonstration

Objective:

Verify that the DAQ can talk to test machines at the BDC through the DWDM network.

LVV-T1556	LDM-503-10B Large Scale CCOB Data Access			
Owner	Status	Version	Critical Event	Verification Type
Michelle Butler	Draft	1	false	Demonstration

Objective:

Demonstrate the ability to transfer data from the SLAC test stand or CCOB with 21 rafts from SLAC and ingested at NCSA and make available through an instance of the LSP

Draft

2.24 [LVV-29] DMS-REQ-0069-V-01: Processed Visit Images

Jira Link	Assignee	Status	Test Cases
			LVV-T15
			LVV-T18
LVV-29	Jim Bosch	Not Covered	LVV-T19
			LVV-T38
			LVV-T362

Verification Element Description:

Use simulated raw data in format from DMS-REQ-0024. Run end-to-end test for one visit. Check that Processed Visit images have been created in expected format.

Requirement Details	
Requirement ID	DMS-REQ-0069
Requirement Description	Specification: The DMS shall produce Processed Visit Images, in which the corresponding raw sensor array data has been trimmed of overscan and corrected for instrumental signature, including crosstalk. Images obtained in pairs during a standard visit are combined.
Requirement Discussion	Discussion: Processed science exposures are not archived, and are retained for only a limited time to facilitate down-stream processing. They will be re-generated for users on-demand using the latest processing software and calibrations. This aspect of the processing for Special Programs data is specific to each program.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0129 Exposures (Level 1) OSS-REQ-0349 Data Release Production Crosstalk Correction OSS-REQ-0348 Alert Production Crosstalk Correction OSS-REQ-0328 Crosstalk Aggressor Limits

2.24.1 Test Cases Summary

Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	1	false	Test

Objective:

This test will check that the Processed Visit Images (PVIs) delivered by the DRP science payload meet the requirements laid down by LSE-61.

Specifically, this will demonstrate that:

- Processed visit images have been generated and persisted during payload execution;
- Each PVI includes a background model (DMS-REQ-0327), photometric zero-point (DMS- REQ-0029), spatially-varying PSF (DMS-REQ-0070) and WCS (DMS-REQ-0030).
- Saturated pixels are correctly masked.
- Pixels affected by cosmic rays are correctly masked.
- The background is not oversubtracted around bright objects.

This test does not include quantitative targets for the science quality criteria; we instead require for each test that we be able to quickly construct a plot or display summary images that allow such a target can be visualized.

Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Approved	1	false	Test

Objective:

This test will check that the basic data products produced by Alert Generation are generated by execution of the science payload. These products will include:

- Processed visit images (PVIs; DMS-REQ-0069);
- Difference Exposures (DMS-REQ-0010);
- DIASource catalogs (DMS-REQ-0269);
- DIAObject catalogs (DMS-REQ-0271);

Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Approved	1	false	Test

Objective:

This test will check that the Processed Visit Images (PVIs) delivered by the alert generation science payload meet the requirements laid down by LSE-61.

Specifically, this will demonstrate that:

- Processed visit images have been generated and persisted during payload execution;
- Each PVI includes a science pixel array, a mask array, and a variance array. (DMS-REQ-0072).
- Each PVI includes a background model (DMS-REQ-0327), photometric zero-point (DMS- REQ-0029), spatially-varying PSF (DMS-REQ-0070) and WCS (DMS-REQ-0030).

- Saturated pixels are correctly masked.
- Pixels affected by cosmic rays are correctly masked.
- The background is not oversubtracted around bright objects.

This test does not include quantitative targets for the science quality criteria.

LWV-T38	Verify implementation of Processed Visit Images			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Defined	1	false	Test

Objective:

Verify that the DMS

1. Successfully produces Processed Visit Images, where the instrument signature has been removed.
2. Successfully combines images obtained during a standard visit.

LWV-T362	Installation of the LSST Science Pipelines Payloads			
Owner	Status	Version	Critical Event	Verification Type
John Swinbank	Draft	1	false	Test

Objective:

This test will check that:

- The Alert Production Pipeline payload is available for installation from documented channels;
- The Data Release Production Pipeline payload is available for installation from documented channels;
- The Calibration Products Production Pipeline payload is available for installation from documented channels;
- These payloads can be installed on systems at the LSST Data Facility following available documentation;
- The installed pipeline payloads are capable of successfully executing basic integration tests.

Note that this test assumes a 2018-era packaging of the Science Pipelines software, in which all the above payloads are represented by a single “meta-package”, `lsst_distrib`.

2.25 [LVV-30] DMS-REQ-0070-V-01: Generate PSF for Visit Images

Jira Link	Assignee	Status	Test Cases
			LVV-T15
LVV-30	Jim Bosch	Not Covered	LVV-T19
			LVV-T41

Verification Element Description:

Can be checked with any test data. No requirement on accuracy. Just test that a PSF model can be retrieved from any location in the Processed Visit.

Requirement Details	
Requirement ID	DMS-REQ-0070
Requirement Description	Specification: The DMS shall determine a characterization of the PSF for any specified location in Processed Visit Images.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0056 System Monitoring & Diagnostics DMS-REQ-0116 Extended Object Shape Parameters

2.25.1 Test Cases Summary

LVV-T15	DRP-00-30: Scientific Verification of Processed Visit Images			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	1	false	Test

Objective:

This test will check that the Processed Visit Images (PVIs) delivered by the DRP science payload meet the requirements laid down by LSE-61.

Specifically, this will demonstrate that:

- Processed visit images have been generated and persisted during payload execution;
- Each PVI includes a background model (DMS-REQ-0327), photometric zero-point (DMS-REQ-0029), spatially-varying PSF (DMS-REQ-0070) and WCS (DMS-REQ-0030).
- Saturated pixels are correctly masked.
- Pixels affected by cosmic rays are correctly masked.
- The background is not oversubtracted around bright objects.

This test does not include quantitative targets for the science quality criteria; we instead require for each test that we be able to quickly construct a plot or display summary images that allow such a target can be visualized.

LVV-T19	AG-00-10: Scientific Verification of Processed Visit Images			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Approved	1	false	Test

Objective:

This test will check that the Processed Visit Images (PVI) delivered by the alert generation science payload meet the requirements laid down by LSE-61.

Specifically, this will demonstrate that:

- Processed visit images have been generated and persisted during payload execution;
- Each PVI includes a science pixel array, a mask array, and a variance array. (DMS-REQ-0072).
- Each PVI includes a background model (DMS-REQ-0327), photometric zero-point (DMS-REQ-0029), spatially-varying PSF (DMS-REQ-0070) and WCS (DMS-REQ-0030).
- Saturated pixels are correctly masked.
- Pixels affected by cosmic rays are correctly masked.
- The background is not oversubtracted around bright objects.

This test does not include quantitative targets for the science quality criteria.

LVV-T41	Verify implementation of Generate PSF for Visit Images			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	1	false	Test

Objective:

Verify that Processed Visit Images produced by the DRP and AP pipelines are associated with a model from which one can obtain an image of the PSF given a point on the image.

2.26 [LVV-31] DMS-REQ-0072-V-01: Processed Visit Image Content

Jira Link	Assignee	Status	Test Cases
			LVV-T15
LVV-31	Jim Bosch	Not Covered	LVV-T19
			LVV-T42

Verification Element Description:

Take output from DMS-REQ-0069 and compare against the processed visit ICD.

Requirement Details	
Requirement ID	DMS-REQ-0072
Requirement Description	Specification: Processed visit images shall include the corrected science pixel array, an integer mask array where each bit-plane represents a logical statement about whether a particular detector pathology affects the pixel, a variance array which represents the expected variance in the corresponding science pixel, and a representation of the spatially varying PSF that applies over the extent of the science array. These images shall also contain metadata that map pixel to world (sky) coordinates (the WCS) as well as metadata from which photometric measurements can be derived.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0129 Exposures (Level 1) DMS-REQ-0066 Keep Exposure Archive

2.26.1 Test Cases Summary

LVV-T15	DRP-00-30: Scientific Verification of Processed Visit Images			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	1	false	Test

Objective:

This test will check that the Processed Visit Images (PVI) delivered by the DRP science payload meet the requirements laid down by LSE-61.

Specifically, this will demonstrate that:

- Processed visit images have been generated and persisted during payload execution;
- Each PVI includes a background model (DMS-REQ-0327), photometric zero-point (DMS-REQ-0029), spatially-varying PSF (DMS-REQ-0070) and WCS (DMS-REQ-0030).
- Saturated pixels are correctly masked.

- Pixels affected by cosmic rays are correctly masked.
- The background is not oversubtracted around bright objects.

This test does not include quantitative targets for the science quality criteria; we instead require for each test that we be able to quickly construct a plot or display summary images that allow such a target can be visualized.

Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Approved	1	false	Test

Objective:

This test will check that the Processed Visit Images (PVIs) delivered by the alert generation science payload meet the requirements laid down by LSE-61.

Specifically, this will demonstrate that:

- Processed visit images have been generated and persisted during payload execution;
- Each PVI includes a science pixel array, a mask array, and a variance array. (DMS-REQ-0072).
- Each PVI includes a background model (DMS-REQ-0327), photometric zero-point (DMS-REQ-0029), spatially-varying PSF (DMS-REQ-0070) and WCS (DMS-REQ-0030).
- Saturated pixels are correctly masked.
- Pixels affected by cosmic rays are correctly masked.
- The background is not oversubtracted around bright objects.

This test does not include quantitative targets for the science quality criteria.

Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Defined	1	false	Test

Objective:

Verify that Processed Visit Images produced by the DRP and AP pipelines include the observed data, a mask array, a variance array, a PSF model, and a WCS model.

2.27 [LVV-33] DMS-REQ-0075-V-01: Catalog Queries

Jira Link	Assignee	Status	Test Cases
LWV-33	Colin Slater	Not Covered	LVV-T149 LVV-T1085 LVV-T1086 LVV-T1087

Verification Element Description:

Using a TAP service, send an ADQL query and verify that the results are as expected.

Requirement Details	
Requirement ID	DMS-REQ-0075
Requirement Description	Specification: The catalogs shall be queryable with a structured language, such as SQL.
Requirement Discussion	Discussion: Queries are expected to be generated via Science User Interfaces, and software within and external to DMS, including VO clients. The queries may be translated to (and optimized for) the native query language of the DMS database server.
Requirement Priority	1a
Upper Level Requirement	DMS-REQ-0076 Keep Science Data Archive OSS-REQ-0176 Data Access

2.27.1 Test Cases Summary

LVV-T149	Verify implementation of Catalog Queries			
Owner	Status	Version	Critical Event	Verification Type
Colin Slater	Defined	1	false	Test

Objective:

Verify that SQL, or a similar structured language, can be used to query catalogs.

LVV-T1085	Short Queries Functional Test			
Owner	Status	Version	Critical Event	Verification Type
Fritz Mueller	Approved	1	false	Test

Objective:

The objective of this test is to ensure that the short queries are performing as expected and establish a timing baseline benchmark for these types of queries.

LVV-T1086	Full Table Scans Functional Test			
Owner	Status	Version	Critical Event	Verification Type
Fritz Mueller	Approved	1	false	Test

Objective:

The objective of this test is to ensure that the full table scan queries are performing as expected and establish a timing baseline benchmark for these types of queries.

LVV-T1087	Full Table Joins Functional Test			
Owner	Status	Version	Critical Event	Verification Type
Fritz Mueller	Approved	1	false	Test

Objective:

The objective of this test is to ensure that the full table join queries are performing as expected and establish a timing baseline benchmark for these types of queries.

2.28 [LVV-38] DMS-REQ-0096-V-01: Generate Data Quality Report Within Specified Time

Jira Link	Assignee	Status	Test Cases
LVV-38	Simon Krughoff	Not Covered	LVV-T103

Verification Element Description:

Reduce a night of L1 data. Wait for report to appear. Is it on time? Is it human-readable? "Machine-readable" is a database table or a text file. The clock begins when Prompt Processing ends in the morning.

Requirement Details	
Requirement ID	DMS-REQ-0096
Requirement Description	Specification: The DMS shall generate a nightly Data Quality Report within time dqReportComplTime in both human-readable and machine-readable forms.
Requirement Parameters	dqReportComplTime = 4[hour] Latency for producing Level 1 Data Quality Report.
Requirement Discussion	Discussion: The Report must be timely in order to evaluate whether changes to hardware, software, or procedures are needed for the following night's observing.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0131 Nightly Summary Products

2.28.1 Test Cases Summary

LVV-T103	Verify implementation of Generate Data Quality Report Within Specified Time			
Owner	Status	Version	Critical Event	Verification Type
Kian-Tat Lim	Defined	1	false	Test

Objective:

Verify that the DMS can generate a nightly L1 Data Quality Report within **dqReportComplTime = 4[hour]**, in both human- and machine-readable formats.

2.29 [LVV-39] DMS-REQ-0097-V-01: Level 1 Data Quality Report Definition

Jira Link	Assignee	Status	Test Cases
LVV-39	Simon Krughoff	Not Covered	LVV-T45

Verification Element Description:

Run multiple visits through the L1 pipeline (can start with raw data files), check that report is created. The report is a dynamic UI as well as a static document.

Requirement Details	
Requirement ID	DMS-REQ-0097
Requirement Description	Specification: The DMS shall produce a Level 1 Data Quality Report that contains indicators of data quality that result from running the DMS pipelines, including at least: Photometric zero point vs. time for each utilized filter; Sky brightness vs. time for each utilized filter; seeing vs. time for each utilized filter; PSF parameters vs. time for each utilized filter; detection efficiency for point sources vs. mag for each utilized filter.
Requirement Discussion	Discussion: The seeing report is intended as a broad-brush measure of image quality. The PSF parameters provide more detail, as they include asymmetries and field location dependence.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0131 Nightly Summary Products DMS-REQ-0096 Generate Data Quality Report Within Specified Time

2.29.1 Test Cases Summary

LVV-T45	Verify implementation of Prompt Processing Data Quality Report Definition			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Defined	1	false	Test

Objective:

Verify that the DMS produces a Prompt Processing Data Quality Report. Specifically check absolute value and temporal variation of

1. Photometric zeropoint
2. Sky brightness
3. Seeing

4. PSF
5. Detection efficiency

Draft

2.30 [LVV-41] DMS-REQ-0099-V-01: Level 1 Performance Report Definition

Jira Link	Assignee	Status	Test Cases
LVV-41	Robert Gruendl	Not Covered	LVV-T46

Verification Element Description:

Run multiple visits through the L1 pipeline (can start with raw data files; optimally an entire night), check that report is created. The report is a dynamic UI as well as a static document.

Requirement Details	
Requirement ID	DMS-REQ-0099
Requirement Description	Specification: The DMS shall produce a Level 1 Performance Report that provides indicators of how the DMS has performed in processing the night's observations, including at least: number of observations successfully processed through each pipeline; number of observations for each pipeline that had recoverable failures (with a record of the failure type and recovery mechanism); number of observations for each pipeline that had unrecoverable failures; number of observations archived at each DMS Facility; number of observations satisfying the science criteria for each active science program.
Requirement Priority	1b
Upper Level Requirement	DMS-REQ-0098 Generate DMS Performance Report Within Specified Time OSS-REQ-0131 Nightly Summary Products

2.30.1 Test Cases Summary

LVV-T46	Verify implementation of Prompt Processing Performance Report Definition			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Draft	1	false	Test

Objective:

Verify that the DMS produces a Prompt Processing Performance Report. Specifically check that the number of observations that describe each of the following:

1. Successfully processed, recoverable failures, unrecoverable failures.
2. Archived
3. Result in science.

This is testing more the processing rather than the observatory system.

Draft

2.31 [LVV-43] DMS-REQ-0101-V-01: Level 1 Calibration Report Definition

Jira Link	Assignee	Status	Test Cases
LVV-43	Robert Lupton	Not Covered	LVV-T47

Verification Element Description:

Using precursor and simulated calibration data, run the L1 calibration pipeline and check report. The report is dynamic and triggers alerts if calibrations go out of range. Check a static report is created.

Requirement Details	
Requirement ID	DMS-REQ-0101
Requirement Description	Specification: The DMS shall produce a Level 1 Calibration Report that provides a summary of significant differences in Calibration Images that may indicate evolving problems with the telescope or camera, including a nightly broad-band flat in each filter.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0131 Nightly Summary Products DMS-REQ-0100 Generate Calibration Report Within Specified Time

2.31.1 Test Cases Summary

LVV-T47	Verify implementation of Prompt Processing Calibration Report Definition			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Defined	1	false	Test

Objective:

Verify that the DMS produces a Prompt Processing Calibration Report. Specifically check that this report is capable of identifying when aspects of the telescope or camera are changing with time.

2.32 [LVV-46] DMS-REQ-0106-V-01: Coadded Image Provenance

Jira Link	Assignee	Status	Test Cases
LVV-46	Robert Gruendl	Not Covered	LVV-T11 LVV-T64

Verification Element Description:

Given a coadd downloaded from the archive. Request provenance information. Regenerate coadd. Compare download with newly created coadd. Can this use the L3 system?

Requirement Details	
Requirement ID	DMS-REQ-0106
Requirement Description	Specification: For each Coadded Image, DMS shall store: the list of input images and the pipeline parameters, including software versions, used to derive it, and a sufficient set of metadata attributes for users to re-create them in whole or in part.
Requirement Discussion	Discussion: Not all coadded image types will be made available to end-users or retained for the life of the survey; however, sufficient metadata will be preserved so that they may be recreated by end-users.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0122 Provenance DMS-REQ-0104 Produce Co-Added Exposures

2.32.1 Test Cases Summary

LVV-T11	DRP-00-05: Execution of the DRP Science Payload by the Batch Production Service			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	1	false	Test

Objective:

This test will check that the DRP Science Payload can be executed using a specific version of the Batch Production Service provided by the LSST Data Facility. Since the outputs are stored in the Data Backbone, it too is a component of this test.

LVV-T64	Verify implementation of Coadded Image Provenance			
Owner	Status	Version	Critical Event	Verification Type

Jim Bosch	Draft	1	false	Test
-----------	-------	---	-------	------

Objective:

Verify that all coadd data products produced by the DRP pipelines are associated with provenance information that includes the set of input epochs contributing to that coadd as well as any additional information needed to exactly produce that coadd.

Draft

2.33 [LVV-48] DMS-REQ-0120-V-01: Level 3 Data Product Self Consistency

Jira Link	Assignee	Status	Test Cases
LVV-48	Robert Gruendl	Not Covered	LVV-T118

Verification Element Description:

This verification is hard. All you can do is inspect the APIs to ensure that missed DRs can not happen without being explicit, and ensure that the butler can be configured to access a specific DR.

Requirement Details	
Requirement ID	DMS-REQ-0120
Requirement Description	Specification: The DMS shall provide a means for ensuring that users' Level 3 processing tasks can be carried out on self-consistent inputs - i.e., catalogs, images, metadata, calibrations, camera configuration data, etc., that match each other and all arise from consistent Level 1 and Level 2 processings.
Requirement Priority	2
Upper Level Requirement	OSS-REQ-0120 Consistency OSS-REQ-0118 Consistency and Completeness

2.33.1 Test Cases Summary

LVV-T118	Verify implementation of Level 3 Data Product Self Consistency			
Owner	Status	Version	Critical Event	Verification Type
Colin Slater	Draft	1	false	Test

Objective:

Verify that user-driven Level 3 processing is conducted on consistent sets of input data.

2.34 [LVV-49] DMS-REQ-0121-V-01: Provenance for Level 3 processing at DACs

Jira Link	Assignee	Status	Test Cases
LVV-49	Robert Gruendl	Not Covered	LVV-T119

Verification Element Description:

Show that an API exists for reading and writing provenance information in a L3 environment.

Requirement Details	
Requirement ID	DMS-REQ-0121
Requirement Description	Specification: The DMS shall provide a means for recording provenance information for Level 3 processing that is performed at DACs, covering at least all the DMS-provided inputs to the processing (e.g., catalog data used as inputs, dataset metadata, calibrations and camera data from the EFD).
Requirement Discussion	Discussion: The DMS should also provide an optional means for Level 3 processing users at DACs to maintain basic provenance information on their own inputs to a processing task, such as code or additional calibration data.
Rationale: the DMS should facilitate Level 3 processing users in being able to carry out their work in a reproducible way.	
Requirement Priority	2
Upper Level Requirement	OSS-REQ-0122 Provenance

2.34.1 Test Cases Summary

LVV-T119	Verify implementation of Provenance for Level 3 processing at DACs			
Owner	Status	Version	Critical Event	Verification Type
Colin Slater	Draft	1	false	Test

Objective:

Verify that provenance information is recorded and accessible for user-generated Level 3 products.

2.35 [LVV-52] DMS-REQ-0124-V-01: Federation with external catalogs

Jira Link	Assignee	Status	Test Cases
LVV-52	Gregory Dubois-Felsmann	Not Covered	LVV-T206

Verification Element Description:

Show that an external catalog can be combined with L1/2/3 catalogs. Show that the specification document exists. Show that more that at least one community standard is supported.

Requirement Details	
Requirement ID	DMS-REQ-0124
Requirement Description	Specification: The DMS shall provide a means for federating Level 1, 2, and 3 catalogs with externally provided catalogs, for joint analysis. The DMS shall provide specifications for how external data must be provided in order for this to be achieved. The DMS shall strive to support community standards in this regard, including, but not limited to, virtual observatory facilities that may be available during the project lifetime.
Requirement Priority	2
Upper Level Requirement	OSS-REQ-0140 Production DMS-REQ-0125 Software framework for Level 3 catalog processing

2.35.1 Test Cases Summary

LVV-T206	Verify implementation of Federation with external catalogs			
Owner	Status	Version	Critical Event	Verification Type
Colin Slater	Draft	1	false	Test

Objective:

Verify that LSST-produced data can be combined with external datasets.

2.36 [LVV-57] DMS-REQ-0130-V-01: Calibration Data Products

Jira Link	Assignee	Status	Test Cases
LVV-57	Robert Lupton	Not Covered	LVV-T88

Verification Element Description:

For every calibration mode, prove that the data can be processed. Can be done with simulated data and that from the auxilliary telescope. Will need to be redone with real LSST camera data.

Requirement Details	
Requirement ID	DMS-REQ-0130
Requirement Description	Specification: The DMS shall produce and archive Calibration Data Products that capture the signature of the telescope, camera and detector, including at least: Crosstalk correction matrix, Bias and Dark correction frames, a set of monochromatic dome flats spanning the wavelength range, a synthetic broad-band flat per filter, and an illumination correction frame per filter.
Requirement Priority	1a
Upper Level Requirement	DMS-REQ-0076 Keep Science Data Archive OSS-REQ-0271 Supported Image Types OSS-REQ-0194 Calibration Exposures Per Day OSS-REQ-0129 Exposures (Level 1)

2.36.1 Test Cases Summary

LVV-T88	Verify implementation of Calibration Data Products			
Owner	Status	Version	Critical Event	Verification Type
Robert Lupton	Defined	1	false	Test

Objective:

Verify that the DMS can produce and archive the required Calibration Data Products: cross talk correction, bias, dark, monochromatic dome flats, broad-band flats, fringe correction, and illumination corrections.

2.37 [LVV-59] DMS-REQ-0132-V-01: Calibration Image Provenance

Jira Link	Assignee	Status	Test Cases
LVV-59	Robert Lupton	Not Covered	LVV-T89

Verification Element Description:

Can be done with precursor or simulated data. Verify that provenance information is present.

Requirement Details	
Requirement ID	DMS-REQ-0132
Requirement Description	Specification: For each Calibration Production data product, DMS shall record: the list of input exposures and the range of dates over which they were obtained; the processing parameters; the calibration products used to derive it; and a set of metadata attributes including at least: the date of creation; the calibration image type (e.g. dome flat, superflat, bias, etc); the provenance of the processing software; and the instrument configuration including the filter in use, if applicable.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0122 Provenance OSS-REQ-0123 Reproducibility DMS-REQ-0130 Calibration Data Products

2.37.1 Test Cases Summary

LVV-T89	Verify implementation of Calibration Image Provenance			
Owner	Status	Version	Critical Event	Verification Type
Robert Lupton	Defined	1	false	Test

Objective:

Verify that the DMS records the required provenance information for the Calibration Data Products.

2.38 [LVV-62] DMS-REQ-0158-V-01: Provide Pipeline Construction Services

Jira Link	Assignee	Status	Test Cases
LVV-62	Robert Lupton	Not Covered	LVV-T11

Verification Element Description:

Aggregate of LVV-137 (DMS-REQ-0306), LVV-136 (DMS-REQ-0305), LVV-138 (DMS-REQ-0307).

Requirement Details	
Requirement ID	DMS-REQ-0158
Requirement Description	
Requirement Discussion	(This is a composite requirement in the SysML model, which simply aggregates its children.)
Requirement Priority	1a
Upper Level Requirement	

2.38.1 Verified By

- . LVV-136 (??) DMS-REQ-0305-V-01: Task Specification
- . LVV-137 (??) DMS-REQ-0306-V-01: Task Configuration
- . LVV-138 (2.72) DMS-REQ-0307-V-01: Unique Processing Coverage

2.38.2 Test Cases Summary

LVV-T11	DRP-00-05: Execution of the DRP Science Payload by the Batch Production Service			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	1	false	Test

Objective:

This test will check that the DRP Science Payload can be executed using a specific version of the Batch Production Service

provided by the LSST Data Facility. Since the outputs are stored in the Data Backbone, it too is a component of this test.

Draft

2.39 [LVV-64] DMS-REQ-0161-V-01: Optimization of Cost, Reliability and Availability in Order

Jira Link	Assignee	Status	Test Cases
LVV-64	Robert Gruendl	Not Covered	LVV-T172

Verification Element Description:

Inspect resource management policies that devote resources to production catch-up (when required) over end users.

Requirement Details	
Requirement ID	DMS-REQ-0161
Requirement Description	Specification: Within a fixed cost envelope for the Data Management subsystem, the allocation of processing and storage facilities will optimize reliability over availability to end users.
Requirement Priority	1b
Upper Level Requirement	

2.39.1 Test Cases Summary

LVV-T172	Verify implementation of Optimization of Cost, Reliability and Availability			
Owner	Status	Version	Critical Event	Verification Type
Robert Gruendl	Draft	1	false	Test

Objective:

In matters of cost, system reliability (functioning properly at a given time) has precedence over system availability (ability to use the system at a given time). The optimization may be outside the realm of direct testing as it is more of a system provisioning guideline but on its face it demands that the Data Management System include failure reporting, regimented change control, acceptance testing, maintenance and monitoring.

2.40 [LVV-96] DMS-REQ-0265-V-01: Guider Calibration Data Acquisition

Jira Link	Assignee	Status	Test Cases
LVV-96	Gregory Dubois-Felsmann	Not Covered	LVV-T34 LVV-T283 LVV-T284

Verification Element Description:

Needs a simulated DAQ for guider and data backbone. Does not say whether data are archived or not.

Requirement Details	
Requirement ID	DMS-REQ-0265
Requirement Description	Specification: The DMS shall acquire raw, full-frame exposures from the camera guider sensors during calibration. The DMS shall produce calibration data products for the guide sensors.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0194 Calibration Exposures Per Day

2.40.1 Test Cases Summary

LVV-T34	Verify implementation of Guider Calibration Data Acquisition			
Owner	Status	Version	Critical Event	Verification Type
Kian-Tat Lim	Defined	1	false	Test

Objective:

Verify successful

1. Ingestion of calibration frames from L1 Test Stand DAQ
2. Execution of CPP payloads
3. Availability of observed guider calibration products

LVV-T283	RAS-00-00: Writing well-formed raw image			
Owner	Status	Version	Critical Event	Verification Type
Michelle Butler	Approved	1	false	Test

Objective:

This test will check:

- The successful integration of the Pathfinder components with the DM Header Service and the Level 1 Archiver;
- That the raw images are well-formed and meet specifications in change-controlled documents LSE-61;

This Test Case shall be repeated for each of the different cameras (ATScam, LSSTCam) and sensors (Science, Wavefront, and Guider) combination.

LVV-T284	RAS-00-05: (LDM-503-8b) Writing data from CCOB to the DBB for further data processing			
Owner	Status	Version	Critical Event	Verification Type
Michelle Butler	Draft	1	false	Test

Objective:

This test will check:

- The successful integration of the DAQ archiver components with the CCOB
- That the file can then be ingested into the DBB and be retrieved for further analysis

2.41 [LVV-97] DMS-REQ-0266-V-01: Exposure Catalog

Jira Link	Assignee	Status	Test Cases
LVV-97	Jim Bosch	Not Covered	LVV-T48

Verification Element Description:

This requires a database table to be created with the relevant columns and for those columns to be verified. Also show that the data stored in the table is appropriate.

Requirement Details	
Requirement ID	DMS-REQ-0266
Requirement Description	Specification: The DMS shall create an Exposure Catalog containing information for each exposure that includes the exposure date/time and duration, properties of the filter used, dome and telescope pointing and orientation, status of calibration apparatus, airmass and zenith distance, telescope and dome status, environmental information, and information regarding each sensor including an ID, its location in the focal plane, electronic configuration, and WCS.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0130 Catalogs (Level 1)

2.41.1 Test Cases Summary

LVV-T48	Verify implementation of Exposure Catalog			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Defined	1	false	Test

Objective:

Verify that the DMS creates an Exposure Catalog that includes

1. Observation datetime, exposure time
2. Filter
3. Dome, telescope orientation and status
4. Calibration status
5. Airmass and zenith
6. Environmental information
7. Per-sensor information

2.42 [LVV-98] DMS-REQ-0267-V-01: Source Catalog

Jira Link	Assignee	Status	Test Cases
LVV-98	Jim Bosch	Not Covered	LVV-T12
			LVV-T13
			LVV-T65
			LVV-T362

Verification Element Description:

First L2 requirement. Can be done with precursor data. At minimum two visits of the same field and filter and one coadd.

Requirement Details	
Requirement ID	DMS-REQ-0267
Requirement Description	Specification: The DMS shall create a Catalog containing all Sources detected in single (standard) visits and on Co-Adds, and will contain an identifier of the Exposure on which the Source was detected, as well as measurements of Source Attributes. The measured attributes (and associated errors) include location on the focal plane; a static point-source model fit to world coordinates and flux; a centroid and adaptive moments; and surface brightnesses through elliptical multiple apertures that are concentric, PSF-homogenized, and logarithmically spaced in intensity.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0137 Catalogs (Level 2)

2.42.1 Test Cases Summary

Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	1	false	Test

Objective:

This test will check that the basic data products which should be in an data release are generated by execution of the science payload.

These products will include:

- Source catalogs, derived from PVIs and coadded images (DMS-REQ-0267 & DMS-REQ-0277);

- Forced source catalogs (DMS-REQ-0268);
- Object catalogs (DMS-REQ-0275);
- Processed visit images (PVIs; DMS-REQ-0069);
- Coadded images (DMS-REQ-0279);

LVV-T13	DRP-00-15: Scientific Verification of Source Catalog			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	1	false	Test

Objective:

This test will check that the source catalogs delivered by the DRP science payload meet the requirements laid down by LSE-61. Specifically, this will demonstrate that:

- Measurements in the catalog are presented in flux units (DMS-REQ-0347);
- Derived quantities are provided in pre-computed columns (DMS-REQ-0331);
- Aperture corrections for different photometry algorithms are consistent.
- Photometry measurements are consistent with reference catalog photometry (including sources not used in photometric calibration).
- Astrometry measurements are consistent with reference catalog positions (including sources not used in astrometric calibration).

This test does not include quantitative targets for the science quality criteria; we instead require for each test that we be able to quickly construct a plot in which such a target can be visualized.

LVV-T65	Verify implementation of Source Catalog			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Defined	1	false	Test

Objective:

Verify that all Sources produced by the DRP pipelines contain the entries listed in DMS-REQ-0267.

LVV-T362	Installation of the LSST Science Pipelines Payloads			
Owner	Status	Version	Critical Event	Verification Type
John Swinbank	Draft	1	false	Test

Objective:

This test will check that:

- The Alert Production Pipeline payload is available for installation from documented channels;
- The Data Release Production Pipeline payload is available for installation from documented channels;
- The Calibration Products Production Pipeline payload is available for installation from documented channels;
- These payloads can be installed on systems at the LSST Data Facility following available documentation;
- The installed pipeline payloads are capable of successfully executing basic integration tests.

Note that this test assumes a 2018-era packaging of the Science Pipelines software, in which all the above payloads are represented by a single “meta-package”, `lsst_distrib`.

Draft

2.43 [LVV-99] DMS-REQ-0268-V-01: Forced-Source Catalog

Jira Link	Assignee	Status	Test Cases
LVV-99	Jim Bosch	Not Covered	LVV-T12 LVV-T66

Verification Element Description:

With the precursor data verify that forced source table is created from all calibrated exposures.

Requirement Details	
Requirement ID	DMS-REQ-0268
Requirement Description	Specification: The DMS shall create a Forced-Source Catalog, consisting of measured fluxes for all entries in the Object Catalog on all Processed Visit Images and Difference Images. Measurements for each forced-source shall include the object and visit IDs, the modelled flux and error (given fixed position, shape, and deblending parameters), and measurement quality flags.
Requirement Discussion	Discussion: The large number of Forced Sources makes it impractical to measure more attributes than are necessary to construct a light curve for variability studies.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0137 Catalogs (Level 2)

2.43.1 Test Cases Summary

LVV-T12	DRP-00-10: Data Release Includes Required Data Products			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	1	false	Test

Objective:

This test will check that the basic data products which should be in an data release are generated by execution of the science payload.

These products will include:

- Source catalogs, derived from PVIs and coadded images (DMS-REQ-0267 & DMS-REQ-0277);
- Forced source catalogs (DMS-REQ-0268);
- Object catalogs (DMS-REQ-0275);
- Processed visit images (PVIs; DMS-REQ-0069);

- Coadded images (DMS-REQ-0279);

LVV-T66	Verify implementation of Forced-Source Catalog			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Draft	1	false	Test

Objective:

Verify that all ForcedSources produced by the DRP pipelines contain fluxes measured on difference and direct single-epoch images, associated uncertainties, an Object ID, and a Visit ID.

2.44 [LVV-100] DMS-REQ-0269-V-01: DIASource Catalog

Jira Link	Assignee	Status	Test Cases
			LVV-T18
LVV-100	Jim Bosch	Not Covered	LVV-T21
			LVV-T49

Verification Element Description:

Assume this is verified by performing a difference image processing and checking that reasonable data automatically appears in the DIASource table. Verify against DPDD.

Requirement Details	
Requirement ID	DMS-REQ-0269
Requirement Description	<p>Specification: The DMS shall construct a catalog of all Sources detected on Difference Exposures with SNR > transSNR. For each Difference Source (DIASource), the DMS shall be able to provide the identity of the Difference Exposure from which it was derived; the identity of the associated SSOBJect, if any; the identity of the parent Source from which this DIASource has been deblended, if any. The DMS shall also measure and record a set of attributes for each DIASource including at least: epoch of the observation, focal plane position centroid and error (pixel), sky position and associated error (radec), SNR of the detection; calibrated PS flux and associated error; likelihood of the observed data given the PS model; calibrated aperture flux and associated error; calibrated flux and associated error for a trailed source model, and length and angle of the trail; flux and associated parameters for a dipole model; parameters of an adaptive shape measurement and associated error; a measure of source extendedness; the estimated background at the position of the object in the template image with associated uncertainty; a measure of spuriousness; and flags indicating problems encountered while computing the aforementioned attributes. The DMS shall also determine and record measurements on the Calibrated exposure the following: calibrated flux and associated error for the source as measured on the Visit image.</p>
Requirement Parameters	transSNR = 5[float] The signal-to-noise ratio in single-visit difference images above which all optical transients are to be reported.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0130 Catalogs (Level 1) DMS-REQ-0270 Faint DIASource Measurements

2.44.1 Test Cases Summary

LVV-T18	AG-00-05: Alert Generation Produces Required Data Products
---------	--

Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Approved	1	false	Test

Objective:

This test will check that the basic data products produced by Alert Generation are generated by execution of the science payload. These products will include:

- Processed visit images (PVIs; DMS-REQ-0069);
- Difference Exposures (DMS-REQ-0010);
- DIASource catalogs (DMS-REQ-0269);
- DIAObject catalogs (DMS-REQ-0271);

LVV-T21	AG-00-20: Scientific Verification of DIASource Catalog			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Approved	1	false	Test

Objective:

This test will check that the difference image source catalogs delivered by the Alert Generation science payload meet the requirements laid down by LSE-61.

- Specifically, this will demonstrate that:
- Measurements in the catalog are presented in flux units (DMS-REQ-0347);
- Each DIASource record contains an appropriate subset of the attributes required by DMS-REQ-0269. In particular, the LDM-503-3-era pipeline is expected to provide DIASource positions (sky and focal plane), fluxes, and flags indicative of issues encountered during processing.
- Faint DIASources satisfying additional criteria are stored (DMS-REQ-0270).
- Derived quantities are provided in pre-computed columns (DMS-REQ-0331);

This test does not include quantitative targets for the science quality criteria.

LVV-T49	Verify implementation of DIASource Catalog			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Draft	1	false	Test

Objective:

Verify that the DMS produces a Source catalog from Difference Exposures with the required attributes.

Draft

2.45 [LVV-101] DMS-REQ-0270-V-01: Faint DIASource Measurements

Jira Link	Assignee	Status	Test Cases
LVV-101	Eric Bellm	Not Covered	LVV-T21 LVV-T50

Verification Element Description:

We first need to define some criteria. Then we need to work out whether this is an after burner, triggered after processing, or something directly integrated into L1 processing and triggered automatically.

Requirement Details	
Requirement ID	DMS-REQ-0270
Requirement Description	Specification: The DMS shall be able to measure and store DIASources fainter than transSNR that satisfy additional criteria. A limited number of such sources shall be made to enable monitoring of DIA quality.
Requirement Parameters	transSNR = 5[float] The signal-to-noise ratio in single-visit difference images above which all optical transients are to be reported.
Requirement Discussion	Discussion: Some individual faint sources may be of high significance, such as a potentially hazardous asteroid.
Requirement Priority	2
Upper Level Requirement	OSS-REQ-0166 Alert Completeness and Purity

2.45.1 Test Cases Summary

Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Approved	1	false	Test

Objective:

This test will check that the difference image source catalogs delivered by the Alert Generation science payload meet the requirements laid down by LSE-61.

- Specifically, this will demonstrate that:
- Measurements in the catalog are presented in flux units (DMS-REQ-0347);
- Each DIASource record contains an appropriate subset of the attributes required by DMS-REQ-0269. In particular, the

LDM-503-3-era pipeline is expected to provide DIASource positions (sky and focal plane), fluxes, and flags indicative of issues encountered during processing.

- Faint DIASources satisfying additional criteria are stored (DMS-REQ-0270).
- Derived quantities are provided in pre-computed columns (DMS-REQ-0331);

This test does not include quantitative targets for the science quality criteria.

LVV-T50	Verify implementation of Faint DIASource Measurements			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Draft	1	false	Test

Objective:

Verify that the DMS can produce DIASources measurements for sources below the nominal S/N cutoff that satisfy additional criteria.

2.46 [LVV-102] DMS-REQ-0271-V-01: Max nearby galaxies associated with DIA-Source

Jira Link	Assignee	Status	Test Cases
			LVV-T18
LVV-102	Eric Bellm	Not Covered	LVV-T22
			LVV-T51

Verification Element Description:

Run multiple visits through image differencing. Run association pipeline. Verify that DIA-Sources are correctly associated with DIAObjects and DIAObjects correctly associated with Objects. Can use precursor data.

Associated element (LVV-9743) satisfies the radius within which an Object is considered coincident with a DIASource.

Associated element (LVV-9742) satisfies the maximum number of stars that can be associated with a DIASource.

Requirement Details	
Requirement ID	DMS-REQ-0271
Requirement Description	Specification: The DMS shall construct a catalog of all astrophysical objects identified through difference image analysis (DIAObjects). The DIAObject entries shall include meta-data attributes including at least: a unique identifier; the identifiers of the diaNearbyObjMaxStar nearest stars and diaNearbyObjMaxGalaxy nearest galaxies in the Object catalog lying within diaNearbyObjRadius , the probability that the DIAObject is the same as the nearby Object; and a set of DIAObject properties.
Requirement Parameters	[diaNearbyObjMaxGalaxy = 3[integer] Maximum number of nearby galaxies that can be associated with a DIASource., diaNearbyObjRadius = 60[arcsecond] Radius within which an Object is considered to be near, and possibly coincident with, the DIASource., diaNearbyObjMaxStar = 3[integer] Maximum number of stars that can be associated with a DIASource.]
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0130 Catalogs (Level 1)

2.46.1 Test Cases Summary

LVV-T18	AG-00-05: Alert Generation Produces Required Data Products			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Approved	1	false	Test

Objective:

This test will check that the basic data products produced by Alert Generation are generated by execution of the science payload. These products will include:

- Processed visit images (PVI; DMS-REQ-0069);
- Difference Exposures (DMS-REQ-0010);
- DIASource catalogs (DMS-REQ-0269);
- DIAObject catalogs (DMS-REQ-0271);

LVV-T22	AG-00-25: Scientific Verification of DIAObject Catalog			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Approved	1	false	Test

Objective:

This test will check that the DIAObject catalogs delivered by the Alert Generation science payload meet the requirements laid down by LSE-61.

Specifically, this will demonstrate that:

- DIAObjects are recorded with unique identifiers (DMS-REQ-0271);
- Measurements in the catalog are presented in flux units (DMS-REQ-0347);
- EachDIAObjectrecordcontainsanappropriatesetofsummaryattributes(DMS-REQ-0271 and DMS-REQ-0272). Note:
 - This test is executed independently of the Data Release Production system. Hence, DIAObjects are not associated to Objects, and the association metadata specified by DMS-REQ-0271 is not expected to be available.
 - TheLDM-503-3erapipelineisnotexpectedto calculateorpersistallattributesspecified by DMS-REQ-0272 requirement.
- Relevant derived quantities are provided in pre-computed columns (DMS-REQ-0331);

This test does not include quantitative targets for the science quality criteria.

LVV-T51	Verify implementation of DIAObject Catalog			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Draft	1	false	Test

Objective:

Verify that the DIAObject includes a unique ID, identifiers for nearest stars and nearest galaxies, and probability of matching to static Object.

Draft

2.47 [LVV-103] DMS-REQ-0272-V-01: DIAObject Attributes

Jira Link	Assignee	Status	Test Cases
LVV-103	Eric Bellm	Not Covered	LVV-T22 LVV-T52

Verification Element Description:

Compare contents of table populated in DMS-REQ- 0271 with DPDD.

Requirement Details	
Requirement ID	DMS-REQ-0272
Requirement Description	Specification: For each DIAObject the DMS shall store summary attributes including at least: sky position at the time of the observation; astrometric attributes including proper motion, parallax and related errors; point-source magnitude in each passband and related error; weighted mean forced-photometry flux and related error; periodic and non-periodic variability measures; and flags that encode special conditions encountered in measuring the above quantities.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0130 Catalogs (Level 1)

2.47.1 Verified By

- . LVV-10990 (??) Explore time domain with summary statistics
- . LVV-10990 (??) Explore time domain with summary statistics

2.47.2 Test Cases Summary

LVV-T22	AG-00-25: Scientific Verification of DIAObject Catalog			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Approved	1	false	Test

Objective:

This test will check that the DIAObject catalogs delivered by the Alert Generation science payload meet the requirements laid down by LSE-61.

Specifically, this will demonstrate that:

- DIAObjects are recorded with unique identifiers (DMS-REQ-0271);
- Measurements in the catalog are presented in flux units (DMS-REQ-0347);
- EachDIAObjectrecordcontainscontainsanappropriatesetofsummaryattributes(DMS- REQ-0271 and DMS-REQ-0272). Note:
 - This test is executed independently of the Data Release Production system. Hence, DIAObjects are not associated to Objects, and the association metadata specified by DMS-REQ-0271 is not expected to be available.
 - TheLDM-503-3erapipelineisnotexpectedtocalculateorpersistallattributesspec- ified by DMS-REQ-0272 requirement.
- Relevant derived quantities are provided in pre-computed columns (DMS-REQ-0331);

This test does not include quantitative targets for the science quality criteria.

LWV-T52	Verify implementation of DIAObject Attributes			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Draft	1	false	Test

Objective:

Verify that the DMS provides summary attributes for each DIAObject, including periodicity measures.

2.48 [LVV-104] DMS-REQ-0273-V-01: SSOBJECT Catalog

Jira Link	Assignee	Status	Test Cases
LVV-104	Eric Bellm	Not Covered	LVV-T53

Verification Element Description:

We might be able to demonstrate this by providing calculated positions of known asteroids to MOPS and then checking the SSOBJECT table. Better, use data from precursor surveys. Also use full simulations with injected asteroids. Final verification requires a mini-survey of LSST.

Requirement Details	
Requirement ID	DMS-REQ-0273
Requirement Description	Specification: The DMS shall produce a catalog of all Solar System Objects (SSObjects) that have been identified via Moving Object Processing. The SSOBJECT catalog shall include for each entry attributes including at least the following: Osculating orbital elements and associated uncertainties, minimum orbit intersection distance (MOID), mean absolute magnitude and slope parameter per band and associated errors, and flags that describe conditions of the description.
Requirement Discussion	Discussion: The magnitude and angular velocity limits for identifying SSOBJECTS are TBD. These limits may be driven more by computational resource constraints than by the raw reach of the collected data. The software may well be capable of exceeding the required limits, but at an unacceptable cost. The slope parameter will be poorly constrained until later in the survey. A baseline algorithm and acceptance criteria should be developed prior to verification.
Requirement Priority	2
Upper Level Requirement	OSS-REQ-0130 Catalogs (Level 1)

2.48.1 Test Cases Summary

LVV-T53	Verify implementation of SSOBJECT Catalog			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Draft	1	false	Test

Objective:

Verify that the DMS produces a catalog of Solar System Objects identify from Moving Object Processing.

Verify that the SSOBJECT catalog includes orbital elements and additional related quantities.

2.49 [LVV-105] DMS-REQ-0274-V-01: Alert Content

Jira Link	Assignee	Status	Test Cases
LVV-105	Eric Bellm	Not Covered	LVV-T54

Verification Element Description:

Interpret this as a full end to end test of L1, rather than the ability to publish alerts from a DIASources catalog. Compare contents of DIASources catalog with contents of alert stream.

Requirement Details	
Requirement ID	DMS-REQ-0274
Requirement Description	Specification: The DMS shall create an Alert for each detected DIASource, to be broadcast using community protocols, with content that includes: a unique Alert ID, the Level-1 database ID, the DIASource record that triggered the alert, the DIAObject (or SSOBJECT) record, 12 months of previous DIASource records corresponding to the object (if available), and cut-outs of images (from both the template image and the difference image) of sufficient areal coverage to identify the DIASource and its immediate surroundings. These cutouts should include WCS, PSF, variance and mask information. The Alert should also include program and/or scheduler metadata.
Requirement Discussion	Discussion: The aim for the Alert content is to include sufficient information to be relatively self-contained, and to minimize the demand for follow-up queries of the Level-1 database. This approach will likely increase the speed and efficiency of down-stream object classifiers. The included program and/or scheduler metadata should be sufficient to identify whether the image is associated with a Special Program (such as an in-progress Deep Drilling Field).
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0128 Alerts

2.49.1 Test Cases Summary

LVV-T54	Verify implementation of Alert Content			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Draft	1	false	Test

Objective:

Verify that the DMS creates an Alert for each detected DIASource

Verify that this Alert is broadcasted using community protocols

Verify that the context of the Alert packet match requirements.

Draft

2.50 [LVV-106] DMS-REQ-0275-V-01: Object Catalog

Jira Link	Assignee	Status	Test Cases
			LVV-T12
LVV-106	Jim Bosch	Not Covered	LVV-T14
			LVV-T67

Verification Element Description:

Precursor data spread across multiple epochs. Must contain SSObjects and DIASources. Must be coaddable. Can be single filter. Must verify Object catalog

Requirement Details	
Requirement ID	DMS-REQ-0275
Requirement Description	Specification: The DMS shall create an Object Catalog, based on sources deblended based on knowledge of CoaddSource, DIASource, DIAObject, and SSObject Catalogs, after multi-epoch spatial association and characterization.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0137 Catalogs (Level 2)

2.50.1 Verified By

- . DM-9953 (??) Pixels rejected from coaddition and CCD are not masked on coadds
- . DM-13058 (??) Inconsistent aperture corrections in W44 reprocessing of HSC RC1

2.50.2 Test Cases Summary

LVV-T12	DRP-00-10: Data Release Includes Required Data Products			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	1	false	Test

Objective:

This test will check that the basic data products which should be in an data release are generated by execution of the science payload.

These products will include:

- Source catalogs, derived from PVIs and coadded images (DMS-REQ-0267 & DMS-REQ-0277);
- Forced source catalogs (DMS-REQ-0268);
- Object catalogs (DMS-REQ-0275);
- Processed visit images (PVIs; DMS-REQ-0069);
- Coadded images (DMS-REQ-0279);

LVV-T14	DRP-00-25: Scientific Verification of Object Catalog			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	1	false	Test

Objective:

This test will check that the object catalogs delivered by the DRP science payload meet the requirements laid down by LSE-61. Specifically, this will demonstrate that:

- Measurements in the catalog are presented in flux units (DMS-REQ-0347);
- Derived quantities are provided in pre-computed columns (DMS-REQ-0331);
- Aperture corrections for different photometry algorithms are consistent.
- PSF models correctly predict the ellipticities of stars over each tract.
- Photometry measurements are consistent with reference catalog photometry (including sources not used in photometric calibration).
- Astrometry measurements are consistent with reference catalog positions (including sources not used in astrometric calibration).
- Forced and unforced photometry measurements are consistent.
- The slope of the stellar locus in color-color space is not a function of position on the sky.

This test does not include quantitative targets for the science quality criteria; we instead require for each test that we be able to quickly construct a plot in which such a target can be visualized.

All science quality tests in this section shall distinguish between blended and isolated objects.

LVV-T67	Verify implementation of Object Catalog			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Draft	1	false	Test

Objective:

Verify that the DRP pipelines produce an Object catalog derived from detections made on both coadded images and difference images and measurements performed on coadds and possibly overlapping single-epoch images.

2.51 [LVV-107] DMS-REQ-0276-V-01: Object Characterization

Jira Link	Assignee	Status	Test Cases
LVV-107	Jim Bosch	Not Covered	LVV-T69

Verification Element Description:

For each object in DMS-REQ-0275 verify that the characterization measures are defined.

Requirement Details	
Requirement ID	DMS-REQ-0276
Requirement Description	Specification: Each entry in the Object Catalog shall include the following characterization measures: a point-source model fit, a bulge-disk model fit, standard colors, a centroid, adaptive moments, Petrosian and Kron fluxes, surface brightness at multiple apertures, proper motion and parallax, and a variability characterization.
Requirement Discussion	Discussion: These measurements are intended to enable LSST “static sky” science.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0137 Catalogs (Level 2)

2.51.1 Test Cases Summary

LVV-T69	Verify implementation of Object Characterization			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Draft	1	false	Test

Objective:

Verify that Object catalogs produced by the DRP pipeline include all measurements listed in DMS-REQ-0276: a point-source model fit, a bulge-disk model fit, standard colors, a centroid, adaptive moments, Petrosian and Kron fluxes, surface brightness at multiple apertures, proper motion and parallax, and a variability characterization.

2.52 [LVV-108] DMS-REQ-0277-V-01: Coadd Source Catalog

Jira Link	Assignee	Status	Test Cases
LVV-108	Jim Bosch	Not Covered	

Verification Element Description:

Precursor data. Do a miniDRP and verify that a source catalog is created at that threshold. It's not clear why we have a requirement for a transient internal catalog.

Requirement Details	
Requirement ID	DMS-REQ-0277
Requirement Description	Specification: The DMS shall, in the course of creating the master Source Catalog, create a catalog from the coadds of all sources detected in each passband with a SNR > coaddDetectThresh .
Requirement Parameters	coaddDetectThresh = 5[float] S/N threshold for detecting sources in Co-Add images for building the Source Catalog.
Requirement Discussion	Discussion: CoaddSources are in general composites of overlapping astrophysical objects. This catalog is an intermediate product in DR production, and will not be permanently archived nor released to end-users.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0137 Catalogs (Level 2) DMS-REQ-0267 Source Catalog

2.53 [LVV-109] DMS-REQ-0278-V-01: Coadd Image Method Constraints

Jira Link	Assignee	Status	Test Cases
LVV-109	Jim Bosch	Not Covered	LVV-T16 LVV-T72

Verification Element Description:

This is like DMS-REQ-0279 but specifically for overlapping spatial visits and describing HOW it should be done. Verify that the images are on the required output grid.

Requirement Details	
Requirement ID	DMS-REQ-0278
Requirement Description	Specification: Coadd Images shall be created by combining spatially overlapping Processed Visit Images (on which bad pixels and transient sources have been masked), where the contributing Processed Visit Images have been re-projected to a common reference geometry, and matched to a common background level which best approximates the astrophysical background.
Requirement Discussion	Discussion: It is expected that coadded images will be produced for all observed regions of the sky, not just the main survey area.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0136 Co-added Exposures

2.53.1 Test Cases Summary

LVV-T16	DRP-00-35: Scientific Verification of Coadd Images			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	1	false	Test

Objective:

This test will check that the coadded images delivered by the DRP science payload meet the requirements laid down by LSE-61. Specifically, this will demonstrate that:

- Coadds have been generated and persisted during payload execution;
- Each coadd provides a spatially varying PSF model (DMS-REQ-0047).
- Saturated pixels are correctly masked.
- Pixels affected by satellite trails and ghosts are rejected from the coadd.
- The background is not oversubtracted around bright objects.

This test does not include quantitative targets for the science quality criteria; we instead require for each test that we be able to quickly construct a plot or display summary images that allow such a target can be visualized.

LVV-T72	Verify implementation of Coadd Image Method Constraints			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Draft	1	false	Test

Objective:

Verify the implementation of how Coadd images are created.

Draft

2.54 [LVV-110] DMS-REQ-0279-V-01: Deep Detection Coadds

Jira Link	Assignee	Status	Test Cases
			LVV-T12
LVV-110	Jim Bosch	Not Covered	LVV-T16
			LVV-T73

Verification Element Description:

Precursor data. Multi filter. System should automatically trigger co-add processing and filter out poor data. Timescale for this should be configurable. Add more data and verify coadd has been changed.

Requirement Details	
Requirement ID	DMS-REQ-0279
Requirement Description	Specification: The DMS shall periodically create Co-added Images in each of the u,g,r,i,z,y passbands by combining all archived exposures taken of the same region of sky and in the same passband that meet specified quality conditions.
Requirement Discussion	Discussion: Quality attributes may include thresholds on seeing, sky brightness, wavefront quality, PSF shape and spatial variability, or date of exposure.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0136 Co-added Exposures

2.54.1 Test Cases Summary

LVV-T12	DRP-00-10: Data Release Includes Required Data Products			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	1	false	Test

Objective:

This test will check that the basic data products which should be in an data release are generated by execution of the science payload.

These products will include:

- Source catalogs, derived from PVIs and coadded images (DMS-REQ-0267 & DMS-REQ-0277);
- Forced source catalogs (DMS-REQ-0268);
- Object catalogs (DMS-REQ-0275);

- Processed visit images (PVIs; DMS-REQ-0069);
- Coadded images (DMS-REQ-0279);

LVV-T16	DRP-00-35: Scientific Verification of Coadd Images			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	1	false	Test

Objective:

This test will check that the coadded images delivered by the DRP science payload meet the requirements laid down by LSE-61. Specifically, this will demonstrate that:

- Coadds have been generated and persisted during payload execution;
- Each coadd provides a spatially varying PSF model (DMS-REQ-0047).
- Saturated pixels are correctly masked.
- Pixels affected by satellite trails and ghosts are rejected from the coadd.
- The background is not oversubtracted around bright objects.

This test does not include quantitative targets for the science quality criteria; we instead require for each test that we be able to quickly construct a plot or display summary images that allow such a target can be visualized.

LVV-T73	Verify implementation of Deep Detection Coadds			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Draft	1	false	Test

Objective:

Verify that the DRP pipelines produce a suite of per-band coadded images that are optimized for depth.

2.55 [LVV-111] DMS-REQ-0280-V-01: Template Coadds

Jira Link	Assignee	Status	Test Cases
LVV-111	Eric Bellm	Not Covered	LVV-T74

Verification Element Description:

Precursor data. Not obvious this has to be demonstrated with all filters. Is “periodic” manual or automated? Much like DMS-REQ-0279 with different constraints. Demonstrate that templates are created with appropriate bins.

Requirement Details	
Requirement ID	DMS-REQ-0280
Requirement Description	Specification: The DMS shall periodically create Template Images in each of the u, g, r, i, z, y passbands. Templates may be constructed as part of executing the Data Release Production payload, or by a separate execution of the Template Generation payload. Prior to their availability from Data Releases these coadds shall be created incrementally when sufficient data passing relevant quality criteria is available.
Requirement Discussion	Discussion: Image Templates are used by the Image Difference pipeline in the course of identifying transient or variable sources. The temporal range of epochs may be limited to avoid confusing slowly moving sources (such as high proper motion stars) with genuine transients. Incremental template building enables Alert Production when no Data Release template is yet available. It is anticipated that incremental template generation could be run nightly, but once a template is produced for a sky position and filter it will not be replaced until the next Data Release to avoid repeated baseline changes. To enable artifact rejection and to comply with OSS-REQ-0158, incremental templates will be built with at least three images.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0158 Coaddition for Templates for Subtraction OSS-REQ-0136 Co-added Exposures

2.55.1 Test Cases Summary

LVV-T74	Verify implementation of Template Coadds			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Draft	1	false	Test

Objective:

Verify that the DMS can produce Template Coadds for DIA processing.

2.56 [LVV-112] DMS-REQ-0281-V-01: Multi-band Coadds

Jira Link	Assignee	Status	Test Cases
LVV-112	Jim Bosch	Not Covered	LVV-T75

Verification Element Description:

Like DMS-REQ-0279 with different constraints.

Requirement Details	
Requirement ID	DMS-REQ-0281
Requirement Description	Specification: The DMS shall periodically create Multi-band Coadd images which are constructed similarly to Deep Detection Coadds, but where all passbands are combined.
Requirement Discussion	Discussion: The multi-color Coadds are intended for very deep detection.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0136 Co-added Exposures

2.56.1 Test Cases Summary

LVV-T75	Verify implementation of Multi-band Coadds			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Draft	1	false	Test

Objective:

Verify that the DRP pipelines produce multi-band coadds for detection purposes.

2.57 [LVV-113] DMS-REQ-0282-V-01: Dark Current Correction Frame Creation

Jira Link	Assignee	Status	Test Cases
LVV-113	Robert Lupton	Not Covered	LVV-T90

Verification Element Description:

Can demonstrate dark processing with camera in lab and with simulated dark data.

Requirement Details	
Requirement ID	DMS-REQ-0282
Requirement Description	Specification: The DMS shall produce on an as-needed basis a dark current correction image, which is constructed from multiple, closed-shutter exposures of appropriate duration. The effectiveness of the Dark Correction shall be verified in production processing on science data.
Requirement Discussion	Discussion: The need for a dark current correction will have to be quantified during Commissioning. Collecting closed-dome dark exposures may be deemed necessary to monitor the health of the detectors, even if not used in calibration processing.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0271 Supported Image Types OSS-REQ-0046 Calibration

2.57.1 Test Cases Summary

LVV-T90	Verify implementation of Dark Current Correction Frame			
Owner	Status	Version	Critical Event	Verification Type
Robert Lupton	Defined	1	false	Test

Objective:

Verify that the DMS can produce a dark correction frame calibration product.

2.58 [LVV-114] DMS-REQ-0283-V-01: Fringe Correction Frame

Jira Link	Assignee	Status	Test Cases
LVV-114	Robert Lupton	Not Covered	LVV-T91

Verification Element Description:

Needs a real camera during commissioning and data taken in the correct mode. Can possibly be done prior to commissioning with simulated data.

Requirement Details	
Requirement ID	DMS-REQ-0283
Requirement Description	Specification: The DMS shall produce on an as-needed basis an image that corrects for detector fringing. The effectiveness of the Fringe Correction shall be verified in production processing on science data.
Requirement Discussion	Discussion: Fringing is likely to affect only the reddest filters, where the CCD substrate becomes semi-transparent to incident light.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0271 Supported Image Types OSS-REQ-0046 Calibration

2.58.1 Test Cases Summary

LVV-T91	Verify implementation of Fringe Correction Frame			
Owner	Status	Version	Critical Event	Verification Type
Robert Lupton	Draft	1	false	Test

Objective:

Verify that the DMS can produce an fringe-correction frame calibration product.

Verify that the DMS can determine the effectiveness of the fringe-correction frame and determine how often it should be updated.

2.59 [LVV-116] DMS-REQ-0285-V-01: Level 1 Source Association

Jira Link	Assignee	Status	Test Cases
			LVV-T22
LVV-116	Eric Bellm	Not Covered	LVV-T108
			LVV-T550

Verification Element Description:

How is this not just DMS-REQ-0271 rewritten? Is “clusters” important here? Night of precursor L1 data processing should result in DIAObject and SSOBJect association.

Requirement Details	
Requirement ID	DMS-REQ-0285
Requirement Description	Specification: The DMS shall associate clusters of DIASources detected on multiple visits taken at different times with either a DIAObject or an SSOBJect.
Requirement Discussion	Discussion: The association will represent the underlying astrophysical phenomenon.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0130 Catalogs (Level 1) OSS-REQ-0160 Level 1 Difference Source - Difference Object Association Quality OSS-REQ-0159 Level 1 Moving Object Quality

2.59.1 Test Cases Summary

LVV-T22	AG-00-25: Scientific Verification of DIAObject Catalog			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Approved	1	false	Test

Objective:

This test will check that the DIAObject catalogs delivered by the Alert Generation science payload meet the requirements laid down by LSE-61.

Specifically, this will demonstrate that:

- DIAObjects are recorded with unique identifiers (DMS-REQ-0271);
- Measurements in the catalog are presented in flux units (DMS-REQ-0347);
- Each DIAObject record contains an appropriate set of summary attributes (DMS-REQ-0271 and DMS-REQ-0272). Note:
 - This test is executed independently of the Data Release Production system. Hence, DIAObjects are not associated

- to Objects, and the association metadata specified by DMS-REQ-0271 is not expected to be available.
- The LDM-503-3era pipeline is not expected to calculate or persist all attributes specified by DMS-REQ-0272 requirement.
- Relevant derived quantities are provided in pre-computed columns (DMS-REQ-0331);

This test does not include quantitative targets for the science quality criteria.

LVV-T108	Verify implementation of Level 1 Source Association			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Draft	1	false	Test

Objective:

Verify that the DMS associates DIASources into a DIAObject or SSOBJect.

LVV-T550	MOPS – orbit association completeness			
Owner	Status	Version	Critical Event	Verification Type
Scott Daniel	Defined	1	true	Test

Objective:

Test completeness of orbit association using simulated data

2.60 [LVV-117] DMS-REQ-0286-V-01: SSOBJECT Preccovery

Jira Link	Assignee	Status	Test Cases
LVV-117	Eric Bellm	Not Covered	LVV-T109

Verification Element Description:

Carefully craft an input dataset from precursor data that ensures that preccovery will only be triggered later in the processing. Check that preccovery occurs and object association is done.

Requirement Details	
Requirement ID	DMS-REQ-0286
Requirement Description	Specification: Upon identifying a new SSOBJECT, the DMS shall associate additional DIAObjects that are consistent with the orbital parameters (preccovery), and update DIAObject entries so associated.
Requirement Priority	2
Upper Level Requirement	OSS-REQ-0159 Level 1 Moving Object Quality

2.60.1 Test Cases Summary

LVV-T109	Verify implementation of SSOBJECT Preccovery			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Draft	1	false	Test

Objective:

Verify that the DMS associates additional DIAObjects (both forward and back in time) with objects classified as SSOBJECTS.

2.61 [LVV-118] DMS-REQ-0287-V-01: Max look-back time for precovery

Jira Link	Assignee	Status	Test Cases
LVV-118	Eric Bellm	Not Covered	LVV-T110

Verification Element Description:

Precursor or simulated L1 data covering precoveryWindow plus a few days. Detect DIASource towards end of window, ensure, at minimum, precoveryWindow forced photometry is performed.

Associated element (LVV-9747) satisfies the lifetime of cached L1 data products.

Associated element (LVV-9746) satisfies the time in which L1 data products shall be publicly released.

Requirement Details	
Requirement ID	DMS-REQ-0287
Requirement Description	Specification: For all DIASources not associated with either DIAObjects or SSObjects, the DMS shall perform forced photometry at the location of the new source (precovery) on all Difference Exposures obtained in the prior precoveryWindow , and make the results publicly available within L1PublicT .
Requirement Parameters	[precoveryWindow = 30[day] Maximum look-back time for precovery measurements on prior Exposures., l1CacheLifetime = 30[day] Lifetime in the cache of un-archived Level-1 data products., L1PublicT = 24[hour] Maximum time from the acquisition of science data to the release of associated Level 1 Data Products (except alerts)]
Requirement Discussion	Discussion: The precoveryWindow is intended to satisfy the most common scientific use cases (e.g., Supernovae), without placing an undue burden on the processing infrastructure. For reasons of practicality and efficiency, precoveryWindow <= l*1CacheLifetime*.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0130 Catalogs (Level 1)

2.61.1 Test Cases Summary

LVV-T110	Verify implementation of DIASource Precovery			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Draft	1	false	Test

Objective:

Verify that DMS performs forced photometry for new DIAObjects at all available images within the precoveryWindow.

Draft

2.62 [LVV-119] DMS-REQ-0288-V-01: Use of External Orbit Catalogs

Jira Link	Assignee	Status	Test Cases
LVV-119	Eric Bellm	Not Covered	LVV-T111

Verification Element Description:

Either demonstrate an external catalog being used in MOPS, or show the code that would use the external catalog. Former preferred.

Requirement Details	
Requirement ID	DMS-REQ-0288
Requirement Description	Specification: It shall be possible for DMS to make use of approved external catalogs and observations to improve the identification of SSOjects, and therefore increase the purity of the transient Alert stream in nightly processing.
Requirement Priority	2
Upper Level Requirement	OSS-REQ-0159 Level 1 Moving Object Quality

2.62.1 Test Cases Summary

LVV-T111	Verify implementation of Use of External Orbit Catalogs			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Draft	1	false	Test

Objective:

Verify that the DMS can make use of external catalogs to improve identification of SSOjects.

2.63 [LVV-120] DMS-REQ-0289-V-01: Calibration Production Processing

Jira Link	Assignee	Status	Test Cases
LVV-120	Robert Lupton	Not Covered	LVV-T115

Verification Element Description:

Vague. DM needs to be able to take any calibration data and reduce them. This requirement does not cover decisions on when to take calibrations. Show that CPP is in place and can reduce data.

Requirement Details	
Requirement ID	DMS-REQ-0289
Requirement Description	Specification: The DMS shall be capable of producing calibration data products on an as-needed basis, consistent with monitoring the health and performance of the instrument, the availability of raw calibration exposures, the temporal stability of the calibrations, and of the SRD requirements for calibration accuracy.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0004 The Archive Facility OSS-REQ-0170 Calibration Data

2.63.1 Test Cases Summary

LVV-T115	Verify implementation of Calibration Production Processing			
Owner	Status	Version	Critical Event	Verification Type
Kian-Tat Lim	Defined	1	false	Test

Objective:

Execute CPP on a variety of representative cadences, and verify that the calibration pipeline correctly produces necessary calibration products.

2.64 [LVV-121] DMS-REQ-0290-V-01: Level 3 Data Import

Jira Link	Assignee	Status	Test Cases
LVV-121	Colin Slater	Not Covered	LVV-T122

Verification Element Description:

Requires a fixed list of import formats. L3 user uploads catalog into L3 system and can then do queries upon it.

Requirement Details	
Requirement ID	DMS-REQ-0290
Requirement Description	Specification: The DMS shall be able to ingest tables from common file formats (e.g. FITS tables, CSV files with supporting metadata) to facilitate the loading of external catalogs and the production of Level-3 data products.
Requirement Priority	2
Upper Level Requirement	OSS-REQ-0140 Production

2.64.1 Test Cases Summary

LVV-T122	Verify implementation of Level 3 Data Import			
Owner	Status	Version	Critical Event	Verification Type
Colin Slater	Draft	1	false	Test

Objective:

Verify that the Science Platform can ingest data from community-standard file formats.

2.65 [LVV-122] DMS-REQ-0291-V-01: Query Repeatability

Jira Link	Assignee	Status	Test Cases
LVV-122	Colin Slater	Not Covered	LVV-T96

Verification Element Description:

Can be verified prior to commissioning with processed precursor test data along with a defined set of queries. Query on previous DR run is verified to work even when newer DR is the default.

Requirement Details	
Requirement ID	DMS-REQ-0291
Requirement Description	Specification: The DMS shall ensure that any query executed at a particular point in time against any DMS delivered database shall be repeatable at a later date, and produce results that are either identical or include additional results (owing to updates from Level-1 processing).
Requirement Discussion	Discussion: It would be desirable to have the ability to “save” a query such that the date or data release would be included explicitly. Additionally, the ability to associate this query with a DOI would allow queries to be shared and included in scientific papers without requiring a large copy and paste.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0181 Data Products Query and Download Infrastructure

2.65.1 Test Cases Summary

LVV-T96	Verify implementation of Query Repeatability			
Owner	Status	Version	Critical Event	Verification Type
Colin Slater	Draft	1	false	Test

Objective:

Verify that prior queries can be rerun with identical results, or with new additional data for live (Alert Production) databases.

2.66 [LVV-123] DMS-REQ-0292-V-01: Uniqueness of IDs Across Data Releases

Jira Link	Assignee	Status	Test Cases
LVV-123	Colin Slater	Not Covered	LVV-T97

Verification Element Description:

Simple: Inspect the ID generation code and confirm that DR number is encoded in each ID.
 Better: With carefully selected precursor data, do multiple DRP runs and verify that IDs are not reused.

Requirement Details	
Requirement ID	DMS-REQ-0292
Requirement Description	Specification: To reduce the likelihood for confusion, all IDs shall be unique across databases and database versions, other than those corresponding to uniquely identifiable entities (i.e., IDs of exposures).
Requirement Discussion	Discussion: For example, DR4 and DR5 (or any other) release will share no identical Object, Source, DIAObject or DIASource IDs.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0130 Catalogs (Level 1) OSS-REQ-0137 Catalogs (Level 2)

2.66.1 Test Cases Summary

LVV-T97	Verify implementation of Uniqueness of IDs Across Data Releases			
Owner	Status	Version	Critical Event	Verification Type
Kian-Tat Lim	Defined	1	false	Test

Objective:

Verify that the IDs of Objects, Sources, DIAObjects, and DIASources from different Data Releases are unique.

2.67 [LVV-124] DMS-REQ-0293-V-01: Selection of Datasets

Jira Link	Assignee	Status	Test Cases
LVV-124	Jim Bosch	Not Covered	LVV-T11 LVV-T98

Verification Element Description:

Demonstrate that composites can be assembled in the butler for a reasonable sampling of dataset types.

Requirement Details	
Requirement ID	DMS-REQ-0293
Requirement Description	Specification: A Dataset may consist of one or more pixel images, a set of records in a file or database, or any other grouping of data that are processed or produced as a logical unit. The DMS shall be able to identify and retrieve complete, consistent datasets for processing.
Requirement Discussion	Discussion: Logical groupings might be pairs of Exposures in a Visit, along with supporting metadata and provenance information, or might be groupings defined in the context of Level-3 processing.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0176 Data Access OSS-REQ-0118 Consistency and Completeness

2.67.1 Test Cases Summary

LVV-T11	DRP-00-05: Execution of the DRP Science Payload by the Batch Production Service			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	1	false	Test

Objective:

This test will check that the DRP Science Payload can be executed using a specific version of the Batch Production Service provided by the LSST Data Facility. Since the outputs are stored in the Data Backbone, it too is a component of this test.

LVV-T98	Verify implementation of Selection of Datasets			
Owner	Status	Version	Critical Event	Verification Type

Kian-Tat Lim	Defined	1	false	Test
--------------	---------	---	-------	------

Objective:

Verify that the DMS can identify and retrieve datasets consisting of logical groupings of Exposures, metadata, provenance, etc., or other groupings that are processed or produced as a logical unit.

Draft

2.68 [LVV-125] DMS-REQ-0294-V-01: Processing of Datasets

Jira Link	Assignee	Status	Test Cases
LVV-125	Robert Lupton	Not Covered	LVV-T12 LVV-T99

Verification Element Description:

The intent is (at least partially) that (1) no datasets requested to be processed will be inadvertently omitted and that (2) no duplicate results will be produced that need to be de-duplicated downstream. As written, the requirement could also be read to mean that the status of all datasets that have been attempted to process must be recorded.

Â

This requirement needs clarification and is impossible to verify as written.

Requirement Details									
Requirement ID	DMS-REQ-0294								
Requirement Description	Specification: The DMS shall process all requested datasets until either a successful result is recorded or a permanent failure is recognized. If any dataset is processed, in part or in whole, more than once, only one of the wholly processed results will be recorded for further processing.								
Requirement Discussion	Discussion: The criteria may be specified by DMS processing software, or by a scientist end-user for Level-3 production.								
Requirement Priority	1b								
Upper Level Requirement	<table border="0"> <tr> <td>OSS-REQ-0120</td> <td>Consistency</td> </tr> <tr> <td>OSS-REQ-0119</td> <td>Completeness</td> </tr> <tr> <td>OSS-REQ-0118</td> <td>Consistency and Completeness</td> </tr> <tr> <td>OSS-REQ-0117</td> <td>Automated Production</td> </tr> </table>	OSS-REQ-0120	Consistency	OSS-REQ-0119	Completeness	OSS-REQ-0118	Consistency and Completeness	OSS-REQ-0117	Automated Production
OSS-REQ-0120	Consistency								
OSS-REQ-0119	Completeness								
OSS-REQ-0118	Consistency and Completeness								
OSS-REQ-0117	Automated Production								

2.68.1 Test Cases Summary

Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	1	false	Test

Objective:

This test will check that the basic data products which should be in an data release are generated by execution of the science payload.

These products will include:

- Source catalogs, derived from PVIs and coadded images (DMS-REQ-0267 & DMS-REQ-0277);
- Forced source catalogs (DMS-REQ-0268);
- Object catalogs (DMS-REQ-0275);
- Processed visit images (PVIs; DMS-REQ-0069);
- Coadded images (DMS-REQ-0279);

LWV-T99	Verify implementation of Processing of Datasets			
Owner	Status	Version	Critical Event	Verification Type
Kian-Tat Lim	Draft	1	false	Test

Objective:

Execute AP and DRP, simulate failures, observe correct processing

2.69 [LVV-127] DMS-REQ-0296-V-01: Pre-cursor, and Real Data

Jira Link	Assignee	Status	Test Cases
LVV-127	Simon Krughoff	Not Covered	LVV-T132 LVV-T362

Verification Element Description:

Proven by reducing precursor data.

Requirement Details	
Requirement ID	DMS-REQ-0296
Requirement Description	Specification: The DMS shall provide for the ability to process data from other electronic, pixel-oriented astronomical imaging cameras.
Requirement Discussion	Discussion: A comparison of DMS products to that produced by similar systems for other cameras provides an essential validation of DMS algorithms and techniques.
Requirement Priority	1a
Upper Level Requirement	

2.69.1 Test Cases Summary

LVV-T132	Verify implementation of Pre-cursor and Real Data			
Owner	Status	Version	Critical Event	Verification Type
Robert Gruendl	Approved	1	false	Test

Objective:

Demonstrate that pixel-oriented data from astronomical imaging cameras (precursor or otherwise) can be processed using LSST Science Algorithms and organized for access through the Data Butler Access Client.

LVV-T362	Installation of the LSST Science Pipelines Payloads			
Owner	Status	Version	Critical Event	Verification Type
John Swinbank	Draft	1	false	Test

Objective:

This test will check that:

- The Alert Production Pipeline payload is available for installation from documented channels;
- The Data Release Production Pipeline payload is available for installation from documented channels;
- The Calibration Products Production Pipeline payload is available for installation from documented channels;
- These payloads can be installed on systems at the LSST Data Facility following available documentation;
- The installed pipeline payloads are capable of successfully executing basic integration tests.

Note that this test assumes a 2018-era packaging of the Science Pipelines software, in which all the above payloads are represented by a single “meta-package”, `lsst_distrib`.

Draft

2.70 [LVV-130] DMS-REQ-0299-V-01: Data Product Ingest

Jira Link	Assignee	Status	Test Cases
LVV-130	Jim Bosch	Not Covered	LVV-T137 LVV-T374

Verification Element Description:

Verify by running a mini-DRP (L1 and L2) and running the ingest phase and checking that all items appear in the archive.

Requirement Details	
Requirement ID	DMS-REQ-0299
Requirement Description	Specification: The DMS shall provide software to ingest data products into the Science Data Archive.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0141 Storage OSS-REQ-0004 The Archive Facility

2.70.1 Test Cases Summary

LVV-T137	Verify implementation of Data Product Ingest			
Owner	Status	Version	Critical Event	Verification Type
Colin Slater	Defined	1	false	Test

Objective:

Verify that data products can be ingested.

LVV-T374	Ingesting Camera test data			
Owner	Status	Version	Critical Event	Verification Type
John Swinbank	Approved	1	false	Test

Objective:

This test will check:

- That raw Camera test data is available on a filesystem in the LSST Data Facility;
- That raw Camera test data can be ingested and made available through the Data Management I/O abstraction (the “Data Butler”).

Draft

2.71 [LVV-132] DMS-REQ-0301-V-01: Control of Level-1 Production

Jira Link	Assignee	Status	Test Cases
LVV-132	Eric Bellm	Not Covered	LVV-T147

Verification Element Description:

Run a test night of L1 data.

Requirement Details	
Requirement ID	DMS-REQ-0301
Requirement Description	Specification: The DMS shall contain a component to control all Level-1 Data Product production.
Requirement Discussion	Discussion: This specifically addresses the need to control the Alert Production across all DMS facilities.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0044 Standard Operating States

2.71.1 Test Cases Summary

LVV-T147	Verify implementation of Control of Level-1 Production			
Owner	Status	Version	Critical Event	Verification Type
Robert Gruendl	Draft	1	false	Test

Objective:

Demonstrate that the DMS can control all Prompt Processing across DMS facilities.

2.72 [LVV-138] DMS-REQ-0307-V-01: Unique Processing Coverage

Jira Link	Assignee	Status	Test Cases
LVV-138	Jim Bosch	Not Covered	LVV-T148

Verification Element Description:

Similar to DMS-REQ-0125. I don't know how to control this. Is an iterator interface enough to verify this?

Requirement Details	
Requirement ID	DMS-REQ-0307
Requirement Description	<p>Specification: The DMS shall enable applications to process every record in a table meeting user-specified criteria exactly once.</p> <p>Commentary: The "exactly once" constraint can be confusing to some readers and would benefit from clarification in the discussion.</p>
Requirement Priority	2
Upper Level Requirement	<p>OSS-REQ-0120 Consistency</p> <p>OSS-REQ-0118 Consistency and Completeness</p>

2.72.1 Test Cases Summary

LVV-T148	Verify implementation of Unique Processing Coverage			
Owner	Status	Version	Critical Event	Verification Type
Colin Slater	Draft	1	false	Test

Objective:

Verify that a user-specified criterion can be used to process each record in a table exactly once.

2.73 [LVV-142] DMS-REQ-0311-V-01: Regenerate Un-archived Data Products

Jira Link	Assignee	Status	Test Cases
LVV-142	Robert Gruendl	Not Covered	LVV-T156

Verification Element Description:

Run a small processing job. Download the unarchived data products. From information in the provenance of those data products, request a new processing and compare. Required that the baseline software is updated before this test is performed so that the provenance system is forced to use an older build.

Requirement Details	
Requirement ID	DMS-REQ-0311
Requirement Description	Specification: The DMS shall be able to regenerate unarchived data products to within scientifically reasonable tolerances.
Requirement Discussion	Discussion: Unarchived data products currently include Processed Visit Images for single visits, some Coadds, and Difference Images. Scientifically reasonable tolerances means well within the formal uncertainties of the data product, given the same production software, calibrations, and compute platform, all of which are expected to change (and improve) during the course of the survey.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0129 Exposures (Level 1)

2.73.1 Test Cases Summary

LVV-T156	Verify implementation of Regenerate Un-archived Data Products			
Owner	Status	Version	Critical Event	Verification Type
Simon Krughoff	Draft	1	false	Test

Objective:

Not all of the ancillary data products produced by a data release will be archived permanently. These ancillary products have been promised as accessible to the community. Show that these products can be produced from an archived data release after the fact.

2.74 [LVV-148] DMS-REQ-0317-V-01: DIAForcedSource Catalog

Jira Link	Assignee	Status	Test Cases
LVV-148	Eric Bellm	Not Covered	LVV-T55

Verification Element Description:

From precursor data reduced with difference imaging, calculate forced sources and insert into table. Verify content of table against DPDD.

Requirement Details	
Requirement ID	DMS-REQ-0317
Requirement Description	Specification: The DMS shall create a DIAForcedSource Catalog, consisting of measured fluxes for entries in the DIAObject Catalog on Difference Exposures. Measurements for each forced-source shall include the DIAObject and visit IDs, the modeled flux and error (given fixed position, shape, and deblending parameters), and measurement quality flags.
Requirement Discussion	Discussion: The large number of such forced sources makes it impractical to measure more attributes than are necessary to construct a light curve for variability studies.
Requirement Priority	2
Upper Level Requirement	OSS-REQ-0130 Catalogs (Level 1)

2.74.1 Test Cases Summary

LVV-T55	Verify implementation of DIAForcedSource Catalog			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Draft	1	false	Test

Objective:

Verify that the DMS produces a DIAForcedSource Catalog and that the catalog contains measured fluxes for DIAObjects.

2.75 [LVV-150] DMS-REQ-0319-V-01: Characterizing Variability

Jira Link	Assignee	Status	Test Cases
LVV-150	Eric Bellm	Not Covered	LVV-T56

Verification Element Description:

Using a DIAObject database populated with a simulated 2 year history, run a simulated image through the alert production system and test that the issued alerts use the correct range of data for characterization.

Requirement Details	
Requirement ID	DMS-REQ-0319
Requirement Description	Specification: For alert production, DIAObject variability characterization shall include data collected during the time period from the present to at least diaCharacterizationCutoff in the past.
Requirement Parameters	diaCharacterizationCutoff = 1[year] Time-period to use for characterizing variability in L1 system.
Requirement Discussion	Discussion: These measurements can come from the live L1 database. For level 1 processing during Data Release Production, all data should be used for characterization.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0126 Level 1 Data Products

2.75.1 Test Cases Summary

LVV-T56	Verify implementation of Characterizing Variability			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Draft	1	false	Test

Objective:

Verify that the variability characterization in the DIAObject catalog includes data collected within previous “diaCharacterizationCutoff” period of time.

2.76 [LVV-152] DMS-REQ-0321-V-01: Level 1 Processing of Special Programs Data

Jira Link	Assignee	Status	Test Cases
LVV-152	Melissa Graham	Not Covered	LVV-T93

Verification Element Description:

Process some representative special programs style data and demonstrate that a full night could be reduced in time.

Requirement Details	
Requirement ID	DMS-REQ-0321
Requirement Description	Specification: All Level 1 processing from special programs shall be completed before data arrives from the following night's observations.
Requirement Discussion	Discussion: Only Special Programs data that can be incorporated into the prompt pipeline (i.e., standard visit images, or non-standard visit images that can be shown to result in quality DIA products), will be processed with the prompt pipeline and contribute to the Alert Stream.
Requirement Priority	2
Upper Level Requirement	OSS-REQ-0392 Data Products Handling for Special Programs

2.76.1 Test Cases Summary

LVV-T93	Verify implementation of Level 1 Processing of Special Programs Data			
Owner	Status	Version	Critical Event	Verification Type
Melissa Graham	Draft	1	false	Test

Objective:

Execute multi-day operations rehearsal. Observe whether Prompt Processing data products generated in time and confirm whether processing has completed before the start of the next simulated night.

2.77 [LVV-154] DMS-REQ-0323-V-01: Calculating SSOBJECT Parameters

Jira Link	Assignee	Status	Test Cases
LVV-154	Eric Bellm	Not Covered	LVV-T57

Verification Element Description:

Use the APIs to calculate the required parameters for a sample of different categories of SSOBJECTS.

Requirement Details	
Requirement ID	DMS-REQ-0323
Requirement Description	Specification: The LSST database shall provide functions to compute, for every SSOBJECT, the phase angle for every observation, and the reduced and absolute asteroid magnitudes in all LSST bands.
Requirement Priority	3
Upper Level Requirement	OSS-REQ-0126 Level 1 Data Products

2.77.1 Test Cases Summary

LVV-T57	Verify implementation of Calculating SSOBJECT Parameters			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Draft	1	false	Test

Objective:

Verify that the DMS database provides functions to compute phase angles and magnitudes in LSST bands for every SSOBJECT.

2.78 [LVV-155] DMS-REQ-0324-V-01: Matching DIASources to Objects

Jira Link	Assignee	Status	Test Cases
LVV-155	Eric Bellm	Not Covered	LVV-T58

Verification Element Description:

Do a mini data release production run, search for an Object and request the associated DIASources.

Requirement Details	
Requirement ID	DMS-REQ-0324
Requirement Description	Specification: A L1 DIASource to L2 Object positional cross-match table or database view shall be made available.
Requirement Discussion	Discussion: Care should be taken to note that this is purely a cross-match based on separation on the sky and does not imply the DIASource and Object are physically the same.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0126 Level 1 Data Products

2.78.1 Test Cases Summary

LVV-T58	Verify implementation of Matching DIASources to Objects			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Draft	1	false	Test

Objective:

Verify that a cross-match table is available between DIASources and Objects.

2.79 [LVV-156] DMS-REQ-0325-V-01: Regenerating L1 Data Products During Data Release Processing

Jira Link	Assignee	Status	Test Cases
LVV-156	Jim Bosch	Not Covered	LVV-T59

Verification Element Description:

Do a mini data release production run and show that L1 data products were regenerated.

Requirement Details	
Requirement ID	DMS-REQ-0325
Requirement Description	Specification: During Data Release Processing, all the Level 1 data products shall be regenerated using the current best algorithms.
Requirement Discussion	Discussion: Variability characterization will use the full light curve history.
Requirement Priority	2
Upper Level Requirement	OSS-REQ-0135 Uniformly calibrated and processed versions of Level 1 Data Products

2.79.1 Test Cases Summary

LVV-T59	Verify implementation of Regenerating L1 Data Products During Data Release Processing			
Owner	Status	Version	Critical Event	Verification Type
Kian-Tat Lim	Draft	1	false	Test

Objective:

Verify that the Prompt Processing data products are regenerated during DRP.

2.80 [LVV-157] DMS-REQ-0326-V-01: Storing Approximations of Per-pixel Meta-data

Jira Link	Assignee	Status	Test Cases
LVV-157	Simon Krughoff	Not Covered	LVV-T23

Verification Element Description:

Generate a coadd and inspect the output file to verify that parametrized forms of are available.

Requirement Details	
Requirement ID	DMS-REQ-0326
Requirement Description	Specification: Image depth and mask information shall be available in a parametrized approximate form in addition to a full per-pixel form.
Requirement Discussion	Discussion: This parametrization could be in formats such as MOC, Mangle polygons, or STC regions. Note that, under requirements DMS-REQ-0383 and DMS-REQ-0379, MOCs for the survey coverage as a simple Boolean map are required to be generated; the present requirement covers maps providing additional information as a function of sky position.
Requirement Priority	2
Upper Level Requirement	OSS-REQ-0391 Data Product Conventions

2.80.1 Test Cases Summary

LVV-T23	Verify implementation of Storing Approximations of Per-pixel Meta-data			
Owner	Status	Version	Critical Event	Verification Type
Simon Krughoff	Draft	1	false	Test

Objective:

Test Items

Show that the compressed form depth and mask maps adequately represents the exact version of the same information.

2.81 [LVV-158] DMS-REQ-0327-V-01: Background Model Calculation

Jira Link	Assignee	Status	Test Cases
			LVV-T15
LVV-158	Robert Lupton	Not Covered	LVV-T19
			LVV-T43

Verification Element Description:

Process a visit. Retrieve that visit from the output repository and verify that a background model is available.

Requirement Details	
Requirement ID	DMS-REQ-0327
Requirement Description	Specification: The DMS shall derive and persist a background model (both due to night sky and astrophysical) for each visit image, per CCD.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0056 System Monitoring & Diagnostics

2.81.1 Test Cases Summary

LVV-T15	DRP-00-30: Scientific Verification of Processed Visit Images			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	1	false	Test

Objective:

This test will check that the Processed Visit Images (PVI) delivered by the DRP science payload meet the requirements laid down by LSE-61.

Specifically, this will demonstrate that:

- Processed visit images have been generated and persisted during payload execution;
- Each PVI includes a background model (DMS-REQ-0327), photometric zero-point (DMS-REQ-0029), spatially-varying PSF (DMS-REQ-0070) and WCS (DMS-REQ-0030).
- Saturated pixels are correctly masked.
- Pixels affected by cosmic rays are correctly masked.
- The background is not oversubtracted around bright objects.

This test does not include quantitative targets for the science quality criteria; we instead require for each test that we be able to quickly construct a plot or display summary images that allow such a target can be visualized.

LVV-T19	AG-00-10: Scientific Verification of Processed Visit Images			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Approved	1	false	Test

Objective:

This test will check that the Processed Visit Images (PVI) delivered by the alert generation science payload meet the requirements laid down by LSE-61.

Specifically, this will demonstrate that:

- Processed visit images have been generated and persisted during payload execution;
- Each PVI includes a science pixel array, a mask array, and a variance array. (DMS-REQ-0072).
- Each PVI includes a background model (DMS-REQ-0327), photometric zero-point (DMS-REQ-0029), spatially-varying PSF (DMS-REQ-0070) and WCS (DMS-REQ-0030).
- Saturated pixels are correctly masked.
- Pixels affected by cosmic rays are correctly masked.
- The background is not oversubtracted around bright objects.

This test does not include quantitative targets for the science quality criteria.

LVV-T43	Verify implementation of Background Model Calculation			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	1	false	Test

Objective:

Verify that Processed Visit Images produced by the DRP and AP pipelines have had a model of the background subtracted, and that this model is persisted in a way that permits the background subtracted from any CCD to be retrieved along with the image for that CCD.

2.82 [LVV-159] DMS-REQ-0328-V-01: Documenting Image Characterization

Jira Link	Assignee	Status	Test Cases
LVV-159	Robert Lupton	Not Covered	LVV-T44

Verification Element Description:

Verify existence of documentation. Compare file contents with document descriptions.

Requirement Details	
Requirement ID	DMS-REQ-0328
Requirement Description	Specification: The persisted format for Processed Visit Images shall be fully documented, and shall include a description of all image characterization data products.
Requirement Discussion	Discussion: This will allow the community to use them to increase understanding of LSST images and derived LSST catalogs.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0391 Data Product Conventions

2.82.1 Test Cases Summary

LVV-T44	Verify implementation of Documenting Image Characterization			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Draft	1	false	Test

Objective:

Verify that the persisted format for Processed Visit Images and associated instrument-signature-removal data products is documented.

2.83 [LVV-160] DMS-REQ-0329-V-01: All-Sky Visualization of Data Releases

Jira Link	Assignee	Status	Test Cases
LVV-160	Simon Krughoff	Not Covered	LVV-T76

Verification Element Description:

Test that generated images can be displayed in all sky tool. The exact details of that format are TBD.

Requirement Details	
Requirement ID	DMS-REQ-0329
Requirement Description	Specification: Data Release Processing shall generate co-adds suitable for use in all-sky visualization tools, allowing panning and zooming of the entire data release.
Requirement Discussion	Discussion: For example, this could mean HEALPix tiles suitable for use in a HiPS server. The exact technology choice has to be confirmed before understanding which format is required.
Requirement Priority	2
Upper Level Requirement	OSS-REQ-0136 Co-added Exposures

2.83.1 Test Cases Summary

LVV-T76	Verify implementation of All-Sky Visualization of Data Releases			
Owner	Status	Version	Critical Event	Verification Type
Simon Krughoff	Draft	1	false	Test

Objective:

Show that it's possible to produce large area visualizations from Data Release data products.

2.84 [LVV-161] DMS-REQ-0330-V-01: Best Seeing Coadds

Jira Link	Assignee	Status	Test Cases
LVV-161	Jim Bosch	Not Covered	LVV-T77

Verification Element Description:

Using a suitable test dataset, form a query specifying a seeing range and submit a job to create a coadd from the resulting images.

Requirement Details	
Requirement ID	DMS-REQ-0330
Requirement Description	Specification: Best seeing coadds shall be made for each band (including multi-color).
Requirement Discussion	Discussion: DMS-REQ-0279 states that seeing-based co-adds should be possible. This requirement states that they shall be made.
Requirement Priority	2
Upper Level Requirement	OSS-REQ-0136 Co-added Exposures

2.84.1 Test Cases Summary

LVV-T77	Verify implementation of Best Seeing Coadds			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Draft	1	false	Test

Objective:

Verify that the DRP pipelines produce a suite of per-band coadds with input images filtered to optimize the size of the effective PSF on the coadd.

2.85 [LVV-162] DMS-REQ-0331-V-01: Computing Derived Quantities

Jira Link	Assignee	Status	Test Cases
			LVV-T13
			LVV-T14
LVV-162	Melissa Graham	Not Covered	LVV-T21
			LVV-T22
			LVV-T24

Verification Element Description:

Verify that derived quantities have been stored in the database. The exact list of items is TBD.

Requirement Details	
Requirement ID	DMS-REQ-0331
Requirement Description	Specification: Common derived quantities shall be made available to end-users by either providing pre-computed columns or providing functions that can be used dynamically in queries. These should at least include the ability to calculate the reduced chi-squared of fitted models and make it as easy as possible to calculate color-color diagrams.
Requirement Discussion	Discussion: Example quantities include those used to assess model fit quality or those required for calculating color-magnitude diagrams. Care should be taken to name the derived columns in a clear unambiguous way.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0391 Data Product Conventions

2.85.1 Verified By

- . DM-9953 (??) Pixels rejected from coaddition and CCD are not masked on coadds
- . DM-13058 (??) Inconsistent aperture corrections in W44 reprocessing of HSC RC1

2.85.2 Test Cases Summary

LVV-T13	DRP-00-15: Scientific Verification of Source Catalog			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	1	false	Test

Objective:

This test will check that the source catalogs delivered by the DRP science payload meet the requirements laid down by LSE-61. Specifically, this will demonstrate that:

- Measurements in the catalog are presented in flux units (DMS-REQ-0347);
- Derived quantities are provided in pre-computed columns (DMS-REQ-0331);
- Aperture corrections for different photometry algorithms are consistent.
- Photometry measurements are consistent with reference catalog photometry (including sources not used in photometric calibration).
- Astrometry measurements are consistent with reference catalog positions (including sources not used in astrometric calibration).

This test does not include quantitative targets for the science quality criteria; we instead require for each test that we be able to quickly construct a plot in which such a target can be visualized.

LVV-T14	DRP-00-25: Scientific Verification of Object Catalog			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	1	false	Test

Objective:

This test will check that the object catalogs delivered by the DRP science payload meet the requirements laid down by LSE-61. Specifically, this will demonstrate that:

- Measurements in the catalog are presented in flux units (DMS-REQ-0347);
- Derived quantities are provided in pre-computed columns (DMS-REQ-0331);
- Aperture corrections for different photometry algorithms are consistent.
- PSF models correctly predict the ellipticities of stars over each tract.
- Photometry measurements are consistent with reference catalog photometry (including sources not used in photometric calibration).
- Astrometry measurements are consistent with reference catalog positions (including sources not used in astrometric calibration).
- Forced and unforced photometry measurements are consistent.
- The slope of the stellar locus in color-color space is not a function of position on the sky.

This test does not include quantitative targets for the science quality criteria; we instead require for each test that we be able to quickly construct a plot in which such a target can be visualized.

All science quality tests in this section shall distinguish between blended and isolated objects.

LVV-T21	AG-00-20: Scientific Verification of DIASource Catalog
---------	--

Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Approved	1	false	Test

Objective:

This test will check that the difference image source catalogs delivered by the Alert Generation science payload meet the requirements laid down by LSE-61.

- Specifically, this will demonstrate that:
 - Measurements in the catalog are presented in flux units (DMS-REQ-0347);
 - Each DIASource record contains an appropriate subset of the attributes required by DMS-REQ-0269. In particular, the LDM-503-3-era pipeline is expected to provide DIASource positions (sky and focal plane), fluxes, and flags indicative of issues encountered during processing.
 - Faint DIASources satisfying additional criteria are stored (DMS-REQ-0270).
 - Derived quantities are provided in pre-computed columns (DMS-REQ-0331);

This test does not include quantitative targets for the science quality criteria.

LVV-T22	AG-00-25: Scientific Verification of DIAObject Catalog			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Approved	1	false	Test

Objective:

This test will check that the DIAObject catalogs delivered by the Alert Generation science payload meet the requirements laid down by LSE-61.

Specifically, this will demonstrate that:

- DIAObjects are recorded with unique identifiers (DMS-REQ-0271);
- Measurements in the catalog are presented in flux units (DMS-REQ-0347);
- Each DIAObject record contains an appropriate set of summary attributes (DMS-REQ-0271 and DMS-REQ-0272). Note:
 - This test is executed independently of the Data Release Production system. Hence, DIAObjects are not associated to Objects, and the association metadata specified by DMS-REQ-0271 is not expected to be available.
 - The LDM-503-3-era pipeline is not expected to calculate or persist all attributes specified by DMS-REQ-0272 requirement.
- Relevant derived quantities are provided in pre-computed columns (DMS-REQ-0331);

This test does not include quantitative targets for the science quality criteria.

LWV-T24	Verify implementation of Computing Derived Quantities			
Owner	Status	Version	Critical Event	Verification Type
Melissa Graham	Draft	1	false	Test

Objective:

To confirm that common derived quantities (apparent magnitude, FWHM in arcsec, ellipticity) are available to an end-user by, e.g., ensuring a color-color diagram is easy to construction, fitting functions to derived data, or generating other common scientific derivatives.

Draft

2.86 [LVV-163] DMS-REQ-0332-V-01: Denormalizing Database Tables

Jira Link	Assignee	Status	Test Cases
LVV-163	Colin Slater	Not Covered	LVV-T25

Verification Element Description:

Show that some tables have been denormalized. This requirement needs some more explicit phrasing.

Requirement Details	
Requirement ID	DMS-REQ-0332
Requirement Description	Specification: The database tables shall contain views presented to the users that will be appropriately denormalized for ease of use.
Requirement Priority	2
Upper Level Requirement	OSS-REQ-0133 Level 2 Data Products

2.86.1 Test Cases Summary

LVV-T25	Verify implementation of Denormalizing Database Tables			
Owner	Status	Version	Critical Event	Verification Type
Colin Slater	Draft	1	false	Test

Objective:

Verify that commonly useful views of data are easy to obtain through the Science Platform.

2.87 [LVV-164] DMS-REQ-0333-V-01: Maximum Likelihood Values and Covariances

Jira Link	Assignee	Status	Test Cases
LVV-164	Jim Bosch	Not Covered	LVV-T26

Verification Element Description:

Inspect the tables and show that maximum likelihood values and covariances have been calculated.

Requirement Details	
Requirement ID	DMS-REQ-0333
Requirement Description	Specification: Quantities delivered by all measurement algorithms shall include maximum likelihood values and covariances.
Requirement Discussion	Discussion: Algorithms for which such values are impossible, will be documented explicitly to declare that the values are unavailable.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0391 Data Product Conventions

2.87.1 Test Cases Summary

LVV-T26	Verify implementation of Maximum Likelihood Values and Covariances			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Draft	1	false	Test

Objective:

- Check that all measurements in source and object schemas include columns containing uncertainties, including covariances between jointly-measured quantities.
- Check that all model-fit measurements in source and object schemas include columns that report goodness-of-fit.
- Check that most sources and objects with successful measurements report finite uncertainty values for those measurements.
- Check that most sources and objects with successful model-fit measurements report finite goodness-of-fit values.

2.88 [LVV-166] DMS-REQ-0335-V-01: PSF-Matched Coadds

Jira Link	Assignee	Status	Test Cases
LVV-166	Jim Bosch	Not Covered	LVV-T79

Verification Element Description:

Do a mini data release production. Demonstrate that a PSF-matched coadd was created and inspect the archive to confirm that the file is not present.

Requirement Details	
Requirement ID	DMS-REQ-0335
Requirement Description	Specification: One (ugrizy plus multi-band) set of PSF-matched coadds shall be made but shall not be archived.
Requirement Discussion	Discussion: These are used to measure colors and shapes of objects at "standard" seeing. Sufficient provenance information will be made available to allow these coadds to be recreated by Level 3 users.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0133 Level 2 Data Products

2.88.1 Test Cases Summary

LVV-T79	Verify implementation of PSF-Matched Coadds			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Draft	1	false	Test

Objective:

Verify that the DRP pipelines produce PSF matched coadds.

2.89 [LVV-167] DMS-REQ-0336-V-01: Regenerating Data Products from Previous Data Releases

Jira Link	Assignee	Status	Test Cases
LVV-167	Robert Lupton	Not Covered	LVV-T159

Verification Element Description:

Generate a data product on demand using an old version of the software. The general problem of demonstrating that a DR1 product generated at the time of DR1 is reproducible at the time of DR11 is hard to verify.

Requirement Details	
Requirement ID	DMS-REQ-0336
Requirement Description	Specification: The DMS shall be able to regenerate data products from previous data releases to within scientifically reasonable tolerances.
Requirement Discussion	Discussion: This is similar to DMS-REQ-0311, but covering prior data releases. The intent is for the software to be runnable in the same environment as was used for the original data release without the software having to be ported to a modern operating system.
Requirement Priority	1b
Upper Level Requirement	LSR-REQ-0049 Data Product Archiving

2.89.1 Test Cases Summary

LVV-T159	Verify implementation of Regenerating Data Products from Previous Data Releases			
Owner	Status	Version	Critical Event	Verification Type
Simon Krughoff	Draft	1	false	Test

Objective:

Show that un-archived data products from previous data releases can be generated using through the LSST Science Platform.

2.90 [LVV-168] DMS-REQ-0337-V-01: Detecting faint variable objects

Jira Link	Assignee	Status	Test Cases
LVV-168	Melissa Graham	Not Covered	LVV-T80

Verification Element Description:

Given a suitable dataset, process it in such a way as to detect more faint sources.

Requirement Details	
Requirement ID	DMS-REQ-0337
Requirement Description	Specification: The DMS shall be able to detect faint objects showing long-term variability, or nearby object with high proper motions.
Requirement Discussion	Discussion: For example, this could be implemented using short-period (yearly) coadds.
Requirement Priority	2
Upper Level Requirement	OSS-REQ-0136 Co-added Exposures

2.90.1 Test Cases Summary

LVV-T80	Verify implementation of Detecting faint variable objects			
Owner	Status	Version	Critical Event	Verification Type
Melissa Graham	Draft	1	false	Test

Objective:

To verify that the Data Release Production pipeline will be able to detect faint sources with long-term variability (e.g., quasars, proper motion stars) via, e.g., shorter timescale coadds (month to a few months).

2.91 [LVV-169] DMS-REQ-0338-V-01: Targeted Coadds

Jira Link	Assignee	Status	Test Cases
LVV-169	Robert Lupton	Not Covered	LVV-T81

Verification Element Description:

Show procedure for persisting cutouts from a coadd. Show user interface for retrieving the history of cutouts for a specific location.

Requirement Details	
Requirement ID	DMS-REQ-0338
Requirement Description	Specification: It shall be possible to retain small sections of all generated coadds.
Requirement Discussion	Discussion: This supports quality assessment and targeted science.
Requirement Priority	2
Upper Level Requirement	LSR-REQ-0040 Data Quality Monitoring OSS-REQ-0136 Co-added Exposures

2.91.1 Test Cases Summary

LVV-T81	Verify implementation of Targeted Coadds			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Draft	1	false	Test

Objective:

Verify that small sections of any coadd produced by the DRP pipelines can be retained, even if the full coadd is not.

2.92 [LVV-170] DMS-REQ-0339-V-01: Tracking Characterization Changes Between Data Releases

Jira Link	Assignee	Status	Test Cases
LVV-170	Colin Slater	Not Covered	LVV-T82

Verification Element Description:

Show procedure for selecting samples for long term persistence. Demonstrate that some data can be moved from a data release to a separate store.

Requirement Details	
Requirement ID	DMS-REQ-0339
Requirement Description	Specification: Small, overlapping, samples of data from older releases shall be kept loaded in the database.
Requirement Discussion	Discussion: This enables a comparison of how current data releases relate to previous data releases and to improve data quality monitoring.
Requirement Priority	1a
Upper Level Requirement	LSR-REQ-0040 Data Quality Monitoring

2.92.1 Test Cases Summary

LVV-T82	Verify implementation of Tracking Characterization Changes Between Data Releases			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Defined	1	false	Test

Objective:

Verify that small-area subsets of a DR can be retained when most of that DR is retired, for comparison with future DRs.

2.93 [LVV-178] DMS-REQ-0347-V-01: Measurements in catalogs

Jira Link	Assignee	Status	Test Cases
			LVV-T13
			LVV-T14
LVV-178	Colin Slater	Not Covered	LVV-T21
			LVV-T22
			LVV-T28

Verification Element Description:

Inspect the schema for each table and ensure that measurement columns use appropriate units.

Requirement Details	
Requirement ID	DMS-REQ-0347
Requirement Description	Specification: All catalogs shall record source measurements in flux units.
Requirement Discussion	Discussion: Difference measurements can go negative and in multi-epoch surveys averaging of fluxes rather than magnitudes is required. This requirement does not preclude making magnitudes available where appropriate.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0391 Data Product Conventions

2.93.1 Verified By

- . DM-9953 (??) Pixels rejected from coaddition and CCD are not masked on coadds
- . DM-13058 (??) Inconsistent aperture corrections in W44 reprocessing of HSC RC1

2.93.2 Test Cases Summary

LVV-T13	DRP-00-15: Scientific Verification of Source Catalog			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	1	false	Test

Objective:

This test will check that the source catalogs delivered by the DRP science payload meet the requirements laid down by LSE-61. Specifically, this will demonstrate that:

- Measurements in the catalog are presented in flux units (DMS-REQ-0347);
- Derived quantities are provided in pre-computed columns (DMS-REQ-0331);
- Aperture corrections for different photometry algorithms are consistent.
- Photometry measurements are consistent with reference catalog photometry (including sources not used in photometric calibration).
- Astrometry measurements are consistent with reference catalog positions (including sources not used in astrometric calibration).

This test does not include quantitative targets for the science quality criteria; we instead require for each test that we be able to quickly construct a plot in which such a target can be visualized.

LVV-T14	DRP-00-25: Scientific Verification of Object Catalog			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	1	false	Test

Objective:

This test will check that the object catalogs delivered by the DRP science payload meet the requirements laid down by LSE-61. Specifically, this will demonstrate that:

- Measurements in the catalog are presented in flux units (DMS-REQ-0347);
- Derived quantities are provided in pre-computed columns (DMS-REQ-0331);
- Aperture corrections for different photometry algorithms are consistent.
- PSF models correctly predict the ellipticities of stars over each tract.
- Photometry measurements are consistent with reference catalog photometry (including sources not used in photometric calibration).
- Astrometry measurements are consistent with reference catalog positions (including sources not used in astrometric calibration).
- Forced and unforced photometry measurements are consistent.
- The slope of the stellar locus in color-color space is not a function of position on the sky.

This test does not include quantitative targets for the science quality criteria; we instead require for each test that we be able to quickly construct a plot in which such a target can be visualized.

All science quality tests in this section shall distinguish between blended and isolated objects.

LVV-T21	AG-00-20: Scientific Verification of DIASource Catalog			
---------	--	--	--	--

Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Approved	1	false	Test

Objective:

This test will check that the difference image source catalogs delivered by the Alert Generation science payload meet the requirements laid down by LSE-61.

- Specifically, this will demonstrate that:
 - Measurements in the catalog are presented in flux units (DMS-REQ-0347);
 - Each DIASource record contains an appropriate subset of the attributes required by DMS-REQ-0269. In particular, the LDM-503-3-era pipeline is expected to provide DIASource positions (sky and focal plane), fluxes, and flags indicative of issues encountered during processing.
 - Faint DIASources satisfying additional criteria are stored (DMS-REQ-0270).
 - Derived quantities are provided in pre-computed columns (DMS-REQ-0331);

This test does not include quantitative targets for the science quality criteria.

LVV-T22	AG-00-25: Scientific Verification of DIAObject Catalog			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Approved	1	false	Test

Objective:

This test will check that the DIAObject catalogs delivered by the Alert Generation science payload meet the requirements laid down by LSE-61.

Specifically, this will demonstrate that:

- DIAObjects are recorded with unique identifiers (DMS-REQ-0271);
- Measurements in the catalog are presented in flux units (DMS-REQ-0347);
- Each DIAObject record contains an appropriate set of summary attributes (DMS-REQ-0271 and DMS-REQ-0272). Note:
 - This test is executed independently of the Data Release Production system. Hence, DIAObjects are not associated to Objects, and the association metadata specified by DMS-REQ-0271 is not expected to be available.
 - The LDM-503-3-era pipeline is not expected to calculate or persist all attributes specified by DMS-REQ-0272 requirement.
- Relevant derived quantities are provided in pre-computed columns (DMS-REQ-0331);

This test does not include quantitative targets for the science quality criteria.

LW-T28	Verify implementation of Measurements in catalogs			
Owner	Status	Version	Critical Event	Verification Type
Colin Slater	Approved	1	false	Test

Objective:

Verify that source measurements in catalogs are in flux units.

Draft

2.94 [LVV-179] DMS-REQ-0348-V-01: Pre-defined alert filters

Jira Link	Assignee	Status	Test Cases
LVV-179	Eric Bellm	Not Covered	LVV-T114 LVV-T218

Verification Element Description:

Create a filter from a restricted set of predefined filters.

Requirement Details	
Requirement ID	DMS-REQ-0348
Requirement Description	Specification: Users of the LSST Alert Filtering Service shall be able to use a predefined set of simple filters.
Requirement Discussion	Discussion: See LSR-REQ-0026
Requirement Priority	2
Upper Level Requirement	LSR-REQ-0026 Predefined Transient Filters

2.94.1 Test Cases Summary

LVV-T114	Verify implementation of Pre-defined alert filters			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Defined	1	false	Test

Objective:

Verify that users of the Alert Filtering service can use a predefined set of filters.

LVV-T218	Simple Filtering of the LSST Alert Stream			
Owner	Status	Version	Critical Event	Verification Type
Eric Bellm	Approved	1	false	Test

Objective:

This test will demonstrate the LSST Alert Filtering Service that returns a subset of alerts from the full stream identified by user-provided filters.

Specifically, this will demonstrate that:

- The filtering service can retrieve alerts from the full alert stream and filter them according to their contents;
- The filtered subset can be delivered to science users.

Draft

2.95 [LVV-180] DMS-REQ-0349-V-01: Detecting extended low surface brightness objects

Jira Link	Assignee	Status	Test Cases
LVV-180	Jim Bosch	Not Covered	LVV-T71

Verification Element Description:

From a suitable dataset, using LSST code, post process it and detect low surface brightness objects.

Requirement Details	
Requirement ID	DMS-REQ-0349
Requirement Description	Specification: It shall be possible to detect extended low surface brightness objects in coadds.
Requirement Discussion	Discussion: For example, this could be done by using the binned detection algorithm from SDSS.
Requirement Priority	2
Upper Level Requirement	OSS-REQ-0133 Level 2 Data Products

2.95.1 Test Cases Summary

LVV-T71	Verify implementation of Detecting extended low surface brightness objects			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Draft	1	false	Test

Objective:

Verify that low-surface brightness objects (including those whose PSF S/N is lower than the detection threshold) are detected in coadds.

2.96 [LVV-181] DMS-REQ-0350-V-01: Associating Objects across data releases

Jira Link	Assignee	Status	Test Cases
LVV-181	Colin Slater	Not Covered	LVV-T116

Verification Element Description:

Do two mini data release production runs on a single dataset that covers a shared area multiple times. Query the second data release's Object table and request an association with the previous data release. Do this with the previous data release being inaccessible.

Requirement Details	
Requirement ID	DMS-REQ-0350
Requirement Description	Specification: It shall be possible to associate an Object in one data release to the most likely match in the Object table from another data release. This shall be possible without the previous data releases being online.
Requirement Discussion	Discussion: This could be done with a database table mapping every Object in one data release to the matched Object in every other data release.
Requirement Priority	2
Upper Level Requirement	

2.96.1 Test Cases Summary

LVV-T116	Verify implementation of Associating Objects across data releases			
Owner	Status	Version	Critical Event	Verification Type
Kian-Tat Lim	Draft	1	false	Test

Objective:

Load DR, observe queryable association

2.97 [LVV-182] DMS-REQ-0351-V-01: Provide Beam Projector Coordinate Calculation Software

Jira Link	Assignee	Status	Test Cases
LVV-182	Robert Lupton	Not Covered	LVV-T133

Verification Element Description:

Convert some coordinates using the transformation code and compare with expectations.

Requirement Details	
Requirement ID	DMS-REQ-0351
Requirement Description	Specification: The DMS shall provide software to represent the coordinate transformations relating the collimated beam projector position and telescope pupil position to the illumination position on the telescope optical elements and focal plane.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0383 Beam Projector Coordinate Relationship

2.97.1 Test Cases Summary

LVV-T133	Verify implementation of Provide Beam Projector Coordinate Calculation Software			
Owner	Status	Version	Critical Event	Verification Type
Robert Lupton	Defined	1	false	Test

Objective:

Verify that the DMS provides software to calculate coordinates relating the collimated beam projector position and telescope pupil position to the illumination position on the telescope optical elements and focal plane.

2.98 [LVV-3399] DMS-REQ-0378-V-01: Simultaneous Image Access Performance

Jira Link	Assignee	Status	Test Cases
LVV-3399	Leanne Guy	Not Covered	

Verification Element Description:

Undefined

Requirement Details	
Requirement ID	DMS-REQ-0378
Requirement Description	Specification: All the enclosed performance metrics shall be met simultaneously.
Requirement Discussion	Discussion: While these image access requirements specify maximum timings and minimum capacities for retrieval by a particular mechanism (VO services), it should be noted that simultaneous usage of other access mechanisms will in practice increase timings and/or reduce available capacity.
Requirement Priority	2
Upper Level Requirement	OSS-REQ-0181 Data Products Query and Download Infrastructure

2.99 [LVV-3401] DMS-REQ-0359-V-01: RMS photometric repeatability in uzy

Jira Link	Assignee	Status	Test Cases
LVV-3401	Leanne Guy	Not Covered	LVV-T1756

Verification Element Description:

The RMS photometric repeatability of bright non-saturated unresolved point sources in the u, z, and y filters shall be less than **PA1uzy = 7.5 millimagnitudes**.

Associated element DMS-REQ-0359-V-02 (LVV-9751) satisfies the requirement on the maximum fraction of sensors with scientifically unusable pixels.

Associated element DMS-REQ-0359-V-03 (LVV-9752) satisfies the constraint on maximum fraction of outliers among non-saturated point sources.

Associated element DMS-REQ-0359-V-04 (LVV-9753) satisfies the accuracy of zero-point for colors that use the u-band.

Associated element DMS-REQ-0359-V-05 (LVV-9754) satisfies the repeatability outlier limit in g, r, and i-bands.

Associated element DMS-REQ-0359-V-06 (LVV-9755) satisfies the constraint on the accuracy of the transformation from internal to physical photometric scales.

Associated element DMS-REQ-0359-V-07 (LVV-9756) satisfies the rms width of the internal photometric zero-point in u-band.

Associated element DMS-REQ-0359-V-08 (LVV-9757) satisfies the maximum local significance of imperfect crosstalk corrections.

Associated element DMS-REQ-0359-V-09 (LVV-9758) satisfies the repeatability outlier limit in u, z, and y-bands.

Associated element DMS-REQ-0359-V-10 (LVV-9759) satisfies the rms photometric repeatability in g, r, and i-bands.

Associated element DMS-REQ-0359-V-11 (LVV-9760) satisfies the fraction of zero-point errors that can exceed the outlier limit.

Associated element DMS-REQ-0359-V-12 (LVV-9761) satisfies the maximum fraction of unusable pixels per sensor.

Associated element DMS-REQ-0359-V-13 (LVV-9762) satisfies the maximum allowable precision in the sky brightness determination.

Associated element DMS-REQ-0359-V-14 (LVV-9763) satisfies the rms width of the internal photometric zero-point in g, r, i, z, and y-bands.

Associated element DMS-REQ-0359-V-15 (LVV-9764) satisfies the percentage of the image area affected by ghosts that exceed the threshold.

Associated element DMS-REQ-0359-V-16 (LVV-9765) satisfies the accuracy of zero-point for colors that do not include the u-band.

Associated element DMS-REQ-0359-V-17 (LVV-9766) satisfies the maximum RMS of the ratio of the flux measurement error between resolved/unresolved sources.

Requirement Details

Requirement ID	DMS-REQ-0359
Requirement Description	Specification: The DMS shall include software to enable the calculation of the photometric performance metrics defined in OSS-REQ-0387.

Requirement Parameters	<p>[GhostAF = 1[percent]] Percentage of image area that can have ghosts with surface brightness gradient amplitude of more than 1/3 of the sky noise over 1 arcsec., PF1 = 10[percent] The maximum fraction of isolated non-saturated point source measurements exceeding the outlier limit., PA1gri = 5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the g, r, and i filters., PA3 = 10[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) for all bands except u-band., PA4 = 15[millimagnitude] The zero point error outlier limit., PF2 = 10[percent] Fraction of zeropoint errors that can exceed the zero point error outlier limit., PixFrac = 1[percent] The maximum fraction of pixels scientifically unusable per sensor out of the total allowable fraction of sensors meeting this performance., PA1uzy = 7.5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the u, z, and y filters., PA6 = 10[millimagnitude] Accuracy of the transformation of the internal LSST photometry to a physical scale (e.g. AB magnitudes), Xtalk = 3[sigma] The maximum local significance integrated over the PSF of imperfect crosstalk corrections., PA5u = 10[millimagnitude] Accuracy of absolute band-to-band color zero-point for colors constructed using the u-band., ResSource = 2[unitless] Maximum RMS of the ratio of the error in integrated flux measurement between bright, isolated, resolved sources less than 10 arcsec in diameter and bright, isolated unresolved point sources., PA2uzy = 22.5[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the u, z, and y filters., SensorFraction = 15[percent] The maximum allowable fraction of sensors with PixFrac scientifically unusable pixels., PA3u = 20[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) in the u-band., PA2gri = 15[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the g, r, and i filters., SBPrec = 1[percent] The maximum error in the precision of the sky brightness determination., PA5 = 5[millimagnitude] Accuracy of absolute band-to-band color zero-point for all colors constructed from any filter pair, excluding the u-band.]</p>	
Requirement Discussion	<p>Discussion: The relevant metrics are listed in the table photometricPerformance below. The values in the tables are the target values for LSST but are not verified as part of this requirement.</p>	
Requirement Priority	1a	
Upper Level Requirement	OSS-REQ-0387	Photometric Performance

2.99.1 Test Cases Summary

LVV-T1756	Verify calculation of photometric repeatability in uzy filters			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Approved	1	false	Test

Objective:

Verify that the DM system has provided the code to calculate the RMS photometric repeatability of bright non-saturated unresolved point sources in the u, z, and y filters, and assess whether it meets the requirement that it shall be less than **PA1uzy = 7.5 millimagnitudes**.

Draft

2.100 [LVV-3402] DMS-REQ-0360-V-01: Median astrometric error on 20 arcmin scales

Jira Link	Assignee	Status	Test Cases
LVV-3402	Leanne Guy	Not Covered	LVV-T363 LVV-T1745

Verification Element Description:

Median relative astrometric measurement error on 20 arcminute scales shall be no more than **AM2 = 10 milliarcseconds**.

Associated element DMS-REQ-0360-V-02 (LVV-9767) satisfies the maximum fraction of astrometric outliers on 5 arcminute scales.

Associated element DMS-REQ-0360-V-03 (LVV-9768) satisfies the median astrometric error on 5 arcminute scales.

Associated element DMS-REQ-0360-V-04 (LVV-9769) satisfies the median astrometric error in absolute positions.

Associated element DMS-REQ-0360-V-05 (LVV-9770) satisfies the astrometric outlier limit on 20 arcminute scales.

Associated element DMS-REQ-0360-V-06 (LVV-9771) satisfies the color difference outlier limit relative to r-band.

Associated element DMS-REQ-0360-V-07 (LVV-9773) satisfies the astrometric outlier limit on 5 arcminute scales.

Associated element DMS-REQ-0360-V-08 (LVV-9774) satisfies the median astrometric error on 200 arcminute scales.

Associated element DMS-REQ-0360-V-09 (LVV-9775) satisfies the astrometric outlier limit on 200 arcminute scales.

Associated element DMS-REQ-0360-V-10 (LVV-9776) satisfies the maximum fraction of astro-

metric outliers on 20 arcminute scales.

Associated element DMS-REQ-0360-V-11 (LVV-9777) satisfies the maximum fraction of r-band color difference outliers.

Associated element DMS-REQ-0360-V-12 (LVV-9778) satisfies the RMS difference between separations measured in the r-band and those measured in any other filter.

Associated element DMS-REQ-0360-V-13 (LVV-9779) satisfies the maximum fraction of astrometric outliers on 200 arcminute scales.

Requirement Details	
Requirement ID	DMS-REQ-0360
Requirement Description	Specification: The DMS shall include software to enable the calculation of the astrometric performance metrics defined in OSS-REQ-0388.
Requirement Parameters	[AM2 = 10[milliarcsecond]] Median relative astrometric measurement error on 20 arcminute scales., AM1 = 10[milliarcsecond] Median relative astrometric measurement error on 5 arcminute scales shall be less than AM1., AM3 = 15[milliarcsecond] Median relative astrometric measurement error on 200 arcminute scales., AA1 = 50[milliarcsecond] Median error in absolute position for each axis, RA and DEC, shall be less than AA1., AF1 = 10[percent] The maximum fraction of relative astrometric measurements on 5 arcminute scales to exceed 5 arcminute outlier limit., AD3 = 30[milliarcsecond] 200 arcminute outlier limit., AB1 = 10[milliarcsecond] RMS difference between separations measured in the r-band and those measured in any other filter., AD1 = 20[milliarcsecond] 5 arcminute outlier limit., AB2 = 20[milliarcsecond] The color difference outlier limit for separations measured relative the r-band filter in any other filter., AD2 = 20[milliarcsecond] 20 arcminute outlier limit., ABF1 = 10[percent] Fraction of separations measured relative to the r-band that can exceed the color difference outlier limit., AF3 = 10[percent] Fraction of relative astrometric measurements on 200 arcminute scales to exceed 200 arcminute outlier limit., AF2 = 10[percent] The maximum fraction of relative astrometric measurements on 20 arcminute scales to exceed 20 arcminute outlier limit.]
Requirement Discussion	Discussion: The relevant metrics are listed in the table below. The values in the tables are the target values for LSST but are not verified as part of this requirement.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0388 Astrometric Performance

2.100.1 Test Cases Summary

LVV-T363	Science Pipelines Release Documentation			
Owner	Status	Version	Critical Event	Verification Type
John Swinbank	Draft	1	false	Inspection

Objective:

This test will check:

- That a particular Science Pipelines release is adequately described by documentation at the <https://pipelines.lsst.io/> site;
- That the Science Pipelines release is accompanied by a characterization report which describes its scientific performance.

LVV-T1745	Verify calculation of median relative astrometric measurement error on 20 arcminute scales			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Approved	1	false	Test

Objective:

Verify that the DM system has provided the code to calculate the median relative astrometric measurement error on 20 arcminute scales and assess whether it meets the requirement that it shall be no more than $AM2 = 10$ milliarcseconds.

2.101 [LVV-3404] DMS-REQ-0362-V-01: Median residual PSF ellipticity correlations on 5 arcmin scales

Jira Link	Assignee	Status	Test Cases
LVV-3404	Leanne Guy	Not Covered	LVV-T376 LVV-T1754

Verification Element Description:

Median residual PSF ellipticity correlations averaged over an arbitrary field of view for separations less than 5 arcmin shall be no greater than **TE2 = 1.0e-7[arcminuteSeparationCorrelation]**.

Associated element DMS-REQ-0362-V-02 (LVV-9780) satisfies the maximum fraction of ellipticity residuals exceeding the outlier limits.

Associated element DMS-REQ-0362-V-03 (LVV-9781) satisfies the outlier limit on the PSF ellipticity correlation residuals on 5 arcmin scales.

Associated element DMS-REQ-0362-V-04 (LVV-9782) satisfies the median residual PSF ellipticity correlations on 1 arcmin scales.

Associated element DMS-REQ-0362-V-05 (LVV-9783) satisfies the outlier limit on the PSF ellipticity correlation residuals on 1 arcmin scales.

Requirement Details	
Requirement ID	DMS-REQ-0362
Requirement Description	Specification: The DMS shall include software to enable the calculation of the ellipticity correlations metrics defined in OSS-REQ-0403, OSS-REQ-0404, and OSS-REQ-0405.
Requirement Parameters	[TE3 = 4.0e-5[unitless (angular correlation)]] Per-image limit on the median residual ellipticity correlations at scales less than 5 arcmin., TE4 = 2.0e-7[unitless (angular correlation)] Per-image limit on the median residual ellipticity correlations at scales greater than or equal to 5 arcmin., TE2 = 1.0e-7[unitless (angular correlation)] Maximum full-survey median for residual ellipticity correlations at scales greater than or equal to 5 arcmin., TEF = 15[percent] Maximum fraction of visit images that may exceed the TE3 or TE4 limits., TE1 = 2.0e-5[unitless (angular correlation)] Maximum full-survey median for residual ellipticity correlations at scales less than or equal to 1 arcmin.]
Requirement Discussion	Discussion: The relevant metrics are listed in the table below. The values in the tables are the target values for LSST but are not verified as part of this requirement.
Requirement Priority	1b

	OSS-REQ-0403	Ellipticity Correlation Function Distribution per Image
Upper Level Re-	OSS-REQ-0404	Ellipticity Correlation Function Distribution for Full Survey (medians)
quirement	OSS-REQ-0405	Ellipticity Correlation Function Distribution for Full Survey (continuity)

2.101.1 Test Cases Summary

LVV-T376	Verify the Calculation of Ellipticity Residuals and Correlations			
Owner	Status	Version	Critical Event	Verification Type
Leanne Guy	Approved	1	false	Test

Objective:

Verify that the DMS includes software to enable the calculation of the ellipticity residuals and correlation metrics defined in the OSS.

LVV-T1754	Verify calculation of residual PSF ellipticity correlations for separations less than 5 arcmin			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Approved	1	false	Test

Objective:

Verify that the DM system has provided the code to calculate the median residual PSF ellipticity correlations averaged over an arbitrary field of view for separations less than 5 arcmin, and assess whether it meets the requirement that it shall be no greater than $TE2 = 1.0e-7[\text{arcminuteSeparationCorrelation}]$.

2.102 [LVV-5640] DM-TS-CON-ICD-0011-V-01: Data Format_DM_1

Jira Link	Assignee	Status	Test Cases
LVV-5640	Leanne Guy	Not Covered	

Verification Element Description:

Undefined

Requirement Details	
Requirement ID	DM-TS-CON-ICD-0011
Requirement Description	Specification: The WCS solution published by Data Management shall include the following items: equinox (double, currently 2000.0), system (string, currently 'FK5'), unit (string, currently 'deg'), and then, for each sensor, reference pixel x/y coordinates (two doubles), reference pixel RA/dec coordinates (two doubles), and rotation and scale matrix (four doubles).
Requirement Discussion	Discussion: DM does not calculate the WCS for the wavefront sensors. The idea is then to use the offset and rotation information from the WCS to define the exact location of the donuts to use. The distortion will be measured carefully during commissioning. The WCS solution is also required for the Calibration mode using the science detectors as wavefront sensors.
Requirement Priority	
Upper Level Requirement	

2.103 [LVV-5641] DM-TS-CON-ICD-0011-V-02: Data Format_DM_2

Jira Link	Assignee	Status	Test Cases
LVV-5641	Leanne Guy	Not Covered	

Verification Element Description:

Undefined

Requirement Details	
Requirement ID	DM-TS-CON-ICD-0011
Requirement Description	Specification: The WCS solution published by Data Management shall include the following items: equinox (double, currently 2000.0), system (string, currently 'FK5'), unit (string, currently 'deg'), and then, for each sensor, reference pixel x/y coordinates (two doubles), reference pixel RA/dec coordinates (two doubles), and rotation and scale matrix (four doubles).
Requirement Discussion	Discussion: DM does not calculate the WCS for the wavefront sensors. The idea is then to use the offset and rotation information from the WCS to define the exact location of the donuts to use. The distortion will be measured carefully during commissioning. The WCS solution is also required for the Calibration mode using the science detectors as wavefront sensors.
Requirement Priority	
Upper Level Requirement	

2.104 [LVV-5646] DM-TS-CON-ICD-0002-V-01: Timing_DM_1

Jira Link	Assignee	Status	Test Cases
LVV-5646	Leanne Guy	Not Covered	

Verification Element Description:

Undefined

Requirement Details	
Requirement ID	DM-TS-CON-ICD-0002
Requirement Description	Specification: Data Management shall provide, for each exposure, a calculation of the WCS for each sensor including the wavefront sensors and guider sensors. The solution shall be published as telemetry within time wcsSolutionFeedbackTime of the close of data acquisition for the visit.
Requirement Parameters	wcsSolutionFeedbackTime = 60[second] Time following the conclusion of readout of an exposure within which DM must provide a WCS solution for each sensor.
Requirement Discussion	Discussion: The T&S and commissioning teams express the need to know about the WCS coordinates on a 60s timeframe to decrease the time overhead of the wait during Active Optics System (AOS) applications.
	Note that this is not in the baseline for Com-Cam. There is no alert production so that's not in the baseline and potentially has some cost and schedule impacts.
Requirement Priority	
Upper Level Requirement	

2.105 [LVV-5647] DM-TS-CON-ICD-0002-V-02: Timing_DM_2

Jira Link	Assignee	Status	Test Cases
LVV-5647	Leanne Guy	Not Covered	

Verification Element Description:

Undefined

Requirement Details	
Requirement ID	DM-TS-CON-ICD-0002
Requirement Description	Specification: Data Management shall provide, for each exposure, a calculation of the WCS for each sensor including the wavefront sensors and guider sensors. The solution shall be published as telemetry within time wcsSolutionFeedbackTime of the close of data acquisition for the visit.
Requirement Parameters	wcsSolutionFeedbackTime = 60[second] Time following the conclusion of readout of an exposure within which DM must provide a WCS solution for each sensor.
Requirement Discussion	Discussion: The T&S and commissioning teams express the need to know about the WCS coordinates on a 60s timeframe to decrease the time overhead of the wait during Active Optics System (AOS) applications.
	Note that this is not in the baseline for Com-Cam. There is no alert production so that's not in the baseline and potentially has some cost and schedule impacts.
Requirement Priority	
Upper Level Requirement	

2.106 [LVV-9741] DMS-REQ-0030-V-02: Minimum astrometric standards per CCD

Jira Link	Assignee	Status	Test Cases
LVV-9741	Leanne Guy	Not Covered	LVV-T1240

Verification Element Description:

Verify that the minimum number of astrometric standards available per CCD for determining the WCS is at least **astrometricMinStandards = 5**.

Associated element (LVV-13) satisfies the constraint on absolute accuracy of the WCS.

Requirement Details	
Requirement ID	DMS-REQ-0030
Requirement Description	Specification: The DMS shall generate and persist a WCS for each visit image. The absolute accuracy of the WCS shall be at least astrometricAccuracy in all areas of the image, provided that there are at least astrometricMinStandards astrometric standards available in each CCD.
Requirement Parameters	[astrometricAccuracy = 50[milliarcsecond]] Absolute accuracy of the WCS across the focal plane (approximately one-quarter of a pixel), astrometricMinStandards = 5[integer] Minimum number of astrometric standards per CCD.]
Requirement Discussion	Discussion: The World Coordinate System for visits will be expressed in terms of a FITS Standard representation, which provides for named metadata to be interpreted as coefficients of one of a finite set of coordinate transformations.
Requirement Priority	1a
Upper Level Requirement	DMS-REQ-0090 Generate Alerts DMS-REQ-0104 Produce Co-Added Exposures OSS-REQ-0149 Level 1 Catalog Precision OSS-REQ-0162 Level 2 Catalog Accuracy

2.106.1 Test Cases Summary

LVV-T1240	Verify implementation of minimum astrometric standards per CCD			
Owner	Status	Version	Critical Event	Verification Type
Jim Bosch	Approved	1	false	Test

Objective:

Verify that each CCD in a processed dataset had its astrometric solution determined by at least **astrometricMinStandards =**

5 astrometric standards.

Draft

2.107 [LVV-9743] DMS-REQ-0271-V-03: Radius considered nearby

Jira Link	Assignee	Status	Test Cases
LVV-9743	Leanne Guy	Not Covered	

Verification Element Description:

Verify that the radius used to determine coincidence between an Object and a DIASource is **diaNearbyObjRadius = 60 arcseconds**.

Associated element (LVV-9742) satisfies the maximum number of stars that can be associated with a DIASource.

Associated element (LVV-102) satisfies the maximum number of galaxies that can be associated with a DIASource.

Â

Requirement Details	
Requirement ID	DMS-REQ-0271
Requirement Description	Specification: The DMS shall construct a catalog of all astrophysical objects identified through difference image analysis (DIAObjects). The DIAObject entries shall include metadata attributes including at least: a unique identifier; the identifiers of the diaNearbyObjMaxStar nearest stars and diaNearbyObjMaxGalaxy nearest galaxies in the Object catalog lying within diaNearbyObjRadius , the probability that the DIAObject is the same as the nearby Object; and a set of DIAObject properties.
Requirement Parameters	[diaNearbyObjMaxGalaxy = 3[integer] Maximum number of nearby galaxies that can be associated with a DIASource., diaNearbyObjRadius = 60[arcsecond] Radius within which an Object is considered to be near, and possibly coincident with, the DIASource., diaNearbyObjMaxStar = 3[integer] Maximum number of stars that can be associated with a DIASource.]
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0130 Catalogs (Level 1)

2.108 [LVV-9745] DMS-REQ-0131-V-02: Max number of calibs to be processed

Jira Link	Assignee	Status	Test Cases
LVV-9745	Leanne Guy	Not Covered	LVV-T1277

Verification Element Description:

Verify that **nCalExpProc = 25** calibration exposures can be processed simultaneously and made available within the allotted time.

Associated element (LVV-58) satisfies the time allowed for processing calibration exposures.

Requirement Details	
Requirement ID	DMS-REQ-0131
Requirement Description	Specification: Calibration products from a group of up to nCalExpProc related exposures that should be processed together, shall be available from the DMS image archive within calProcTime of the end of the acquisition of images/data for that group.
Requirement Parameters	[nCalExpProc = 25[integer] Maximum number of calibration exposures that can be processed together within time calProcTime., calProcTime = 1200[second] Time allowed to process nCalExpProc calibration exposures and have them available within the DMS.]
Requirement Discussion	Discussion: The motivation here is that calibration images will be needed at least 1 hour prior to the start of observing and this requirement allows the calibration observations to be planned accordingly.
Requirement Priority	2
Upper Level Requirement	OSS-REQ-0046 Calibration OSS-REQ-0021 Base Site OSS-REQ-0194 Calibration Exposures Per Day DMS-REQ-0130 Calibration Data Products

2.108.1 Test Cases Summary

LVV-T1277	Verify processing of maximum number of calibration exposures			
Owner	Status	Version	Critical Event	Verification Type
Kian-Tat Lim	Draft	1	false	Test

Objective:

Verify that as many as **nCalExpProc = 25** calibration exposures can be processed together within time calProcTime.

2.109 [LVV-9746] DMS-REQ-0287-V-02: Max time from acquisition to L1 data release

Jira Link	Assignee	Status	Test Cases
LVV-9746	Leanne Guy	Not Covered	

Verification Element Description:

Verify that L1 associated data products are available within $L1PublicT = 24$ hours.

Associated element (LVV-9747) satisfies the lifetime of cached L1 data products.

Associated element (LVV-118) satisfies the maximum look-back time for precovery measurements.

Requirement Details	
Requirement ID	DMS-REQ-0287
Requirement Description	Specification: For all DIASources not associated with either DIAObjects or SSObjects, the DMS shall perform forced photometry at the location of the new source (precovery) on all Difference Exposures obtained in the prior precoveryWindow , and make the results publicly available within L1PublicT .
Requirement Parameters	[precoveryWindow = 30[day] Maximum look-back time for precovery measurements on prior Exposures., l1CacheLifetime = 30[day] Lifetime in the cache of un-archived Level-1 data products., L1PublicT = 24[hour] Maximum time from the acquisition of science data to the release of associated Level 1 Data Products (except alerts)]
Requirement Discussion	Discussion: The precoveryWindow is intended to satisfy the most common scientific use cases (e.g., Supernovae), without placing an undue burden on the processing infrastructure. For reasons of practicality and efficiency, precoveryWindow $\leq l1CacheLifetime^*$.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0130 Catalogs (Level 1)

2.110 [LVV-9747] DMS-REQ-0287-V-03: Lifetime of archived L1 data products

Jira Link	Assignee	Status	Test Cases
LVV-9747	Leanne Guy	Not Covered	

Verification Element Description:

Verify storage of unarchived Level-1 data products for at least **I1CacheLifetime = 30 days**.

Associated element (LVV-9746) satisfies the time in which L1 data products shall be publicly released.

Associated element (LVV-118) satisfies the maximum look-back time for precovery measurements.

Requirement Details	
Requirement ID	DMS-REQ-0287
Requirement Description	Specification: For all DIASources not associated with either DIAObjects or SSObjects, the DMS shall perform forced photometry at the location of the new source (precovery) on all Difference Exposures obtained in the prior precoveryWindow , and make the results publicly available within L1PublicT .
Requirement Parameters	[precoveryWindow = 30[day] Maximum look-back time for precovery measurements on prior Exposures., I1CacheLifetime = 30[day] Lifetime in the cache of un-archived Level-1 data products., L1PublicT = 24[hour] Maximum time from the acquisition of science data to the release of associated Level 1 Data Products (except alerts)]
Requirement Discussion	Discussion: The precoveryWindow is intended to satisfy the most common scientific use cases (e.g., Supernovae), without placing an undue burden on the processing infrastructure. For reasons of practicality and efficiency, precoveryWindow <= I*1CacheLifetime* .
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0130 Catalogs (Level 1)

2.111 [LVV-9751] DMS-REQ-0359-V-02: Max fraction of sensors with excess unusable pixels

Jira Link	Assignee	Status	Test Cases
LVV-9751	Leanne Guy	Not Covered	LVV-T377 LVV-T1847

Verification Element Description:

The maximum allowable fraction of sensors with **PixFrac > 1** percent scientifically unusable pixels shall be **SensorFraction = 15 percent**.

Associated element DMS-REQ-0359-V-01 (LVV-3401) satisfies the requirement on photometric repeatability in the u, z, and y-band filters.

Associated element DMS-REQ-0359-V-03 (LVV-9752) satisfies the constraint on maximum fraction of outliers among non-saturated point sources.

Associated element DMS-REQ-0359-V-04 (LVV-9753) satisfies the accuracy of zero-point for colors that use the u-band.

Associated element DMS-REQ-0359-V-05 (LVV-9754) satisfies the repeatability outlier limit in g, r, and i-bands.

Associated element DMS-REQ-0359-V-06 (LVV-9755) satisfies the constraint on the accuracy of the transformation from internal to physical photometric scales.

Associated element DMS-REQ-0359-V-07 (LVV-9756) satisfies the rms width of the internal photometric zero-point in u-band.

Associated element DMS-REQ-0359-V-08 (LVV-9757) satisfies the maximum local significance of imperfect crosstalk corrections.

Associated element DMS-REQ-0359-V-09 (LVV-9758) satisfies the repeatability outlier limit in u, z, and y-bands.

Associated element DMS-REQ-0359-V-10 (LVV-9759) satisfies the rms photometric repeatabil-

ity in g, r, and i-bands.

Associated element DMS-REQ-0359-V-11 (LVV-9760) satisfies the fraction of zero-point errors that can exceed the outlier limit.

Associated element DMS-REQ-0359-V-12 (LVV-9761) satisfies the maximum fraction of unusable pixels per sensor.

Associated element DMS-REQ-0359-V-13 (LVV-9762) satisfies the maximum allowable precision in the sky brightness determination.

Associated element DMS-REQ-0359-V-14 (LVV-9763) satisfies the rms width of the internal photometric zero-point in g, r, i, z, and y-bands.

Associated element DMS-REQ-0359-V-15 (LVV-9764) satisfies the percentage of the image area affected by ghosts that exceed the threshold.

Associated element DMS-REQ-0359-V-16 (LVV-9765) satisfies the accuracy of zero-point for colors that do not include the u-band.

Associated element DMS-REQ-0359-V-17 (LVV-9766) satisfies the maximum RMS of the ratio of the flux measurement error between resolved/unresolved sources.

Requirement Details

Requirement ID	DMS-REQ-0359
Requirement Description	Specification: The DMS shall include software to enable the calculation of the photometric performance metrics defined in OSS-REQ-0387.

Requirement Parameters	<p>[GhostAF = 1[percent] Percentage of image area that can have ghosts with surface brightness gradient amplitude of more than 1/3 of the sky noise over 1 arcsec., PF1 = 10[percent] The maximum fraction of isolated non-saturated point source measurements exceeding the outlier limit., PA1gri = 5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the g, r, and i filters., PA3 = 10[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) for all bands except u-band., PA4 = 15[millimagnitude] The zero point error outlier limit., PF2 = 10[percent] Fraction of zeropoint errors that can exceed the zero point error outlier limit., PixFrac = 1[percent] The maximum fraction of pixels scientifically unusable per sensor out of the total allowable fraction of sensors meeting this performance., PA1uzy = 7.5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the u, z, and y filters., PA6 = 10[millimagnitude] Accuracy of the transformation of the internal LSST photometry to a physical scale (e.g. AB magnitudes), Xtalk = 3[sigma] The maximum local significance integrated over the PSF of imperfect crosstalk corrections., PA5u = 10[millimagnitude] Accuracy of absolute band-to-band color zero-point for colors constructed using the u-band., ResSource = 2[unitless] Maximum RMS of the ratio of the error in integrated flux measurement between bright, isolated, resolved sources less than 10 arcsec in diameter and bright, isolated unresolved point sources., PA2uzy = 22.5[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the u, z, and y filters., SensorFraction = 15[percent] The maximum allowable fraction of sensors with PixFrac scientifically unusable pixels., PA3u = 20[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) in the u-band., PA2gri = 15[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the g, r, and i filters., SBPrec = 1[percent] The maximum error in the precision of the sky brightness determination., PA5 = 5[millimagnitude] Accuracy of absolute band-to-band color zero-point for all colors constructed from any filter pair, excluding the u-band.]</p>	
Requirement Discussion	<p>Discussion: The relevant metrics are listed in the table photometricPerformance below. The values in the tables are the target values for LSST but are not verified as part of this requirement.</p>	
Requirement Priority	1a	
Upper Level Requirement	OSS-REQ-0387	Photometric Performance

2.111.1 Test Cases Summary

LVV-T377	Verify Calculation of Photometric Performance Metrics			
Owner	Status	Version	Critical Event	Verification Type
Leanne Guy	Approved	1	false	Test

Objective:

Verify that the DMS system provides software to calculate photometric performance metrics, and that the algorithms are properly calculating the desired quantities. Note that because the DMS requirement is that the software shall be provided (and not on the actual measured values of the metrics), we verify all of the requirements via a single test case.

LVV-T1847	Verify calculation of sensor fraction with unusable pixels			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Draft	1	false	Test

Objective:

Verify that the DM system provides software to assess whether the maximum allowable fraction of sensors with **PixFrac > 1** percent scientifically unusable pixels is less than **SensorFraction = 15 percent**.

2.112 [LVV-9752] DMS-REQ-0359-V-03: Max fraction of outliers among non-saturated sources

Jira Link	Assignee	Status	Test Cases
LVV-9752	Leanne Guy	Not Covered	LVV-T1758 LVV-T1759

Verification Element Description:

The maximum fraction of isolated non-saturated point source measurements exceeding the outlier limit shall be less than **PF1 = 10 percent**.

Associated element DMS-REQ-0359-V-01 (LVV-3401) satisfies the requirement on photometric repeatability in the u, z, and y-band filters.

Associated element DMS-REQ-0359-V-02 (LVV-9751) satisfies the requirement on the maximum fraction of sensors with scientifically unusable pixels.

Associated element DMS-REQ-0359-V-04 (LVV-9753) satisfies the accuracy of zero-point for colors that use the u-band.

Associated element DMS-REQ-0359-V-05 (LVV-9754) satisfies the repeatability outlier limit in g, r, and i-bands.

Associated element DMS-REQ-0359-V-06 (LVV-9755) satisfies the constraint on the accuracy of the transformation from internal to physical photometric scales.

Associated element DMS-REQ-0359-V-07 (LVV-9756) satisfies the rms width of the internal photometric zero-point in u-band.

Associated element DMS-REQ-0359-V-08 (LVV-9757) satisfies the maximum local significance of imperfect crosstalk corrections.

Associated element DMS-REQ-0359-V-09 (LVV-9758) satisfies the repeatability outlier limit in u, z, and y-bands.

Associated element DMS-REQ-0359-V-10 (LVV-9759) satisfies the rms photometric repeatabil-

ity in g, r, and i-bands.

Associated element DMS-REQ-0359-V-11 (LVV-9760) satisfies the fraction of zero-point errors that can exceed the outlier limit.

Associated element DMS-REQ-0359-V-12 (LVV-9761) satisfies the maximum fraction of unusable pixels per sensor.

Associated element DMS-REQ-0359-V-13 (LVV-9762) satisfies the maximum allowable precision in the sky brightness determination.

Associated element DMS-REQ-0359-V-14 (LVV-9763) satisfies the rms width of the internal photometric zero-point in g, r, i, z, and y-bands.

Associated element DMS-REQ-0359-V-15 (LVV-9764) satisfies the percentage of the image area affected by ghosts that exceed the threshold.

Associated element DMS-REQ-0359-V-16 (LVV-9765) satisfies the accuracy of zero-point for colors that do not include the u-band.

Associated element DMS-REQ-0359-V-17 (LVV-9766) satisfies the maximum RMS of the ratio of the flux measurement error between resolved/unresolved sources.

Requirement Details

Requirement ID	DMS-REQ-0359
Requirement Description	Specification: The DMS shall include software to enable the calculation of the photometric performance metrics defined in OSS-REQ-0387.

Requirement Parameters	<p>[GhostAF = 1[percent]] Percentage of image area that can have ghosts with surface brightness gradient amplitude of more than 1/3 of the sky noise over 1 arcsec., PF1 = 10[percent] The maximum fraction of isolated non-saturated point source measurements exceeding the outlier limit., PA1gri = 5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the g, r, and i filters., PA3 = 10[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) for all bands except u-band., PA4 = 15[millimagnitude] The zero point error outlier limit., PF2 = 10[percent] Fraction of zeropoint errors that can exceed the zero point error outlier limit., PixFrac = 1[percent] The maximum fraction of pixels scientifically unusable per sensor out of the total allowable fraction of sensors meeting this performance., PA1uzy = 7.5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the u, z, and y filters., PA6 = 10[millimagnitude] Accuracy of the transformation of the internal LSST photometry to a physical scale (e.g. AB magnitudes), Xtalk = 3[sigma] The maximum local significance integrated over the PSF of imperfect crosstalk corrections., PA5u = 10[millimagnitude] Accuracy of absolute band-to-band color zero-point for colors constructed using the u-band., ResSource = 2[unitless] Maximum RMS of the ratio of the error in integrated flux measurement between bright, isolated, resolved sources less than 10 arcsec in diameter and bright, isolated unresolved point sources., PA2uzy = 22.5[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the u, z, and y filters., SensorFraction = 15[percent] The maximum allowable fraction of sensors with PixFrac scientifically unusable pixels., PA3u = 20[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) in the u-band., PA2gri = 15[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the g, r, and i filters., SBPrec = 1[percent] The maximum error in the precision of the sky brightness determination., PA5 = 5[millimagnitude] Accuracy of absolute band-to-band color zero-point for all colors constructed from any filter pair, excluding the u-band.]</p>	
Requirement Discussion	<p>Discussion: The relevant metrics are listed in the table photometricPerformance below. The values in the tables are the target values for LSST but are not verified as part of this requirement.</p>	
Requirement Priority	1a	
Upper Level Requirement	OSS-REQ-0387	Photometric Performance

2.112.1 Test Cases Summary

LVV-T1758	Verify calculation of photometric outliers in uzy bands			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Approved	1	false	Test

Objective:

Verify that the DM system has provided the code to calculate the photometric repeatability in the u, z, and y filters, and assess whether it meets the requirement that no more than **PF1 = 10[percent]** of the repeatability outliers exceed the outlier limit of **PA2uzy = 22.5 millimagnitudes**.

LWV-T1759	Verify calculation of photometric outliers in gri bands			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Approved	1	false	Test

Objective:

Verify that the DM system has provided the code to calculate the photometric repeatability in the g, r, and i filters, and assess whether it meets the requirement that no more than **PF1 = 10[percent]** of the repeatability outliers exceed the outlier limit of **PA2gri = 15 millimagnitudes**.

2.113 [LVV-9753] DMS-REQ-0359-V-04: Accuracy of zero point for colors with u-band

Jira Link	Assignee	Status	Test Cases
LVV-9753	Leanne Guy	Not Covered	LVV-T377 LVV-T1846

Verification Element Description:

The accuracy of absolute band-to-band color zero-points for all colors constructed from any filter pair, including the u-band shall be less than **PA5u = 10 millimagnitudes**.

Associated element DMS-REQ-0359-V-01 (LVV-3401) satisfies the requirement on photometric repeatability in the u, z, and y-band filters.

Associated element DMS-REQ-0359-V-02 (LVV-9751) satisfies the requirement on the maximum fraction of sensors with scientifically unusable pixels.

Associated element DMS-REQ-0359-V-03 (LVV-9752) satisfies the constraint on maximum fraction of outliers among non-saturated point sources.

Associated element DMS-REQ-0359-V-05 (LVV-9754) satisfies the repeatability outlier limit in g, r, and i-bands.

Associated element DMS-REQ-0359-V-06 (LVV-9755) satisfies the constraint on the accuracy of the transformation from internal to physical photometric scales.

Associated element DMS-REQ-0359-V-07 (LVV-9756) satisfies the rms width of the internal photometric zero-point in u-band.

Associated element DMS-REQ-0359-V-08 (LVV-9757) satisfies the maximum local significance of imperfect crosstalk corrections.

Associated element DMS-REQ-0359-V-09 (LVV-9758) satisfies the repeatability outlier limit in u, z, and y-bands.

Associated element DMS-REQ-0359-V-10 (LVV-9759) satisfies the rms photometric repeatabil-

ity in g, r, and i-bands.

Associated element DMS-REQ-0359-V-11 (LVV-9760) satisfies the fraction of zero-point errors that can exceed the outlier limit.

Associated element DMS-REQ-0359-V-12 (LVV-9761) satisfies the maximum fraction of unusable pixels per sensor.

Associated element DMS-REQ-0359-V-13 (LVV-9762) satisfies the maximum allowable precision in the sky brightness determination.

Associated element DMS-REQ-0359-V-14 (LVV-9763) satisfies the rms width of the internal photometric zero-point in g, r, i, z, and y-bands.

Associated element DMS-REQ-0359-V-15 (LVV-9764) satisfies the percentage of the image area affected by ghosts that exceed the threshold.

Associated element DMS-REQ-0359-V-16 (LVV-9765) satisfies the accuracy of zero-point for colors that do not include the u-band.

Associated element DMS-REQ-0359-V-17 (LVV-9766) satisfies the maximum RMS of the ratio of the flux measurement error between resolved/unresolved sources.

Requirement Details

Requirement ID	DMS-REQ-0359
Requirement Description	Specification: The DMS shall include software to enable the calculation of the photometric performance metrics defined in OSS-REQ-0387.

Requirement Parameters	<p>[GhostAF = 1[percent] Percentage of image area that can have ghosts with surface brightness gradient amplitude of more than 1/3 of the sky noise over 1 arcsec., PF1 = 10[percent] The maximum fraction of isolated non-saturated point source measurements exceeding the outlier limit., PA1gri = 5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the g, r, and i filters., PA3 = 10[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) for all bands except u-band., PA4 = 15[millimagnitude] The zero point error outlier limit., PF2 = 10[percent] Fraction of zeropoint errors that can exceed the zero point error outlier limit., PixFrac = 1[percent] The maximum fraction of pixels scientifically unusable per sensor out of the total allowable fraction of sensors meeting this performance., PA1uzy = 7.5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the u, z, and y filters., PA6 = 10[millimagnitude] Accuracy of the transformation of the internal LSST photometry to a physical scale (e.g. AB magnitudes), Xtalk = 3[sigma] The maximum local significance integrated over the PSF of imperfect crosstalk corrections., PA5u = 10[millimagnitude] Accuracy of absolute band-to-band color zero-point for colors constructed using the u-band., ResSource = 2[unitless] Maximum RMS of the ratio of the error in integrated flux measurement between bright, isolated, resolved sources less than 10 arcsec in diameter and bright, isolated unresolved point sources., PA2uzy = 22.5[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the u, z, and y filters., SensorFraction = 15[percent] The maximum allowable fraction of sensors with PixFrac scientifically unusable pixels., PA3u = 20[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) in the u-band., PA2gri = 15[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the g, r, and i filters., SBPrec = 1[percent] The maximum error in the precision of the sky brightness determination., PA5 = 5[millimagnitude] Accuracy of absolute band-to-band color zero-point for all colors constructed from any filter pair, excluding the u-band.]</p>	
Requirement Discussion	<p>Discussion: The relevant metrics are listed in the table photometricPerformance below. The values in the tables are the target values for LSST but are not verified as part of this requirement.</p>	
Requirement Priority	1a	
Upper Level Requirement	OSS-REQ-0387	Photometric Performance

2.113.1 Test Cases Summary

LVV-T377	Verify Calculation of Photometric Performance Metrics			
Owner	Status	Version	Critical Event	Verification Type
Leanne Guy	Approved	1	false	Test

Objective:

Verify that the DMS system provides software to calculate photometric performance metrics, and that the algorithms are properly calculating the desired quantities. Note that because the DMS requirement is that the software shall be provided (and not on the actual measured values of the metrics), we verify all of the requirements via a single test case.

LVV-T1846	Verify calculation of band-to-band color zero-point accuracy including u-band			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Draft	1	false	Test

Objective:

Verify that the DM system provides software to assess whether the accuracy of absolute band-to-band color zero-points for all colors constructed from any filter pair, including the u-band, is less than **PA5u = 10 millimagnitudes**.

2.114 [LVV-9754] DMS-REQ-0359-V-05: Repeatability outlier limit in gri

Jira Link	Assignee	Status	Test Cases
LVV-9754	Leanne Guy	Not Covered	LVV-T1759

Verification Element Description:

The repeatability outlier limit for isolated bright non-saturated point sources in the g, r, and i filters shall be less than $\hat{PA2gri} = 15$ millimagnitudes.

Associated element DMS-REQ-0359-V-01 (LVV-3401) satisfies the requirement on photometric repeatability in the u, z, and y-band filters.

Associated element DMS-REQ-0359-V-02 (LVV-9751) satisfies the requirement on the maximum fraction of sensors with scientifically unusable pixels.

Associated element DMS-REQ-0359-V-03 (LVV-9752) satisfies the constraint on maximum fraction of outliers among non-saturated point sources.

Associated element DMS-REQ-0359-V-04 (LVV-9753) satisfies the accuracy of zero-point for colors that use the u-band.

Associated element DMS-REQ-0359-V-06 (LVV-9755) satisfies the constraint on the accuracy of the transformation from internal to physical photometric scales.

Associated element DMS-REQ-0359-V-07 (LVV-9756) satisfies the rms width of the internal photometric zero-point in u-band.

Associated element DMS-REQ-0359-V-08 (LVV-9757) satisfies the maximum local significance of imperfect crosstalk corrections.

Associated element DMS-REQ-0359-V-09 (LVV-9758) satisfies the repeatability outlier limit in u, z, and y-bands.

Associated element DMS-REQ-0359-V-10 (LVV-9759) satisfies the rms photometric repeatability in g, r, and i-bands.

Associated element DMS-REQ-0359-V-11 (LVV-9760) satisfies the fraction of zero-point errors that can exceed the outlier limit.

Associated element DMS-REQ-0359-V-12 (LVV-9761) satisfies the maximum fraction of unusable pixels per sensor.

Associated element DMS-REQ-0359-V-13 (LVV-9762) satisfies the maximum allowable precision in the sky brightness determination.

Associated element DMS-REQ-0359-V-14 (LVV-9763) satisfies the rms width of the internal photometric zero-point in g, r, i, z, and y-bands.

Associated element DMS-REQ-0359-V-15 (LVV-9764) satisfies the percentage of the image area affected by ghosts that exceed the threshold.

Associated element DMS-REQ-0359-V-16 (LVV-9765) satisfies the accuracy of zero-point for colors that do not include the u-band.

Associated element DMS-REQ-0359-V-17 (LVV-9766) satisfies the maximum RMS of the ratio of the flux measurement error between resolved/unresolved sources.

Requirement Details

Requirement ID	DMS-REQ-0359
Requirement Description	Specification: The DMS shall include software to enable the calculation of the photometric performance metrics defined in OSS-REQ-0387.

Requirement Parameters	<p>[GhostAF = 1[percent] Percentage of image area that can have ghosts with surface brightness gradient amplitude of more than 1/3 of the sky noise over 1 arcsec., PF1 = 10[percent] The maximum fraction of isolated non-saturated point source measurements exceeding the outlier limit., PA1gri = 5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the g, r, and i filters., PA3 = 10[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) for all bands except u-band., PA4 = 15[millimagnitude] The zero point error outlier limit., PF2 = 10[percent] Fraction of zeropoint errors that can exceed the zero point error outlier limit., PixFrac = 1[percent] The maximum fraction of pixels scientifically unusable per sensor out of the total allowable fraction of sensors meeting this performance., PA1uzy = 7.5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the u, z, and y filters., PA6 = 10[millimagnitude] Accuracy of the transformation of the internal LSST photometry to a physical scale (e.g. AB magnitudes), Xtalk = 3[sigma] The maximum local significance integrated over the PSF of imperfect crosstalk corrections., PA5u = 10[millimagnitude] Accuracy of absolute band-to-band color zero-point for colors constructed using the u-band., ResSource = 2[unitless] Maximum RMS of the ratio of the error in integrated flux measurement between bright, isolated, resolved sources less than 10 arcsec in diameter and bright, isolated unresolved point sources., PA2uzy = 22.5[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the u, z, and y filters., SensorFraction = 15[percent] The maximum allowable fraction of sensors with PixFrac scientifically unusable pixels., PA3u = 20[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) in the u-band., PA2gri = 15[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the g, r, and i filters., SBPrec = 1[percent] The maximum error in the precision of the sky brightness determination., PA5 = 5[millimagnitude] Accuracy of absolute band-to-band color zero-point for all colors constructed from any filter pair, excluding the u-band.]</p>	
Requirement Discussion	<p>Discussion: The relevant metrics are listed in the table photometricPerformance below. The values in the tables are the target values for LSST but are not verified as part of this requirement.</p>	
Requirement Priority	1a	
Upper Level Requirement	OSS-REQ-0387	Photometric Performance

2.114.1 Test Cases Summary

LVV-T1759	Verify calculation of photometric outliers in gri bands			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Approved	1	false	Test

Objective:

Verify that the DM system has provided the code to calculate the photometric repeatability in the g, r, and i filters, and assess whether it meets the requirement that no more than **PF1 = 10[percent]** of the repeatability outliers exceed the outlier limit of **PA2gri = 15 millimagnitudes**.

Draft

2.115 [LVV-9755] DMS-REQ-0359-V-06: Accuracy of photometric transformation

Jira Link	Assignee	Status	Test Cases
LVV-9755	Leanne Guy	Not Covered	LVV-T377 LVV-T1845

Verification Element Description:

The accuracy of the transformation of internal LSST photometry to a physical scale (e.g. AB magnitudes) shall be less than **PA6 = 10 millimagnitudes**.

Associated element DMS-REQ-0359-V-01 (LVV-3401) satisfies the requirement on photometric repeatability in the u, z, and y-band filters.

Associated element DMS-REQ-0359-V-02 (LVV-9751) satisfies the requirement on the maximum fraction of sensors with scientifically unusable pixels.

Associated element DMS-REQ-0359-V-03 (LVV-9752) satisfies the constraint on maximum fraction of outliers among non-saturated point sources.

Associated element DMS-REQ-0359-V-04 (LVV-9753) satisfies the accuracy of zero-point for colors that use the u-band.

Associated element DMS-REQ-0359-V-05 (LVV-9754) satisfies the repeatability outlier limit in g, r, and i-bands.

Associated element DMS-REQ-0359-V-07 (LVV-9756) satisfies the rms width of the internal photometric zero-point in u-band.

Associated element DMS-REQ-0359-V-08 (LVV-9757) satisfies the maximum local significance of imperfect crosstalk corrections.

Associated element DMS-REQ-0359-V-09 (LVV-9758) satisfies the repeatability outlier limit in u, z, and y-bands.

Associated element DMS-REQ-0359-V-10 (LVV-9759) satisfies the rms photometric repeatability in g, r, and i-bands.

Associated element DMS-REQ-0359-V-11 (LVV-9760) satisfies the fraction of zero-point errors that can exceed the outlier limit.

Associated element DMS-REQ-0359-V-12 (LVV-9761) satisfies the maximum fraction of unusable pixels per sensor.

Associated element DMS-REQ-0359-V-13 (LVV-9762) satisfies the maximum allowable precision in the sky brightness determination.

Associated element DMS-REQ-0359-V-14 (LVV-9763) satisfies the rms width of the internal photometric zero-point in g, r, i, z, and y-bands.

Associated element DMS-REQ-0359-V-15 (LVV-9764) satisfies the percentage of the image area affected by ghosts that exceed the threshold.

Associated element DMS-REQ-0359-V-16 (LVV-9765) satisfies the accuracy of zero-point for colors that do not include the u-band.

Associated element DMS-REQ-0359-V-17 (LVV-9766) satisfies the maximum RMS of the ratio of the flux measurement error between resolved/unresolved sources.

Requirement Details

Requirement ID	DMS-REQ-0359
Requirement Description	Specification: The DMS shall include software to enable the calculation of the photometric performance metrics defined in OSS-REQ-0387.

Requirement Parameters	<p>[GhostAF = 1[percent]] Percentage of image area that can have ghosts with surface brightness gradient amplitude of more than 1/3 of the sky noise over 1 arcsec., PF1 = 10[percent] The maximum fraction of isolated non-saturated point source measurements exceeding the outlier limit., PA1gri = 5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the g, r, and i filters., PA3 = 10[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) for all bands except u-band., PA4 = 15[millimagnitude] The zero point error outlier limit., PF2 = 10[percent] Fraction of zeropoint errors that can exceed the zero point error outlier limit., PixFrac = 1[percent] The maximum fraction of pixels scientifically unusable per sensor out of the total allowable fraction of sensors meeting this performance., PA1uzy = 7.5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the u, z, and y filters., PA6 = 10[millimagnitude] Accuracy of the transformation of the internal LSST photometry to a physical scale (e.g. AB magnitudes), Xtalk = 3[sigma] The maximum local significance integrated over the PSF of imperfect crosstalk corrections., PA5u = 10[millimagnitude] Accuracy of absolute band-to-band color zero-point for colors constructed using the u-band., ResSource = 2[unitless] Maximum RMS of the ratio of the error in integrated flux measurement between bright, isolated, resolved sources less than 10 arcsec in diameter and bright, isolated unresolved point sources., PA2uzy = 22.5[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the u, z, and y filters., SensorFraction = 15[percent] The maximum allowable fraction of sensors with PixFrac scientifically unusable pixels., PA3u = 20[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) in the u-band., PA2gri = 15[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the g, r, and i filters., SBPrec = 1[percent] The maximum error in the precision of the sky brightness determination., PA5 = 5[millimagnitude] Accuracy of absolute band-to-band color zero-point for all colors constructed from any filter pair, excluding the u-band.]</p>	
Requirement Discussion	<p>Discussion: The relevant metrics are listed in the table photometricPerformance below. The values in the tables are the target values for LSST but are not verified as part of this requirement.</p>	
Requirement Priority	1a	
Upper Level Requirement	OSS-REQ-0387	Photometric Performance

2.115.1 Test Cases Summary

LVV-T377	Verify Calculation of Photometric Performance Metrics			
Owner	Status	Version	Critical Event	Verification Type
Leanne Guy	Approved	1	false	Test

Objective:

Verify that the DMS system provides software to calculate photometric performance metrics, and that the algorithms are properly calculating the desired quantities. Note that because the DMS requirement is that the software shall be provided (and not on the actual measured values of the metrics), we verify all of the requirements via a single test case.

LVV-T1845	Verify accuracy of photometric transformation to physical scale			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Draft	1	false	Test

Objective:

Verify that the DM system provides software to assess whether the accuracy of the transformation of internal LSST photometry to a physical scale (e.g. AB magnitudes) is less than **PA6 = 10 millimagnitudes**.

2.116 [LVV-9756] DMS-REQ-0359-V-07: RMS width of zero point in u-band

Jira Link	Assignee	Status	Test Cases
LVV-9756	Leanne Guy	Not Covered	LVV-T377 LVV-T1844

Verification Element Description:

The RMS width of internal photometric zero-point (precision of system uniformity across the sky) in the u-band shall be less than **PA3u = 20 millimagnitudes**.

Associated element DMS-REQ-0359-V-01 (LVV-3401) satisfies the requirement on photometric repeatability in the u, z, and y-band filters.

Associated element DMS-REQ-0359-V-02 (LVV-9751) satisfies the requirement on the maximum fraction of sensors with scientifically unusable pixels.

Associated element DMS-REQ-0359-V-03 (LVV-9752) satisfies the constraint on maximum fraction of outliers among non-saturated point sources.

Associated element DMS-REQ-0359-V-04 (LVV-9753) satisfies the accuracy of zero-point for colors that use the u-band.

Associated element DMS-REQ-0359-V-05 (LVV-9754) satisfies the repeatability outlier limit in g, r, and i-bands.

Associated element DMS-REQ-0359-V-06 (LVV-9755) satisfies the constraint on the accuracy of the transformation from internal to physical photometric scales.

Associated element DMS-REQ-0359-V-08 (LVV-9757) satisfies the maximum local significance of imperfect crosstalk corrections.

Associated element DMS-REQ-0359-V-09 (LVV-9758) satisfies the repeatability outlier limit in u, z, and y-bands.

Associated element DMS-REQ-0359-V-10 (LVV-9759) satisfies the rms photometric repeatability in g, r, and i-bands.

Associated element DMS-REQ-0359-V-11 (LVV-9760) satisfies the fraction of zero-point errors that can exceed the outlier limit.

Associated element DMS-REQ-0359-V-12 (LVV-9761) satisfies the maximum fraction of unusable pixels per sensor.

Associated element DMS-REQ-0359-V-13 (LVV-9762) satisfies the maximum allowable precision in the sky brightness determination.

Associated element DMS-REQ-0359-V-14 (LVV-9763) satisfies the rms width of the internal photometric zero-point in g, r, i, z, and y-bands.

Associated element DMS-REQ-0359-V-15 (LVV-9764) satisfies the percentage of the image area affected by ghosts that exceed the threshold.

Associated element DMS-REQ-0359-V-16 (LVV-9765) satisfies the accuracy of zero-point for colors that do not include the u-band.

Associated element DMS-REQ-0359-V-17 (LVV-9766) satisfies the maximum RMS of the ratio of the flux measurement error between resolved/unresolved sources.

Requirement Details

Requirement ID	DMS-REQ-0359
Requirement Description	Specification: The DMS shall include software to enable the calculation of the photometric performance metrics defined in OSS-REQ-0387.

Requirement Parameters	<p>[GhostAF = 1[percent]] Percentage of image area that can have ghosts with surface brightness gradient amplitude of more than 1/3 of the sky noise over 1 arcsec., PF1 = 10[percent] The maximum fraction of isolated non-saturated point source measurements exceeding the outlier limit., PA1gri = 5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the g, r, and i filters., PA3 = 10[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) for all bands except u-band., PA4 = 15[millimagnitude] The zero point error outlier limit., PF2 = 10[percent] Fraction of zeropoint errors that can exceed the zero point error outlier limit., PixFrac = 1[percent] The maximum fraction of pixels scientifically unusable per sensor out of the total allowable fraction of sensors meeting this performance., PA1uzy = 7.5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the u, z, and y filters., PA6 = 10[millimagnitude] Accuracy of the transformation of the internal LSST photometry to a physical scale (e.g. AB magnitudes), Xtalk = 3[sigma] The maximum local significance integrated over the PSF of imperfect crosstalk corrections., PA5u = 10[millimagnitude] Accuracy of absolute band-to-band color zero-point for colors constructed using the u-band., ResSource = 2[unitless] Maximum RMS of the ratio of the error in integrated flux measurement between bright, isolated, resolved sources less than 10 arcsec in diameter and bright, isolated unresolved point sources., PA2uzy = 22.5[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the u, z, and y filters., SensorFraction = 15[percent] The maximum allowable fraction of sensors with PixFrac scientifically unusable pixels., PA3u = 20[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) in the u-band., PA2gri = 15[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the g, r, and i filters., SBPrec = 1[percent] The maximum error in the precision of the sky brightness determination., PA5 = 5[millimagnitude] Accuracy of absolute band-to-band color zero-point for all colors constructed from any filter pair, excluding the u-band.]</p>	
Requirement Discussion	<p>Discussion: The relevant metrics are listed in the table photometricPerformance below. The values in the tables are the target values for LSST but are not verified as part of this requirement.</p>	
Requirement Priority	1a	
Upper Level Requirement	OSS-REQ-0387	Photometric Performance

2.116.1 Test Cases Summary

LVV-T377	Verify Calculation of Photometric Performance Metrics			
Owner	Status	Version	Critical Event	Verification Type
Leanne Guy	Approved	1	false	Test

Objective:

Verify that the DMS system provides software to calculate photometric performance metrics, and that the algorithms are properly calculating the desired quantities. Note that because the DMS requirement is that the software shall be provided (and not on the actual measured values of the metrics), we verify all of the requirements via a single test case.

LVV-T1844	Verify calculation of u-band photometric zero-point RMS			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Draft	1	false	Test

Objective:

Verify that the DM system provides software to assess whether the RMS width of internal photometric zero-point (precision of system uniformity across the sky) in the u-band is less than **PA3u = 20 millimagnitudes**.

2.117 [LVV-9757] DMS-REQ-0359-V-08: Max cross-talk imperfections

Jira Link	Assignee	Status	Test Cases
LVV-9757	Leanne Guy	Not Covered	LVV-T377 LVV-T1843

Verification Element Description:

The maximum local significance integrated over the PSF of imperfect crosstalk corrections shall be less than **Xtalk = 3 sigma**.

Associated element DMS-REQ-0359-V-01 (LVV-3401) satisfies the requirement on photometric repeatability in the u, z, and y-band filters.

Associated element DMS-REQ-0359-V-02 (LVV-9751) satisfies the requirement on the maximum fraction of sensors with scientifically unusable pixels.

Associated element DMS-REQ-0359-V-03 (LVV-9752) satisfies the constraint on maximum fraction of outliers among non-saturated point sources.

Associated element DMS-REQ-0359-V-04 (LVV-9753) satisfies the accuracy of zero-point for colors that use the u-band.

Associated element DMS-REQ-0359-V-05 (LVV-9754) satisfies the repeatability outlier limit in g, r, and i-bands.

Associated element DMS-REQ-0359-V-06 (LVV-9755) satisfies the constraint on the accuracy of the transformation from internal to physical photometric scales.

Associated element DMS-REQ-0359-V-07 (LVV-9756) satisfies the rms width of the internal photometric zero-point in u-band.

Associated element DMS-REQ-0359-V-09 (LVV-9758) satisfies the repeatability outlier limit in u, z, and y-bands.

Associated element DMS-REQ-0359-V-10 (LVV-9759) satisfies the rms photometric repeatability in g, r, and i-bands.

Associated element DMS-REQ-0359-V-11 (LVV-9760) satisfies the fraction of zero-point errors that can exceed the outlier limit.

Associated element DMS-REQ-0359-V-12 (LVV-9761) satisfies the maximum fraction of unusable pixels per sensor.

Associated element DMS-REQ-0359-V-13 (LVV-9762) satisfies the maximum allowable precision in the sky brightness determination.

Associated element DMS-REQ-0359-V-14 (LVV-9763) satisfies the rms width of the internal photometric zero-point in g, r, i, z, and y-bands.

Associated element DMS-REQ-0359-V-15 (LVV-9764) satisfies the percentage of the image area affected by ghosts that exceed the threshold.

Associated element DMS-REQ-0359-V-16 (LVV-9765) satisfies the accuracy of zero-point for colors that do not include the u-band.

Associated element DMS-REQ-0359-V-17 (LVV-9766) satisfies the maximum RMS of the ratio of the flux measurement error between resolved/unresolved sources.

Requirement Details

Requirement ID	DMS-REQ-0359
Requirement Description	Specification: The DMS shall include software to enable the calculation of the photometric performance metrics defined in OSS-REQ-0387.

Requirement Parameters	<p>[GhostAF = 1[percent]] Percentage of image area that can have ghosts with surface brightness gradient amplitude of more than 1/3 of the sky noise over 1 arcsec., PF1 = 10[percent] The maximum fraction of isolated non-saturated point source measurements exceeding the outlier limit., PA1gri = 5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the g, r, and i filters., PA3 = 10[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) for all bands except u-band., PA4 = 15[millimagnitude] The zero point error outlier limit., PF2 = 10[percent] Fraction of zeropoint errors that can exceed the zero point error outlier limit., PixFrac = 1[percent] The maximum fraction of pixels scientifically unusable per sensor out of the total allowable fraction of sensors meeting this performance., PA1uzy = 7.5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the u, z, and y filters., PA6 = 10[millimagnitude] Accuracy of the transformation of the internal LSST photometry to a physical scale (e.g. AB magnitudes), Xtalk = 3[sigma] The maximum local significance integrated over the PSF of imperfect crosstalk corrections., PA5u = 10[millimagnitude] Accuracy of absolute band-to-band color zero-point for colors constructed using the u-band., ResSource = 2[unitless] Maximum RMS of the ratio of the error in integrated flux measurement between bright, isolated, resolved sources less than 10 arcsec in diameter and bright, isolated unresolved point sources., PA2uzy = 22.5[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the u, z, and y filters., SensorFraction = 15[percent] The maximum allowable fraction of sensors with PixFrac scientifically unusable pixels., PA3u = 20[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) in the u-band., PA2gri = 15[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the g, r, and i filters., SBPrec = 1[percent] The maximum error in the precision of the sky brightness determination., PA5 = 5[millimagnitude] Accuracy of absolute band-to-band color zero-point for all colors constructed from any filter pair, excluding the u-band.]</p>	
Requirement Discussion	<p>Discussion: The relevant metrics are listed in the table photometricPerformance below. The values in the tables are the target values for LSST but are not verified as part of this requirement.</p>	
Requirement Priority	1a	
Upper Level Requirement	OSS-REQ-0387	Photometric Performance

2.117.1 Test Cases Summary

LVV-T377	Verify Calculation of Photometric Performance Metrics			
Owner	Status	Version	Critical Event	Verification Type
Leanne Guy	Approved	1	false	Test

Objective:

Verify that the DMS system provides software to calculate photometric performance metrics, and that the algorithms are properly calculating the desired quantities. Note that because the DMS requirement is that the software shall be provided (and not on the actual measured values of the metrics), we verify all of the requirements via a single test case.

LVV-T1843	Verify calculation of significance of imperfect crosstalk corrections			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Draft	1	false	Test

Objective:

Verify that the DM system provides software to assess whether the maximum local significance integrated over the PSF of imperfect crosstalk corrections is less than **Xtalk = 3 sigma**.

2.118 [LVV-9758] DMS-REQ-0359-V-09: Repeatability outlier limit in uzy

Jira Link	Assignee	Status	Test Cases
LVV-9758	Leanne Guy	Not Covered	LVV-T1758

Verification Element Description:

The repeatability outlier limit for isolated bright non-saturated point sources in the u, z, and y filters shall be less than **PA2uzy = 22.5 millimagnitudes**.

Associated element DMS-REQ-0359-V-01 (LVV-3401) satisfies the requirement on photometric repeatability in the u, z, and y-band filters.

Associated element DMS-REQ-0359-V-02 (LVV-9751) satisfies the requirement on the maximum fraction of sensors with scientifically unusable pixels.

Associated element DMS-REQ-0359-V-03 (LVV-9752) satisfies the constraint on maximum fraction of outliers among non-saturated point sources.

Associated element DMS-REQ-0359-V-04 (LVV-9753) satisfies the accuracy of zero-point for colors that use the u-band.

Associated element DMS-REQ-0359-V-05 (LVV-9754) satisfies the repeatability outlier limit in g, r, and i-bands.

Associated element DMS-REQ-0359-V-06 (LVV-9755) satisfies the constraint on the accuracy of the transformation from internal to physical photometric scales.

Associated element DMS-REQ-0359-V-07 (LVV-9756) satisfies the rms width of the internal photometric zero-point in u-band.

Associated element DMS-REQ-0359-V-08 (LVV-9757) satisfies the maximum local significance of imperfect crosstalk corrections.

Associated element DMS-REQ-0359-V-10 (LVV-9759) satisfies the rms photometric repeatability in g, r, and i-bands.

Associated element DMS-REQ-0359-V-11 (LVV-9760) satisfies the fraction of zero-point errors that can exceed the outlier limit.

Associated element DMS-REQ-0359-V-12 (LVV-9761) satisfies the maximum fraction of unusable pixels per sensor.

Associated element DMS-REQ-0359-V-13 (LVV-9762) satisfies the maximum allowable precision in the sky brightness determination.

Associated element DMS-REQ-0359-V-14 (LVV-9763) satisfies the rms width of the internal photometric zero-point in g, r, i, z, and y-bands.

Associated element DMS-REQ-0359-V-15 (LVV-9764) satisfies the percentage of the image area affected by ghosts that exceed the threshold.

Associated element DMS-REQ-0359-V-16 (LVV-9765) satisfies the accuracy of zero-point for colors that do not include the u-band.

Associated element DMS-REQ-0359-V-17 (LVV-9766) satisfies the maximum RMS of the ratio of the flux measurement error between resolved/unresolved sources.

Requirement Details

Requirement ID	DMS-REQ-0359
Requirement Description	Specification: The DMS shall include software to enable the calculation of the photometric performance metrics defined in OSS-REQ-0387.

Requirement Parameters	<p>[GhostAF = 1[percent] Percentage of image area that can have ghosts with surface brightness gradient amplitude of more than 1/3 of the sky noise over 1 arcsec., PF1 = 10[percent] The maximum fraction of isolated non-saturated point source measurements exceeding the outlier limit., PA1gri = 5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the g, r, and i filters., PA3 = 10[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) for all bands except u-band., PA4 = 15[millimagnitude] The zero point error outlier limit., PF2 = 10[percent] Fraction of zeropoint errors that can exceed the zero point error outlier limit., PixFrac = 1[percent] The maximum fraction of pixels scientifically unusable per sensor out of the total allowable fraction of sensors meeting this performance., PA1uzy = 7.5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the u, z, and y filters., PA6 = 10[millimagnitude] Accuracy of the transformation of the internal LSST photometry to a physical scale (e.g. AB magnitudes), Xtalk = 3[sigma] The maximum local significance integrated over the PSF of imperfect crosstalk corrections., PA5u = 10[millimagnitude] Accuracy of absolute band-to-band color zero-point for colors constructed using the u-band., ResSource = 2[unitless] Maximum RMS of the ratio of the error in integrated flux measurement between bright, isolated, resolved sources less than 10 arcsec in diameter and bright, isolated unresolved point sources., PA2uzy = 22.5[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the u, z, and y filters., SensorFraction = 15[percent] The maximum allowable fraction of sensors with PixFrac scientifically unusable pixels., PA3u = 20[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) in the u-band., PA2gri = 15[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the g, r, and i filters., SBPrec = 1[percent] The maximum error in the precision of the sky brightness determination., PA5 = 5[millimagnitude] Accuracy of absolute band-to-band color zero-point for all colors constructed from any filter pair, excluding the u-band.]</p>	
Requirement Discussion	<p>Discussion: The relevant metrics are listed in the table photometricPerformance below. The values in the tables are the target values for LSST but are not verified as part of this requirement.</p>	
Requirement Priority	1a	
Upper Level Requirement	OSS-REQ-0387	Photometric Performance

2.118.1 Test Cases Summary

LVV-T1758	Verify calculation of photometric outliers in uzy bands			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Approved	1	false	Test

Objective:

Verify that the DM system has provided the code to calculate the photometric repeatability in the u, z, and y filters, and assess whether it meets the requirement that no more than **PF1 = 10[percent]** of the repeatability outliers exceed the outlier limit of **PA2uzy = 22.5 millimagnitudes**.

Draft

2.119 [LVV-9759] DMS-REQ-0359-V-10: RMS photometric repeatability in gri

Jira Link	Assignee	Status	Test Cases
LVV-9759	Leanne Guy	Not Covered	LVV-T1757

Verification Element Description:

The RMS photometric repeatability of bright non-saturated unresolved point sources in the g, r, and i filters must be less than $\hat{\Delta} \text{PA1gri} = 5$ millimagnitudes.

Associated element DMS-REQ-0359-V-01 (LVV-3401) satisfies the requirement on photometric repeatability in the u, z, and y-band filters.

Associated element DMS-REQ-0359-V-02 (LVV-9751) satisfies the requirement on the maximum fraction of sensors with scientifically unusable pixels.

Associated element DMS-REQ-0359-V-03 (LVV-9752) satisfies the constraint on maximum fraction of outliers among non-saturated point sources.

Associated element DMS-REQ-0359-V-04 (LVV-9753) satisfies the accuracy of zero-point for colors that use the u-band.

Associated element DMS-REQ-0359-V-05 (LVV-9754) satisfies the repeatability outlier limit in g, r, and i-bands.

Associated element DMS-REQ-0359-V-06 (LVV-9755) satisfies the constraint on the accuracy of the transformation from internal to physical photometric scales.

Associated element DMS-REQ-0359-V-07 (LVV-9756) satisfies the rms width of the internal photometric zero-point in u-band.

Associated element DMS-REQ-0359-V-08 (LVV-9757) satisfies the maximum local significance of imperfect crosstalk corrections.

Associated element DMS-REQ-0359-V-09 (LVV-9758) satisfies the repeatability outlier limit in u, z, and y-bands.

Associated element DMS-REQ-0359-V-11 (LVV-9760) satisfies the fraction of zero-point errors that can exceed the outlier limit.

Associated element DMS-REQ-0359-V-12 (LVV-9761) satisfies the maximum fraction of unusable pixels per sensor.

Associated element DMS-REQ-0359-V-13 (LVV-9762) satisfies the maximum allowable precision in the sky brightness determination.

Associated element DMS-REQ-0359-V-14 (LVV-9763) satisfies the rms width of the internal photometric zero-point in g, r, i, z, and y-bands.

Associated element DMS-REQ-0359-V-15 (LVV-9764) satisfies the percentage of the image area affected by ghosts that exceed the threshold.

Associated element DMS-REQ-0359-V-16 (LVV-9765) satisfies the accuracy of zero-point for colors that do not include the u-band.

Associated element DMS-REQ-0359-V-17 (LVV-9766) satisfies the maximum RMS of the ratio of the flux measurement error between resolved/unresolved sources.

Requirement Details

Requirement ID	DMS-REQ-0359
Requirement Description	Specification: The DMS shall include software to enable the calculation of the photometric performance metrics defined in OSS-REQ-0387.

Requirement Parameters	<p>[GhostAF = 1[percent]] Percentage of image area that can have ghosts with surface brightness gradient amplitude of more than 1/3 of the sky noise over 1 arcsec., PF1 = 10[percent] The maximum fraction of isolated non-saturated point source measurements exceeding the outlier limit., PA1gri = 5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the g, r, and i filters., PA3 = 10[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) for all bands except u-band., PA4 = 15[millimagnitude] The zero point error outlier limit., PF2 = 10[percent] Fraction of zeropoint errors that can exceed the zero point error outlier limit., PixFrac = 1[percent] The maximum fraction of pixels scientifically unusable per sensor out of the total allowable fraction of sensors meeting this performance., PA1uzy = 7.5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the u, z, and y filters., PA6 = 10[millimagnitude] Accuracy of the transformation of the internal LSST photometry to a physical scale (e.g. AB magnitudes), Xtalk = 3[sigma] The maximum local significance integrated over the PSF of imperfect crosstalk corrections., PA5u = 10[millimagnitude] Accuracy of absolute band-to-band color zero-point for colors constructed using the u-band., ResSource = 2[unitless] Maximum RMS of the ratio of the error in integrated flux measurement between bright, isolated, resolved sources less than 10 arcsec in diameter and bright, isolated unresolved point sources., PA2uzy = 22.5[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the u, z, and y filters., SensorFraction = 15[percent] The maximum allowable fraction of sensors with PixFrac scientifically unusable pixels., PA3u = 20[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) in the u-band., PA2gri = 15[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the g, r, and i filters., SBPrec = 1[percent] The maximum error in the precision of the sky brightness determination., PA5 = 5[millimagnitude] Accuracy of absolute band-to-band color zero-point for all colors constructed from any filter pair, excluding the u-band.]</p>	
Requirement Discussion	<p>Discussion: The relevant metrics are listed in the table photometricPerformance below. The values in the tables are the target values for LSST but are not verified as part of this requirement.</p>	
Requirement Priority	1a	
Upper Level Requirement	OSS-REQ-0387	Photometric Performance

2.119.1 Test Cases Summary

LVV-T1757	Verify calculation of photometric repeatability in gri filters			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Approved	1	false	Test

Objective:

Verify that the DM system has provided the code to calculate the RMS photometric repeatability of bright non-saturated unresolved point sources in the g, r, and i filters, and assess whether it meets the requirement that it shall be less than **PA1gri = 5.0 millimagnitudes**.

Draft

2.120 [LVV-9760] DMS-REQ-0359-V-11: Fraction of zero point outliers

Jira Link	Assignee	Status	Test Cases
LVV-9760	Leanne Guy	Not Covered	LVV-T377 LVV-T1842

Verification Element Description:

The fraction of zeropoint errors that can exceed the zero point error outlier limit is less than **PF2 = 10 percent**.

Associated element DMS-REQ-0359-V-01 (LVV-3401) satisfies the requirement on photometric repeatability in the u, z, and y-band filters.

Associated element DMS-REQ-0359-V-02 (LVV-9751) satisfies the requirement on the maximum fraction of sensors with scientifically unusable pixels.

Associated element DMS-REQ-0359-V-03 (LVV-9752) satisfies the constraint on maximum fraction of outliers among non-saturated point sources.

Associated element DMS-REQ-0359-V-04 (LVV-9753) satisfies the accuracy of zero-point for colors that use the u-band.

Associated element DMS-REQ-0359-V-05 (LVV-9754) satisfies the repeatability outlier limit in g, r, and i-bands.

Associated element DMS-REQ-0359-V-06 (LVV-9755) satisfies the constraint on the accuracy of the transformation from internal to physical photometric scales.

Associated element DMS-REQ-0359-V-07 (LVV-9756) satisfies the rms width of the internal photometric zero-point in u-band.

Associated element DMS-REQ-0359-V-08 (LVV-9757) satisfies the maximum local significance of imperfect crosstalk corrections.

Associated element DMS-REQ-0359-V-09 (LVV-9758) satisfies the repeatability outlier limit in u, z, and y-bands.

Associated element DMS-REQ-0359-V-10 (LVV-9759) satisfies the rms photometric repeatability in g, r, and i-bands.

Associated element DMS-REQ-0359-V-12 (LVV-9761) satisfies the maximum fraction of unusable pixels per sensor.

Associated element DMS-REQ-0359-V-13 (LVV-9762) satisfies the maximum allowable precision in the sky brightness determination.

Associated element DMS-REQ-0359-V-14 (LVV-9763) satisfies the rms width of the internal photometric zero-point in g, r, i, z, and y-bands.

Associated element DMS-REQ-0359-V-15 (LVV-9764) satisfies the percentage of the image area affected by ghosts that exceed the threshold.

Associated element DMS-REQ-0359-V-16 (LVV-9765) satisfies the accuracy of zero-point for colors that do not include the u-band.

Associated element DMS-REQ-0359-V-17 (LVV-9766) satisfies the maximum RMS of the ratio of the flux measurement error between resolved/unresolved sources.

Requirement Details

Requirement ID	DMS-REQ-0359
Requirement Description	Specification: The DMS shall include software to enable the calculation of the photometric performance metrics defined in OSS-REQ-0387.

Requirement Parameters	<p>[GhostAF = 1[percent]] Percentage of image area that can have ghosts with surface brightness gradient amplitude of more than 1/3 of the sky noise over 1 arcsec., PF1 = 10[percent] The maximum fraction of isolated non-saturated point source measurements exceeding the outlier limit., PA1gri = 5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the g, r, and i filters., PA3 = 10[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) for all bands except u-band., PA4 = 15[millimagnitude] The zero point error outlier limit., PF2 = 10[percent] Fraction of zeropoint errors that can exceed the zero point error outlier limit., PixFrac = 1[percent] The maximum fraction of pixels scientifically unusable per sensor out of the total allowable fraction of sensors meeting this performance., PA1uzy = 7.5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the u, z, and y filters., PA6 = 10[millimagnitude] Accuracy of the transformation of the internal LSST photometry to a physical scale (e.g. AB magnitudes), Xtalk = 3[sigma] The maximum local significance integrated over the PSF of imperfect crosstalk corrections., PA5u = 10[millimagnitude] Accuracy of absolute band-to-band color zero-point for colors constructed using the u-band., ResSource = 2[unitless] Maximum RMS of the ratio of the error in integrated flux measurement between bright, isolated, resolved sources less than 10 arcsec in diameter and bright, isolated unresolved point sources., PA2uzy = 22.5[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the u, z, and y filters., SensorFraction = 15[percent] The maximum allowable fraction of sensors with PixFrac scientifically unusable pixels., PA3u = 20[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) in the u-band., PA2gri = 15[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the g, r, and i filters., SBPrec = 1[percent] The maximum error in the precision of the sky brightness determination., PA5 = 5[millimagnitude] Accuracy of absolute band-to-band color zero-point for all colors constructed from any filter pair, excluding the u-band.]</p>	
Requirement Discussion	<p>Discussion: The relevant metrics are listed in the table photometricPerformance below. The values in the tables are the target values for LSST but are not verified as part of this requirement.</p>	
Requirement Priority	1a	
Upper Level Requirement	OSS-REQ-0387	Photometric Performance

2.120.1 Test Cases Summary

LVV-T377	Verify Calculation of Photometric Performance Metrics			
Owner	Status	Version	Critical Event	Verification Type
Leanne Guy	Approved	1	false	Test

Objective:

Verify that the DMS system provides software to calculate photometric performance metrics, and that the algorithms are properly calculating the desired quantities. Note that because the DMS requirement is that the software shall be provided (and not on the actual measured values of the metrics), we verify all of the requirements via a single test case.

LVV-T1842	Verify calculation of zeropoint error fraction exceeding the outlier limit			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Draft	1	false	Test

Objective:

Verify that the DM system provides software to calculate the fraction of zeropoint errors that exceed the zero point error outlier limit, and confirm that it is less than **PF2 = 10 percent**.

2.121 [LVV-9761] DMS-REQ-0359-V-12: Max fraction of unusable pixels per sensor

Jira Link	Assignee	Status	Test Cases
LVV-9761	Leanne Guy	Not Covered	LVV-T377 LVV-T1841

Verification Element Description:

The maximum fraction of pixels scientifically unusable per sensor out of the total allowable fraction of sensors meeting this performance shall be **PixFrac = 1 percent**.

Associated element DMS-REQ-0359-V-01 (LVV-3401) satisfies the requirement on photometric repeatability in the u, z, and y-band filters.

Associated element DMS-REQ-0359-V-02 (LVV-9751) satisfies the requirement on the maximum fraction of sensors with scientifically unusable pixels.

Associated element DMS-REQ-0359-V-03 (LVV-9752) satisfies the constraint on maximum fraction of outliers among non-saturated point sources.

Associated element DMS-REQ-0359-V-04 (LVV-9753) satisfies the accuracy of zero-point for colors that use the u-band.

Associated element DMS-REQ-0359-V-05 (LVV-9754) satisfies the repeatability outlier limit in g, r, and i-bands.

Associated element DMS-REQ-0359-V-06 (LVV-9755) satisfies the constraint on the accuracy of the transformation from internal to physical photometric scales.

Associated element DMS-REQ-0359-V-07 (LVV-9756) satisfies the rms width of the internal photometric zero-point in u-band.

Associated element DMS-REQ-0359-V-08 (LVV-9757) satisfies the maximum local significance of imperfect crosstalk corrections.

Associated element DMS-REQ-0359-V-09 (LVV-9758) satisfies the repeatability outlier limit in

u, z, and y-bands.

Associated element DMS-REQ-0359-V-10 (LVV-9759) satisfies the rms photometric repeatability in g, r, and i-bands.

Associated element DMS-REQ-0359-V-11 (LVV-9760) satisfies the fraction of zero-point errors that can exceed the outlier limit.

Associated element DMS-REQ-0359-V-13 (LVV-9762) satisfies the maximum allowable precision in the sky brightness determination.

Associated element DMS-REQ-0359-V-14 (LVV-9763) satisfies the rms width of the internal photometric zero-point in g, r, i, z, and y-bands.

Associated element DMS-REQ-0359-V-15 (LVV-9764) satisfies the percentage of the image area affected by ghosts that exceed the threshold.

Associated element DMS-REQ-0359-V-16 (LVV-9765) satisfies the accuracy of zero-point for colors that do not include the u-band.

Associated element DMS-REQ-0359-V-17 (LVV-9766) satisfies the maximum RMS of the ratio of the flux measurement error between resolved/unresolved sources.

Requirement Details

Requirement ID	DMS-REQ-0359
Requirement Description	Specification: The DMS shall include software to enable the calculation of the photometric performance metrics defined in OSS-REQ-0387.

Requirement Parameters	<p>[GhostAF = 1[percent]] Percentage of image area that can have ghosts with surface brightness gradient amplitude of more than 1/3 of the sky noise over 1 arcsec., PF1 = 10[percent] The maximum fraction of isolated non-saturated point source measurements exceeding the outlier limit., PA1gri = 5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the g, r, and i filters., PA3 = 10[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) for all bands except u-band., PA4 = 15[millimagnitude] The zero point error outlier limit., PF2 = 10[percent] Fraction of zeropoint errors that can exceed the zero point error outlier limit., PixFrac = 1[percent] The maximum fraction of pixels scientifically unusable per sensor out of the total allowable fraction of sensors meeting this performance., PA1uzy = 7.5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the u, z, and y filters., PA6 = 10[millimagnitude] Accuracy of the transformation of the internal LSST photometry to a physical scale (e.g. AB magnitudes), Xtalk = 3[sigma] The maximum local significance integrated over the PSF of imperfect crosstalk corrections., PA5u = 10[millimagnitude] Accuracy of absolute band-to-band color zero-point for colors constructed using the u-band., ResSource = 2[unitless] Maximum RMS of the ratio of the error in integrated flux measurement between bright, isolated, resolved sources less than 10 arcsec in diameter and bright, isolated unresolved point sources., PA2uzy = 22.5[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the u, z, and y filters., SensorFraction = 15[percent] The maximum allowable fraction of sensors with PixFrac scientifically unusable pixels., PA3u = 20[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) in the u-band., PA2gri = 15[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the g, r, and i filters., SBPrec = 1[percent] The maximum error in the precision of the sky brightness determination., PA5 = 5[millimagnitude] Accuracy of absolute band-to-band color zero-point for all colors constructed from any filter pair, excluding the u-band.]</p>	
Requirement Discussion	<p>Discussion: The relevant metrics are listed in the table photometricPerformance below. The values in the tables are the target values for LSST but are not verified as part of this requirement.</p>	
Requirement Priority	1a	
Upper Level Requirement	OSS-REQ-0387	Photometric Performance

2.121.1 Test Cases Summary

LVV-T377	Verify Calculation of Photometric Performance Metrics			
Owner	Status	Version	Critical Event	Verification Type
Leanne Guy	Approved	1	false	Test

Objective:

Verify that the DMS system provides software to calculate photometric performance metrics, and that the algorithms are properly calculating the desired quantities. Note that because the DMS requirement is that the software shall be provided (and not on the actual measured values of the metrics), we verify all of the requirements via a single test case.

LVV-T1841	Verify calculation of scientifically unusable pixel fraction			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Draft	1	false	Test

Objective:

Verify that the DM system provides software to assess whether the maximum fraction of pixels scientifically unusable per sensor out of the total allowable fraction of sensors meeting this performance is less than **PixFrac = 1 percent**.

2.122 [LVV-9762] DMS-REQ-0359-V-13: Max sky brightness error

Jira Link	Assignee	Status	Test Cases
LVV-9762	Leanne Guy	Not Covered	LVV-T377 LVV-T1840

Verification Element Description:

The maximum error in the precision of the sky brightness determination shall be less than **SBPrec = 1 percent**.

Associated element DMS-REQ-0359-V-01 (LVV-3401) satisfies the requirement on photometric repeatability in the u, z, and y-band filters.

Associated element DMS-REQ-0359-V-02 (LVV-9751) satisfies the requirement on the maximum fraction of sensors with scientifically unusable pixels.

Associated element DMS-REQ-0359-V-03 (LVV-9752) satisfies the constraint on maximum fraction of outliers among non-saturated point sources.

Associated element DMS-REQ-0359-V-04 (LVV-9753) satisfies the accuracy of zero-point for colors that use the u-band.

Associated element DMS-REQ-0359-V-05 (LVV-9754) satisfies the repeatability outlier limit in g, r, and i-bands.

Associated element DMS-REQ-0359-V-06 (LVV-9755) satisfies the constraint on the accuracy of the transformation from internal to physical photometric scales.

Associated element DMS-REQ-0359-V-07 (LVV-9756) satisfies the rms width of the internal photometric zero-point in u-band.

Associated element DMS-REQ-0359-V-08 (LVV-9757) satisfies the maximum local significance of imperfect crosstalk corrections.

Associated element DMS-REQ-0359-V-09 (LVV-9758) satisfies the repeatability outlier limit in u, z, and y-bands.

Associated element DMS-REQ-0359-V-10 (LVV-9759) satisfies the rms photometric repeatability in g, r, and i-bands.

Associated element DMS-REQ-0359-V-11 (LVV-9760) satisfies the fraction of zero-point errors that can exceed the outlier limit.

Associated element DMS-REQ-0359-V-12 (LVV-9761) satisfies the maximum fraction of unusable pixels per sensor.

Associated element DMS-REQ-0359-V-14 (LVV-9763) satisfies the rms width of the internal photometric zero-point in g, r, i, z, and y-bands.

Associated element DMS-REQ-0359-V-15 (LVV-9764) satisfies the percentage of the image area affected by ghosts that exceed the threshold.

Associated element DMS-REQ-0359-V-16 (LVV-9765) satisfies the accuracy of zero-point for colors that do not include the u-band.

Associated element DMS-REQ-0359-V-17 (LVV-9766) satisfies the maximum RMS of the ratio of the flux measurement error between resolved/unresolved sources.

Requirement Details

Requirement ID	DMS-REQ-0359
Requirement Description	Specification: The DMS shall include software to enable the calculation of the photometric performance metrics defined in OSS-REQ-0387.

Requirement Parameters	<p>[GhostAF = 1[percent] Percentage of image area that can have ghosts with surface brightness gradient amplitude of more than 1/3 of the sky noise over 1 arcsec., PF1 = 10[percent] The maximum fraction of isolated non-saturated point source measurements exceeding the outlier limit., PA1gri = 5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the g, r, and i filters., PA3 = 10[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) for all bands except u-band., PA4 = 15[millimagnitude] The zero point error outlier limit., PF2 = 10[percent] Fraction of zeropoint errors that can exceed the zero point error outlier limit., PixFrac = 1[percent] The maximum fraction of pixels scientifically unusable per sensor out of the total allowable fraction of sensors meeting this performance., PA1uzy = 7.5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the u, z, and y filters., PA6 = 10[millimagnitude] Accuracy of the transformation of the internal LSST photometry to a physical scale (e.g. AB magnitudes), Xtalk = 3[sigma] The maximum local significance integrated over the PSF of imperfect crosstalk corrections., PA5u = 10[millimagnitude] Accuracy of absolute band-to-band color zero-point for colors constructed using the u-band., ResSource = 2[unitless] Maximum RMS of the ratio of the error in integrated flux measurement between bright, isolated, resolved sources less than 10 arcsec in diameter and bright, isolated unresolved point sources., PA2uzy = 22.5[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the u, z, and y filters., SensorFraction = 15[percent] The maximum allowable fraction of sensors with PixFrac scientifically unusable pixels., PA3u = 20[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) in the u-band., PA2gri = 15[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the g, r, and i filters., SBPrec = 1[percent] The maximum error in the precision of the sky brightness determination., PA5 = 5[millimagnitude] Accuracy of absolute band-to-band color zero-point for all colors constructed from any filter pair, excluding the u-band.]</p>	
Requirement Discussion	<p>Discussion: The relevant metrics are listed in the table photometricPerformance below. The values in the tables are the target values for LSST but are not verified as part of this requirement.</p>	
Requirement Priority	1a	
Upper Level Requirement	OSS-REQ-0387	Photometric Performance

2.122.1 Test Cases Summary

LVV-T377	Verify Calculation of Photometric Performance Metrics			
Owner	Status	Version	Critical Event	Verification Type
Leanne Guy	Approved	1	false	Test

Objective:

Verify that the DMS system provides software to calculate photometric performance metrics, and that the algorithms are properly calculating the desired quantities. Note that because the DMS requirement is that the software shall be provided (and not on the actual measured values of the metrics), we verify all of the requirements via a single test case.

LVV-T1840	Verify calculation of sky brightness precision			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Draft	1	false	Test

Objective:

Verify that the DM system provides software to assess whether the maximum error in the precision of the sky brightness determination is less than **SBPrec = 1 percent**.

2.123 [LVV-9763] DMS-REQ-0359-V-14: RMS width of zero point in all bands except u

Jira Link	Assignee	Status	Test Cases
LVV-9763	Leanne Guy	Not Covered	LVV-T377 LVV-T1839

Verification Element Description:

The RMS width of the internal photometric zero-point (precision of system uniformity across the sky) for all bands except u-band shall be less than **PA3 = 10 millimagnitudes**.

Associated element DMS-REQ-0359-V-01 (LVV-3401) satisfies the requirement on photometric repeatability in the u, z, and y-band filters.

Associated element DMS-REQ-0359-V-02 (LVV-9751) satisfies the requirement on the maximum fraction of sensors with scientifically unusable pixels.

Associated element DMS-REQ-0359-V-03 (LVV-9752) satisfies the constraint on maximum fraction of outliers among non-saturated point sources.

Associated element DMS-REQ-0359-V-04 (LVV-9753) satisfies the accuracy of zero-point for colors that use the u-band.

Associated element DMS-REQ-0359-V-05 (LVV-9754) satisfies the repeatability outlier limit in g, r, and i-bands.

Associated element DMS-REQ-0359-V-06 (LVV-9755) satisfies the constraint on the accuracy of the transformation from internal to physical photometric scales.

Associated element DMS-REQ-0359-V-07 (LVV-9756) satisfies the rms width of the internal photometric zero-point in u-band.

Associated element DMS-REQ-0359-V-08 (LVV-9757) satisfies the maximum local significance of imperfect crosstalk corrections.

Associated element DMS-REQ-0359-V-09 (LVV-9758) satisfies the repeatability outlier limit in

u, z, and y-bands.

Associated element DMS-REQ-0359-V-10 (LVV-9759) satisfies the rms photometric repeatability in g, r, and i-bands.

Associated element DMS-REQ-0359-V-11 (LVV-9760) satisfies the fraction of zero-point errors that can exceed the outlier limit.

Associated element DMS-REQ-0359-V-12 (LVV-9761) satisfies the maximum fraction of unusable pixels per sensor.

Associated element DMS-REQ-0359-V-13 (LVV-9762) satisfies the maximum allowable precision in the sky brightness determination.

Associated element DMS-REQ-0359-V-15 (LVV-9764) satisfies the percentage of the image area affected by ghosts that exceed the threshold.

Associated element DMS-REQ-0359-V-16 (LVV-9765) satisfies the accuracy of zero-point for colors that do not include the u-band.

Associated element DMS-REQ-0359-V-17 (LVV-9766) satisfies the maximum RMS of the ratio of the flux measurement error between resolved/unresolved sources.

Requirement Details

Requirement ID	DMS-REQ-0359
Requirement Description	Specification: The DMS shall include software to enable the calculation of the photometric performance metrics defined in OSS-REQ-0387.

Requirement Parameters	<p>[GhostAF = 1[percent]] Percentage of image area that can have ghosts with surface brightness gradient amplitude of more than 1/3 of the sky noise over 1 arcsec., PF1 = 10[percent] The maximum fraction of isolated non-saturated point source measurements exceeding the outlier limit., PA1gri = 5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the g, r, and i filters., PA3 = 10[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) for all bands except u-band., PA4 = 15[millimagnitude] The zero point error outlier limit., PF2 = 10[percent] Fraction of zeropoint errors that can exceed the zero point error outlier limit., PixFrac = 1[percent] The maximum fraction of pixels scientifically unusable per sensor out of the total allowable fraction of sensors meeting this performance., PA1uzy = 7.5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the u, z, and y filters., PA6 = 10[millimagnitude] Accuracy of the transformation of the internal LSST photometry to a physical scale (e.g. AB magnitudes), Xtalk = 3[sigma] The maximum local significance integrated over the PSF of imperfect crosstalk corrections., PA5u = 10[millimagnitude] Accuracy of absolute band-to-band color zero-point for colors constructed using the u-band., ResSource = 2[unitless] Maximum RMS of the ratio of the error in integrated flux measurement between bright, isolated, resolved sources less than 10 arcsec in diameter and bright, isolated unresolved point sources., PA2uzy = 22.5[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the u, z, and y filters., SensorFraction = 15[percent] The maximum allowable fraction of sensors with PixFrac scientifically unusable pixels., PA3u = 20[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) in the u-band., PA2gri = 15[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the g, r, and i filters., SBPrec = 1[percent] The maximum error in the precision of the sky brightness determination., PA5 = 5[millimagnitude] Accuracy of absolute band-to-band color zero-point for all colors constructed from any filter pair, excluding the u-band.]</p>	
Requirement Discussion	<p>Discussion: The relevant metrics are listed in the table photometricPerformance below. The values in the tables are the target values for LSST but are not verified as part of this requirement.</p>	
Requirement Priority	1a	
Upper Level Requirement	OSS-REQ-0387	Photometric Performance

2.123.1 Test Cases Summary

LVV-T377	Verify Calculation of Photometric Performance Metrics			
Owner	Status	Version	Critical Event	Verification Type
Leanne Guy	Approved	1	false	Test

Objective:

Verify that the DMS system provides software to calculate photometric performance metrics, and that the algorithms are properly calculating the desired quantities. Note that because the DMS requirement is that the software shall be provided (and not on the actual measured values of the metrics), we verify all of the requirements via a single test case.

LVV-T1839	Verify calculation of RMS width of photometric zeropoint			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Draft	1	false	Test

Objective:

Verify that the DM system provides code to assess whether the RMS width of the internal photometric zero-point (precision of system uniformity across the sky) for all bands except u-band is less than **PA3 = 10 millimagnitudes**.

2.124 [LVV-9764] DMS-REQ-0359-V-15: Percentage of image area with ghosts

Jira Link	Assignee	Status	Test Cases
LVV-9764	Leanne Guy	Not Covered	LVV-T377 LVV-T1838

Verification Element Description:

The percentage of image area that has ghosts with surface brightness gradient amplitude of more than $1/3$ of the sky noise over 1 arcsec shall be less than **GhostAF = 1 percent**.

Associated element DMS-REQ-0359-V-01 (LVV-3401) satisfies the requirement on photometric repeatability in the u, z, and y-band filters.

Associated element DMS-REQ-0359-V-02 (LVV-9751) satisfies the requirement on the maximum fraction of sensors with scientifically unusable pixels.

Associated element DMS-REQ-0359-V-03 (LVV-9752) satisfies the constraint on maximum fraction of outliers among non-saturated point sources.

Associated element DMS-REQ-0359-V-04 (LVV-9753) satisfies the accuracy of zero-point for colors that use the u-band.

Associated element DMS-REQ-0359-V-05 (LVV-9754) satisfies the repeatability outlier limit in g, r, and i-bands.

Associated element DMS-REQ-0359-V-06 (LVV-9755) satisfies the constraint on the accuracy of the transformation from internal to physical photometric scales.

Associated element DMS-REQ-0359-V-07 (LVV-9756) satisfies the rms width of the internal photometric zero-point in u-band.

Associated element DMS-REQ-0359-V-08 (LVV-9757) satisfies the maximum local significance of imperfect crosstalk corrections.

Associated element DMS-REQ-0359-V-09 (LVV-9758) satisfies the repeatability outlier limit in u, z, and y-bands.

Associated element DMS-REQ-0359-V-10 (LVV-9759) satisfies the rms photometric repeatability in g, r, and i-bands.

Associated element DMS-REQ-0359-V-11 (LVV-9760) satisfies the fraction of zero-point errors that can exceed the outlier limit.

Associated element DMS-REQ-0359-V-12 (LVV-9761) satisfies the maximum fraction of unusable pixels per sensor.

Associated element DMS-REQ-0359-V-13 (LVV-9762) satisfies the maximum allowable precision in the sky brightness determination.

Associated element DMS-REQ-0359-V-14 (LVV-9763) satisfies the rms width of the internal photometric zero-point in g, r, i, z, and y-bands.

Associated element DMS-REQ-0359-V-16 (LVV-9765) satisfies the accuracy of zero-point for colors that do not include the u-band.

Associated element DMS-REQ-0359-V-17 (LVV-9766) satisfies the maximum RMS of the ratio of the flux measurement error between resolved/unresolved sources.

Requirement Details

Requirement ID	DMS-REQ-0359
Requirement Description	Specification: The DMS shall include software to enable the calculation of the photometric performance metrics defined in OSS-REQ-0387.

Requirement Parameters	<p>[GhostAF = 1[percent]] Percentage of image area that can have ghosts with surface brightness gradient amplitude of more than 1/3 of the sky noise over 1 arcsec., PF1 = 10[percent] The maximum fraction of isolated non-saturated point source measurements exceeding the outlier limit., PA1gri = 5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the g, r, and i filters., PA3 = 10[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) for all bands except u-band., PA4 = 15[millimagnitude] The zero point error outlier limit., PF2 = 10[percent] Fraction of zeropoint errors that can exceed the zero point error outlier limit., PixFrac = 1[percent] The maximum fraction of pixels scientifically unusable per sensor out of the total allowable fraction of sensors meeting this performance., PA1uzy = 7.5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the u, z, and y filters., PA6 = 10[millimagnitude] Accuracy of the transformation of the internal LSST photometry to a physical scale (e.g. AB magnitudes), Xtalk = 3[sigma] The maximum local significance integrated over the PSF of imperfect crosstalk corrections., PA5u = 10[millimagnitude] Accuracy of absolute band-to-band color zero-point for colors constructed using the u-band., ResSource = 2[unitless] Maximum RMS of the ratio of the error in integrated flux measurement between bright, isolated, resolved sources less than 10 arcsec in diameter and bright, isolated unresolved point sources., PA2uzy = 22.5[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the u, z, and y filters., SensorFraction = 15[percent] The maximum allowable fraction of sensors with PixFrac scientifically unusable pixels., PA3u = 20[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) in the u-band., PA2gri = 15[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the g, r, and i filters., SBPrec = 1[percent] The maximum error in the precision of the sky brightness determination., PA5 = 5[millimagnitude] Accuracy of absolute band-to-band color zero-point for all colors constructed from any filter pair, excluding the u-band.]</p>	
Requirement Discussion	<p>Discussion: The relevant metrics are listed in the table photometricPerformance below. The values in the tables are the target values for LSST but are not verified as part of this requirement.</p>	
Requirement Priority	1a	
Upper Level Requirement	OSS-REQ-0387	Photometric Performance

2.124.1 Test Cases Summary

LVV-T377	Verify Calculation of Photometric Performance Metrics			
Owner	Status	Version	Critical Event	Verification Type
Leanne Guy	Approved	1	false	Test

Objective:

Verify that the DMS system provides software to calculate photometric performance metrics, and that the algorithms are properly calculating the desired quantities. Note that because the DMS requirement is that the software shall be provided (and not on the actual measured values of the metrics), we verify all of the requirements via a single test case.

LVV-T1838	Verify calculation of image fraction affected by ghosts			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Draft	1	false	Test

Objective:

Verify that the DM system provides code to assess whether the percentage of image area that has ghosts with surface brightness gradient amplitude of more than 1/3 of the sky noise over 1 arcsec is less than **GhostAF = 1 percent**.

2.125 [LVV-9765] DMS-REQ-0359-V-16: Accuracy of zero point for colors without u-band

Jira Link	Assignee	Status	Test Cases
LVV-9765	Leanne Guy	Not Covered	LVV-T377 LVV-T1837

Verification Element Description:

The accuracy of absolute band-to-band color zero-points for all colors constructed from any filter pair, excluding the u-band, shall be less than **PA5 = 5 millimagnitudes**.

Associated element DMS-REQ-0359-V-01 (LVV-3401) satisfies the requirement on photometric repeatability in the u, z, and y-band filters.

Associated element DMS-REQ-0359-V-02 (LVV-9751) satisfies the requirement on the maximum fraction of sensors with scientifically unusable pixels.

Associated element DMS-REQ-0359-V-03 (LVV-9752) satisfies the constraint on maximum fraction of outliers among non-saturated point sources.

Associated element DMS-REQ-0359-V-04 (LVV-9753) satisfies the accuracy of zero-point for colors that use the u-band.

Associated element DMS-REQ-0359-V-05 (LVV-9754) satisfies the repeatability outlier limit in g, r, and i-bands.

Associated element DMS-REQ-0359-V-06 (LVV-9755) satisfies the constraint on the accuracy of the transformation from internal to physical photometric scales.

Associated element DMS-REQ-0359-V-07 (LVV-9756) satisfies the rms width of the internal photometric zero-point in u-band.

Associated element DMS-REQ-0359-V-08 (LVV-9757) satisfies the maximum local significance of imperfect crosstalk corrections.

Associated element DMS-REQ-0359-V-09 (LVV-9758) satisfies the repeatability outlier limit in

u, z, and y-bands.

Associated element DMS-REQ-0359-V-10 (LVV-9759) satisfies the rms photometric repeatability in g, r, and i-bands.

Associated element DMS-REQ-0359-V-11 (LVV-9760) satisfies the fraction of zero-point errors that can exceed the outlier limit.

Associated element DMS-REQ-0359-V-12 (LVV-9761) satisfies the maximum fraction of unusable pixels per sensor.

Associated element DMS-REQ-0359-V-13 (LVV-9762) satisfies the maximum allowable precision in the sky brightness determination.

Associated element DMS-REQ-0359-V-14 (LVV-9763) satisfies the rms width of the internal photometric zero-point in g, r, i, z, and y-bands.

Associated element DMS-REQ-0359-V-15 (LVV-9764) satisfies the percentage of the image area affected by ghosts that exceed the threshold.

Associated element DMS-REQ-0359-V-17 (LVV-9766) satisfies the maximum RMS of the ratio of the flux measurement error between resolved/unresolved sources.

Requirement Details

Requirement ID	DMS-REQ-0359
Requirement Description	Specification: The DMS shall include software to enable the calculation of the photometric performance metrics defined in OSS-REQ-0387.

Requirement Parameters	<p>[GhostAF = 1[percent]] Percentage of image area that can have ghosts with surface brightness gradient amplitude of more than 1/3 of the sky noise over 1 arcsec., PF1 = 10[percent] The maximum fraction of isolated non-saturated point source measurements exceeding the outlier limit., PA1gri = 5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the g, r, and i filters., PA3 = 10[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) for all bands except u-band., PA4 = 15[millimagnitude] The zero point error outlier limit., PF2 = 10[percent] Fraction of zeropoint errors that can exceed the zero point error outlier limit., PixFrac = 1[percent] The maximum fraction of pixels scientifically unusable per sensor out of the total allowable fraction of sensors meeting this performance., PA1uzy = 7.5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the u, z, and y filters., PA6 = 10[millimagnitude] Accuracy of the transformation of the internal LSST photometry to a physical scale (e.g. AB magnitudes), Xtalk = 3[sigma] The maximum local significance integrated over the PSF of imperfect crosstalk corrections., PA5u = 10[millimagnitude] Accuracy of absolute band-to-band color zero-point for colors constructed using the u-band., ResSource = 2[unitless] Maximum RMS of the ratio of the error in integrated flux measurement between bright, isolated, resolved sources less than 10 arcsec in diameter and bright, isolated unresolved point sources., PA2uzy = 22.5[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the u, z, and y filters., SensorFraction = 15[percent] The maximum allowable fraction of sensors with PixFrac scientifically unusable pixels., PA3u = 20[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) in the u-band., PA2gri = 15[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the g, r, and i filters., SBPrec = 1[percent] The maximum error in the precision of the sky brightness determination., PA5 = 5[millimagnitude] Accuracy of absolute band-to-band color zero-point for all colors constructed from any filter pair, excluding the u-band.]</p>	
Requirement Discussion	<p>Discussion: The relevant metrics are listed in the table photometricPerformance below. The values in the tables are the target values for LSST but are not verified as part of this requirement.</p>	
Requirement Priority	1a	
Upper Level Requirement	OSS-REQ-0387	Photometric Performance

2.125.1 Test Cases Summary

LVV-T377	Verify Calculation of Photometric Performance Metrics			
Owner	Status	Version	Critical Event	Verification Type
Leanne Guy	Approved	1	false	Test

Objective:

Verify that the DMS system provides software to calculate photometric performance metrics, and that the algorithms are properly calculating the desired quantities. Note that because the DMS requirement is that the software shall be provided (and not on the actual measured values of the metrics), we verify all of the requirements via a single test case.

LVV-T1837	Verify calculation of band-to-band color zero-point accuracy			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Draft	1	false	Test

Objective:

Verify that the DM system provides code to assess whether the accuracy of absolute band-to-band color zero-points for all colors constructed from any filter pair, excluding the u-band, is less than **PA5 = 5 millimagnitudes**.

2.126 [LVV-9766] DMS-REQ-0359-V-17: Max RMS of resolved/unresolved flux ratio

Jira Link	Assignee	Status	Test Cases
LVV-9766	Leanne Guy	Not Covered	LVV-T377 LVV-T1836

Verification Element Description:

The maximum RMS of the ratio of the error in integrated flux measurement between bright, isolated, resolved sources less than 10 arcsec in diameter and bright, isolated unresolved point sources shall be less than **ResSource = 2**.

Associated element DMS-REQ-0359-V-01 (LVV-3401) satisfies the requirement on photometric repeatability in the u, z, and y-band filters.

Associated element DMS-REQ-0359-V-02 (LVV-9751) satisfies the requirement on the maximum fraction of sensors with scientifically unusable pixels.

Associated element DMS-REQ-0359-V-03 (LVV-9752) satisfies the constraint on maximum fraction of outliers among non-saturated point sources.

Associated element DMS-REQ-0359-V-04 (LVV-9753) satisfies the accuracy of zero-point for colors that use the u-band.

Associated element DMS-REQ-0359-V-05 (LVV-9754) satisfies the repeatability outlier limit in g, r, and i-bands.

Associated element DMS-REQ-0359-V-06 (LVV-9755) satisfies the constraint on the accuracy of the transformation from internal to physical photometric scales.

Associated element DMS-REQ-0359-V-07 (LVV-9756) satisfies the rms width of the internal photometric zero-point in u-band.

Associated element DMS-REQ-0359-V-08 (LVV-9757) satisfies the maximum local significance of imperfect crosstalk corrections.

Associated element DMS-REQ-0359-V-09 (LVV-9758) satisfies the repeatability outlier limit in u, z, and y-bands.

Associated element DMS-REQ-0359-V-10 (LVV-9759) satisfies the rms photometric repeatability in g, r, and i-bands.

Associated element DMS-REQ-0359-V-11 (LVV-9760) satisfies the fraction of zero-point errors that can exceed the outlier limit.

Associated element DMS-REQ-0359-V-12 (LVV-9761) satisfies the maximum fraction of unusable pixels per sensor.

Associated element DMS-REQ-0359-V-13 (LVV-9762) satisfies the maximum allowable precision in the sky brightness determination.

Associated element DMS-REQ-0359-V-14 (LVV-9763) satisfies the rms width of the internal photometric zero-point in g, r, i, z, and y-bands.

Associated element DMS-REQ-0359-V-15 (LVV-9764) satisfies the percentage of the image area affected by ghosts that exceed the threshold.

Associated element DMS-REQ-0359-V-16 (LVV-9765) satisfies the accuracy of zero-point for colors that do not include the u-band.

Requirement Details

Requirement ID	DMS-REQ-0359
Requirement Description	Specification: The DMS shall include software to enable the calculation of the photometric performance metrics defined in OSS-REQ-0387.

Requirement Parameters	<p>[GhostAF = 1[percent] Percentage of image area that can have ghosts with surface brightness gradient amplitude of more than 1/3 of the sky noise over 1 arcsec., PF1 = 10[percent] The maximum fraction of isolated non-saturated point source measurements exceeding the outlier limit., PA1gri = 5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the g, r, and i filters., PA3 = 10[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) for all bands except u-band., PA4 = 15[millimagnitude] The zero point error outlier limit., PF2 = 10[percent] Fraction of zeropoint errors that can exceed the zero point error outlier limit., PixFrac = 1[percent] The maximum fraction of pixels scientifically unusable per sensor out of the total allowable fraction of sensors meeting this performance., PA1uzy = 7.5[millimagnitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the u, z, and y filters., PA6 = 10[millimagnitude] Accuracy of the transformation of the internal LSST photometry to a physical scale (e.g. AB magnitudes), Xtalk = 3[sigma] The maximum local significance integrated over the PSF of imperfect crosstalk corrections., PA5u = 10[millimagnitude] Accuracy of absolute band-to-band color zero-point for colors constructed using the u-band., ResSource = 2[unitless] Maximum RMS of the ratio of the error in integrated flux measurement between bright, isolated, resolved sources less than 10 arcsec in diameter and bright, isolated unresolved point sources., PA2uzy = 22.5[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the u, z, and y filters., SensorFraction = 15[percent] The maximum allowable fraction of sensors with PixFrac scientifically unusable pixels., PA3u = 20[millimagnitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) in the u-band., PA2gri = 15[millimagnitude] Repeatability outlier limit for isolated bright non-saturated point sources in the g, r, and i filters., SBPrec = 1[percent] The maximum error in the precision of the sky brightness determination., PA5 = 5[millimagnitude] Accuracy of absolute band-to-band color zero-point for all colors constructed from any filter pair, excluding the u-band.]</p>	
Requirement Discussion	<p>Discussion: The relevant metrics are listed in the table photometricPerformance below. The values in the tables are the target values for LSST but are not verified as part of this requirement.</p>	
Requirement Priority	1a	
Upper Level Requirement	OSS-REQ-0387	Photometric Performance

2.126.1 Test Cases Summary

LVV-T377	Verify Calculation of Photometric Performance Metrics			
Owner	Status	Version	Critical Event	Verification Type
Leanne Guy	Approved	1	false	Test

Objective:

Verify that the DMS system provides software to calculate photometric performance metrics, and that the algorithms are properly calculating the desired quantities. Note that because the DMS requirement is that the software shall be provided (and not on the actual measured values of the metrics), we verify all of the requirements via a single test case.

LVV-T1836	Verify calculation of resolved-to-unresolved flux ratio errors			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Draft	1	false	Test

Objective:

Verify that the DM system has provided code to assess whether the maximum RMS of the ratio of the error in integrated flux measurement between bright, isolated, resolved sources less than 10 arcsec in diameter and bright, isolated unresolved point sources is less than **ResSource = 2**.

2.127 [LVV-9767] DMS-REQ-0360-V-02: Max fraction exceeding limit on 5 arcmin scales

Jira Link	Assignee	Status	Test Cases
LVV-9767	Leanne Guy	Not Covered	LVV-T378 LVV-T1746

Verification Element Description:

The maximum fraction of relative astrometric measurements on 5 arcminute scales to exceed the 5 arcminute outlier limit shall be less than **AF1 = 10 percent**.

Associated element DMS-REQ-0360-V-01 (LVV-3402) satisfies the maximum fraction of astrometric outliers on 5 arcminute scales.

Associated element DMS-REQ-0360-V-03 (LVV-9768) satisfies the median astrometric error on 5 arcminute scales.

Associated element DMS-REQ-0360-V-04 (LVV-9769) satisfies the median astrometric error in absolute positions.

Associated element DMS-REQ-0360-V-05 (LVV-9770) satisfies the astrometric outlier limit on 20 arcminute scales.

Associated element DMS-REQ-0360-V-06 (LVV-9771) satisfies the color difference outlier limit relative to r-band.

Associated element DMS-REQ-0360-V-07 (LVV-9773) satisfies the astrometric outlier limit on 5 arcminute scales.

Associated element DMS-REQ-0360-V-08 (LVV-9774) satisfies the median astrometric error on 200 arcminute scales.

Associated element DMS-REQ-0360-V-09 (LVV-9775) satisfies the astrometric outlier limit on 200 arcminute scales.

Associated element DMS-REQ-0360-V-10 (LVV-9776) satisfies the maximum fraction of astro-

metric outliers on 20 arcminute scales.

Associated element DMS-REQ-0360-V-11 (LVV-9777) satisfies the maximum fraction of r-band color difference outliers.

Associated element DMS-REQ-0360-V-12 (LVV-9778) satisfies the RMS difference between separations measured in the r-band and those measured in any other filter.

Associated element DMS-REQ-0360-V-13 (LVV-9779) satisfies the maximum fraction of astrometric outliers on 200 arcminute scales.

Requirement Details	
Requirement ID	DMS-REQ-0360
Requirement Description	Specification: The DMS shall include software to enable the calculation of the astrometric performance metrics defined in OSS-REQ-0388.
Requirement Parameters	[AM2 = 10[milliarcsecond]] Median relative astrometric measurement error on 20 arcminute scales., AM1 = 10[milliarcsecond] Median relative astrometric measurement error on 5 arcminute scales shall be less than AM1., AM3 = 15[milliarcsecond] Median relative astrometric measurement error on 200 arcminute scales., AA1 = 50[milliarcsecond] Median error in absolute position for each axis, RA and DEC, shall be less than AA1., AF1 = 10[percent] The maximum fraction of relative astrometric measurements on 5 arcminute scales to exceed 5 arcminute outlier limit., AD3 = 30[milliarcsecond] 200 arcminute outlier limit., AB1 = 10[milliarcsecond] RMS difference between separations measured in the r-band and those measured in any other filter., AD1 = 20[milliarcsecond] 5 arcminute outlier limit., AB2 = 20[milliarcsecond] The color difference outlier limit for separations measured relative the r-band filter in any other filter., AD2 = 20[milliarcsecond] 20 arcminute outlier limit., ABF1 = 10[percent] Fraction of separations measured relative to the r-band that can exceed the color difference outlier limit., AF3 = 10[percent] Fraction of relative astrometric measurements on 200 arcminute scales to exceed 200 arcminute outlier limit., AF2 = 10[percent] The maximum fraction of relative astrometric measurements on 20 arcminute scales to exceed 20 arcminute outlier limit.]
Requirement Discussion	Discussion: The relevant metrics are listed in the table below. The values in the tables are the target values for LSST but are not verified as part of this requirement.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0388 Astrometric Performance

2.127.1 Test Cases Summary

LVV-T378	Verify Calculation of Astrometric Performance Metrics			
Owner	Status	Version	Critical Event	Verification Type
Leanne Guy	Approved	1	false	Test

Objective:

Verify that the DMS system provides software to calculate astrometric performance metrics, and that the algorithms are properly calculating the desired quantities. Note that because the DMS requirement is that the software shall be provided (and not on the actual measured values of the metrics), we verify all of the requirements via a single test case.

LVV-T1746	Verify calculation of fraction of relative astrometric measurement error on 5 arcminute scales exceeding outlier limit			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Approved	1	false	Test

Objective:

Verify that the DM system has provided the code to calculate the maximum fraction of relative astrometric measurements on 5 arcminute scales that exceed the 5 arcminute outlier limit **AD1 = 20 milliarcseconds**, and assess whether it meets the requirement that it shall be less than **AF1 = 10 percent**.

2.128 [LVV-9768] DMS-REQ-0360-V-03: Median astrometric error on 5 arcmin scales

Jira Link	Assignee	Status	Test Cases
LVV-9768	Leanne Guy	Not Covered	LVV-T378 LVV-T1747

Verification Element Description:

The median relative astrometric measurement error on 5 arcminute scales shall be less than **AM1 = 10 milliarcseconds**.

Associated element DMS-REQ-0360-V-01 (LVV-3402) satisfies the maximum fraction of astrometric outliers on 5 arcminute scales.

Associated element DMS-REQ-0360-V-02 (LVV-9767) satisfies the maximum fraction of astrometric outliers on 5 arcminute scales.

Associated element DMS-REQ-0360-V-04 (LVV-9769) satisfies the median astrometric error in absolute positions.

Associated element DMS-REQ-0360-V-05 (LVV-9770) satisfies the astrometric outlier limit on 20 arcminute scales.

Associated element DMS-REQ-0360-V-06 (LVV-9771) satisfies the color difference outlier limit relative to r-band.

Associated element DMS-REQ-0360-V-07 (LVV-9773) satisfies the astrometric outlier limit on 5 arcminute scales.

Associated element DMS-REQ-0360-V-08 (LVV-9774) satisfies the median astrometric error on 200 arcminute scales.

Associated element DMS-REQ-0360-V-09 (LVV-9775) satisfies the astrometric outlier limit on 200 arcminute scales.

Associated element DMS-REQ-0360-V-10 (LVV-9776) satisfies the maximum fraction of astro-

metric outliers on 20 arcminute scales.

Associated element DMS-REQ-0360-V-11 (LVV-9777) satisfies the maximum fraction of r-band color difference outliers.

Associated element DMS-REQ-0360-V-12 (LVV-9778) satisfies the RMS difference between separations measured in the r-band and those measured in any other filter.

Associated element DMS-REQ-0360-V-13 (LVV-9779) satisfies the maximum fraction of astrometric outliers on 200 arcminute scales.

Requirement Details	
Requirement ID	DMS-REQ-0360
Requirement Description	Specification: The DMS shall include software to enable the calculation of the astrometric performance metrics defined in OSS-REQ-0388.
Requirement Parameters	[AM2 = 10[milliarcsecond]] Median relative astrometric measurement error on 20 arcminute scales., AM1 = 10[milliarcsecond] Median relative astrometric measurement error on 5 arcminute scales shall be less than AM1., AM3 = 15[milliarcsecond] Median relative astrometric measurement error on 200 arcminute scales., AA1 = 50[milliarcsecond] Median error in absolute position for each axis, RA and DEC, shall be less than AA1., AF1 = 10[percent] The maximum fraction of relative astrometric measurements on 5 arcminute scales to exceed 5 arcminute outlier limit., AD3 = 30[milliarcsecond] 200 arcminute outlier limit., AB1 = 10[milliarcsecond] RMS difference between separations measured in the r-band and those measured in any other filter., AD1 = 20[milliarcsecond] 5 arcminute outlier limit., AB2 = 20[milliarcsecond] The color difference outlier limit for separations measured relative the r-band filter in any other filter., AD2 = 20[milliarcsecond] 20 arcminute outlier limit., ABF1 = 10[percent] Fraction of separations measured relative to the r-band that can exceed the color difference outlier limit., AF3 = 10[percent] Fraction of relative astrometric measurements on 200 arcminute scales to exceed 200 arcminute outlier limit., AF2 = 10[percent] The maximum fraction of relative astrometric measurements on 20 arcminute scales to exceed 20 arcminute outlier limit.]
Requirement Discussion	Discussion: The relevant metrics are listed in the table below. The values in the tables are the target values for LSST but are not verified as part of this requirement.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0388 Astrometric Performance

2.128.1 Test Cases Summary

LVV-T378	Verify Calculation of Astrometric Performance Metrics			
Owner	Status	Version	Critical Event	Verification Type
Leanne Guy	Approved	1	false	Test

Objective:

Verify that the DMS system provides software to calculate astrometric performance metrics, and that the algorithms are properly calculating the desired quantities. Note that because the DMS requirement is that the software shall be provided (and not on the actual measured values of the metrics), we verify all of the requirements via a single test case.

LVV-T1747	Verify calculation of relative astrometric measurement error on 5 arcminute scales			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Approved	1	false	Test

Objective:

Verify that the DM system has provided the code to calculate the relative astrometric measurement error on 5 arcminute scales, and assess whether it meets the requirement that it shall be less than **AM1 = 10 milliarcseconds**.

2.129 [LVV-9769] DMS-REQ-0360-V-04: Median absolute error in RA, Dec

Jira Link	Assignee	Status	Test Cases
LVV-9769	Leanne Guy	Not Covered	LVV-T378 LVV-T1748

Verification Element Description:

The median error in absolute position for each axis, RA and DEC, shall be less than **AA1 = 50 milliarcseconds**.

Associated element DMS-REQ-0360-V-01 (LVV-3402) satisfies the maximum fraction of astrometric outliers on 5 arcminute scales.

Associated element DMS-REQ-0360-V-02 (LVV-9767) satisfies the maximum fraction of astrometric outliers on 5 arcminute scales.

Associated element DMS-REQ-0360-V-03 (LVV-9768) satisfies the median astrometric error on 5 arcminute scales.

Associated element DMS-REQ-0360-V-05 (LVV-9770) satisfies the astrometric outlier limit on 20 arcminute scales.

Associated element DMS-REQ-0360-V-06 (LVV-9771) satisfies the color difference outlier limit relative to r-band.

Associated element DMS-REQ-0360-V-07 (LVV-9773) satisfies the astrometric outlier limit on 5 arcminute scales.

Associated element DMS-REQ-0360-V-08 (LVV-9774) satisfies the median astrometric error on 200 arcminute scales.

Associated element DMS-REQ-0360-V-09 (LVV-9775) satisfies the astrometric outlier limit on 200 arcminute scales.

Associated element DMS-REQ-0360-V-10 (LVV-9776) satisfies the maximum fraction of astrometric outliers on 20 arcminute scales.

Associated element DMS-REQ-0360-V-11 (LVV-9777) satisfies the maximum fraction of r-band color difference outliers.

Associated element DMS-REQ-0360-V-12 (LVV-9778) satisfies the RMS difference between separations measured in the r-band and those measured in any other filter.

Associated element DMS-REQ-0360-V-13 (LVV-9779) satisfies the maximum fraction of astrometric outliers on 200 arcminute scales.

Requirement Details	
Requirement ID	DMS-REQ-0360
Requirement Description	Specification: The DMS shall include software to enable the calculation of the astrometric performance metrics defined in OSS-REQ-0388.
Requirement Parameters	[AM2 = 10[milliarcsecond]] Median relative astrometric measurement error on 20 arcminute scales., AM1 = 10[milliarcsecond] Median relative astrometric measurement error on 5 arcminute scales shall be less than AM1., AM3 = 15[milliarcsecond] Median relative astrometric measurement error on 200 arcminute scales., AA1 = 50[milliarcsecond] Median error in absolute position for each axis, RA and DEC, shall be less than AA1., AF1 = 10[percent] The maximum fraction of relative astrometric measurements on 5 arcminute scales to exceed 5 arcminute outlier limit., AD3 = 30[milliarcsecond] 200 arcminute outlier limit., AB1 = 10[milliarcsecond] RMS difference between separations measured in the r-band and those measured in any other filter., AD1 = 20[milliarcsecond] 5 arcminute outlier limit., AB2 = 20[milliarcsecond] The color difference outlier limit for separations measured relative the r-band filter in any other filter., AD2 = 20[milliarcsecond] 20 arcminute outlier limit., ABF1 = 10[percent] Fraction of separations measured relative to the r-band that can exceed the color difference outlier limit., AF3 = 10[percent] Fraction of relative astrometric measurements on 200 arcminute scales to exceed 200 arcminute outlier limit., AF2 = 10[percent] The maximum fraction of relative astrometric measurements on 20 arcminute scales to exceed 20 arcminute outlier limit.]
Requirement Discussion	Discussion: The relevant metrics are listed in the table below. The values in the tables are the target values for LSST but are not verified as part of this requirement.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0388 Astrometric Performance

2.129.1 Test Cases Summary

LVV-T378	Verify Calculation of Astrometric Performance Metrics			
Owner	Status	Version	Critical Event	Verification Type

Leanne Guy	Approved	1	false	Test
------------	----------	---	-------	------

Objective:

Verify that the DMS system provides software to calculate astrometric performance metrics, and that the algorithms are properly calculating the desired quantities. Note that because the DMS requirement is that the software shall be provided (and not on the actual measured values of the metrics), we verify all of the requirements via a single test case.

LVV-T1748	Verify calculation of median error in absolute position for RA, Dec axes			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Approved	1	false	Test

Objective:

Verify that the DM system has provided the code to calculate the median error in absolute position for each axis, RA and DEC, and assess whether it meets the requirement that it shall be less than **AA1 = 50 milliarcseconds**.

2.130 [LVV-9770] DMS-REQ-0360-V-05: Outlier limit on 20 arcmin scales

Jira Link	Assignee	Status	Test Cases
LVV-9770	Leanne Guy	Not Covered	LVV-T378 LVV-T1749

Verification Element Description:

The 20 arcminute outlier limit is **AD2 = 20 milliarcseconds**.

Associated element DMS-REQ-0360-V-01 (LVV-3402) satisfies the maximum fraction of astrometric outliers on 5 arcminute scales.

Associated element DMS-REQ-0360-V-02 (LVV-9767) satisfies the maximum fraction of astrometric outliers on 5 arcminute scales.

Associated element DMS-REQ-0360-V-03 (LVV-9768) satisfies the median astrometric error on 5 arcminute scales.

Associated element DMS-REQ-0360-V-04 (LVV-9769) satisfies the median astrometric error in absolute positions.

Associated element DMS-REQ-0360-V-06 (LVV-9771) satisfies the color difference outlier limit relative to r-band.

Associated element DMS-REQ-0360-V-07 (LVV-9773) satisfies the astrometric outlier limit on 5 arcminute scales.

Associated element DMS-REQ-0360-V-08 (LVV-9774) satisfies the median astrometric error on 200 arcminute scales.

Associated element DMS-REQ-0360-V-09 (LVV-9775) satisfies the astrometric outlier limit on 200 arcminute scales.

Associated element DMS-REQ-0360-V-10 (LVV-9776) satisfies the maximum fraction of astrometric outliers on 20 arcminute scales.

Associated element DMS-REQ-0360-V-11 (LVV-9777) satisfies the maximum fraction of r-band color difference outliers.

Associated element DMS-REQ-0360-V-12 (LVV-9778) satisfies the RMS difference between separations measured in the r-band and those measured in any other filter.

Associated element DMS-REQ-0360-V-13 (LVV-9779) satisfies the maximum fraction of astrometric outliers on 200 arcminute scales.

Requirement Details	
Requirement ID	DMS-REQ-0360
Requirement Description	Specification: The DMS shall include software to enable the calculation of the astrometric performance metrics defined in OSS-REQ-0388.
Requirement Parameters	[AM2 = 10[milliarcsecond]] Median relative astrometric measurement error on 20 arcminute scales., AM1 = 10[milliarcsecond] Median relative astrometric measurement error on 5 arcminute scales shall be less than AM1., AM3 = 15[milliarcsecond] Median relative astrometric measurement error on 200 arcminute scales., AA1 = 50[milliarcsecond] Median error in absolute position for each axis, RA and DEC, shall be less than AA1., AF1 = 10[percent] The maximum fraction of relative astrometric measurements on 5 arcminute scales to exceed 5 arcminute outlier limit., AD3 = 30[milliarcsecond] 200 arcminute outlier limit., AB1 = 10[milliarcsecond] RMS difference between separations measured in the r-band and those measured in any other filter., AD1 = 20[milliarcsecond] 5 arcminute outlier limit., AB2 = 20[milliarcsecond] The color difference outlier limit for separations measured relative the r-band filter in any other filter., AD2 = 20[milliarcsecond] 20 arcminute outlier limit., ABF1 = 10[percent] Fraction of separations measured relative to the r-band that can exceed the color difference outlier limit., AF3 = 10[percent] Fraction of relative astrometric measurements on 200 arcminute scales to exceed 200 arcminute outlier limit., AF2 = 10[percent] The maximum fraction of relative astrometric measurements on 20 arcminute scales to exceed 20 arcminute outlier limit.]
Requirement Discussion	Discussion: The relevant metrics are listed in the table below. The values in the tables are the target values for LSST but are not verified as part of this requirement.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0388 Astrometric Performance

2.130.1 Test Cases Summary

LVV-T378	Verify Calculation of Astrometric Performance Metrics			
Owner	Status	Version	Critical Event	Verification Type

Leanne Guy	Approved	1	false	Test
------------	----------	---	-------	------

Objective:

Verify that the DMS system provides software to calculate astrometric performance metrics, and that the algorithms are properly calculating the desired quantities. Note that because the DMS requirement is that the software shall be provided (and not on the actual measured values of the metrics), we verify all of the requirements via a single test case.

LVV-T1749	Verify calculation of fraction of relative astrometric measurement error on 20 arcminute scales exceeding outlier limit			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Approved	1	false	Test

Objective:

Verify that the DM system has provided the code to calculate the maximum fraction of relative astrometric measurements on 20 arcminute scales that exceed the 20 arcminute outlier limit **AD2 = 20 milliarcseconds**, and assess whether it meets the requirement that it shall be less than **AF2 = 10 percent**.

2.131 [LVV-9771] DMS-REQ-0360-V-06: Color difference outlier limit relative to r-band

Jira Link	Assignee	Status	Test Cases
LVV-9771	Leanne Guy	Not Covered	LVV-T378 LVV-T1750

Verification Element Description:

The color difference outlier limit for separations measured relative to the r-band filter in any other filter is **AB2 = 20 milliarcseconds**.

Associated element DMS-REQ-0360-V-01 (LVV-3402) satisfies the maximum fraction of astrometric outliers on 5 arcminute scales.

Associated element DMS-REQ-0360-V-02 (LVV-9767) satisfies the maximum fraction of astrometric outliers on 5 arcminute scales.

Associated element DMS-REQ-0360-V-03 (LVV-9768) satisfies the median astrometric error on 5 arcminute scales.

Associated element DMS-REQ-0360-V-04 (LVV-9769) satisfies the median astrometric error in absolute positions.

Associated element DMS-REQ-0360-V-05 (LVV-9770) satisfies the astrometric outlier limit on 20 arcminute scales.

Associated element DMS-REQ-0360-V-07 (LVV-9773) satisfies the astrometric outlier limit on 5 arcminute scales.

Associated element DMS-REQ-0360-V-08 (LVV-9774) satisfies the median astrometric error on 200 arcminute scales.

Associated element DMS-REQ-0360-V-09 (LVV-9775) satisfies the astrometric outlier limit on 200 arcminute scales.

Associated element DMS-REQ-0360-V-10 (LVV-9776) satisfies the maximum fraction of astro-

metric outliers on 20 arcminute scales.

Associated element DMS-REQ-0360-V-11 (LVV-9777) satisfies the maximum fraction of r-band color difference outliers.

Associated element DMS-REQ-0360-V-12 (LVV-9778) satisfies the RMS difference between separations measured in the r-band and those measured in any other filter.

Associated element DMS-REQ-0360-V-13 (LVV-9779) satisfies the maximum fraction of astrometric outliers on 200 arcminute scales.

Requirement Details	
Requirement ID	DMS-REQ-0360
Requirement Description	Specification: The DMS shall include software to enable the calculation of the astrometric performance metrics defined in OSS-REQ-0388.
Requirement Parameters	[AM2 = 10[milliarcsecond]] Median relative astrometric measurement error on 20 arcminute scales., AM1 = 10[milliarcsecond] Median relative astrometric measurement error on 5 arcminute scales shall be less than AM1., AM3 = 15[milliarcsecond] Median relative astrometric measurement error on 200 arcminute scales., AA1 = 50[milliarcsecond] Median error in absolute position for each axis, RA and DEC, shall be less than AA1., AF1 = 10[percent] The maximum fraction of relative astrometric measurements on 5 arcminute scales to exceed 5 arcminute outlier limit., AD3 = 30[milliarcsecond] 200 arcminute outlier limit., AB1 = 10[milliarcsecond] RMS difference between separations measured in the r-band and those measured in any other filter., AD1 = 20[milliarcsecond] 5 arcminute outlier limit., AB2 = 20[milliarcsecond] The color difference outlier limit for separations measured relative the r-band filter in any other filter., AD2 = 20[milliarcsecond] 20 arcminute outlier limit., ABF1 = 10[percent] Fraction of separations measured relative to the r-band that can exceed the color difference outlier limit., AF3 = 10[percent] Fraction of relative astrometric measurements on 200 arcminute scales to exceed 200 arcminute outlier limit., AF2 = 10[percent] The maximum fraction of relative astrometric measurements on 20 arcminute scales to exceed 20 arcminute outlier limit.]
Requirement Discussion	Discussion: The relevant metrics are listed in the table below. The values in the tables are the target values for LSST but are not verified as part of this requirement.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0388 Astrometric Performance

2.131.1 Test Cases Summary

LVV-T378	Verify Calculation of Astrometric Performance Metrics			
Owner	Status	Version	Critical Event	Verification Type
Leanne Guy	Approved	1	false	Test

Objective:

Verify that the DMS system provides software to calculate astrometric performance metrics, and that the algorithms are properly calculating the desired quantities. Note that because the DMS requirement is that the software shall be provided (and not on the actual measured values of the metrics), we verify all of the requirements via a single test case.

LVV-T1750	Verify calculation of separations relative to r-band exceeding color difference outlier limit			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Approved	1	false	Test

Objective:

Verify that the DM system has provided the code to calculate the separations measured relative to the r-band that exceed the color difference outlier limit **AB2 = 20 milliarcseconds**, and assess whether it meets the requirement that it shall be less than **ABF1 = 10 percent**.

2.132 [LVV-9773] DMS-REQ-0360-V-07: Outlier limit on 5 arcmin scales

Jira Link	Assignee	Status	Test Cases
LVV-9773	Leanne Guy	Not Covered	LVV-T378 LVV-T1746

Verification Element Description:

The 5 arcminute outlier limit is **AD1 = 20 milliarcseconds**.

Associated element DMS-REQ-0360-V-01 (LVV-3402) satisfies the maximum fraction of astrometric outliers on 5 arcminute scales.

Associated element DMS-REQ-0360-V-02 (LVV-9767) satisfies the maximum fraction of astrometric outliers on 5 arcminute scales.

Associated element DMS-REQ-0360-V-03 (LVV-9768) satisfies the median astrometric error on 5 arcminute scales.

Associated element DMS-REQ-0360-V-04 (LVV-9769) satisfies the median astrometric error in absolute positions.

Associated element DMS-REQ-0360-V-05 (LVV-9770) satisfies the astrometric outlier limit on 20 arcminute scales.

Associated element DMS-REQ-0360-V-06 (LVV-9771) satisfies the color difference outlier limit relative to r-band.

Associated element DMS-REQ-0360-V-08 (LVV-9774) satisfies the median astrometric error on 200 arcminute scales.

Associated element DMS-REQ-0360-V-09 (LVV-9775) satisfies the astrometric outlier limit on 200 arcminute scales.

Associated element DMS-REQ-0360-V-10 (LVV-9776) satisfies the maximum fraction of astrometric outliers on 20 arcminute scales.

Associated element DMS-REQ-0360-V-11 (LVV-9777) satisfies the maximum fraction of r-band color difference outliers.

Associated element DMS-REQ-0360-V-12 (LVV-9778) satisfies the RMS difference between separations measured in the r-band and those measured in any other filter.

Associated element DMS-REQ-0360-V-13 (LVV-9779) satisfies the maximum fraction of astrometric outliers on 200 arcminute scales.

Requirement Details	
Requirement ID	DMS-REQ-0360
Requirement Description	Specification: The DMS shall include software to enable the calculation of the astrometric performance metrics defined in OSS-REQ-0388.
Requirement Parameters	[AM2 = 10[milliarcsecond]] Median relative astrometric measurement error on 20 arcminute scales., AM1 = 10[milliarcsecond] Median relative astrometric measurement error on 5 arcminute scales shall be less than AM1., AM3 = 15[milliarcsecond] Median relative astrometric measurement error on 200 arcminute scales., AA1 = 50[milliarcsecond] Median error in absolute position for each axis, RA and DEC, shall be less than AA1., AF1 = 10[percent] The maximum fraction of relative astrometric measurements on 5 arcminute scales to exceed 5 arcminute outlier limit., AD3 = 30[milliarcsecond] 200 arcminute outlier limit., AB1 = 10[milliarcsecond] RMS difference between separations measured in the r-band and those measured in any other filter., AD1 = 20[milliarcsecond] 5 arcminute outlier limit., AB2 = 20[milliarcsecond] The color difference outlier limit for separations measured relative the r-band filter in any other filter., AD2 = 20[milliarcsecond] 20 arcminute outlier limit., ABF1 = 10[percent] Fraction of separations measured relative to the r-band that can exceed the color difference outlier limit., AF3 = 10[percent] Fraction of relative astrometric measurements on 200 arcminute scales to exceed 200 arcminute outlier limit., AF2 = 10[percent] The maximum fraction of relative astrometric measurements on 20 arcminute scales to exceed 20 arcminute outlier limit.]
Requirement Discussion	Discussion: The relevant metrics are listed in the table below. The values in the tables are the target values for LSST but are not verified as part of this requirement.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0388 Astrometric Performance

2.132.1 Test Cases Summary

LVV-T378	Verify Calculation of Astrometric Performance Metrics			
Owner	Status	Version	Critical Event	Verification Type

Leanne Guy	Approved	1	false	Test
------------	----------	---	-------	------

Objective:

Verify that the DMS system provides software to calculate astrometric performance metrics, and that the algorithms are properly calculating the desired quantities. Note that because the DMS requirement is that the software shall be provided (and not on the actual measured values of the metrics), we verify all of the requirements via a single test case.

LVV-T1746	Verify calculation of fraction of relative astrometric measurement error on 5 arcminute scales exceeding outlier limit			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Approved	1	false	Test

Objective:

Verify that the DM system has provided the code to calculate the maximum fraction of relative astrometric measurements on 5 arcminute scales that exceed the 5 arcminute outlier limit **AD1 = 20 milliarcseconds**, and assess whether it meets the requirement that it shall be less than **AF1 = 10 percent**.

2.133 [LVV-9774] DMS-REQ-0360-V-08: Median astrometric error on 200 arcmin scales

Jira Link	Assignee	Status	Test Cases
LVV-9774	Leanne Guy	Not Covered	LVV-T378 LVV-T1751

Verification Element Description:

The median relative astrometric measurement error on 200 arcminute scales is less than **AM3 = 15 milliarcseconds**.

Associated element DMS-REQ-0360-V-01 (LVV-3402) satisfies the maximum fraction of astrometric outliers on 5 arcminute scales.

Associated element DMS-REQ-0360-V-02 (LVV-9767) satisfies the maximum fraction of astrometric outliers on 5 arcminute scales.

Associated element DMS-REQ-0360-V-03 (LVV-9768) satisfies the median astrometric error on 5 arcminute scales.

Associated element DMS-REQ-0360-V-04 (LVV-9769) satisfies the median astrometric error in absolute positions.

Associated element DMS-REQ-0360-V-05 (LVV-9770) satisfies the astrometric outlier limit on 20 arcminute scales.

Associated element DMS-REQ-0360-V-06 (LVV-9771) satisfies the color difference outlier limit relative to r-band.

Associated element DMS-REQ-0360-V-07 (LVV-9773) satisfies the astrometric outlier limit on 5 arcminute scales.

Associated element DMS-REQ-0360-V-09 (LVV-9775) satisfies the astrometric outlier limit on 200 arcminute scales.

Associated element DMS-REQ-0360-V-10 (LVV-9776) satisfies the maximum fraction of astro-

metric outliers on 20 arcminute scales.

Associated element DMS-REQ-0360-V-11 (LVV-9777) satisfies the maximum fraction of r-band color difference outliers.

Associated element DMS-REQ-0360-V-12 (LVV-9778) satisfies the RMS difference between separations measured in the r-band and those measured in any other filter.

Associated element DMS-REQ-0360-V-13 (LVV-9779) satisfies the maximum fraction of astrometric outliers on 200 arcminute scales.

Requirement Details	
Requirement ID	DMS-REQ-0360
Requirement Description	Specification: The DMS shall include software to enable the calculation of the astrometric performance metrics defined in OSS-REQ-0388.
Requirement Parameters	[AM2 = 10[milliarcsecond]] Median relative astrometric measurement error on 20 arcminute scales., AM1 = 10[milliarcsecond] Median relative astrometric measurement error on 5 arcminute scales shall be less than AM1., AM3 = 15[milliarcsecond] Median relative astrometric measurement error on 200 arcminute scales., AA1 = 50[milliarcsecond] Median error in absolute position for each axis, RA and DEC, shall be less than AA1., AF1 = 10[percent] The maximum fraction of relative astrometric measurements on 5 arcminute scales to exceed 5 arcminute outlier limit., AD3 = 30[milliarcsecond] 200 arcminute outlier limit., AB1 = 10[milliarcsecond] RMS difference between separations measured in the r-band and those measured in any other filter., AD1 = 20[milliarcsecond] 5 arcminute outlier limit., AB2 = 20[milliarcsecond] The color difference outlier limit for separations measured relative the r-band filter in any other filter., AD2 = 20[milliarcsecond] 20 arcminute outlier limit., ABF1 = 10[percent] Fraction of separations measured relative to the r-band that can exceed the color difference outlier limit., AF3 = 10[percent] Fraction of relative astrometric measurements on 200 arcminute scales to exceed 200 arcminute outlier limit., AF2 = 10[percent] The maximum fraction of relative astrometric measurements on 20 arcminute scales to exceed 20 arcminute outlier limit.]
Requirement Discussion	Discussion: The relevant metrics are listed in the table below. The values in the tables are the target values for LSST but are not verified as part of this requirement.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0388 Astrometric Performance

2.133.1 Test Cases Summary

LVV-T378	Verify Calculation of Astrometric Performance Metrics			
Owner	Status	Version	Critical Event	Verification Type
Leanne Guy	Approved	1	false	Test

Objective:

Verify that the DMS system provides software to calculate astrometric performance metrics, and that the algorithms are properly calculating the desired quantities. Note that because the DMS requirement is that the software shall be provided (and not on the actual measured values of the metrics), we verify all of the requirements via a single test case.

LVV-T1751	Verify calculation of median relative astrometric measurement error on 200 arcminute scales			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Approved	1	false	Test

Objective:

Verify that the DM system has provided the code to calculate the median relative astrometric measurement error on 200 arcminute scales and assess whether it meets the requirement that it shall be no more than AM3 = 15 milliarcseconds.

2.134 [LVV-9775] DMS-REQ-0360-V-09: Outlier limit on 200 arcmin scales

Jira Link	Assignee	Status	Test Cases
LVV-9775	Leanne Guy	Not Covered	LVV-T378

Verification Element Description:

The 200 arcminute outlier limit is **AD3 = 30 milliarcseconds**.

Associated element DMS-REQ-0360-V-01 (LVV-3402) satisfies the maximum fraction of astrometric outliers on 5 arcminute scales.

Associated element DMS-REQ-0360-V-02 (LVV-9767) satisfies the maximum fraction of astrometric outliers on 5 arcminute scales.

Associated element DMS-REQ-0360-V-03 (LVV-9768) satisfies the median astrometric error on 5 arcminute scales.

Associated element DMS-REQ-0360-V-04 (LVV-9769) satisfies the median astrometric error in absolute positions.

Associated element DMS-REQ-0360-V-05 (LVV-9770) satisfies the astrometric outlier limit on 20 arcminute scales.

Associated element DMS-REQ-0360-V-06 (LVV-9771) satisfies the color difference outlier limit relative to r-band.

Associated element DMS-REQ-0360-V-07 (LVV-9773) satisfies the astrometric outlier limit on 5 arcminute scales.

Associated element DMS-REQ-0360-V-08 (LVV-9774) satisfies the median astrometric error on 200 arcminute scales.

Associated element DMS-REQ-0360-V-10 (LVV-9776) satisfies the maximum fraction of astrometric outliers on 20 arcminute scales.

Associated element DMS-REQ-0360-V-11 (LVV-9777) satisfies the maximum fraction of r-band

color difference outliers.

Associated element DMS-REQ-0360-V-12 (LVV-9778) satisfies the RMS difference between separations measured in the r-band and those measured in any other filter.

Associated element DMS-REQ-0360-V-13 (LVV-9779) satisfies the maximum fraction of astrometric outliers on 200 arcminute scales.

Requirement Details	
Requirement ID	DMS-REQ-0360
Requirement Description	Specification: The DMS shall include software to enable the calculation of the astrometric performance metrics defined in OSS-REQ-0388.
Requirement Parameters	[AM2 = 10[milliarcsecond]] Median relative astrometric measurement error on 20 arcminute scales., AM1 = 10[milliarcsecond] Median relative astrometric measurement error on 5 arcminute scales shall be less than AM1., AM3 = 15[milliarcsecond] Median relative astrometric measurement error on 200 arcminute scales., AA1 = 50[milliarcsecond] Median error in absolute position for each axis, RA and DEC, shall be less than AA1., AF1 = 10[percent] The maximum fraction of relative astrometric measurements on 5 arcminute scales to exceed 5 arcminute outlier limit., AD3 = 30[milliarcsecond] 200 arcminute outlier limit., AB1 = 10[milliarcsecond] RMS difference between separations measured in the r-band and those measured in any other filter., AD1 = 20[milliarcsecond] 5 arcminute outlier limit., AB2 = 20[milliarcsecond] The color difference outlier limit for separations measured relative the r-band filter in any other filter., AD2 = 20[milliarcsecond] 20 arcminute outlier limit., ABF1 = 10[percent] Fraction of separations measured relative to the r-band that can exceed the color difference outlier limit., AF3 = 10[percent] Fraction of relative astrometric measurements on 200 arcminute scales to exceed 200 arcminute outlier limit., AF2 = 10[percent] The maximum fraction of relative astrometric measurements on 20 arcminute scales to exceed 20 arcminute outlier limit.]
Requirement Discussion	Discussion: The relevant metrics are listed in the table below. The values in the tables are the target values for LSST but are not verified as part of this requirement.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0388 Astrometric Performance

2.134.1 Test Cases Summary

LVV-T378	Verify Calculation of Astrometric Performance Metrics			
Owner	Status	Version	Critical Event	Verification Type
Leanne Guy	Approved	1	false	Test

Objective:

Verify that the DMS system provides software to calculate astrometric performance metrics, and that the algorithms are properly calculating the desired quantities. Note that because the DMS requirement is that the software shall be provided (and not on the actual measured values of the metrics), we verify all of the requirements via a single test case.

Draft

2.135 [LVV-9776] DMS-REQ-0360-V-10: Max fraction exceeding limit on 20 arcmin scales

Jira Link	Assignee	Status	Test Cases
LVV-9776	Leanne Guy	Not Covered	LVV-T378 LVV-T1749

Verification Element Description:

The maximum fraction of relative astrometric measurements on 20 arcminute scales that exceeds the 20 arcminute outlier limit is **AF2 = 10 percent**.

Associated element DMS-REQ-0360-V-01 (LVV-3402) satisfies the maximum fraction of astrometric outliers on 5 arcminute scales.

Associated element DMS-REQ-0360-V-02 (LVV-9767) satisfies the maximum fraction of astrometric outliers on 5 arcminute scales.

Associated element DMS-REQ-0360-V-03 (LVV-9768) satisfies the median astrometric error on 5 arcminute scales.

Associated element DMS-REQ-0360-V-04 (LVV-9769) satisfies the median astrometric error in absolute positions.

Associated element DMS-REQ-0360-V-05 (LVV-9770) satisfies the astrometric outlier limit on 20 arcminute scales.

Associated element DMS-REQ-0360-V-06 (LVV-9771) satisfies the color difference outlier limit relative to r-band.

Associated element DMS-REQ-0360-V-07 (LVV-9773) satisfies the astrometric outlier limit on 5 arcminute scales.

Associated element DMS-REQ-0360-V-08 (LVV-9774) satisfies the median astrometric error on 200 arcminute scales.

Associated element DMS-REQ-0360-V-09 (LVV-9775) satisfies the astrometric outlier limit on

200 arcminute scales.

Associated element DMS-REQ-0360-V-11 (LVV-9777) satisfies the maximum fraction of r-band color difference outliers.

Associated element DMS-REQ-0360-V-12 (LVV-9778) satisfies the RMS difference between separations measured in the r-band and those measured in any other filter.

Associated element DMS-REQ-0360-V-13 (LVV-9779) satisfies the maximum fraction of astrometric outliers on 200 arcminute scales.

Requirement Details	
Requirement ID	DMS-REQ-0360
Requirement Description	Specification: The DMS shall include software to enable the calculation of the astrometric performance metrics defined in OSS-REQ-0388.
Requirement Parameters	[AM2 = 10[milliarcsecond]] Median relative astrometric measurement error on 20 arcminute scales., AM1 = 10[milliarcsecond] Median relative astrometric measurement error on 5 arcminute scales shall be less than AM1., AM3 = 15[milliarcsecond] Median relative astrometric measurement error on 200 arcminute scales., AA1 = 50[milliarcsecond] Median error in absolute position for each axis, RA and DEC, shall be less than AA1., AF1 = 10[percent] The maximum fraction of relative astrometric measurements on 5 arcminute scales to exceed 5 arcminute outlier limit., AD3 = 30[milliarcsecond] 200 arcminute outlier limit., AB1 = 10[milliarcsecond] RMS difference between separations measured in the r-band and those measured in any other filter., AD1 = 20[milliarcsecond] 5 arcminute outlier limit., AB2 = 20[milliarcsecond] The color difference outlier limit for separations measured relative the r-band filter in any other filter., AD2 = 20[milliarcsecond] 20 arcminute outlier limit., ABF1 = 10[percent] Fraction of separations measured relative to the r-band that can exceed the color difference outlier limit., AF3 = 10[percent] Fraction of relative astrometric measurements on 200 arcminute scales to exceed 200 arcminute outlier limit., AF2 = 10[percent] The maximum fraction of relative astrometric measurements on 20 arcminute scales to exceed 20 arcminute outlier limit.]
Requirement Discussion	Discussion: The relevant metrics are listed in the table below. The values in the tables are the target values for LSST but are not verified as part of this requirement.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0388 Astrometric Performance

2.135.1 Test Cases Summary

LVV-T378	Verify Calculation of Astrometric Performance Metrics			
Owner	Status	Version	Critical Event	Verification Type
Leanne Guy	Approved	1	false	Test

Objective:

Verify that the DMS system provides software to calculate astrometric performance metrics, and that the algorithms are properly calculating the desired quantities. Note that because the DMS requirement is that the software shall be provided (and not on the actual measured values of the metrics), we verify all of the requirements via a single test case.

LVV-T1749	Verify calculation of fraction of relative astrometric measurement error on 20 arcminute scales exceeding outlier limit			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Approved	1	false	Test

Objective:

Verify that the DM system has provided the code to calculate the maximum fraction of relative astrometric measurements on 20 arcminute scales that exceed the 20 arcminute outlier limit **AD2 = 20 milliarcseconds**, and assess whether it meets the requirement that it shall be less than **AF2 = 10 percent**.

2.136 [LVV-9777] DMS-REQ-0360-V-11: Max fraction of r-band color difference outliers

Jira Link	Assignee	Status	Test Cases
LVV-9777	Leanne Guy	Not Covered	LVV-T378 LVV-T1750

Verification Element Description:

The fraction of separations measured relative to the r-band that can exceed the color difference outlier limit is **ABF1 = 10 percent**.

Associated element DMS-REQ-0360-V-01 (LVV-3402) satisfies the maximum fraction of astrometric outliers on 5 arcminute scales.

Associated element DMS-REQ-0360-V-02 (LVV-9767) satisfies the maximum fraction of astrometric outliers on 5 arcminute scales.

Associated element DMS-REQ-0360-V-03 (LVV-9768) satisfies the median astrometric error on 5 arcminute scales.

Associated element DMS-REQ-0360-V-04 (LVV-9769) satisfies the median astrometric error in absolute positions.

Associated element DMS-REQ-0360-V-05 (LVV-9770) satisfies the astrometric outlier limit on 20 arcminute scales.

Associated element DMS-REQ-0360-V-06 (LVV-9771) satisfies the color difference outlier limit relative to r-band.

Associated element DMS-REQ-0360-V-07 (LVV-9773) satisfies the astrometric outlier limit on 5 arcminute scales.

Associated element DMS-REQ-0360-V-08 (LVV-9774) satisfies the median astrometric error on 200 arcminute scales.

Associated element DMS-REQ-0360-V-09 (LVV-9775) satisfies the astrometric outlier limit on

200 arcminute scales.

Associated element DMS-REQ-0360-V-10 (LVV-9776) satisfies the maximum fraction of astrometric outliers on 20 arcminute scales.

Associated element DMS-REQ-0360-V-12 (LVV-9778) satisfies the RMS difference between separations measured in the r-band and those measured in any other filter.

Associated element DMS-REQ-0360-V-13 (LVV-9779) satisfies the maximum fraction of astrometric outliers on 200 arcminute scales.

Requirement Details	
Requirement ID	DMS-REQ-0360
Requirement Description	Specification: The DMS shall include software to enable the calculation of the astrometric performance metrics defined in OSS-REQ-0388.
Requirement Parameters	[AM2 = 10[milliarcsecond]] Median relative astrometric measurement error on 20 arcminute scales., AM1 = 10[milliarcsecond] Median relative astrometric measurement error on 5 arcminute scales shall be less than AM1., AM3 = 15[milliarcsecond] Median relative astrometric measurement error on 200 arcminute scales., AA1 = 50[milliarcsecond] Median error in absolute position for each axis, RA and DEC, shall be less than AA1., AF1 = 10[percent] The maximum fraction of relative astrometric measurements on 5 arcminute scales to exceed 5 arcminute outlier limit., AD3 = 30[milliarcsecond] 200 arcminute outlier limit., AB1 = 10[milliarcsecond] RMS difference between separations measured in the r-band and those measured in any other filter., AD1 = 20[milliarcsecond] 5 arcminute outlier limit., AB2 = 20[milliarcsecond] The color difference outlier limit for separations measured relative the r-band filter in any other filter., AD2 = 20[milliarcsecond] 20 arcminute outlier limit., ABF1 = 10[percent] Fraction of separations measured relative to the r-band that can exceed the color difference outlier limit., AF3 = 10[percent] Fraction of relative astrometric measurements on 200 arcminute scales to exceed 200 arcminute outlier limit., AF2 = 10[percent] The maximum fraction of relative astrometric measurements on 20 arcminute scales to exceed 20 arcminute outlier limit.]
Requirement Discussion	Discussion: The relevant metrics are listed in the table below. The values in the tables are the target values for LSST but are not verified as part of this requirement.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0388 Astrometric Performance

2.136.1 Test Cases Summary

LVV-T378	Verify Calculation of Astrometric Performance Metrics			
Owner	Status	Version	Critical Event	Verification Type
Leanne Guy	Approved	1	false	Test

Objective:

Verify that the DMS system provides software to calculate astrometric performance metrics, and that the algorithms are properly calculating the desired quantities. Note that because the DMS requirement is that the software shall be provided (and not on the actual measured values of the metrics), we verify all of the requirements via a single test case.

LVV-T1750	Verify calculation of separations relative to r-band exceeding color difference outlier limit			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Approved	1	false	Test

Objective:

Verify that the DM system has provided the code to calculate the separations measured relative to the r-band that exceed the color difference outlier limit **AB2 = 20 milliarcseconds**, and assess whether it meets the requirement that it shall be less than **ABF1 = 10 percent**.

2.137 [LVV-9778] DMS-REQ-0360-V-12: RMS difference between r-band and other filter separation

Jira Link	Assignee	Status	Test Cases
LVV-9778	Leanne Guy	Not Covered	LVV-T378 LVV-T1753

Verification Element Description:

The RMS difference between separations measured in the r-band and those measured in any other filter shall be less than **AB1 = 10 milliarcseconds**.

Associated element DMS-REQ-0360-V-01 (LVV-3402) satisfies the maximum fraction of astrometric outliers on 5 arcminute scales.

Associated element DMS-REQ-0360-V-02 (LVV-9767) satisfies the maximum fraction of astrometric outliers on 5 arcminute scales.

Associated element DMS-REQ-0360-V-03 (LVV-9768) satisfies the median astrometric error on 5 arcminute scales.

Associated element DMS-REQ-0360-V-04 (LVV-9769) satisfies the median astrometric error in absolute positions.

Associated element DMS-REQ-0360-V-05 (LVV-9770) satisfies the astrometric outlier limit on 20 arcminute scales.

Associated element DMS-REQ-0360-V-06 (LVV-9771) satisfies the color difference outlier limit relative to r-band.

Associated element DMS-REQ-0360-V-07 (LVV-9773) satisfies the astrometric outlier limit on 5 arcminute scales.

Associated element DMS-REQ-0360-V-08 (LVV-9774) satisfies the median astrometric error on 200 arcminute scales.

Associated element DMS-REQ-0360-V-09 (LVV-9775) satisfies the astrometric outlier limit on

200 arcminute scales.

Associated element DMS-REQ-0360-V-10 (LVV-9776) satisfies the maximum fraction of astrometric outliers on 20 arcminute scales.

Associated element DMS-REQ-0360-V-11 (LVV-9777) satisfies the maximum fraction of r-band color difference outliers.

Associated element DMS-REQ-0360-V-13 (LVV-9779) satisfies the maximum fraction of astrometric outliers on 200 arcminute scales.

Requirement Details	
Requirement ID	DMS-REQ-0360
Requirement Description	Specification: The DMS shall include software to enable the calculation of the astrometric performance metrics defined in OSS-REQ-0388.
Requirement Parameters	[AM2 = 10[milliarcsecond]] Median relative astrometric measurement error on 20 arcminute scales., AM1 = 10[milliarcsecond] Median relative astrometric measurement error on 5 arcminute scales shall be less than AM1., AM3 = 15[milliarcsecond] Median relative astrometric measurement error on 200 arcminute scales., AA1 = 50[milliarcsecond] Median error in absolute position for each axis, RA and DEC, shall be less than AA1., AF1 = 10[percent] The maximum fraction of relative astrometric measurements on 5 arcminute scales to exceed 5 arcminute outlier limit., AD3 = 30[milliarcsecond] 200 arcminute outlier limit., AB1 = 10[milliarcsecond] RMS difference between separations measured in the r-band and those measured in any other filter., AD1 = 20[milliarcsecond] 5 arcminute outlier limit., AB2 = 20[milliarcsecond] The color difference outlier limit for separations measured relative the r-band filter in any other filter., AD2 = 20[milliarcsecond] 20 arcminute outlier limit., ABF1 = 10[percent] Fraction of separations measured relative to the r-band that can exceed the color difference outlier limit., AF3 = 10[percent] Fraction of relative astrometric measurements on 200 arcminute scales to exceed 200 arcminute outlier limit., AF2 = 10[percent] The maximum fraction of relative astrometric measurements on 20 arcminute scales to exceed 20 arcminute outlier limit.]
Requirement Discussion	Discussion: The relevant metrics are listed in the table below. The values in the tables are the target values for LSST but are not verified as part of this requirement.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0388 Astrometric Performance

2.137.1 Test Cases Summary

LVV-T378	Verify Calculation of Astrometric Performance Metrics			
Owner	Status	Version	Critical Event	Verification Type
Leanne Guy	Approved	1	false	Test

Objective:

Verify that the DMS system provides software to calculate astrometric performance metrics, and that the algorithms are properly calculating the desired quantities. Note that because the DMS requirement is that the software shall be provided (and not on the actual measured values of the metrics), we verify all of the requirements via a single test case.

LVV-T1753	Verify calculation of RMS difference of separations relative to r-band			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Approved	1	false	Test

Objective:

Verify that the DM system has provided the code to calculate the separations measured relative to the r-band, and assess whether it meets the requirement that it shall be less than **AB1 = 10 milliarcseconds**.

2.138 [LVV-9779] DMS-REQ-0360-V-13: Max fraction exceeding limit on 200 arcmin scales

Jira Link	Assignee	Status	Test Cases
LVV-9779	Leanne Guy	Not Covered	LVV-T378 LVV-T1752

Verification Element Description:

The fraction of relative astrometric measurements on 200 arcminute scales to exceed the 200 arcminute outlier limit is less than **AF3 = 10 percent**.

Associated element DMS-REQ-0360-V-01 (LVV-3402) satisfies the maximum fraction of astrometric outliers on 5 arcminute scales.

Associated element DMS-REQ-0360-V-02 (LVV-9767) satisfies the maximum fraction of astrometric outliers on 5 arcminute scales.

Associated element DMS-REQ-0360-V-03 (LVV-9768) satisfies the median astrometric error on 5 arcminute scales.

Associated element DMS-REQ-0360-V-04 (LVV-9769) satisfies the median astrometric error in absolute positions.

Associated element DMS-REQ-0360-V-05 (LVV-9770) satisfies the astrometric outlier limit on 20 arcminute scales.

Associated element DMS-REQ-0360-V-06 (LVV-9771) satisfies the color difference outlier limit relative to r-band.

Associated element DMS-REQ-0360-V-07 (LVV-9773) satisfies the astrometric outlier limit on 5 arcminute scales.

Associated element DMS-REQ-0360-V-08 (LVV-9774) satisfies the median astrometric error on 200 arcminute scales.

Associated element DMS-REQ-0360-V-09 (LVV-9775) satisfies the astrometric outlier limit on

200 arcminute scales.

Associated element DMS-REQ-0360-V-10 (LVV-9776) satisfies the maximum fraction of astrometric outliers on 20 arcminute scales.

Associated element DMS-REQ-0360-V-11 (LVV-9777) satisfies the maximum fraction of r-band color difference outliers.

Associated element DMS-REQ-0360-V-12 (LVV-9778) satisfies the RMS difference between separations measured in the r-band and those measured in any other filter.

Requirement Details	
Requirement ID	DMS-REQ-0360
Requirement Description	Specification: The DMS shall include software to enable the calculation of the astrometric performance metrics defined in OSS-REQ-0388.
Requirement Parameters	[AM2 = 10[milliarcsecond]] Median relative astrometric measurement error on 20 arcminute scales., AM1 = 10[milliarcsecond] Median relative astrometric measurement error on 5 arcminute scales shall be less than AM1., AM3 = 15[milliarcsecond] Median relative astrometric measurement error on 200 arcminute scales., AA1 = 50[milliarcsecond] Median error in absolute position for each axis, RA and DEC, shall be less than AA1., AF1 = 10[percent] The maximum fraction of relative astrometric measurements on 5 arcminute scales to exceed 5 arcminute outlier limit., AD3 = 30[milliarcsecond] 200 arcminute outlier limit., AB1 = 10[milliarcsecond] RMS difference between separations measured in the r-band and those measured in any other filter., AD1 = 20[milliarcsecond] 5 arcminute outlier limit., AB2 = 20[milliarcsecond] The color difference outlier limit for separations measured relative the r-band filter in any other filter., AD2 = 20[milliarcsecond] 20 arcminute outlier limit., ABF1 = 10[percent] Fraction of separations measured relative to the r-band that can exceed the color difference outlier limit., AF3 = 10[percent] Fraction of relative astrometric measurements on 200 arcminute scales to exceed 200 arcminute outlier limit., AF2 = 10[percent] The maximum fraction of relative astrometric measurements on 20 arcminute scales to exceed 20 arcminute outlier limit.]
Requirement Discussion	Discussion: The relevant metrics are listed in the table below. The values in the tables are the target values for LSST but are not verified as part of this requirement.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0388 Astrometric Performance

2.138.1 Test Cases Summary

LVV-T378	Verify Calculation of Astrometric Performance Metrics			
Owner	Status	Version	Critical Event	Verification Type
Leanne Guy	Approved	1	false	Test

Objective:

Verify that the DMS system provides software to calculate astrometric performance metrics, and that the algorithms are properly calculating the desired quantities. Note that because the DMS requirement is that the software shall be provided (and not on the actual measured values of the metrics), we verify all of the requirements via a single test case.

LVV-T1752	Verify calculation of fraction of relative astrometric measurement error on 200 arcminute scales exceeding outlier limit			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Approved	1	false	Test

Objective:

Verify that the DM system has provided the code to calculate the maximum fraction of relative astrometric measurements on 200 arcminute scales that exceed the 200 arcminute outlier limit **AD3 = 30 milliarcseconds**, and assess whether it meets the requirement that it shall be less than **AF3 = 10 percent**.

2.139 [LVV-9780] DMS-REQ-0362-V-02: Max fraction of excess ellipticity residuals on 1 and 5 arcmin scales

Jira Link	Assignee	Status	Test Cases
LVV-9780	Leanne Guy	Not Covered	LVV-T376

Verification Element Description:

The maximum fraction of PSF ellipticity correlation residuals that exceed the outlier limits shall be no greater than **TEF = 15 percent**.

Associated element DMS-REQ-0362-V-01 (LVV-3404) satisfies the median residual PSF ellipticity correlations on 5 arcmin scales.

Associated element DMS-REQ-0362-V-03 (LVV-9781) satisfies the outlier limit on the PSF ellipticity correlation residuals on 5 arcmin scales.

Associated element DMS-REQ-0362-V-04 (LVV-9782) satisfies the median residual PSF ellipticity correlations on 1 arcmin scales.

Associated element DMS-REQ-0362-V-05 (LVV-9783) satisfies the outlier limit on the PSF ellipticity correlation residuals on 1 arcmin scales.

Requirement Details	
Requirement ID	DMS-REQ-0362
Requirement Description	Specification: The DMS shall include software to enable the calculation of the ellipticity correlations metrics defined in OSS-REQ-0403, OSS-REQ-0404, and OSS-REQ-0405.
Requirement Parameters	[TE3 = 4.0e-5[unitless (angular correlation)]] Per-image limit on the median residual ellipticity correlations at scales less than 5 arcmin., TE4 = 2.0e-7[unitless (angular correlation)]] Per-image limit on the median residual ellipticity correlations at scales greater than or equal to 5 arcmin., TE2 = 1.0e-7[unitless (angular correlation)]] Maximum full-survey median for residual ellipticity correlations at scales greater than or equal to 5 arcmin., TEF = 15[percent] Maximum fraction of visit images that may exceed the TE3 or TE4 limits., TE1 = 2.0e-5[unitless (angular correlation)]] Maximum full-survey median for residual ellipticity correlations at scales less than or equal to 1 arcmin.]
Requirement Discussion	Discussion: The relevant metrics are listed in the table below. The values in the tables are the target values for LSST but are not verified as part of this requirement.
Requirement Priority	1b

	OSS-REQ-0403	Ellipticity Correlation Function Distribution per Image
Upper Level Re-	OSS-REQ-0404	Ellipticity Correlation Function Distribution for Full Survey (medians)
quirement	OSS-REQ-0405	Ellipticity Correlation Function Distribution for Full Survey (continuity)

2.139.1 Test Cases Summary

LVV-T376	Verify the Calculation of Ellipticity Residuals and Correlations			
Owner	Status	Version	Critical Event	Verification Type
Leanne Guy	Approved	1	false	Test

Objective:

Verify that the DMS includes software to enable the calculation of the ellipticity residuals and correlation metrics defined in the OSS.

2.140 [LVV-9781] DMS-REQ-0362-V-03: Outlier limit on 5 arcmin scales - ellipticity

Jira Link	Assignee	Status	Test Cases
LVV-9781	Leanne Guy	Not Covered	

Verification Element Description:

Residuals of PSF ellipticity correlations on 5 arcmin scales shall be no greater than **TE4 = 2.0e-7[arcminuteOutlierLimit]**.

Associated element DMS-REQ-0362-V-01 (LVV-3404) satisfies the median residual PSF ellipticity correlations on 5 arcmin scales.

Associated element DMS-REQ-0362-V-02 (LVV-9780) satisfies the maximum fraction of ellipticity residuals exceeding the outlier limits.

Associated element DMS-REQ-0362-V-04 (LVV-9782) satisfies the median residual PSF ellipticity correlations on 1 arcmin scales.

Associated element DMS-REQ-0362-V-05 (LVV-9783) satisfies the outlier limit on the PSF ellipticity correlation residuals on 1 arcmin scales.

Requirement Details	
Requirement ID	DMS-REQ-0362
Requirement Description	Specification: The DMS shall include software to enable the calculation of the ellipticity correlations metrics defined in OSS-REQ-0403, OSS-REQ-0404, and OSS-REQ-0405.
Requirement Parameters	[TE3 = 4.0e-5[unitless (angular correlation)]] Per-image limit on the median residual ellipticity correlations at scales less than 5 arcmin., TE4 = 2.0e-7[unitless (angular correlation)]] Per-image limit on the median residual ellipticity correlations at scales greater than or equal to 5 arcmin., TE2 = 1.0e-7[unitless (angular correlation)]] Maximum full-survey median for residual ellipticity correlations at scales greater than or equal to 5 arcmin., TEF = 15[percent] Maximum fraction of visit images that may exceed the TE3 or TE4 limits., TE1 = 2.0e-5[unitless (angular correlation)]] Maximum full-survey median for residual ellipticity correlations at scales less than or equal to 1 arcmin.]
Requirement Discussion	Discussion: The relevant metrics are listed in the table below. The values in the tables are the target values for LSST but are not verified as part of this requirement.
Requirement Priority	1b

	OSS-REQ-0403	Ellipticity Correlation Function Distribution per Image
Upper Level Re-	OSS-REQ-0404	Ellipticity Correlation Function Distribution for Full Survey (medians)
quirement	OSS-REQ-0405	Ellipticity Correlation Function Distribution for Full Survey (continuity)

Draft

2.141 [LVV-9782] DMS-REQ-0362-V-04: Median residual PSF ellipticity correlations on 1 arcmin scales

Jira Link	Assignee	Status	Test Cases
LVV-9782	Leanne Guy	Not Covered	LVV-T1755

Verification Element Description:

Median residual PSF ellipticity correlations averaged over an arbitrary field of view for separations less than 1 arcmin shall be no greater than **TE1 = 2.0e-5[arcminuteSeparationCorrelation]**.

Associated element DMS-REQ-0362-V-01 (LVV-3404) satisfies the median residual PSF ellipticity correlations on 5 arcmin scales.

Associated element DMS-REQ-0362-V-02 (LVV-9780) satisfies the maximum fraction of ellipticity residuals exceeding the outlier limits.

Associated element DMS-REQ-0362-V-03 (LVV-9781) satisfies the outlier limit on the PSF ellipticity correlation residuals on 5 arcmin scales.

Associated element DMS-REQ-0362-V-05 (LVV-9783) satisfies the outlier limit on the PSF ellipticity correlation residuals on 1 arcmin scales.

Requirement Details	
Requirement ID	DMS-REQ-0362
Requirement Description	Specification: The DMS shall include software to enable the calculation of the ellipticity correlations metrics defined in OSS-REQ-0403, OSS-REQ-0404, and OSS-REQ-0405.
Requirement Parameters	[TE3 = 4.0e-5[unitless (angular correlation)]] Per-image limit on the median residual ellipticity correlations at scales less than 5 arcmin., TE4 = 2.0e-7[unitless (angular correlation)]] Per-image limit on the median residual ellipticity correlations at scales greater than or equal to 5 arcmin., TE2 = 1.0e-7[unitless (angular correlation)]] Maximum full-survey median for residual ellipticity correlations at scales greater than or equal to 5 arcmin., TEF = 15[percent] Maximum fraction of visit images that may exceed the TE3 or TE4 limits., TE1 = 2.0e-5[unitless (angular correlation)]] Maximum full-survey median for residual ellipticity correlations at scales less than or equal to 1 arcmin.]
Requirement Discussion	Discussion: The relevant metrics are listed in the table below. The values in the tables are the target values for LSST but are not verified as part of this requirement.
Requirement Priority	1b

	OSS-REQ-0403	Ellipticity Correlation Function Distribution per Image
Upper Level Re-	OSS-REQ-0404	Ellipticity Correlation Function Distribution for Full Survey (medians)
quirement	OSS-REQ-0405	Ellipticity Correlation Function Distribution for Full Survey (continuity)

2.141.1 Test Cases Summary

LVV-T1755	Verify calculation of residual PSF ellipticity correlations for separations less than 1 arcmin			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Approved	1	false	Test

Objective:

Verify that the DM system has provided the code to calculate the median residual PSF ellipticity correlations averaged over an arbitrary field of view for separations less than 1 arcmin, and assess whether it meets the requirement that it shall be no greater than **TE1 = 2.0e-5[arcminuteSeparationCorrelation]**.

2.142 [LVV-9783] DMS-REQ-0362-V-05: Outlier limit on 1 arcmin scales

Jira Link	Assignee	Status	Test Cases
LVV-9783	Leanne Guy	Not Covered	

Verification Element Description:

Residuals of PSF ellipticity correlations on 1 arcmin scales shall be no greater than **TE3 = 4.0e-5[arcminuteOutlierLimit]**.

Associated element DMS-REQ-0362-V-01 (LVV-3404) satisfies the median residual PSF ellipticity correlations on 5 arcmin scales.

Associated element DMS-REQ-0362-V-02 (LVV-9780) satisfies the maximum fraction of ellipticity residuals exceeding the outlier limits.

Associated element DMS-REQ-0362-V-03 (LVV-9781) satisfies the outlier limit on the PSF ellipticity correlation residuals on 5 arcmin scales.

Associated element DMS-REQ-0362-V-04 (LVV-9782) satisfies the median residual PSF ellipticity correlations on 1 arcmin scales.

Requirement Details	
Requirement ID	DMS-REQ-0362
Requirement Description	Specification: The DMS shall include software to enable the calculation of the ellipticity correlations metrics defined in OSS-REQ-0403, OSS-REQ-0404, and OSS-REQ-0405.
Requirement Parameters	[TE3 = 4.0e-5[unitless (angular correlation)] Per-image limit on the median residual ellipticity correlations at scales less than 5 arcmin., TE4 = 2.0e-7[unitless (angular correlation)] Per-image limit on the median residual ellipticity correlations at scales greater than or equal to 5 arcmin., TE2 = 1.0e-7[unitless (angular correlation)] Maximum full-survey median for residual ellipticity correlations at scales greater than or equal to 5 arcmin., TEF = 15[percent] Maximum fraction of visit images that may exceed the TE3 or TE4 limits., TE1 = 2.0e-5[unitless (angular correlation)] Maximum full-survey median for residual ellipticity correlations at scales less than or equal to 1 arcmin.]
Requirement Discussion	Discussion: The relevant metrics are listed in the table below. The values in the tables are the target values for LSST but are not verified as part of this requirement.
Requirement Priority	1b

	OSS-REQ-0403	Ellipticity Correlation Function Distribution per Image
Upper Level Re-	OSS-REQ-0404	Ellipticity Correlation Function Distribution for Full Survey (medians)
quirement	OSS-REQ-0405	Ellipticity Correlation Function Distribution for Full Survey (continuity)

Draft

2.143 [LVV-9867] DMS-PRTL-REQ-0025-V-01: Positional Query: Solar System Object Names_1

Jira Link	Assignee	Status	Test Cases
LVV-9867	Gregory Dubois-Felsmann	Not Covered	LVV-T660

Verification Element Description:

Undefined

Requirement Details	
Requirement ID	DMS-PRTL-REQ-0025
Requirement Description	The Portal aspect shall support positional queries based on external Solar System Object identifiers, including names from, but not limited to, NASA's Navigation and Ancillary Information Facility (NAIF), the Minor Planet Center, and JPL's Horizons, coupled with a date/time range specification.
Requirement Discussion	The intent here is to enable a user to enter a solar system object name (e.g., 25155 van Belle) and, for a given time range, get back a list of observations that LSST may have made of that object because the survey has overlapped the position of that object at the appropriate times.
	This capability is expected to be available for tables that are both spatially and temporally organized, e.g., Visit or DIASource.
Requirement Priority	
Upper Level Requirement	

2.143.1 Test Cases Summary

LVV-T660	Verify positional query based on Solar System object names			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Draft	1	false	Test

Objective:

Verify that positional queries can be performed for coordinates based on a given Solar System object name.

Draft

2.144 [LVV-9869] DMS-PRTL-REQ-0026-V-01: Positional Query by Region: Cone-Search_1

Jira Link	Assignee	Status	Test Cases
			LVV-T5
LVV-9869	Gregory Dubois-Felsmann	Not Covered	LVV-T661
			LVV-T1334

Verification Element Description:

Undefined

Requirement Details	
Requirement ID	DMS-PRTL-REQ-0026
Requirement Description	The Portal aspect shall support position-based queries based on a cone-shaped radial search.
Requirement Priority	
Upper Level Requirement	

2.144.1 Test Cases Summary

LVV-T5	LSP-00-15: Execution of basic catalog queries in the Portal			
Owner	Status	Version	Critical Event	Verification Type
Gregory Dubois-Felsmann	Deprecated	1	false	Test

Objective:

This test will test the functional requirements to be able to perform a range of basic queries through the Portal Aspect of the LSP:

- Cone searches on the Object-like, ForcedSource-like, and Source-like WISE tables;
- Multi-target cone searches;
- Form-based searches for exact equality, e.g., for row IDs; and
- Form-based searches for sets of object attributes.

In addition, it tests the ability to download tabular query results from the Portal Aspect.

LVV-T661	Verify query by cone search			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Draft	1	false	Test

Objective:

Verify that Portal supports position-based queries based on a cone-shaped radial search.

LVV-T1334	LDM-503-10a: Portal Aspect tests for LSP with Authentication and TAP milestone			
Owner	Status	Version	Critical Event	Verification Type
Gregory Dubois-Felsmann	Defined	1	false	Test

Objective:

This test case verifies that the Portal Aspect of the Science Platform is accessible to authorized users through a login process, and that TAP searches can be performed from the Portal Aspect UI.

In so doing and in conjunction with the other LDM-503-10a test cases collected under LVV-P48, it addresses all or part of the following requirements:

- DMS-LSP-REQ-0002, DMS-LSP-REQ-0005, DMS-LSP-REQ-0006, DMS-LSP-REQ-0020, DMS-LSP-REQ-0022, DMS-LSP-REQ-0023, DMS-LSP-REQ-0024
- DMS-PRTL-REQ-0001, DMS-PRTL-REQ-0015, DMS-PRTL-REQ-0016, DMS-PRTL-REQ-0017, DMS-PRTL-REQ-0020, DMS-PRTL-REQ-0026, DMS-PRTL-REQ-0049, and DMS-PRTL-REQ-0095, primarily

Note this test was not designed to perform a full verification of the above requirements, but rather to demonstrate having reached a certain level of partial capability during construction.

2.145 [LVV-9926] DMS-PRTL-REQ-0085-V-01: Distance Measurement Tool_1

Jira Link	Assignee	Status	Test Cases
LVV-9926	Gregory Dubois-Felsmann	Not Covered	LVV-T719

Verification Element Description:

Undefined

Requirement Details	
Requirement ID	DMS-PRTL-REQ-0085
Requirement Description	The Portal aspect shall have the capability to determine the distance between two positions within an image or 2-dimensional plot in both image/plot coordinates (electronic or spatial X and Y) and in astrophysical coordinates (if applicable). Calculations shall be performed in spherical geometry where appropriate.
Requirement Discussion	The point behind this requirement is to enable distance determinations of equatorial, galactic, and ecliptic coordinates and make sure spherical geometry is used.
When applied to general two-dimensional plots, distance measurement should only be supported when a metric and a geometry, or at least the relative scale between the two displayed coordinates, is known.	
This means that this capability is particularly dependent on metadata support.	
Requirement Priority	
Upper Level Requirement	

2.145.1 Test Cases Summary

LVV-T719	Verify distance measurement tool			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Draft	1	false	Inspection

Objective:

Verify that the Portal provides a tool to measure the distance between two points in an image or a 2-dimensional plot. Distances should be calculated in both image/plot coordinates (electronic or spatial X and Y) and in astrophysical coordinates (if applicable). Calculations shall be performed in spherical geometry where appropriate.

Draft

2.146 [LVV-9937] DMS-PRTL-REQ-0097-V-01: Statistical Measurements on Image Data_1

Jira Link	Assignee	Status	Test Cases
LVV-9937	Gregory Dubois-Felsmann	Not Covered	LVV-T731

Verification Element Description:

Undefined

Requirement Details	
Requirement ID	DMS-PRTL-REQ-0097
Requirement Description	The Portal aspect shall enable the capability to perform a set of statistical measurements (e.g., mean, median, RMS, skew, kurtosis) on user-selected regions in images.
Requirement Priority	
Upper Level Requirement	

2.146.1 Test Cases Summary

LVV-T731	Verify statistical measurements on user-selected regions of images			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Draft	1	false	Inspection

Objective:

Verify that the Portal aspect enables the capability to perform a set of statistical measurements (e.g., mean, median, RMS, skew, kurtosis) on user-selected regions in images.

2.147 [LVV-18225] DMS-REQ-0382-V-01: HiPS Visualization_1

Jira Link	Assignee	Status	Test Cases
LVV-18225	Leanne Guy	Not Covered	LVV-T1527

Verification Element Description:

Undefined

Requirement Details	
Requirement ID	DMS-REQ-0382
Requirement Description	Specification: The LSST Science Platform shall support the visualization of the LSST-generated HiPS image maps as well as other HiPS maps which satisfy the IVOA HiPS Recommendation, and shall provide integrated behavior, such as the overplotting of catalog entries, comparable to that provided for individual source images (e.g., PVI and coadd tiles).
Requirement Discussion	Discussion: Further details will be provided in the LSST Science Platform Requirements, LDM-554.
Requirement Priority	1b
Upper Level Requirement	OSS-REQ-0061 Data Visualization

2.147.1 Test Cases Summary

LVV-T1527	Verify Support for HiPS Visualization			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Draft	1	false	Demonstration

Objective:

Verify that the LSST Science Platform supports the visualization of LSST-generated HiPS image maps as well as other HiPS maps which satisfy the IVOA HiPS Recommendation. Also verify that integrated behavior is available, such as the overplotting of catalog entries, comparable to that provided for individual source images (e.g., PVI and coadd tiles).

2.148 [LVV-18227] DMS-REQ-0379-V-01: Produce All-Sky HiPS Map_1

Jira Link	Assignee	Status	Test Cases
LVV-18227	Leanne Guy	Not Covered	LVV-T1529

Verification Element Description:

Undefined

Requirement Details	
Requirement ID	DMS-REQ-0379
Requirement Description	Specification: Data Release Production shall include the production of an all-sky image map for the existing coadded image area in each filter band, and at least one pre-defined all-sky color image map, following the IVOA HiPS Recommendation.
Requirement Discussion	Discussion: The maximum resolution of the image maps is TBD; however, it would be desirable for it to be at least close to the underlying coadded image resolution, in order not to give a poor impression of the data quality. It is possible that the highest-resolution HiPS tiles could be provided on-demand from the LSST cutout service. It is expected that the HiPS tiles will be generated by resampling the existing coadds, not by performing an independent coaddition. This requires work from Science Pipelines on resolving the ambiguities in overlap regions. Whether the lower-resolution levels of the HiPS tiles will be generated by existing community tools (i.e., hipsgen) or by LSST code is also TBD. The color map being “pre-defined” means that the choice of bands will be made by the LSST Project as part of the configuration of a Data Release. This does not preclude the Science Platform additionally providing means for interactive generation of other colorizations from the single-band HiPS maps.

By the terms of the HiPS Recommendation, a HiPS image map should include a corresponding MOC. This may or may not be the same as the MOCs for the survey envisioned under DMS-REQ-0383 elsewhere in this document, depending on choices made for data selection.

The Project should produce a technical note, during the construction era, detailing which of the optional components of the HiPS standard will be supported.

This requirement specifically calls for making HiPS maps from the standard coadds and therefore whatever policies are used for the inclusion of Special Programs data in the standard coadds will also automatically apply here. If there are both main-survey-depth and full-depth coadds for the deep drilling fields, then, it is a separate question as to whether HiPS maps will be generated for those fields.

Requirement Priority 1b

Upper Level Requirement	OSS-REQ-0391	Data Product Conventions
	OSS-REQ-0136	Co-added Exposures

2.148.1 Test Cases Summary

LVV-T1529	Verify Production of All-Sky HiPS Map			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Draft	1	false	Demonstration

Objective:

Verify that Data Release Production includes the production of an all-sky image map for the existing coadded image area in each filter band, and at least one pre-defined all-sky color image map, following the IVOA HiPS Recommendation.

Draft

2.149 [LVV-18228] DMS-REQ-0383-V-01: Produce MOC Maps_1

Jira Link	Assignee	Status	Test Cases
LVV-18228	Leanne Guy	Not Covered	LVV-T1530

Verification Element Description:

Undefined

Requirement Details	
Requirement ID	DMS-REQ-0383
Requirement Description	Specification: Data Release Production shall include the production of Multi-Order Coverage maps for the survey data, conformant with the IVOA MOC recommendation. A separate MOC shall be produced for each filter band for the main survey. Additional MOCs SHOULD be produced to represent special-programs datasets and other collections of on-sky data.
Requirement Discussion	Discussion: It is likely to be useful to produce quite a large number of MOCs as part of releasing the data and documenting its quality. For example, it may be useful to produce both a MOC for all the data from a band and for only that part of the sky for which the SRD requirements in that band have been met. It also seems useful to produce MOCs for the deep drilling fields, etc. It may also be useful to produce MOCs on, for instance, a nightly basis, reflecting that part of the sky for which coverage was obtained in that night. The LSST project should engage in the work begun in 2018 on the development of standards and tools for spatiotemporal MOCs.

The tile resolution chosen for these MOCs should be fine enough to represent the dither pattern of the survey as well as the shape of the focal plane. Some testing should be done to determine a suitable scale.

The Project should produce a technical note, during the construction era, detailing the specific plans for creation of MOCs.

Requirement Priority 1b

Upper Level Requirement	OSS-REQ-0391	Data Product Conventions
	OSS-REQ-0033	Survey Planning and Performance Monitoring

2.149.1 Test Cases Summary

LVV-T1530	Verify Production of Multi-Order Coverage Maps for Survey Data			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Draft	1	false	Demonstration

Objective:

Verify that Data Release Production includes the production of Multi-Order Coverage maps for the survey data, conformant with the IVOA MOC recommendation. Confirm that separate MOC are produced for each filter band for the main survey, and additional MOCs are produced to represent special-programs datasets and other collections of on-sky data.

2.150 [LVV-18229] DMS-REQ-0344-V-01: Time to L1 public release

Jira Link	Assignee	Status	Test Cases
LVV-18229	Melissa Graham	Not Covered	LVV-T1865

Verification Element Description:

This is 3 distinct requirements. OTT1 can be tested with simulated data. L1 Data Products can be created with precursor data but requires that we include some “worst case” datasets (in terms of density and night length). SSO object orbit determination can be done to a certain extent with simulated data. Will need to be verified again during commissioning.

Associated element (LVV-9740) satisfies the latency of reporting transients.

Associated element (LVV-9803) satisfies the availability of Solar System Object orbits.

Associated element (LVV-9744) satisfies the latency of reporting optical transients.

Requirement Details	
Requirement ID	DMS-REQ-0344
Requirement Description	Specification: The publishing of Level 1 data products from Special Programs shall be subject to the same performance requirements of the standard Level 1 system. In particular L1PublicT and OTT1 .
Requirement Parameters	[OTT1 = 1[minute]] The latency of reporting optical transients following the completion of readout of the last image of a visit, L1PublicT = 24[hour] Maximum time from the acquisition of science data to the release of associated Level 1 Data Products (except alerts)]
Requirement Priority	2
Upper Level Requirement	OSS-REQ-0392 Data Products Handling for Special Programs

2.150.1 Test Cases Summary

LVV-T1865	Verify implementation of time to L1 public release for Special Programs			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Draft	1	false	Test

Objective:

Verify that data from Special Programs are made available via public release within **L1PublicT = 24[hour]** from the acquisition of science data.

Draft

2.151 [LVV-18233] DMS-REQ-0390-V-01: Re-Runs on Other Systems_1

Jira Link	Assignee	Status	Test Cases
LVV-18233	Leanne Guy	Not Covered	LVV-T1563

Verification Element Description:

Undefined

Requirement Details									
Requirement ID	DMS-REQ-0390								
Requirement Description	Specification: A re-run based on provenance, if run on a different system (but whose configuration still meets established LSST requirements), shall produce results which are the same to the extent computationally feasible (with the exception of provenance data or other execution records that depend on the wall-clock time or on variable system loads).								
Requirement Discussion	Discussion: "To the extent computationally feasible" refers primarily to the possibility that different implementations of the IEEE floating-point standards may produce different results in the least significant figures, and that under some circumstances these variations can be amplified by algorithms and by choices made by optimizing compilers. It is expected that normal "best practices" for writing floating point code will be followed to minimize the effects of these hardware differences, but they cannot be avoided altogether.								
Requirement Priority	1b								
Upper Level Requirement	<table border="0"> <tr> <td>OSS-REQ-0122</td> <td>Provenance</td> </tr> <tr> <td>OSS-REQ-0169</td> <td>Data Products</td> </tr> <tr> <td>OSS-REQ-0123</td> <td>Reproducibility</td> </tr> <tr> <td>OSS-REQ-0172</td> <td>Provenance Archiving</td> </tr> </table>	OSS-REQ-0122	Provenance	OSS-REQ-0169	Data Products	OSS-REQ-0123	Reproducibility	OSS-REQ-0172	Provenance Archiving
OSS-REQ-0122	Provenance								
OSS-REQ-0169	Data Products								
OSS-REQ-0123	Reproducibility								
OSS-REQ-0172	Provenance Archiving								

2.151.1 Test Cases Summary

LVV-T1563	Verify re-run on different system produces the same results			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Draft	1	false	Demonstration

Objective:

Verify that tools are provided to use the archived provenance data to re-run a data processing operation on different systems, and that the results produced are the same to the extent computationally feasible.

2.152 [LVV-18234] DMS-REQ-0389-V-01: Re-Runs on Similar Systems_1

Jira Link	Assignee	Status	Test Cases
LVV-18234	Leanne Guy	Not Covered	LVV-T1564

Verification Element Description:

Undefined

Requirement Details									
Requirement ID	DMS-REQ-0389								
Requirement Description	Specification: A re-run based on provenance, if run on the same system or a system with identically configured hardware and system software, shall produce the same results (with the exception of provenance data or other execution records that depend on the wall-clock time or on variable system loads).								
Requirement Discussion	Discussion: "System software" refers to the substrate of operating systems, device drivers, language standard libraries, and the like, not to the higher-level software written by LSST or imported into the LSST code base; the latter are constrained by DMS-REQ-0388 to be the same for a provenance-based re-run.								
Requirement Priority	1b								
Upper Level Requirement	<table border="0"> <tr> <td>OSS-REQ-0122</td> <td>Provenance</td> </tr> <tr> <td>OSS-REQ-0169</td> <td>Data Products</td> </tr> <tr> <td>OSS-REQ-0123</td> <td>Reproducibility</td> </tr> <tr> <td>OSS-REQ-0172</td> <td>Provenance Archiving</td> </tr> </table>	OSS-REQ-0122	Provenance	OSS-REQ-0169	Data Products	OSS-REQ-0123	Reproducibility	OSS-REQ-0172	Provenance Archiving
OSS-REQ-0122	Provenance								
OSS-REQ-0169	Data Products								
OSS-REQ-0123	Reproducibility								
OSS-REQ-0172	Provenance Archiving								

2.152.1 Test Cases Summary

LVV-T1564	Verify re-run on similar system produces the same results			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Draft	1	false	Demonstration

Objective:

Verify that a provenance-based re-run that is run on the same system, or a system with identically configured hardware and system software, produces the same results.

2.153 [LVV-18295] DMS-REQ-0394-V-01: Data Management Nightly Reporting_1

Jira Link	Assignee	Status	Test Cases
LVV-18295	Leanne Guy	Not Covered	LVV-T1831

Verification Element Description:

Undefined

Requirement Details	
Requirement ID	DMS-REQ-0394
Requirement Description	Specification: The LSST Data Management subsystem shall produce a searchable - interactive nightly report(s), from information published in the EFD by each subsystem, summarizing performance and behavior over a user defined period of time (e.g. the previous 24 hours).
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0406 Subsystem Nightly Reporting

2.153.1 Test Cases Summary

LVV-T1831	Verify Implementation of Data Management Nightly Reporting			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Draft	1	false	Demonstration

Objective:

Verify that the LSST Data Management subsystem produces a searchable - interactive nightly report(s), from information published in the EFD by each subsystem, summarizing performance and behavior over a user defined period of time (e.g. the previous 24 hours).

2.154 [LVV-18298] DMS-REQ-0392-V-01: Alert Delay and Failure Tolerances_1

Jira Link	Assignee	Status	Test Cases
LVV-18298	Leanne Guy	Not Covered	

Verification Element Description:

Undefined

Requirement Details	
Requirement ID	DMS-REQ-0392
Requirement Description	Specification: The system shall reliably produce alerts for standard science visits read out in the camera [and specified to be analyzed by Data Management] such that no more than sciVisitAlertDelay per cent of visits will fail to have at least OTR1 per cent of its alerts distributed via the LSST alert distribution system within OTT1 , and no more than sciVisitAlertFailure per cent of visits will fail to generate and distribute alerts (integrated over all stages of data handling)
Requirement Parameters	[OTR1 = 98[percent]] Fraction of detectable alerts for which an alert is actually transmitted within latency OTT1 (see LSR-REQ-0101), sciVisitAlertFailure = 0.1[percent] Maximum fraction of visits for which alerts are not generated or distributed., OTT1 = 1[minute] The latency of reporting optical transients following the completion of readout of the last image of a visit, nAlertVisitPeak = 40000[integer] The instantaneous peak number of alerts per standard visit., sciVisitAlertDelay = 1[percent] Maximum fraction of science visits with less than OTR1 percent of the alerts distributed within OTT1.]
Requirement Discussion	Discussion: As with DMS-REQ-0004, this specification applies to visits which should have resulted in fewer than nAlertVisitPeak .
Requirement Priority	2
Upper Level Requirement	OSS-REQ-0112 Science Visit Alert Generation Reliability

2.155 [LVV-18299] DMS-REQ-0393-V-01: Performance Requirements for Transient Alert Distribution_1

Jira Link	Assignee	Status	Test Cases
LVV-18299	Leanne Guy	Not Covered	

Verification Element Description:

Undefined

Requirement Details	
Requirement ID	DMS-REQ-0393
Requirement Description	Specification: The system shall be able to identify and distribute an average of at least nAlertVisitAvg alerts per standard visit during a given night, and at least nAlertVisitPeak for a single standard visit.
Requirement Parameters	Specification: Performance shall degrade gracefully beyond nAlertVisitAvg . [nAlertVisitAvg = 10000[integer] The nightly minimum average number of alerts per standard visit., nAlertVisitPeak = 40000[integer] The instantaneous peak number of alerts per standard visit.]
Requirement Discussion	Discussion: The term 'degrade gracefully' means that visits with an excess of difference-image sources should not cause any DMS downtime; i.e., the system does not crash and is able to distribute alerts from that visit, potentially with greater latency.
Requirement Priority	2
Upper Level Requirement	LSR-REQ-0101 Data Processing for Single Visits and Transients OSS-REQ-0193 Alerts per Visit

2.156 [LVV-18339] DMS-REQ-0359-V-18: Outlier limit on zero points

Jira Link	Assignee	Status	Test Cases
LVV-18339	Leanne Guy	Not Covered	

Verification Element Description:

The distribution width (rms) of the internal photometric zero-point error (the system stability across the sky) will not exceed PA3 millimag, and no more than PF2 % of the distribution will exceed **PA4 = 15 millimag**. (This VE is for PA4.)

Requirement Details	
Requirement ID	DMS-REQ-0359
Requirement Description	Specification: The DMS shall include software to enable the calculation of the photometric performance metrics defined in OSS-REQ-0387.
Requirement Parameters	<p>[GhostAF = 1[percent]] Percentage of image area that can have ghosts with surface brightness gradient amplitude of more than 1/3 of the sky noise over 1 arcsec., PF1 = 10[percent] The maximum fraction of isolated non-saturated point source measurements exceeding the outlier limit., PA1gri = 5[millimagitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the g, r, and i filters., PA3 = 10[millimagitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) for all bands except u-band., PA4 = 15[millimagitude] The zero point error outlier limit., PF2 = 10[percent] Fraction of zeropoint errors that can exceed the zero point error outlier limit., PixFrac = 1[percent] The maximum fraction of pixels scientifically unusable per sensor out of the total allowable fraction of sensors meeting this performance., PA1uzy = 7.5[millimagitude] The RMS photometric repeatability of bright non-saturated unresolved point sources in the u, z, and y filters., PA6 = 10[millimagitude] Accuracy of the transformation of the internal LSST photometry to a physical scale (e.g. AB magnitudes), Xtalk = 3[sigma] The maximum local significance integrated over the PSF of imperfect crosstalk corrections., PA5u = 10[millimagitude] Accuracy of absolute band-to-band color zero-point for colors constructed using the u-band., ResSource = 2[unitless] Maximum RMS of the ratio of the error in integrated flux measurement between bright, isolated, resolved sources less than 10 arcsec in diameter and bright, isolated unresolved point sources., PA2uzy = 22.5[millimagitude] Repeatability outlier limit for isolated bright non-saturated point sources in the u, z, and y filters., SensorFraction = 15[percent] The maximum allowable fraction of sensors with PixFrac scientifically unusable pixels., PA3u = 20[millimagitude] RMS width of internal photometric zero-point (precision of system uniformity across the sky) in the u-band., PA2gri = 15[millimagitude] Repeatability outlier limit for isolated bright non-saturated point sources in the g, r, and i filters., SBPrec = 1[percent] The maximum error in the precision of the sky brightness determination., PA5 = 5[millimagitude] Accuracy of absolute band-to-band color zero-point for all colors constructed from any filter pair, excluding the u-band.]</p>

Requirement Discussion	Discussion: The relevant metrics are listed in the table photometricPerformance below. The values in the tables are the target values for LSST but are not verified as part of this requirement.	
Requirement Priority	1a	
Upper Level Requirement	OSS-REQ-0387	Photometric Performance

Draft

2.157 [LVV-18465] DMS-REQ-0395-V-01: Scientific Visualization of Camera Image Data_1

Jira Link	Assignee	Status	Test Cases
LVV-18465	Leanne Guy	Not Covered	LVV-T1830

Verification Element Description:

Undefined

Requirement Details	
Requirement ID	DMS-REQ-0395
Requirement Description	Specification: All scientific visualization of camera image data shall use the coordinate systems defined in LSE-349.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0408 Scientific Visualization of Camera Image Data

2.157.1 Test Cases Summary

LVV-T1830	Verify Implementation of Scientific Visualization of Camera Image Data			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Draft	1	false	Inspection

Objective:

Verify that all scientific visualization of camera image data uses the coordinate systems defined in LSE-349.

2.158 [LVV-18881] DMS-REQ-0282-V-02: Dark Current Correction Frame Effectiveness

Jira Link	Assignee	Status	Test Cases
LVV-18881	Leanne Guy	Not Covered	LVV-T1862

Verification Element Description:

Undefined

Requirement Details	
Requirement ID	DMS-REQ-0282
Requirement Description	Specification: The DMS shall produce on an as-needed basis a dark current correction image, which is constructed from multiple, closed-shutter exposures of appropriate duration. The effectiveness of the Dark Correction shall be verified in production processing on science data.
Requirement Discussion	Discussion: The need for a dark current correction will have to be quantified during Commissioning. Collecting closed-dome dark exposures may be deemed necessary to monitor the health of the detectors, even if not used in calibration processing.
Requirement Priority	1a
Upper Level Requirement	OSS-REQ-0271 Supported Image Types OSS-REQ-0046 Calibration

2.158.1 Test Cases Summary

LVV-T1862	Verify determining effectiveness of dark current frame			
Owner	Status	Version	Critical Event	Verification Type
Jeffrey Carlin	Draft	1	false	Test

Objective:

Verify that the DMS can determine the effectiveness of a dark correction and determine how often it should be updated.

A Traceability

Requirements	Verification Elements	Test Cases
DMS-REQ-0002	LVV-3	LVV-T101 LVV-T217
DMS-REQ-0009	LVV-6	LVV-T125
DMS-REQ-0010	LVV-7	LVV-T18 LVV-T20 LVV-T36
DMS-REQ-0018	LVV-8	LVV-T29 LVV-T283 LVV-T284 LVV-T1549 LVV-T1550 LVV-T1556
DMS-REQ-0020	LVV-9	LVV-T30 LVV-T283 LVV-T284 LVV-T1549 LVV-T1556
DMS-REQ-0024	LVV-11	LVV-T32 LVV-T283 LVV-T284 LVV-T1549 LVV-T1550 LVV-T1556
DMS-REQ-0029	LVV-12	LVV-T15 LVV-T19 LVV-T39
DMS-REQ-0030	LVV-13	LVV-T15 LVV-T19 LVV-T40
	LVV-9741	LVV-T1240
DMS-REQ-0032	LVV-14	LVV-T126
DMS-REQ-0033	LVV-15	LVV-T127 LVV-T362

DMS-REQ-0034	LVV-16	LVV-T61
DMS-REQ-0042	LVV-17	LVV-T128
DMS-REQ-0043	LVV-18	LVV-T21 LVV-T22 LVV-T129
DMS-REQ-0046	LVV-19	LVV-T68
DMS-REQ-0047	LVV-20	LVV-T16 LVV-T62 LVV-T62
DMS-REQ-0052	LVV-21	LVV-T130
DMS-REQ-0059	LVV-22	LVV-T83
DMS-REQ-0060	LVV-23	LVV-T84 LVV-T368 LVV-T368
DMS-REQ-0061	LVV-24	LVV-T85
DMS-REQ-0062	LVV-25	LVV-T86
DMS-REQ-0063	LVV-26	LVV-T87
DMS-REQ-0065	LVV-27	LVV-T134
DMS-REQ-0065	LVV-27	Verified By LVV-10004 Verified By LVV-10016 Verified By LVV-10017 Verified By LVV-10018
DMS-REQ-0068	LVV-28	LVV-T33 LVV-T283 LVV-T284 LVV-T286 LVV-T1549 LVV-T1550 LVV-T1556
DMS-REQ-0069	LVV-29	LVV-T15 LVV-T18 LVV-T19 LVV-T38 LVV-T362
DMS-REQ-0070	LVV-30	LVV-T15

		LWV-T19
		LWV-T41
DMS-REQ-0072	LWV-31	LWV-T15
		LWV-T19
		LWV-T42
DMS-REQ-0075	LWV-33	LWV-T149
		LWV-T1085
		LWV-T1086
		LWV-T1087
DMS-REQ-0096	LWV-38	LWV-T103
DMS-REQ-0097	LWV-39	LWV-T45
DMS-REQ-0099	LWV-41	LWV-T46
DMS-REQ-0101	LWV-43	LWV-T47
DMS-REQ-0106	LWV-46	LWV-T11
		LWV-T64
DMS-REQ-0120	LWV-48	LWV-T118
DMS-REQ-0121	LWV-49	LWV-T119
DMS-REQ-0124	LWV-52	LWV-T206
DMS-REQ-0130	LWV-57	LWV-T88
DMS-REQ-0132	LWV-59	LWV-T89
DMS-REQ-0158	LWV-62	LWV-T11
DMS-REQ-0158	LWV-62	Verified By LWV-136
		Verified By LWV-137
		Verified By LWV-138
DMS-REQ-0161	LWV-64	LWV-T172
DMS-REQ-0265	LWV-96	LWV-T34
		LWV-T283
		LWV-T284
DMS-REQ-0266	LWV-97	LWV-T48
DMS-REQ-0267	LWV-98	LWV-T12
		LWV-T13
		LWV-T65
		LWV-T362
DMS-REQ-0268	LWV-99	LWV-T12
		LWV-T66

DMS-REQ-0269	LVV-100	LVV-T18 LVV-T21 LVV-T49
DMS-REQ-0270	LVV-101	LVV-T21 LVV-T50
DMS-REQ-0271	LVV-102	LVV-T18 LVV-T22 LVV-T51
DMS-REQ-0271	LVV-9743	
DMS-REQ-0272	LVV-103	LVV-T22 LVV-T52
DMS-REQ-0272	LVV-103	Verified By LVV-10990 Verified By LVV-10990
DMS-REQ-0273	LVV-104	LVV-T53
DMS-REQ-0274	LVV-105	LVV-T54
DMS-REQ-0275	LVV-106	LVV-T12 LVV-T14 LVV-T67
DMS-REQ-0275	LVV-106	Verified By DM-9953 Verified By DM-13058
DMS-REQ-0276	LVV-107	LVV-T69
DMS-REQ-0277	LVV-108	
DMS-REQ-0278	LVV-109	LVV-T16 LVV-T72
DMS-REQ-0279	LVV-110	LVV-T12 LVV-T16 LVV-T73
DMS-REQ-0280	LVV-111	LVV-T74
DMS-REQ-0281	LVV-112	LVV-T75
DMS-REQ-0282	LVV-113	LVV-T90
	LVV-18881	LVV-T1862
DMS-REQ-0283	LVV-114	LVV-T91
DMS-REQ-0285	LVV-116	LVV-T22 LVV-T108

		LVV-T550
DMS-REQ-0286	LVV-117	LVV-T109
DMS-REQ-0287	LVV-118	LVV-T110
DMS-REQ-0287	LVV-9746	
DMS-REQ-0287	LVV-9747	
DMS-REQ-0288	LVV-119	LVV-T111
DMS-REQ-0289	LVV-120	LVV-T115
DMS-REQ-0290	LVV-121	LVV-T122
DMS-REQ-0291	LVV-122	LVV-T96
DMS-REQ-0292	LVV-123	LVV-T97
DMS-REQ-0293	LVV-124	LVV-T11 LVV-T98
DMS-REQ-0294	LVV-125	LVV-T12 LVV-T99
DMS-REQ-0296	LVV-127	LVV-T132 LVV-T362
DMS-REQ-0299	LVV-130	LVV-T137 LVV-T374
DMS-REQ-0301	LVV-132	LVV-T147
DMS-REQ-0307	LVV-138	LVV-T148
DMS-REQ-0311	LVV-142	LVV-T156
DMS-REQ-0317	LVV-148	LVV-T55
DMS-REQ-0319	LVV-150	LVV-T56
DMS-REQ-0321	LVV-152	LVV-T93
DMS-REQ-0323	LVV-154	LVV-T57
DMS-REQ-0324	LVV-155	LVV-T58
DMS-REQ-0325	LVV-156	LVV-T59
DMS-REQ-0326	LVV-157	LVV-T23
DMS-REQ-0327	LVV-158	LVV-T15 LVV-T19 LVV-T43
DMS-REQ-0328	LVV-159	LVV-T44
DMS-REQ-0329	LVV-160	LVV-T76
DMS-REQ-0330	LVV-161	LVV-T77
DMS-REQ-0331	LVV-162	LVV-T13

		LWV-T14
		LWV-T21
		LWV-T22
		LWV-T24
DMS-REQ-0331	LWV-162	Verified By DM-9953 Verified By DM-13058
DMS-REQ-0332	LWV-163	LWV-T25
DMS-REQ-0333	LWV-164	LWV-T26
DMS-REQ-0335	LWV-166	LWV-T79
DMS-REQ-0336	LWV-167	LWV-T159
DMS-REQ-0337	LWV-168	LWV-T80
DMS-REQ-0338	LWV-169	LWV-T81
DMS-REQ-0339	LWV-170	LWV-T82
DMS-REQ-0347	LWV-178	LWV-T13
		LWV-T14
		LWV-T21
		LWV-T22
		LWV-T28
DMS-REQ-0347	LWV-178	Verified By DM-9953 Verified By DM-13058
DMS-REQ-0348	LWV-179	LWV-T114
		LWV-T218
DMS-REQ-0349	LWV-180	LWV-T71
DMS-REQ-0350	LWV-181	LWV-T116
DMS-REQ-0351	LWV-182	LWV-T133
DMS-REQ-0378	LWV-3399	
DMS-REQ-0359	LWV-3401	LWV-T1756
	LWV-9751	LWV-T377
		LWV-T1847
	LWV-9752	LWV-T1758
		LWV-T1759
	LWV-9753	LWV-T377
		LWV-T1846
	LWV-9754	LWV-T1759
	LWV-9755	LWV-T377

		LVV-T1845
	LVV-9756	LVV-T377
		LVV-T1844
	LVV-9757	LVV-T377
		LVV-T1843
	LVV-9758	LVV-T1758
	LVV-9759	LVV-T1757
	LVV-9760	LVV-T377
		LVV-T1842
	LVV-9761	LVV-T377
		LVV-T1841
	LVV-9762	LVV-T377
		LVV-T1840
	LVV-9763	LVV-T377
		LVV-T1839
	LVV-9764	LVV-T377
		LVV-T1838
	LVV-9765	LVV-T377
		LVV-T1837
	LVV-9766	LVV-T377
		LVV-T1836
DMS-REQ-0359	LVV-18339	
DMS-REQ-0360	LVV-3402	LVV-T363
		LVV-T1745
	LVV-9767	LVV-T378
		LVV-T1746
	LVV-9768	LVV-T378
		LVV-T1747
	LVV-9769	LVV-T378
		LVV-T1748
	LVV-9770	LVV-T378
		LVV-T1749
	LVV-9771	LVV-T378
		LVV-T1750
	LVV-9773	LVV-T378
		LVV-T1746

	LVV-9774	LVV-T378
		LVV-T1751
	LVV-9775	LVV-T378
	LVV-9776	LVV-T378
		LVV-T1749
	LVV-9777	LVV-T378
		LVV-T1750
	LVV-9778	LVV-T378
		LVV-T1753
	LVV-9779	LVV-T378
		LVV-T1752
DMS-REQ-0362	LVV-3404	LVV-T376
		LVV-T1754
	LVV-9780	LVV-T376
DMS-REQ-0362	LVV-9781	
	LVV-9782	LVV-T1755
DMS-REQ-0362	LVV-9783	
DM-TS-CON-ICD-0011	LVV-5640	
DM-TS-CON-ICD-0011	LVV-5641	
DM-TS-CON-ICD-0002	LVV-5646	
DM-TS-CON-ICD-0002	LVV-5647	
DMS-REQ-0131	LVV-9745	LVV-T1277
DMS-PRTL-REQ-0025	LVV-9867	LVV-T660
DMS-PRTL-REQ-0026	LVV-9869	LVV-T5
		LVV-T661
		LVV-T1334
DMS-PRTL-REQ-0085	LVV-9926	LVV-T719
DMS-PRTL-REQ-0097	LVV-9937	LVV-T731
DMS-REQ-0382	LVV-18225	LVV-T1527
DMS-REQ-0379	LVV-18227	LVV-T1529
DMS-REQ-0383	LVV-18228	LVV-T1530
DMS-REQ-0344	LVV-18229	LVV-T1865
DMS-REQ-0390	LVV-18233	LVV-T1563
DMS-REQ-0389	LVV-18234	LVV-T1564

DMS-REQ-0394	LWV-18295	LWV-T1831
DMS-REQ-0392	LWV-18298	
DMS-REQ-0393	LWV-18299	
DMS-REQ-0395	LWV-18465	LWV-T1830

Note that some of the requirements listed in this traceability table may be related with additional Verification Elements not in the scope of *Science* Verification, and therefore not listed here.

Draft

B References

- [1] **[LSE-69]**, Dubois-Felsmann, G., 2014, *Interface between the Camera and Data Management*, LSE-69, URL <https://1s.st/LSE-69>
- [2] **[LSE-68]**, Dubois-Felsmann, G., 2015, *Camera Data Acquisition Interface*, LSE-68, URL <https://1s.st/LSE-68>
- [3] **[LSE-61]**, Dubois-Felsmann, G., Jenness, T., 2018, *LSST Data Management Subsystem Requirements*, LSE-61, URL <https://1s.st/LSE-61>
- [4] **[LDM-554]**, Dubois-Felsmann, G., Ciardi, D., Mueller, F., Economou, F., 2018, *Science Platform Requirements*, LDM-554, URL <https://1s.st/LDM-554>
- [5] **[LSE-349]**, Krughoff, K.S., 2019, *Defining the Transformation Between Camera Engineering Coordinates and Camera Data Visualization Coordinates*, LSE-349, URL <https://1s.st/LSE-349>
- [6] **[LSE-160]**, Selvy, B., 2013, *Verification and Validation Process*, LSE-160, URL <https://1s.st/LSE-160>

C Acronyms

Acronym	Description
ADQL	Astronomical Data Query Language
AOS	Active Optics System
AP	Alert Production
API	Application Programming Interface
BAO	Baryon Acoustic Oscillations
BDC	Base Data Center
CCD	Charge-Coupled Device
CCOB	Camera Calibration Optical Bench
CPP	Calibration Production Processing
CSV	Comma Separated Values
ComCam	The commissioning camera is a single-raft, 9-CCD camera that will be installed in LSST during commissioning, before the final camera is ready.
DAQ	Data Acquisition System
DBB	Data Backbone
DEC	Declination
DIA	Difference Image Analysis
DM	Data Management
DMS	Data Management Subsystem
DMS-REQ	Data Management System Requirements prefix
DMSR	DM System Requirements; LSE-61
DOI	Digital Object Identifier
DPDD	Data Product Definition Document
DR	Data Release
DR1	Data Release 1
DR11	Data Release 11
DRP	Data Release Production
DWDM	Dense Wave Division Multiplex
EFD	Engineering and Facility Database
FITS	Flexible Image Transport System
FK5	Fifth Fundamental Catalogue
FWHM	Full Width at Half-Maximum
HEALPix	Hierarchical Equal-Area iso-Latitude Pixelisation

HSC	Hyper Suprime-Cam
ICD	Interface Control Document
IVOA	International Virtual-Observatory Alliance
JPL	Jet Propulsion Laboratory (DE ephemerides)
L1	Lens 1
L2	Lens 2
L3	Lens 3
LDF	LSST Data Facility
LDM	LSST Data Management (Document Handle)
LSE	LSST Systems Engineering (Document Handle)
LSP	LSST Science Platform (now Rubin Science Platform)
LSR	LSST System Requirements; LSE-29
LSST	Legacy Survey of Space and Time (formerly Large Synoptic Survey Telescope)
MOC	Multi Ordered Catalogue
MOPS	Moving Object Processing System (deprecated; see SSP)
NASA	National Aeronautics and Space Administration
NCSA	National Center for Supercomputing Applications
OCS	Observatory Control System
OSS	Observatory System Specifications; LSE-30
PMCS	Project Management Controls System
PS	Project Scientist
PSF	Point Spread Function
PVI	Processed Visit Image
RA	Right Ascension
RMS	Root-Mean-Square
SDSS	Sloan Digital Sky Survey
SED	Spectral Energy Distribution
SIA	Simple Image Access
SLAC	SLAC National Accelerator Laboratory
SODA	Server-side Operations for Data Access
SQL	Structured Query Language
SRD	LSST Science Requirements; LPM-17

SUIT	Science User Interface and Tools (LSST Data Management WBS element and team, responsible for LSP Portal Aspect)
T&S	Telescope and Site
TAI	International Atomic Time
TAP	Table Access Protocol
TBD	To Be Defined (Determined)
TS	Test Specification
UI	User Interface
VE	vendor estimate
VO	Virtual Observatory
WCS	World Coordinate System
WISE	Wide-field Survey Explorer
arcmin	arcminute minute of arc (unit of angle)
arcsec	arcsecond second of arc (unit of angle)
deg	degree; unit of angle