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Vera C. Rubin Observatory
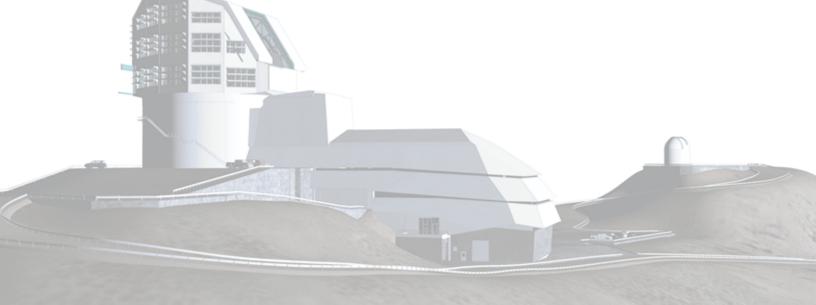## Data Management

LSST DM Raw Image Archiving Service Test Specification

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LDM-538

Latest Revision: 2021-01-06

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Abstract

This document describes the detailed test specification for the LSST DM Raw Image Archiving Service. This is a specific DM test, and will grow as more tests are needed for the entire environment. This includes two individual tests for the overall raw image creation and ingest into the permanent record of the survey.

Change Record

Version	Date	Description	Owner name
	2018-04-18	initial release - draft version	Michelle Butler
1.0	2018-07-13	Approved in RFC-488.	W. O'Mullane
2.0	2021-01-06	Document set to obsolete (RFC-749). Test cases moved to LDM-639.	G. Comoretto

Document curator: Michelle Butler

Document source location: `https://github.com/lsst/LDM-538`

Version from source repository: 8cad643

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LSST DM Raw Image Archiving Service Test Specification

1 Introduction

This document specifies the test procedure for the LSST DM Raw Image Archiving Service.

The LSST DM Raw Image Archiving Service is the component of the LSST system which is responsible for:

- The creation of a well-formed raw image;

- Providing fast access to the raw image by the Observatory Operations staff;

- Saving the raw image into the permanent record of the survey;

A full description of this service is provided in §5.1.1 of LDM-148 and §2.2 (which describes LSSTCam Archiving Service), §2.3 (Spectrograph Archiving Service) and §2.6 (Observatory Operations Data Service) of LDM-230.

1.1 Objectives

This document builds on the description of LSST Data Management's approach to testing as described in LDM-503 to describe the detailed tests that will be performed on the LSST DM Raw Image Archiving Service as part of the verification of the DM system.

It identifies test designs, test cases and procedures for the tests, and the pass/fail criteria for each test.

1.2 Definitions, Acronyms, and Abbreviations

Acronym	Description
ATS	Auxiliary Telescope System
CCD	Charge-Coupled Device
CCOB	Camera Calibration Optical Bench

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DAQ	Data AcQuisition (system)
DBB	Data BackBone
DM	Data Management
DMCS	DM Control System
DMHS	Data Management Header Service
DMS	Data Management Sub-system
EFD	Engineering Facilities Database
L1	Level 1 (ambiguous could mean milestone or processing)
LDM	LSST Data Management (handle for controlled documents)
LSE	LSST Systems Engineering (Document Handle)
LSST	Large Synoptic Survey Telescope
OCS	Observatory Control System
OODS	Observatory Operations Data Service
RAS	Raw image Archive Service (Tag for requirements)
STS	System Test Specification

1.3   Scope

This document describes the test procedures for the Raw Image Archiving Service which includes parts from each of the following components of the LSST system (as described in LDM-148):

- OCS

- Camera DAQ

- DM Header Service

- EFD Large File Annex (limited to communication between the DM Header Service and the Archivers)

- DM OCS Bridge

- CCOB

- DMCS

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- Archiver

- Catch-up Archiver

- Alert Processor

- ATS Achiver

- Data Forwarders

- Observatory Operations Data Service

- Data Backbone Services

1.4   Applicable Documents

LSE-209	Software Component to Observatory Control System (OCS) Interface
LSE-68	Camera Data Acquisition Interface
LSE-70	System Communication Protocol Interface
LSE-72	Data Management - OCS Software Communication Interface
LDM-148	LSST DM System Architecture
LDM-294	LSST DM Organization & Management
LDM-503	LSST DM Test Plan
LSE-61	LSST DM Subsystem Requirements
LSE-163	LSST Data Products Definition Document
LSE-29	LSST Data Products Definition Document

1.5   References

[1] **[LSE-29]**, Claver, C.F., The LSST Systems Engineering Integrated Project Team, 2017, *LSST System Requirements (LSR)*, LSE-29, URL `https://ls.st/LSE-29`

[2] **[LSE-68]**, Dubois-Felsmann, G., 2015, *Camera Data Acquisition Interface*, LSE-68, URL `https://ls.st/LSE-68`

[3] **[LSE-61]**, Dubois-Felsmann, G., Jenness, T., 2018, *LSST Data Management Subsystem Requirements*, LSE-61, URL `https://ls.st/LSE-61`

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[4] **[LSE-72]**, Dubois-Felsmann, G., Schumacher, G., Selvy, B., 2014, *OCS Command Dictionary for Data Management*, LSE-72, URL `https://ls.st/LSE-72`

[5] **[LDM-639]**, Guy, L., 2018, *DM Acceptance Test Specification*, LDM-639, URL `https://ls.st/LDM-639`

[6] **[LSE-163]**, Jurić, M., et al., 2017, *LSST Data Products Definition Document*, LSE-163, URL `https://ls.st/LSE-163`

[7] **[LDM-148]**, Lim, K.T., Bosch, J., Dubois-Felsmann, G., et al., 2018, *Data Management System Design*, LDM-148, URL `https://ls.st/LDM-148`

[8] **[LSE-209]**, Lotz, P., 2016, *Software Component to OCS Interface*, LSE-209, URL `https://ls.st/LSE-209`

[9] **[LSE-70]**, Lotz, P., 2016, *System Communication Protocol Interface*, LSE-70, URL `https://ls.st/LSE-70`

[10] **[LDM-294]**, O'Mullane, W., Swinbank, J., Jurić, M., DMLT, 2018, *Data Management Organization and Management*, LDM-294, URL `https://ls.st/LDM-294`

[11] **[LDM-503]**, O'Mullane, W., Swinbank, J., Jurić, M., Economou, F., 2018, *Data Management Test Plan*, LDM-503, URL `https://ls.st/LDM-503`

[12] **[LDM-230]**, Petravick, D., Butler, M., Gelman, M., 2018, *Concept of Operations for the LSST Data Facility Services*, LDM-230, URL `https://ls.st/LDM-230`

2   Approach

The major activities to be performed are to:

- Show successful integration between Telescope subsystems and Level 1 Archiver Service;

- Show successful integration between CCOB (Camera Calibration Optical Bench) and DBB (Data Backbone);

- Show successful integration between Level 1 Archiver Service and OODS;

- Show successful integration between Level 1 Archiver Service and DBB;

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2.1   Tasks and criteria

The following are the major items under test:

- Create a well-formed raw image with data acquired from the Camera DAQ and the DM Header Service;

- Create a image from a CCOB and ingest the file into the DBB for further processing;;

- Save a raw image in the OODS cache and access it using normal LSST mechanisms (e.g., "Data Butler");

- Ingest a raw image into the DBB;

2.2   Features to be tested

Do the following satisfy the requirements described in LSE-61?

- Completeness and correctness of the raw images including format, metadata, and image data;

- Raw data access;

- Archiving of raw images;

2.3   Features not to be tested

This document describes the end-to-end testing of various components that comprise the Raw Image Archiving service. It does not include tests internal to a single component. Also this test specification does not extend beyond the positive pass/fail options.

2.4   Pass/fail criteria

The results of all tests will be assessed using the criteria described in LDM-503 §4.

2.5   Suspension criteria and resumption requirements

Currently not applicable.

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3   Test Cases Summary

Follows the list of test cases documented in this specification.

Test Id	Test Name
LVV-T283	RAS-00-00: Writing well-formed raw image
LVV-T284	RAS-00-05: Writing data from CCOB to the DBB for further data processing
LVV-T285	RAS-00-10: Raw images in Observatory Operations Data Service
LVV-T286	RAS-00-20: Raw image are part of the permanent record of survey via DBB
LVV-T287	RAS-00-30: Raw Image Archiving Availability, Throughput, Reliability, and Heterogeneity

4 Test Cases

4.1 LVV-T283 - RAS-00-00: Writing well-formed raw image

Version	Status	Priority	Verification Type	Critical Event	Owner
1	Draft	Normal	Test	False	Michelle Butler

4.1.1 Requirements

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

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

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

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

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

- LVV-146 - DMS-REQ-0315-V-01: DMS Communication with OCS

- LVV-115 - DMS-REQ-0284-V-01: Level-1 Production Completeness

4.1.2 Test Items

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.

4.1.3   Intercase Dependencies

None.

4.1.4   Environment Needs

4.1.4.1   Software

- Level 1 software and services needed to create raw image
- LSST Monitoring Service and plugins specific to monitoring Level 1 Test Stand and services

4.1.4.2   Hardware

- Level 1 test stand
- Test machine for LSST Monitoring Service

4.1.5   Input Specification

None.

4.1.6   Output Specification

Raw image(s) that follow specifications defined in change-controlled document LSE-61.

4.1.7   Test Procedure

Step	Description, Input Data and Expected Result	
1	Description	Configure system to pull appropriate data from the DAQ emulator
	Test Data	No data.
	Expected Result	A functional DAQ for images to be received from.

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Step		Description, Input Data and Expected Result
2	Description	Acquire raw data from DAQ readout and DMHS
	Test Data	No data.
	Expected Result	a raw image and a header from the DMHS
3	Description	Fetch data and reassemble correctly, regardless of CCD/Sensor manufacturer type (two different types will be used)
	Test Data	No data.
	Expected Result	Build the data into a fits file
4	Description	CheckCompletenessandcorrectnessoftherawimagesincludingformat,metadata,and image data; • Check proper fetch and reassembly of image data from camera DAQ (correct format and data); • Check proper merge of header service data with image data; • Check correct insertion of exposure specific data needed in the data file that is not supplied by header service; • Check minimum required metadata (from requirements document LSE-61) exists in raw image header;
	Test Data	No data.
	Expected Result	a well formed FITS file with a proper header that has been verified to be correct.
5	Description	Check that the checksum of the file matches the previously calculated value that will be passed on to downstream services
	Test Data	No data.
	Expected Result	a MD5sum number generated from the step 4 file.
6	Description	Check confirmation that the data files arrive at their destination intact
	Test Data	No data.
	Expected Result	a transfer of the file to the correct location for further retrieval from other services.
7	Description	Check that LSST Monitoring Service showed the appropriate information successfully
	Test Data	No data.

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Step	Description, Input Data and Expected Result
Expected Result	all systems remained green through out the test, and showed all systems up and available.

4.2 LVV-T284 - RAS-00-05: Writing data from CCOB to the DBB for further data processing

Version	Status	Priority	Verification Type	Critical Event	Owner
1	Draft	Normal	Test	False	Michelle Butler

4.2.1 Requirements

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

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

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

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

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

- LVV-146 - DMS-REQ-0315-V-01: DMS Communication with OCS

- LVV-115 - DMS-REQ-0284-V-01: Level-1 Production Completeness

4.2.2 Test Items

This test will check:

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

4.2.3   Intercase Dependencies

None.

4.2.4   Environment Needs

4.2.4.1   Software

- CCOB device and the software to produce a file to be transferred and kept
- DBB software to produce a retrieval file for further processing

4.2.4.2   Hardware

- CCOB
- Test machine for LSST Monitoring Service
- consolidate DB
- DBB ingest file system
- DBB output file system
- data transfer protocol to move data from CCOB file systems to DBB ingest file system

4.2.5   Input Specification

None.

4.2.6   Output Specification

- CCOB (raw image) files that follow specifications;
- DBB files that follow specifications;
- CCOB device directs a human to where a file is wanted to be stored in the DBB;
- Transfer the file to the DBB ingest area;

4.2.7   Test Procedure

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Step	Description, Input Data and Expected Result	
1	Description	CCOB device directs a human to where a raw file is wanted to be stored in the DBB
	Test Data	No data.
	Expected Result	A file with a unique file name is in a file system somewhere, and the data is then transferred to NCSA.
2	Description	Move the data from the transferred directory into the DBB foreign file ingest file system.
	Test Data	No data.
	Expected Result	A command is executed by a human with a file name and path to the file wanted to be stored in the DBB. The file is transferred to NCSA's DBB ingest area.
3	Description	The DBB is notified of a new file being in the ingest area, and the DBB ingest is run manually to ingest the CCOB file.
	Test Data	No data.
	Expected Result	The DBB puts the resulting file into the DBB file systems depending on what type of file it is. The DB is updated with metadata and providence of the file to be kept. The resulting file system is queryable by the LSP to find the CCOB raw image.
4	Description	The LSP can review and use the CCOB raw data file that was stored originally somewhere else such as slac
	Test Data	No data.
	Expected Result	LSP has the ability to find the file and view/use it.
5	Description	
	Test Data	No data.
	Expected Result	

4.3   LVV-T285 - RAS-00-10: Raw images in Observatory Operations Data Service

Version	Status	Priority	Verification Type	Critical Event	Owner
1	Draft	Normal	Test	False	Michelle Butler

4.3.1   Requirements

None.

4.3.2   Test Items

This test will check:

- The handoff of a raw image from the Level 1 Archiver to the OODS cache manager is successful;
- A recently taken raw image is accessible to the Observatory Operations staff at the base and summit;

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

4.3.3   Intercase Dependencies

LVV-T283

4.3.4   Environment Needs

4.3.4.1   Software   The following software must be installed:

- Level 1 Test Stand (include software from LVV-T283 - RAS-00-00)
- OODS cache manager
- LSST Monitoring Service and plugins specific to monitoring raw images and OODS
- LSST stack for checking raw images

4.3.4.2   Hardware   To complete all tests in a manner which reflects the real system, the following hardware is needed. Note: If not testing inter-machine access, the hardware can be

minimized to a single machine outside of the Level 1 Test Stand.

- Level1TestStand(include hardware from LVV-T283 - RAS-00-00)+read/write access to OODS cache disk
- Test Machine for OODS cache manager with read/write access to OODS cache disk
- Test machine for Observatory Operations staff at "base" that can access OODS cache disk
- Test machine for Observatory Operations staff at "summit" that can access OODS cache disk
- Test machine for LSST Monitoring Service

Size of cache disk is determined by number of files to be included in the test.

4.3.5   Input Specification

4.3.6   Output Specification

Raw image(s) that follow format defined in LSE-61;
Database (may be SQLite file) that enables the raw image(s) to be accessed via a "Data Butler".

4.3.7   Test Procedure

Step	Description, Input Data and Expected Result	
1	Description	Initialize all services configuring the Level 1 Archiver Service so that the raw images are to be saved to the OODS
	Test Data	No data.
	Expected Result	all camera and services for images are running and reporting green through the monitoring programs for the services.
2	Description	Acquire a raw image
	Test Data	No data.
	Expected Result	Image present in the input folder.

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Step	Description, Input Data and Expected Result	
3	Description	*The handoff of the raw image from the Level 1 Archiver Service to the test OODS automatically occurs*
	Test Data	No data.
	Expected Result	the raw image with a proper header is written to a file area managed by the OODS
4	Description	For each of the expected raw images, verify that the checksum matches the original Level 1 checksum
	Test Data	No data.
	Expected Result	checksum of the file is checked against the file for verification that the OODS has the correct file and it matches the original md5sum of the FITS file.
5	Description	Check that LSST Monitoring Service showed the appropriate information successfully
	Test Data	No data.
	Expected Result	Make sure all camera and OODS systems were available throughout this test.

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

Version	Status	Priority	Verification Type	Critical Event	Owner
1	Draft	Normal	Test	False	Michelle Butler

4.4.1 Requirements

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

- LVV-177 - DMS-REQ-0346-V-01: Data Availability

- LVV-115 - DMS-REQ-0284-V-01: Level-1 Production Completeness

4.4.2 Test Items

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.

4.4.3 Intercase Dependencies

LVV-T283

4.4.4 Environment Needs

4.4.4.1 Software

- Level 1 Test Stand
- DBB buffer manager
- DBB raw image ingestion
- DBB database
- LSST Monitoring Service and plugins specific to monitoring raw images, DBB buffer manager, and DBB

4.4.4.2 Hardware

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- Level 1 Test Stand (include hardware from LVV-T-283 - RAS-00-00) + read/write access to DBB buffer disk;
- Test Machine for DBB buffer manager with read/write access to DBB buffer disk;
- Test machine for each DBB endpoint with read/write access to DBB disk;
- Test machine for LSST Monitoring Service

Size of buffer disk and DBB disk is determined by number of files to be included in the test.

Note: If not testing inter-machine operability, then the hardware can be minimized to a single machine outside of the Level 1 test stand.

4.4.5   Input Specification

None

4.4.6   Output Specification

- Raw image(s) are saved to storage and replicated to correct locations with checksums that match original Level 1 checksum;
- Database containing information of the following types: physical, location, science meta-data, provenance as specified in LSE-61;
- Both image(s) and database entries replicated correctly;

4.4.7   Test Procedure

Step	Description, Input Data and Expected Result	
1	Description	Initialize all services configuring the Level 1 Archiver Service so that the raw images are to be archived to the DBB
	Test Data	No data.
	Expected Result	all services for the camera images and the DBB services are all running and ready for data.
2	Description	Acquire a raw image (see LVV-T283 - RAS-00-00)
	Test Data	No data.

Step	Description, Input Data and Expected Result	
	Expected Result	have a raw Fits file with proper header.
3	Description	After the automatic handoff of the raw image between the Level 1 Archiver Service and the DBB buffer manager, the raw image will automatically be ingested into the Data Backbone
	Test Data	No data.
	Expected Result	the DBB file systems will have the file, and metadata and providence will be recorded in the consolidated DB. The file will also be replicated to mulitple locations for DR.
4	Description	Check that the raw image is accessible at each DBB endpoint and matches original Level 1 checksum
	Test Data	No data.
	Expected Result	data resides at NCSA DBB end point, and Chile end point and match with the same check-sum.
5	Description	Check that LSST Monitoring Service showed the appropriate information successfully
	Test Data	No data.
	Expected Result	all related systems remained up during this test.
6	Description	More complete tests of the DBB can be done by running the DBB service tests on the raw image(s). These would check correctness and completeness of the data stored in the database as well as checking that the file has been replicated to all required places
	Test Data	No data.
	Expected Result	These would be more tests of when things go wrong to make sure that the DBB is able to continue to work, and not be in the way of taking images from the camera

4.5 LVV-T287 - RAS-00-30: Raw Image Archiving Availability, Throughput, Reliability, and Heterogeneity

Version	Status	Priority	Verification Type	Critical Event	Owner
1	Draft	Normal	Test	False	Michelle Butler

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4.5.1   Requirements

- LVV-5 - DMS-REQ-0008-V-01: Pipeline Availability

- LVV-65 - DMS-REQ-0162-V-01: Pipeline Throughput

- LVV-68 - DMS-REQ-0165-V-01: Infrastructure Sizing for "catching up"

- LVV-70 - DMS-REQ-0167-V-01: Incorporate Autonomics

- LVV-145 - DMS-REQ-0314-V-01: Compute Platform Heterogeneity

- LVV-149 - DMS-REQ-0318-V-01: Data Management Unscheduled Downtime

- LVV-140 - DMS-REQ-0309-V-01: Raw Data Archiving Reliability

4.5.2   Test Items

This test will check:

- Raw Image Archiving meets availability requirements;
- Raw Image Archiving meets throughput requirements;
- Raw Image Archiving meets reliability requirements;
- Raw Image Archiving meets heterogeneity requirements;

This test case need to be completed when more information is available.

4.5.3   Intercase Dependencies

4.5.4   Environment Needs

4.5.4.1   Software

4.5.4.2   Hardware

4.5.5   Input Specification

4.5.6   Output Specification

4.5.7   Test Procedure

Step	Description, Input Data and Expected Result	
1	Description	these will be filled out as the service becomes more known as to what the availablility, throughput, reliability and heterogeneity are.
	Test Data	No data.
	Expected Result	The archive system will stay up through thick and thin and perform like it's suppose to.

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Verification Requirement	Test Cases
LVV-8 - DMS-REQ-0018-V-01: Raw Science Image Data Acquisition	LVV-T283 LVV-T284
LVV-9 - DMS-REQ-0020-V-01: Wavefront Sensor Data Acquisition	LVV-T283 LVV-T284
LVV-96 - DMS-REQ-0265-V-01: Guider Calibration Data Acquisition	LVV-T283 LVV-T284
LVV-28 - DMS-REQ-0068-V-01: Raw Science Image Metadata	LVV-T283 LVV-T284 LVV-T286
LVV-11 - DMS-REQ-0024-V-01: Raw Image Assembly	LVV-T283 LVV-T284
LVV-146 - DMS-REQ-0315-V-01: DMS Communication with OCS	LVV-T283 LVV-T284
LVV-115 - DMS-REQ-0284-V-01: Level-1 Production Completeness	LVV-T283 LVV-T284 LVV-T286
LVV-177 - DMS-REQ-0346-V-01: Data Availability	LVV-T286
LVV-5 - DMS-REQ-0008-V-01: Pipeline Availability	LVV-T287
LVV-65 - DMS-REQ-0162-V-01: Pipeline Throughput	LVV-T287
LVV-68 - DMS-REQ-0165-V-01: Infrastructure Sizing for "catching up"	LVV-T287
LVV-70 - DMS-REQ-0167-V-01: Incorporate Autonomics	LVV-T287
LVV-145 - DMS-REQ-0314-V-01: Compute Platform Heterogeneity	LVV-T287
LVV-149 - DMS-REQ-0318-V-01: Data Management Unscheduled Downtime	LVV-T287
LVV-140 - DMS-REQ-0309-V-01: Raw Data Archiving Reliability	LVV-T287