



LARGE SYNOPTIC SURVEY TELESCOPE

## Large Synoptic Survey Telescope (LSST) Data Management

# Proposed DM OPS Rehearsals

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LDM-643

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## Abstract

For discussion about better specifying Operations Rehearsals.

## Change Record

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# Proposed DM OPS Rehearsals

## 1 Introduction

As LSST DM moves from construction through commissioning and into operations a number of rehearsals have been proposed to help prepare for the execution of the survey. Specific rehearsals are outlined in [LDM-503] but in the more comprehensive cases, i.e. the Operations (Ops) Rehearsals (LDM 503-09, LDM 503-11, and LDM 503-12), the contents of those document alone, do not sufficiently outline the scope, content, action and interaction that are being rehearsed. From the software side, [LDM-564] summarizes the DM software features that should be available and helpfully identifies those software releases in the context of the rehearsals. However, the Ops Rehearsals are not simply periods to test hardware and software systems, they are opportunities to develop and understand operations processes and to observe the interactions of hardware, software and personnel.

This document attempts to outline the Ops Rehearsals in greater detail for the following reasons:

- Depending on the impact, missing or late software features and hardware systems may either require mitigation (e.g., shims, fake data, etc...) or might even be grounds for postponement.
- The purpose of an Ops Rehearsal is not to debug a freshly deployed system, but rather to understand whether that system does what is needed.
- The effort to carry out rehearsals will require coordination of personnel and facilities.

Note: This remains a work in progress. The current draft attempts to describe the process for the first Ops rehearsal. The subsequent rehearsals have only been outline to the extent to properly understand their scope.

## 2 LDM 503-09: Operations Rehearsal #1 for Commissioning

Nominal Date: April 2019

Original Description:

- Choose TBD weeks during commissioning to simulate.
- Pick which parts of plan we could rehearse.
- The commissioning team (via Chuck Claver) suggests Instrument Signal Removal should be the focus of this (or the next rehearsal).

### 2.1 An Updated Goal:

The primary goal is to simulate nominal operations, both daytime and nighttime, for a 2–3 day period including the daily meeting(s) that would occur among the SciOps and Data Facility staff. These activities will be accompanied by simulated observations obtained in a “sampling” mode in order to exercise:

1. the transfer, archiving and ingestion of raw data
2. offline processing of calibrations and science data
3. curation of the resulting data products

At the time of this initial rehearsal, we do not expect a functioning observatory system, instead:

- Sampling mode has been used to describe early LSST commissioning observations where observations occur based on the needs of the commissioning team. Such observations would typically include some basic set of calibrations (e.g. biases and flats) followed by nighttime observations that might be used to test and quantify system performance.
- A basic set of raw data will be transferred to a mountaintop computer which will then in turn mimic observations by sending those images from the summit to NCSA via the long-haul networks.
- The contents of the dataset will be minimal (no larger than the calibration and nightly observations that might be expected from ComCam). The current plan is to draw from a

suitable set of test-stand data and then present these as though they were coming from the telescope.

- On arrival at the LDF the observations will be ingested into the current data-backbone which can in turn be used to feed the data through a batch production service to produce “calibrations” and “reduced science products.”
- In the context of this rehearsal, the sophistication (or correctness) of the pipeline(s) is not paramount. What is important is that the raw and resulting products are tracked and can be superficially examined by LDF and SciOps team members. The degree of realism would depend on both the data being sent and availability of working pipeline tasks.

## 2.2 Pre-Requisites:

There are three broad categories of pre-requisites that are needed:

1. Persons must be identified to fill roles within the rehearsals.
2. Services (or facsimiles) need to exist that will be used/tested throughout the rehearsal.
3. Elements that would not otherwise be available in the pre-operations LSST project will be prepared.

### 2.2.1 Pre-Requisites: Roles:

Persons need to be identified that will staff various roles in this rehearsal. These roles are drawn from those in operations which come from three groups: Observatory Operations (ObsOps), Science Operations (SciOps), and the LSST Data Facility (LDF).

- Coordinator: This person acts as an independent executor of the rehearsal. They would be responsible for executing outside actions that drive the simulation (e.g., initiating a script that would start data flowing from summit to LDF).
- ObsOps, Observing Specialist
- SciOps, QA Scientist
- SciOps, Verification and Validation Scientist

- LDF, Operator
- LDF, QA Scientist
- LDF, Admin

## 2.2.2 Pre-Requisites: Services & Service Components:

The broader pieces of the DM system that need to operate for this rehearsal are:

- A service must operate at the mountaintop that will send data. This can be as simple as a shell script that draws from a list of files and transfers them to NCSA with some cadence.
- Nominally the long-haul networks need to be available at the time of this rehearsal. (Note: at the nominal time of this rehearsal we can only expect transfer rates (BASE to LDF) of order 10 MB/s. Therefore, ~500 raft-scale images should require ~8 hrs. In addition, outages due to movement of equipment at the base may occur. A copy of test data should be kept at LDF to mitigate data transfer problems/outages during the rehearsal.)
- A data backbone endpoint to receive and ingest incoming files must exist.
- A mechanism must exist to distribute jobs to a compute resource to process the "new" data-Batch Production.
- A workflow system to configure and launch jobs must exist.
- Pipeline(s) to processes the data must be in place.
- A minimally functional science platform where raw and processed data products can be examined by staff must exist.

Additional monitoring services for the networks, batch production, compute resource(s), and data backbone are desirable.

## 2.2.3 Pre-Requisites: Work:

Work that must be completed prior to Ops Rehearsal but which is not part of the DM development:

- Generate a mock data set. This must have the ability to be ingested with either Gen2 or Gen3 Butler. It is not necessary that the generated data products be curated for a long period.
- Create a shim service that sends data from summit to LDF.
- Specify appropriate pipeline(s) that will be run during the rehearsal.
- Test that services in the preceding section can adequately function for the purposes of this rehearsal.
- Allocate compute and storage resources and specify location of stored products.
- Location to record information about incidents, problem backlog, processing and QA summaries (for the initial test this could be as simple a set of confluence pages).

## 2.3 Rehearsal Outline:

During normal operations the time observing occurs depends on local nighttime in Chile. This is not necessary for the rehearsal and so data delivery and can be shifted to occur in a normal working day. Prior to the execution of the rehearsal the work outlined in Section 2.2.3 must be completed and tested.

A basic outline of the processes that would occur during this rehearsal follows:

1. (ALL: ObsOps+SciOps+LDF) afternoon stand-up operations meeting
2. (ObsOps) mock transmit nightly calibration exposures to LDF for ingestion
3. (LDF) generate nightly master calibrations
4. (SciOps) select configuration and calibrations
5. (ObsOps) mock transmit nightly science images and ingest
6. (LDF) run science pipeline (.e.g. ISR) in offline/batch mode
7. (LDF) generate processing reports for discussion in stand-ups
8. (SciOps) examine input and output data from nightly observations and processing
9. (SciOps) generate quality reports for discussion in stand-ups



10. (ALL) monitor progress of nightly “campaigns,” characterize and assess, make records of failures, diagnose issues, generate problem backlog
11. (ALL) create mock nightly reports
12. repeat (a total of 3 times)

While there are “realistic” components within the outline, much of focus by the actors should be on the processes. How is this going to look in day-to-day operations? If there are problems, what happens? Who gets a call and when? What information needs to be available between a geographically distributed team (and when)? Are the lines of communication between those groups sufficient?

## 2.4 Assess:

Among the activities in the Rehearsal Outline it is expected that some might influence the long-term development within DM. An example is exercising tools and services (e.g. the LSP) with a mind toward operational needs. Another example is to inform the processes and metrics needed to make decisions about configuration and calibration selection in the context of both production success and production failure.

Example questions that can be asked during the assessment phase are:

- Was the rehearsal successful? How long did it take? What anomalies/failure modes were identified, and how did the team cope?
- What fixes are needed, and on what timescale (e.g., next ops rehearsal, or we are go for commissioning)?
- What improvements in procedures, documentation, frameworks, systems, and algorithms were identified and at what priority?
- How is time and effort budgeted to plan and execute priority changes and improvements? How will the next rehearsal be planned?

## 2.5 Addendum:

Operations Rehearsal #1 occurred in May 2019. A short note, DMTN-119, gives a summary report of its execution.

### 3 LDM 503-11: Operations Rehearsal #2 for Commissioning

Nominal Date: December 2019 - February 2020

Original Description:

More complete commissioning rehearsal:

- How do the scientists look at data?
- How do they provide feedback to the telescope?
- How do we create calibrations?
- How do we update calibrations?

#### 3.1 An Updated Goal:

The primary goal is to rehearse for commissioning operations prior to the ComCam verification and validation era (including the mini-surveys). Similar to Ops Rehearsal #1, we would emulate both daytime and nighttime, for a 3-5 days, would include daily meetings, exercise data movement and processing. Additionally this rehearsal could include: application of software changes, simulated outages, or non-standard (unprocessable) engineering observations. If the Auxiliary Telescope Spectrograph has become available, one alternative or extension that should be considered would be to use AuxTel data and a pipeline as part of these exercises.

In the current time frame of this rehearsal, we do not expect a functioning telescope + camera. Instead:

- ComCam should be either at the summit or Tuscon and on a test stand. Therefore, we could use ComCam with a Camera Control System to obtain test-stand images and send them through the DAQ for archiving and batch processing. In addition simulated (or if ComCam is on the telescope, real) raft-scale data would be used.
- If simulated data are used then a set of raw data will be transferred to a mountaintop computer which will then in turn mimic observations by sending those images from the summit to NCSA via the long-haul networks.

- The contents of the dataset would roughly match those expected during ComCam verification activities. Thus, the dataset would be comprised of calibration and nightly observations but might also include engineering data (that might not be processed with a normal pipeline).
- On arrival at the LDF the observations will be ingested into the current data-backbone which can in turn be used to feed the data through a batch production service to produce “calibrations” and “reduced science products.” If the DAQ2.5 hardware/software are available then prompt processing could also be attempted for some observations.
- Similar to the Ops Rehearsal #1, the sophistication (or correctness) of the pipelines are not paramount. What is important is that the raw and resulting data products are tracked and can be superficially examined by LDF and SciOps team members. The degree of realism would depend on both the data being sent and availability of working pipeline tasks.

## 4 LDM 503-12: Operations Rehearsal #3 for Commissioning

Nominal Date: August 2021

Original Description:

Dress rehearsal: commissioning starts in April so by this stage we should be ready to do everything needed.

### 4.1 An Updated Goal:

Here the primary goal is to rehearse for commissioning operations prior to LSSTCam start of integration and test (i.e. while LSSTCam is on the summit but not yet integrated on the telescope). Similar to Ops Rehearsal #2, we would emulate both daytime and nighttime, for a 3–5 days, would include daily meetings, exercise data movement and processing. Additionally this rehearsal could include: application of software changes, simulated problems, or non-standard (unprocessable) engineering observations.

- LSSTCam should be at the summit in the clean room on its test stand. LSSTCam would be exercised with its Camera Control System to obtain test-stand images and send them through the DAQ for archiving and batch processing. This could be supplemented with on-sky data from ComCam to exercise pipeline processing.
- The contents of the data would roughly match those expected during LSSTCam verification activities but the use of on-sky data from ComCam would not be supplemented (to “simulate” data volume) but real-time processing could be exercised.
- On arrival at the LDF the observations will be ingested into the data-backbone which can in turn be used to feed the data through a batch production service to produce calibrations, reduced science products, and quality assessments.
- Similar to the other Ops Rehearsal #1, the sophistication (or correctness) of the pipelines are not paramount. What is important is that the raw and resulting data products are tracked and can be examined by LDF and SciOps team members. The degree of realism would depend on both the data being sent and availability of working pipeline tasks.

## References

- [LDM-564], O'Mullane, W., Economou, F., Jenness, T., Loftus, A., 2018, *Data Management Software Releases for Verification/Integration*, LDM-564, URL <https://ls.st/LDM-564>
- [LDM-503], O'Mullane, W., Swinbank, J., Jurić, M., Economou, F., 2018, *Data Management Test Plan*, LDM-503, URL <https://ls.st/LDM-503>

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