Vera C. Rubin Observatory
Data Management

Rubin Observatory Data Security Standards Implementation

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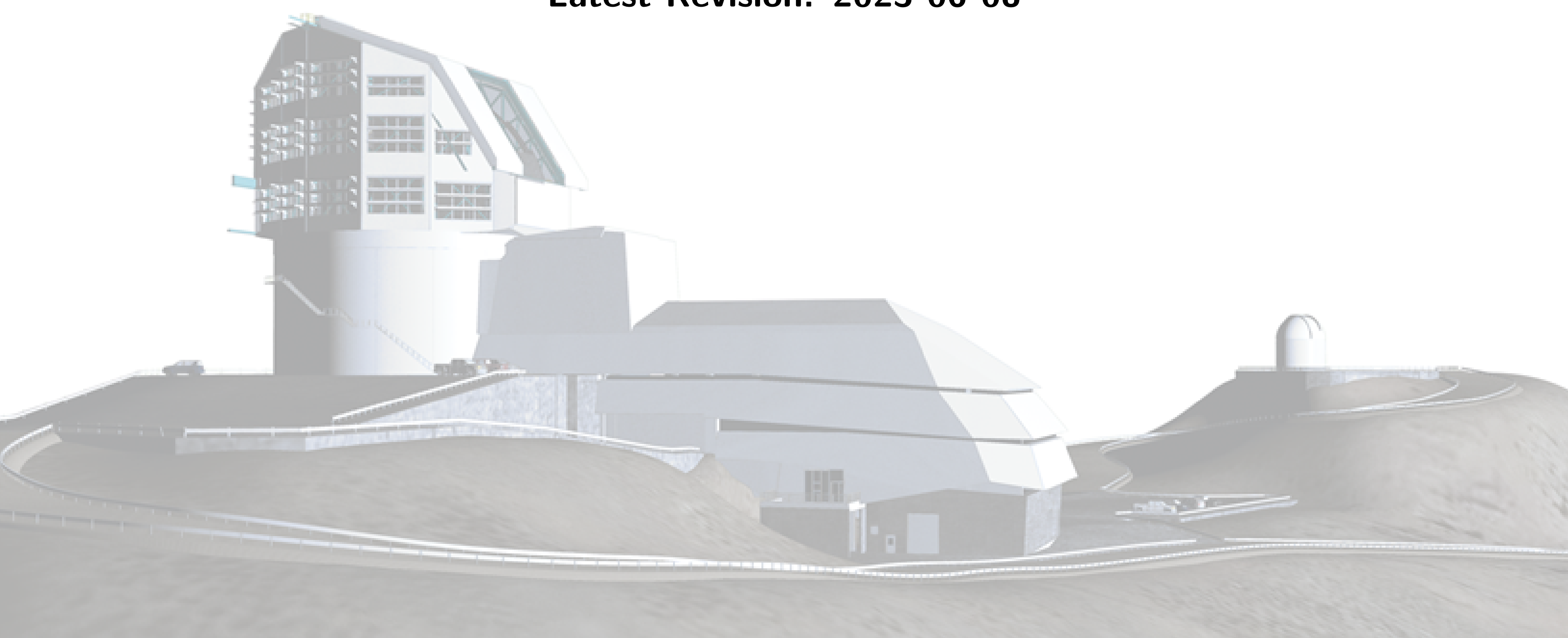

Abstract

In this document we describe a set of measures that we plan to take, in order to secure the data taken at Rubin Observatory to the standards set by the US funding agencies.

Change Record

Version	Date	Description	Owner name
0.1	2021-07-19	Unreleased. Set up structure	William O'Mullane
0.2	2021-09-28	Unreleased. First draft for JSR 2021	William O'Mullane
0.3	2021-10-04	Unreleased. Second draft for JSR 2021	William O'Mullane
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1.2	2022-10-04	Include notes on working with commissioning data	Phil Marshall
1.3	2022-10-26	Embargo clarification	William O'Mullane
2.0	2023-06-08	Updated Requirements from NSF and DOE. Include agency oversight.	William O'Mullane, Bob Blum, Phil Marshall
2.1	2024-07-12	Removed mention of derivative catalogs	Phil Marshall

Document source location: `https://github.com/lsst-dm/dmtn-199`

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Rubin Observatory Data Security Standards Implementation

1 Introduction

The funding agencies, National Science Foundation (NSF) and Department of Energy (DOE), have provided a set of requirements for data security which are addressed in this upgrade plan. This document addresses the upgrades specifically and will augment the overall security plan for Rubin observatory (see LDM-324).

The requirements can be organized and summarized at a high level as follows:

1. Encrypt data using strong, approved encryption standards, following NIST.SP.800-171r3 for Controlled Unclassified Information (CUI) at non federal organizations. The required use of these National Institute of Standards and Technology (USA) (NIST) security standards is limited to the physical security and encryption points. It does not extend to treating the data as CUI. The data should *not* be marked as CUI.
2. Use firewalls and physical security best practices to prevent unauthorized network access. Documented compliance shall be in accordance with NIST.SP.800-171r3.
3. Delay public release of focal plane scientific data for an embargo period of at least 80 hours following the observation. Hold engineering and commissioning imaging data for an embargo period of at least 30 days. Data aside from focal plane data may be made available following the original project plan which includes astronomical metadata (within 24 hours), standard postage stamp images (within 60 sec) not corresponding to artificial Earth-orbiting satellites (see Requirement 4), and weather and sky monitoring data. NSF and DOE require a system in place to extend the embargo times for the release of focal plane scientific data in the unlikely event that it is needed.
4. Eliminate artificial Earth-orbiting satellites. To do this, do not issue alerts on streaks that correspond to objects moving faster than 10 deg/day relative to sidereal tracking or for objects whose angular velocity cannot be determined. Additionally, any object in the appropriate catalogs provided to the U.S. Data Facility shall be eliminated from the Prompt Alert Stream and withheld from the publicly searchable Prompt Processing Database. SLAC shall handle any observations and/or ephemerides used to create and/or update

orbital elements in a satellite database or catalog as OFFICIAL USE ONLY and implement appropriate controls as directed by DOE.

5. Publish the nominal survey schedule 24 hours and an updated schedule at least 2 hours in advance. Once complete, publicly provide the actual executed observation. It is understood the schedule may change in real-time due to weather or other unforeseen circumstances.

6. Only observe without sidereal tracking in regions pre-approved by NSF and DOE. Currently, the only restrictions when operating in non-sidereal tracking modes include that no part of the field of view shall be within ± 2 degrees inclination of the Geosynchronous Earth Orbit (GEO) belt orbital plane. No camera bore sights shall be between $+1.0$ and $+9.0$ degrees of declination. Currently, no other bore sight restrictions are anticipated; however, NSF and DOE may add additional non-sidereal tracking field of view restrictions in the future.

section 3 provides a subsection response for each of these bullets.

As we approach the operations phase of Rubin Observatory and prepare to deliver data products to the community for the Legacy Survey of Space and Time, we want to remind the community of the basic data products delivered by alert production and data releases.

Nightly alert packets will be produced and streamed to community brokers at the 60 sec cadence (design specification, the minimum requirement is 120 sec), including postage stamps of size 32×32 pixels (6.4×6.4 sq. arcsec, or larger—for more details, please see LSE-63). A database of objects detected on difference images will be updated nightly and available through the Rubin Science Platform (Rubin Science Platform (RSP)). Following guidance from the funding agencies, full frame (3.2 Gpix) images in all three flavors (raw, calibrated, and difference), will be made available 80 hours after they were obtained. A small fraction of the total of all images obtained may be held longer than 80 hr and a mechanism for extending embargo periods for certain images at the request of the funding agencies will be implemented. Rubin has consulted with scientists in the community and determined that the policy directive for this 80 hour delay will not significantly impact most science investigations. Additionally no prompt alerts will be issues for sources corresponding to objects in an appropriate satellite catalog. And no prompt alerts for streaks greater than 10 deg/day relative to sidereal. The exclusion of prompt alerts for these streaks will have minimal impact on science. In the rare event an unknown solar system object source with a streak length greater than

10 deg/day relative to sidereal potentially corresponds with ans earth impacting asteroid, the United States Data Facility (USDF) will implement a method to send any candidate impactors to the Minor Planet Center (MPC) during the embargo period. All data in transit shall comply with the strong, approved encryption standards outlined for the embargo period.

In addition, commissioning and engineering data will be embargoed for all non-commissioning team staff for 30 days. After this 30 day embargo, only with explicit approval may proprietary data products from commissioning be shared outside the Commissioning Team SITCOMTN-010.

Commissioning Team members are expected to use approved Project tools and processes for communication, data access and analysis, documentation, software development, work management, etc. In practice, we expect most work done by the Commissioning Team on the commissioning data to be done within private directories at the Rubin US Data Facility at SLAC.

Appropriate data and data products from commissioning will be assembled in data previews and released to the community within about 6 months of the end of the associated phase of commissioning (e.g, DP1 will be released approximately 6 months after the The commissioning camera is a single-raft, 9-CCD camera that will be installed in LSST during commissioning, before the final camera is ready. (ComCam) observations are completed). It is expected that a data preview based on science validation survey data from the ultimate phase of LSST Cam commissioning (about 2 months of Science Validation Surveys) will be made available early in full survey operations, before the first data release processing begins.

As per SITCOMTN-010, Rubin will define a process to approve the sharing of *derived data products* (see the Rubin Data Policy, RDO-013) based on commissioning data with the data rights holder community prior to the associated data preview release. This is needed to enable the Legacy Survey of Space and Time (formerly Large Synoptic Survey Telescope) (LSST) science community to begin learning about Rubin data in preparation for their survey analyses.

Survey data releases including coadded images and updated source photometry will begin about one year after the start of the full survey. Our current plan is to acquire six months of data for the first formal LSST data release. Alert production will reach its full throughput and steady-state efficiency after Data Release 1; during the first survey year, alerts will be produced incrementally once adequate image templates are available (for more details, please see DMTN-107).

2 Cost Summary

A summary of the costs associated with implementing these enhanced security measures are summarized in Table 1 below. The table includes both non-recurring, up-front, costs as well as the costs to operated with these enhanced measures for a 10-year operation period.

Table 1: Cost Sumary Table for Enhance Security Requirements.

Item	**Construction Cost**	**Operations Cost**
Encryption (Table 2)	$2,124,000	$2,724,000
Firewalls and physical security (Table 3)	$1,428,624	$4,800,000
Delayed Data Store (Table 4)	$800,000	$800,000
Satelite elimination(Table 5)		$3,815,000
Total Construction	**$4,352,624**	
Total Operations Cost		**$12,139,000**

Execution of this plan will begin immediately upon approval to complete the changes prior to data collection in the system commissioning phase of Construction.

3 Response to the requirements

This plan follows the applicable elements of NIST.SP.800-171r3. The application of this standard to the Rubin Observatory requires some interpretation. A compliance matrix is provided in Appendix A. In this matrix and in this document we assume the requirements apply to embargoed images before release to the collaboration and the derived difference image sources. Hence it applies to Prompt Processing, the embargoed data store(s), and the summit in Chile. It does not apply to DACs nor the actual alert stream.

The non-recurring costs in this plan include necessary end-equipment to manage the data entering the USDF. The incrimental operating costs at the USDF, expecting that they too will follow NIST 800-171, are provided in this document as reference.

From Section 2.1 of NIST.SP.800-171r3 we note that the confidentiality impact value for the data is no less than moderate. So we may assume our NIST.FIPS.200 security category would be { moderate, low, low}[1].

3.1 Encrypt Data

As outlined in DMTN-108 we shall buy four routers which can perform Internet Protocol Security (IPsec) AES-256 bit encryption between Chile and SLAC. We will not transfer embargoed images to France - hence we should keep a secure data store at Chile and at SLAC National Accelerator Laboratory (SLAC) for redundancy. The router cost in Table 2 is based on a quotation from Cisco as one of the vendors explicitly specified in the agency document. While we have shown that Transport Layer Security (TLS) with AES-256 can provide sufficient performance to meet our Alert timing budget, we have not yet measured performance with the specified routers using IPsec. We assume that performance will be adequate.

NIST also suggests out of band access - an independent network for access to the Summit systems in case the main network is down. A quote for Telconor to give a backup control link is included in Table 2.

See Table 2 for the cost breakdown. The Out Of Bound (Alternative network access) (OOB) access is in Chile only and the routers and cabling are an even split.

Table 2: This table provides cost estimates for encrypted data transfer.

Item	Cost	number	Total	Notes
Cisco Router (2@Chile 2@USDF)	$500,000	4	$2,000,000	Cisco quote
Cabling	$1,000	4	$4,000	
Out of Bounds (OOB) link install (Chile)	$60,000	2	$120,000	Times 2, we need summit-base and base-internet
Total Construction			**$2,124,000**	
OOB Ops running cost/month	$3,000	240	$720,000	
Router rehresh			$2,000,000	
Cabling	$1,000	4	$4,000	
Total Operations			**$2,724,000**	

3.2 Install Firewalls and other physical security devices

This requirement is for physical and cyber security. It includes installing cameras and locks on racks. Some of this such as Firewalls is already in the project plan but much of it is not.

[1]{confidentiality, availability, integrity}

Items already in the baseline include:

- Card access to server rooms.
- Backup network in case main link fails (though the microwave link is a new addition ..)
- Auditable process to handle onboarding/offboarding
- Some cameras are in the project but not complete coverage.

Additional items may include locks on server racks, sensors and cameras to record the opening of cabinets, out of band channel for physical security alerts if the main network is disabled, and controls to prevent booting from USB devices or copying to external media.

The firewalls and physical security will be upgraded to meet the enhanced standard. Table 3 includes the items needed for this upgrade.

Important Note: We shall ring fence the camera in its own firewall with more restricted access than the restricted control network. However we will treat it as a black box deliverable for this requirement. We shall not expect encryption of the internal disks of the camera system. Any perturbation to the camera system will have a deleterious effect on the camera with significant development and schedule impacts.

Signage and labeling, as required in NIST 171 3.8.4 [2], will be developed as appropriate.

NIST 1.7.1 Section 3.10.6 pulls in extra standards for remote work namely NIST.800-46 and NIST.800-114. NIST.800-114 is the broader scope and we are pretty much in line with how it is written - we note Section 5.2.1 that we use Onepassword as a vault for Information Technology (IT) passwords - not paper in a fire proof safe as recommended. Some other suggestions are understood to be useful in general but often not suitable for developers - personal firewalls, application filtering and aggressive antivirus software often trip over developer code and tools.

NIST.800-46 and other related NIST documentation suggest threat modeling - we do this in a limited way e.g SQR-041 and SQR-037. A more exhaustive risk assessment by a third party is not anticipate at this time but the Project team will discuss with SLAC on any plans to review

[2] https://www.archives.gov/files/cui/20161206-cui-marking-handbook-v1-1.pdf

the USDF. We do not store sensitive information on the virtual private network (VPN) nor bastion nodes. We do use Network Address Translation (NAT) in a limited number of places - this will be more important in operations if/when we move to IPv6.

Table 3: This table provides cost estimates for firewalls and other physical security in Chile and at SLAC not in the project plan.

Item	Cost	number	Total	Notes
Locks USDF	$200	30	$6,000	
Cameras Detectors USDF	$2,000	1	$2,000	
Sensors USDF	$38	30	$1,140	https://www.server-rack-online.com/ig-dsw-2m.html
Sensor hub USDF	$448	1	$448	https://www.server-rack-online.com/ec-300m.html
Locks Chile	$200	30	$6,000	1 set has 2 locks, front and back, https://www.apc.com/shop/in/en/products/Combination-Lock-Handles-Qty-2-for-NetShelter-SX-SV-VX-Enclosures/P-AR8132A
Cameras Detectors Chile	$2,000	2	$4,000	
Sensors Chile	$38	30	$1,140	
Sensor hub Chile	$448	2	$896	https://www.server-rack-online.com/ec-300m.html
Faster CPU to handle disk encryption on summit (node price)	$13,000	20	$260,000	sizing model rome price
SSD price differnce to SATA (cost/TB)	$250	260	$65,000	from sizing model NVMe price
Labor to redeploy all summit systems (contract)	$100	1,200	$120,000	Hey Siri FaceTime
Labelling and signage	$2,000	1	$2,000	https://www.archives.gov/files/cui/20161206-cui-marking-handbook-v1-1.pdf
Security related contracts/month	$40,000	24	$960,000	
Total Construction			**$1,428,624**	
Operations Security contracts	$40,000	120	$4,800,000	
Total Operations			**$4,800,000**	

This enhanced security plan includes support from an outside security provider. It is estimated running an Security Operations Centre (SOC) could cost upward of $1.4M per year[3]. This article[4] outlines the pros and cons of an outsourced SOC and estimates it at between 300 and 800K per year. For budgeting purposes $40K a month is included in Table 3. Such a contract (or contracts) should cover:

1. Proactive monitoring and alerting (NIST 171 section 3.3.5)
   - Write alerts for suspicious behaviors
   - Analyze collected logs for anomalies
2. Root cause analysis of any alert or anomaly
3. Incident response
   - Isolation of attacker
   - Forensic analysis leading to timeline and inventory of compromise
   - Identifying systems that will need to be rebuilt

[3] https://expel.io/blog/how-much-does-it-cost-to-build-a-24x7-soc/
[4] https://www.linkbynet.com/outsourced-soc-vs-internal-soc-how-to-choose

4. Vulnerability scanning including filtering out false positives
5. Asset inventory including patch status
6. Penetration testing to proactively look for vulnerabilities

This will require extensive coordination and integration with existing IT services and processes, included as part of this cost.

Since we will have to encrypt systems on the summit (see ITTN-014) for a list of systems) we anticipate upgrade processors and solid state drives (Solid-State Disk (SSD)) are required. Determining the detailed specifications will require experimentation so the values in the table for this are engineering estimates.

Note that compute facilities for the Commissioning Cluster at the Base as well as Alert Production and the Staff RSP at the USDF are not considered to be within the physical security area. Rubin considers the short-term, ephemeral processing on these resources outside of the enhanced security requirements. Including them would approximately double the cost of this item for Construction.

3.3 Delay public release

Rubin considers the best approach to managing public release of data is to keep the embargoed data on a secure device separate from other systems and migrate images to the regular repository as they become *public*. This can be an object store with encryption like MinIO [5]. We will need to have one at SLAC and one at Chile for redundancy to ensure no data loss.

With the commissioning constraint that means this needs to be approximately a one month store for full images and engineering data. Looking at DMTN-135 table 40 this comes out to about 500TB of usable disk. Table 4 gives the cost calculation or this.

The nominal embargo for regular operations we understand to be 80 hours (all images). While not anticipated, the system includes the ability to embargo some images for longer periods of time at the request of the funding agencies.

[5] `https://min.io/product/enterprise-object-storage-encryption`

Table 4: This table provides costs for the embargoed data store.

Description	value	
Number of days data to store	30	
Raw data size per day (TB compressed)	16	Years data from Table 40 of DMTN-135/ 298.3 observing nights (Key Numbers Confluence)
Useable size needed (TB)	484	
Allowing for RAID (TB)	1000	
Cost for 1 store	$400,000	Using SLAC Fast Disk Price from Table 28 of DMTN-135
Total for 2 stores - Construction	**$800,000**	
Total Ops Cost at least 1 Refresh	**$800,000**	

Note: To enact these enhanced security measures on Commissioning data, this plan focuses on early data processing at the SLAC USDF and not the resources originally planned at NCSA. The SLAC USDF must be ready with sufficient services and capacity for ComCam, on sky work.

Figure 1 depicts the encrypted storage and network. Embargoed (delayed) data would be held in the encrypted stores for the time specified. We assume temporary processing for alerts does not have to be encrypted, NIST allows ephemeral unencrypted data for processing.

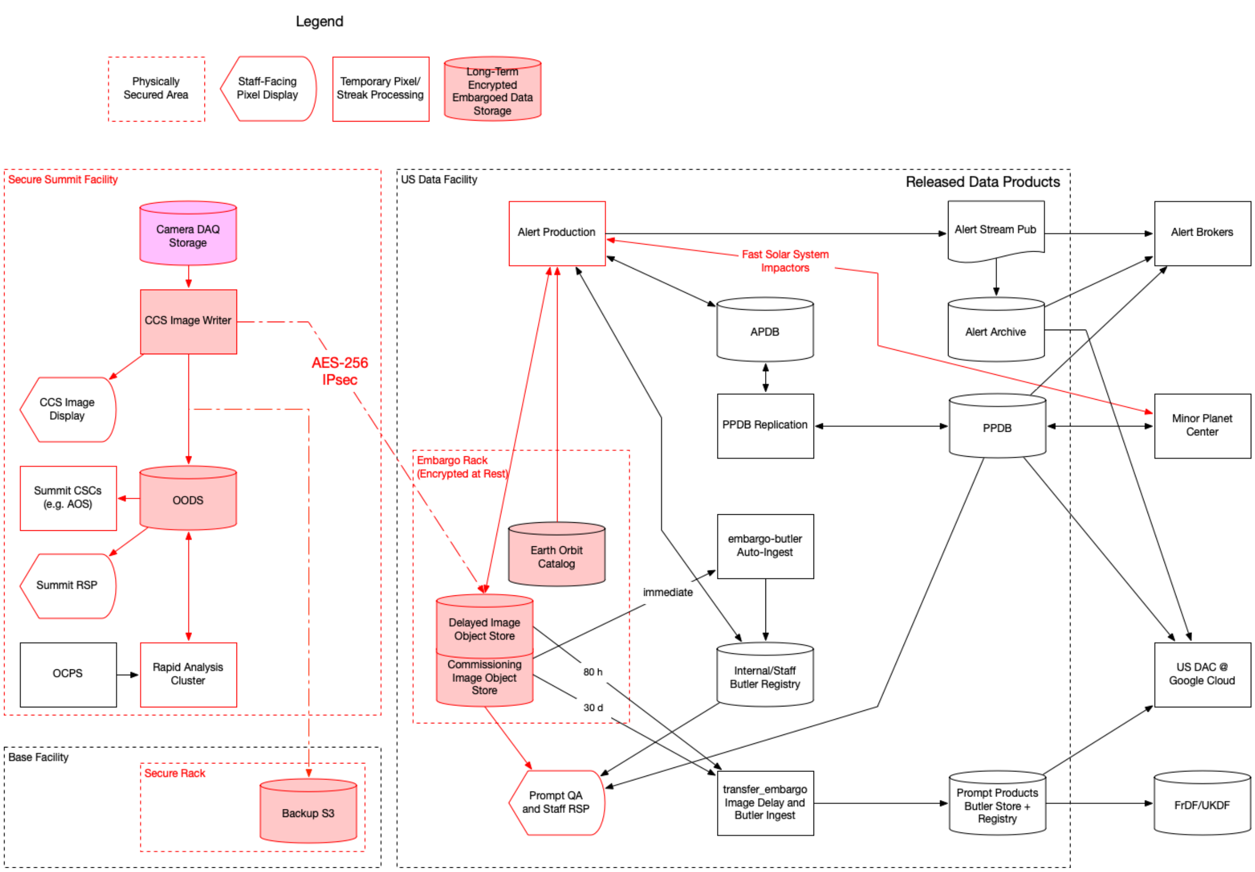

FIGURE 1: Architecture diagram showing many details including the long term encrypted storage and encrypted network from Chile to SLAC.

3.4 Eliminate earth orbiting satellites

Rubin does not publish alerts for streaks associated with artificial satellites. A subset of streaks, potentially consistent with Earth-orbiting satellites or Solar System objects, will be determined by comparison with an appropriate catalog or catalogs at the USDF. Any object that corresponds to an object in this catalog will not be released in the prompt alerts or stored in the prompt alert database. SLAC will not create any catalogs with information corresponding to these objects. Additionally no streaks will be alerted on with a streak length greater than 10 deg/day relative to sidereal. In the rare event an unknown solar system object source with a streak length greater than 10 deg/day potentially corresponds with an Earth-impacting asteroid, SLAC shall implement a method to send any candidate impactors to the Minor Planet Center during the embargo period, complying with encryption standards for data in transit during the embargo period.

The estimated cost for this is based mainly on FTE - we do not consider the need for extra hardware unless the agencies wish for hardware encryption for the few occasions we need to send a secure message to MPC. An estimate is given in Table 5. This also includes the current value in the operations plan. The cost of delaying the data in an encrypted store is already covered in subsection 3.3

Table 5: The elimination of earth-orbiting satellites will require some Alert System modification which is all FTE cost.

Description	**Cost**	**Count**	**Total**
FTE per year (USDF Team, SLAC)	$345,000	0.5	$172,500
FTE per year (AP team)	$200,000	0.5	$100,000
Mission years		10	$2,725,000
Pre operations years (2 FTE)	$545,000	2	$1,090,000
Total			**$3,815,000**
Rubin Operations Plan Value (needs update)			$13,662,042

3.5 Publish nominal schedule

The project was already planning to publish the observing schedule to allow co observing of sources, see Section 2.1 of LSE-30. The Observatory System Specifications; LSST Systems Engineering (Document Handle) (LSE)-30 (OSS) requires publication at least two hours ahead of observing - the request here is to have the schedule also published twenty four hours in advance. This is not a problem as long as one understands the fidelity of the schedule decreases with the look ahead time. The agency requirement acknowledges this.

The schedule is to be delivered publicly. The Project shall also publicly publish the executed observing plan.

We consider no delta cost for this as it was in the project plan.

3.6 Request approval for non sidereal tracking

This is best handled Procedurally and as such will not produce a delta cost on the project.

4 Conclusion

We can comply with the requirements and NIST 1.7.1 at the cost outlined in section 2.

There are a few assumptions explicitly made above which we feel comply with given requirements but did require interpretation. To be explicit:

- section 3 Assumes embargoed images before release to the collaboration are treated securely. After the embargo is lifted there is no longer a need to secure the images at the higher requirements.
- section 3 Assumes NIST 1.7.1 also applies to SLAC even though NIST.FIPS.200 should be applicable.
- subsection 3.2 Makes an important note about *not encrypting* internal camera storage.
- subsection 3.2 Assumes NIST.800 documents were written as guidance they will be noted but we may not always follow all recommendations in all cases.
- subsection 3.3 Assumes the embargo for commissioning applies to use of encrypted storage and transfers. This would imply embargoed data is only held at SLAC and in Chile.
- subsection 3.2 and subsection 3.3 Assumes short stays of data on unencrypted machines for processing is ok (it is in line with NIST).

A Compliance with NIST Standard

Table 6: This table provides an overview of the NIST.SP.800-171r3 and Rubin compliance with it.

NIST 800-171	2024 Status	Intended Compliance	Note
3.1 ACCESS CONTROL			
3.1.1 Limit system access to authorized users, processes acting on behalf of authorized users, and devices (including other systems).	Y	Y	IPA groups are in place for summit and unix groups at SLAC which restrict privileges of individual users.
3.1.2 Limit system access to the types of transactions and functions that authorized users are permitted to execute.	Y	Y	IPA groups are in place on the summit restriiiicting users abilities. Legacy systems use the active directory groups for this.
3.1.3 Control the flow of CUI in accordance with approved authorizations.	Y	Y	DMTN-199 defines the control flow for pixel data.
3.1.4 Separate the duties of individuals to reduce the risk of malevolent activity without collusion.	Y	Y	Principle of least privilege is applied. Many users have access to hosts that is unneeded.
3.1.5 Employ the principle of least privilege, including for specific security functions and privileged accounts.	N	Y	Targeted sudo rules are needed for common operations. IPA controls sudo centrally
3.1.6 Use non-privileged accounts or roles when accessing nonsecurity functions.	Y	Y	Most user accounts are not privileged. Our systems have no form of selecting a role to use.
3.1.7 Prevent non-privileged users from executing privileged functions and capture the execution of such functions in audit logs.		Y	This is probably sudo attempts audits. Full commands can be logged in at the cost of extra load for the servers.
3.1.8 Limit unsuccessful login attempts.	Y	Y	Web Services such as love, foreman, ipa console, nublado, etc. may need rate limiting. We don't use passwords in ssh hosts, only ssh keys (which many consider more secure). We are not aware of a retry limit for ssh-key access; an appropriate extra level of security would be to not use the default port 22. However, we do limit attempts to 6 with a block of 600 minutes, which will effectively block failed SUDO logins.
3.1.9 Provide privacy and security notices consistent with applicable CUI rules.	N	Y	Check login notices etc. A login banner can be displayed upon login
3.1.10 Use session lock with pattern-hiding displays to prevent access and viewing of data after a period of inactivity.	Y	Y	This is our policy.
3.1.11 Terminate (automatically) a user session after a defined condition.	Y	Y	ssh sessions are generally not limited on hosts but VPN will timeout daily; some network equipment has timeouts set;
3.1.12 Monitor and control remote access sessions.	Y	Y	We currently check who and from where is connecting.
3.1.13 Employ cryptographic mechanisms to protect the confidentiality of remote access sessions.	Y	Y	VPN is in use
3.1.14 Route remote access via managed access control points.	Y	Y	Bastion nodes – IPSec routers now inplace also.
3.1.15 Authorize remote execution of privileged commands and remote access to security-relevant information.	Y	Y	Handled via IPA grouos on smmit and UNIX groups at SLAC.
3.1.16 Authorize wireless access prior to allowing such connections.	Y	Y	All devics attaching in Chile need to be registered by Mac address.
3.1.17 Protect wireless access using authentication and encryption.	Y	Y	Withdrawn in revison 3
3.1.18 Control connection of mobile devices.	Y	Y	In the sense there is no open wifi, and on the summit devices must be registered.
3.1.19 Encrypt CUI on mobile devices and mobile computing platforms.23	Y	Y	Data will not exist on mobile devices - in the case where an image may exist on say commissioning team laptop we will have disk encryption enabled.
3.1.20 Verify and control/limit connections to and use of external systems.	Y	Y	This implies vetting of devices that connect to the control network - we use mac address for laptops and personal mobile phones can not connect to the control network. We also have a separation with the long haul network (LHN) Service Set Identifier (SSID) and Virtual Local Area Network (VLAN)s.
3.1.21 Limit use of portable storage devices on external systems.	N	Y	Can be rolled out with puppet but there are some servers that need usb.
3.1.22 Control CUI posted or processed on publicly accessible systems.	Y	Y	We do not intend to post images on publicly accessible systems. (DMTN-286)
3.2 AWARENESS AND TRAINING			
3.2.1 Ensure that managers, systems administrators, and users of organizational systems are made aware of the security risks associated with their activities and of the applicable policies, standards, and procedures related to the security of those systems.	Y	Y	
3.2.2 Ensure that personnel are trained to carry out their assigned information security-related duties and responsibilities.	P	Y	OUO trainign at SLAC
3.2.3 Provide security awareness training on recognizing and reporting potential indicators of insider threat.	Y	Y	We would like to do more here like capture flag exercises for developers or blue/red teams events
3.3 AUDIT AND ACCOUNTABILITY			

3.3.1 Create and retain system audit logs and records to the extent needed to enable the monitoring, analysis, investigation, and reporting of unlawful or unauthorized system activity.	Y	Y	
3.3.2 Ensure that the actions of individual system users can be uniquely traced to those users, so they can be held accountable for their actions.	Y	Y	
3.3.3 Review and update logged events.	P	Y	We may look for a third party contract for this.
3.3.4 Alert in the event of an audit logging process failure.	N	Y	
3.3.5 Correlate audit record review, analysis, and reporting processes for investigation and response to indications of unlawful, unauthorized, suspicious, or unusual activity.	N	Y	Again shall look for third party contract for this
3.3.6 Provide audit record reduction and report generation to support on-demand analysis and reporting.	Y	Y	Observability system
3.3.7 Provide a system capability that compares and synchronizes internal system clocks with an authoritative source to generate timestamps for audit records.	Y	Y	
3.3.8 Protect audit information and audit logging tools from unauthorized access, modification, and deletion.	Y	Y	
3.3.9 Limit management of audit logging functionality to a subset of privileged users.	Y	Y	
3.4 CONFIGURATION MANAGEMENT			
3.4.1 Establish and maintain baseline configurations and inventories of organizational systems (including hardware, software, firmware, and documentation) throughout the respective system development life cycles.	Y	Y	We use mainly infrastructure as code approaches so the software is well tracked. IT inventory all the hardware.
3.4.2 Establish and enforce security configuration settings for information technology products employed in organizational systems.	Y	Y	
3.4.3 Track, review, approve or disapprove, and log changes to organizational systems.	Y	Y	We have CCBs and code change process in place which also cover the infrastructure as code.
3.4.4 Analyze the security impact of changes prior to implementation.	Y	Y	
3.4.5 Define, document, approve, and enforce physical and logical access restrictions associated with changes to organizational systems.	Y	Y	
3.4.6 Employ the principle of least functionality by configuring organizational systems to provide only essential capabilities.	Y	Y	
3.4.7 Restrict, disable, or prevent the use of nonessential programs, functions, ports, protocols, and services.	Y	Y	We get a lot of this by mainly containerizing the applications and having users work within deployed containers.
3.4.8 Apply deny-by-exception (blacklisting) policy to prevent the use of unauthorized software or deny-all, permit-by-exception (whitelisting) policy to allow the execution of authorized software.	Y	Y	SUDO lists to restrict access so users can not install applicaitons on the summit nor in SLAC (outside a container).
3.4.9 Control and monitor user-installed software.	Y	Y	
3.5 IDENTIFICATION AND AUTHENTICATION			
3.5.1 Identify system users, processes acting on behalf of users, and devices.	Y	Y	
3.5.2 Authenticate (or verify) the identities of users, processes, or devices, as a prerequisite to allowing access to organizational systems.	Y	Y	
3.5.3 Use multifactor authentication for local and network access to privileged accounts and for network access to non-privileged accounts.	Y	Y	
3.5.4 Employ replay-resistant authentication mechanisms for network access to privileged and non- privileged accounts.	Y	Y	
3.5.5 Prevent reuse of identifiers for a defined period.	N	Y	
3.5.6 Disable identifiers after a defined period of inactivity.	Y	Y	
3.5.7 Enforce a minimum password complexity and change of characters when new passwords are created.	Y	Y	
3.5.8 Prohibit password reuse for a specified number of generations.	Y	Y	
3.5.9 Allow temporary password use for system logons with an immediate change to a permanent password.	Y	Y	
3.5.10 Store and transmit only cryptographically-protected passwords.	Y	Y	
3.5.11 Obscure feedback of authentication information.	Y	Y	
3.6 INCIDENT RESPONSE			
3.6.1 Establish an operational incident-handling capability for organizational systems that includes preparation, detection, analysis, containment, recovery, and user response activities.	Y	Y	AURA have insurance which covers this. But we really should have a contract to look over logs etc. to note when we are hit.
3.6.2 Track, document, and report incidents to designated officials and/or authorities both internal and external to the organization.	Y	Y	
3.6.3 Test the organizational incident response capability.	Y	Y	This was done at least witht he PEN testing - which we shall repeat.
3.7 MAINTENANCE			
3.7.1 Perform maintenance on organizational systems.	Y	Y	
3.7.2 Provide controls on the tools, techniques, mechanisms, and personnel used to conduct system maintenance.	Y	Y	
3.7.3 Ensure equipment removed for off-site maintenance is sanitized of any CUI.	Y	Y	
3.7.4 Check media containing diagnostic and test programs for malicious code before the media are used in organizational systems.	Y	Y	

3.7.5 Require multifactor authentication to establish nonlocal maintenance sessions via external network connections and terminate such connections when nonlocal maintenance is complete.	Y	Y	
3.7.6 Supervise the maintenance activities of maintenance personnel without required access authorization.	Y	Y	
3.8 MEDIA PROTECTION			
3.8.1 Protect (i.e., physically control and securely store) system media containing CUI, both paper and digital.	Y	Y	Pixel Zone and Embago Rack
3.8.2 Limit access to CUI on system media to authorized users.	Y	Y	Pixel Zone and Embago Rack
3.8.3 Sanitize or destroy system media containing CUI before disposal or release for reuse.	Y	Y	
3.8.4 Mark media with necessary CUI markings and distribution limitations.	N	Y	We decline to label rooms and machines acording to https://www.archives.gov/files/cui/20161206-cui-marking-handbook-v1-1.pdf
3.8.5 Control access to media containing CUI and maintain accountability for media during transport outside of controlled areas.	Y	Y	
3.8.6 Implement cryptographic mechanisms to protect the confidentiality of CUI stored on digital media during transport unless otherwise protected by alternative physical safeguards.	Y	Y	
3.8.7 Control the use of removable media on system components.	N	Y	Can be rolled out with puppet but there are some servers that need usb.
3.8.8 Prohibit the use of portable storage devices when such devices have no identifiable owner.	Y	Y	
3.8.9 Protect the confidentiality of backup CUI at storage locations.	Y	Y	
3.9 PERSONNEL SECURITY			
3.9.1 Screen individuals prior to authorizing access to organizational systems containing CUI.	Y	Y	Only project team members will have access to early images - all are know individuals. This doesn't suggest background security screening and it was also explicitly not required by the agencies in section 2 of the requirements document.
3.9.2 Ensure that organizational systems containing CUI are protected during and after personnel actions such as terminations and transfers.	Y	Y	
3.10 PHYSICAL PROTECTION			
3.10.1 Limit physical access to organizational systems, equipment, and the respective operating environments to authorized individuals.	Y	Y	This physical access includes locks on server cabinets and key card access in base. (Contracted for summit)
3.10.2 Protect and monitor the physical facility and support infrastructure for organizational systems.	Y	Y	Security is in place on Cero Pachon and at the entrance to the mountain - though not only for Rubin so not permanently at the observatory.
3.10.3 Escort visitors and monitor visitor activity.	Y	Y	Actual visitors are escorted on the summit - contractors are considered more like staff.
3.10.4 Maintain audit logs of physical access.	Y	Y	NOIRLab can currently store 80 gigs of data for audit logs of physical access, which will last at least three years - all the equipment being installed is HID and complies with section 889 of the John S. McCain National Defense Authorization Act (NDAA)
3.10.5 Control and manage physical access devices.	Y	Y	
3.10.6 Enforce safeguarding measures for CUI at alternate work sites.	Y	Y	This brings in NIST.800-46 and NIST.800-114. Threat analysis suggested. NAT considered bad.
3.11 RISK ASSESSMENT			
3.11.1 Periodically assess the risk to organizational operations (including mission, functions, image, or reputation), organizational assets, and individuals, resulting from the operation of organizational systems and the associated processing, storage, or transmission of CUI.	Y	Y	
3.11.2 Scan for vulnerabilities in organizational systems and applications periodically and when new vulnerabilities affecting those systems and applications are identified.	Y	Y	Third party contract PEN test
3.12 SECURITY ASSESSMENT			
3.12.1 Periodically assess the security controls in organizational systems to determine if the controls are effective in their application.	Y	Y	
3.12.2 Develop and implement plans of action designed to correct deficiencies and reduce or eliminate vulnerabilities in organizational systems.	Y	Y	
3.12.3 Monitor security controls on an ongoing basis to ensure the continued effectiveness of the controls.	Y	Y	
3.12.4 Develop, document, and periodically update system security plans that describe system boundaries, system environments of operation, how security requirements are implemented, and the relationships with or connections to other systems.	Y	Y	
3.13 SYSTEM AND COMMUNICATIONS PROTECTION			
3.13.1 Monitor, control, and protect communications (i.e., information transmitted or received by organizational systems) at the external boundaries and key internal boundaries of organizational systems.	Y	Y	

3.13.2 Employ architectural designs, software development techniques, and systems engineering principles that promote effective information security within organizational systems.	Y	Y	We can do more here.
3.13.3 Separate user functionality from system management functionality.	Y	Y	Commissioners may be fairly privileged users.
3.13.4 Prevent unauthorized and unintended information transfer via shared system resources.	Y	Y	DMTN-286 and SITCOMTN-076 cover ground rules on this
3.13.5 Implement subnetworks for publicly accessible system components that are physically or logically separated from internal networks.	Y	Y	
3.13.6 Deny network communications traffic by default and allow network communications traffic by exception (i.e., deny all, permit by exception).	Y	Y	We may need to bring up iptables on each host
3.13.7 Prevent remote devices from simultaneously establishing non-remote connections with organizational systems and communicating via some other connection to resources in external networks (i.e., split tunneling).	Y	Y	
3.13.8 Implement cryptographic mechanisms to prevent unauthorized disclosure of CUI during transmission unless otherwise protected by alternative physical safeguards.	Y	Y	IPSec and encryption at rest
3.13.9 Terminate network connections associated with communications sessions at the end of the sessions or after a defined period of inactivity.	Y	Y	
3.13.10 Establish and manage cryptographic keys for cryptography employed in organizational systems.	Y	Y	
3.13.11 Employ FIPS-validated cryptography when used to protect the confidentiality of CUI.	Y	Y	
3.13.12 Prohibit remote activation of collaborative computing devices and provide indication of devices in use to users present at the device.	Y	Y	We should take care with the new roaming camera.
3.13.13 Control and monitor the use of mobile code.	Y	Y	Currently we have no mobile code
3.13.14 Control and monitor the use of Voice over Internet Protocol (VoIP) technologies.	N	N	
3.13.15 Protect the authenticity of communications sessions.	Y	Y	
3.13.16 Protect the confidentiality of CUI at rest.	Y	Y	
3.14 SYSTEM AND INFORMATION INTEGRITY			
3.14.1 Identify, report, and correct system flaws in a timely manner.	Y	Y	
3.14.2 Provide protection from malicious code at designated locations within organizational systems.	Y	Y	
3.14.3 Monitor system security alerts and advisories and take action in response.	Y	Y	
3.14.4 Update malicious code protection mechanisms when new releases are available.	Y	Y	
3.14.5 Perform periodic scans of organizational systems and real-time scans of files from external sources as files are downloaded, opened, or executed.	Y	Y	
3.14.6 Monitor organizational systems, including inbound and outbound communications traffic, to detect attacks and indicators of potential attacks.	Y	Y	
Total requirements		**108**	
Total Rubin Intends to comply with		**107**	
Total Rubin Complies with in 2024		**96**	

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C Acronyms and Glossary

D Glossary

Alert A packet of information for each source detected with signal-to-noise ratio > 5 in a difference image by Alert Production, containing measurement and characterization parameters based on the past 12 months of LSST observations plus small cutouts of the single-visit, template, and difference images, distributed via the internet.

arcsec arcsecond second of arc (unit of angle).

camera An imaging device mounted at a telescope focal plane, composed of optics, a shutter, a set of filters, and one or more sensors arranged in a focal plane array.

Center An entity managed by AURA that is responsible for execution of a federally funded project.

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..

Commissioning A two-year phase at the end of the Construction project during which a technical team a) integrates the various technical components of the three subsystems; b) shows their compliance with ICDs and system-level requirements as detailed in the LSST Observatory System Specifications document (OSS, LSE-30); and c) performs science verification to show compliance with the survey performance specifications as detailed in the LSST Science Requirements Document (SRD, LPM-17).

Construction The period during which LSST observatory facilities, components, hardware, and software are built, tested, integrated, and commissioned. Construction follows design and development and precedes operations. The LSST construction phase is funded through the NSF MREFC account.

CUI Controlled Unclassified Information.

Data Release The approximately annual reprocessing of all LSST data, and the installation of the resulting data products in the LSST Data Access Centers, which marks the start of the two-year proprietary period.

deg degree; unit of angle.

Department of Energy cabinet department of the United States federal government; the DOE has assumed technical and financial responsibility for providing the LSST camera. The DOE's responsibilities are executed by a collaboration led by SLAC National Accelerator Laboratory.

DOE Department of Energy.

GEO Geosynchronous Earth Orbit.

Incident An undesired event, which under slightly different circumstances, could have resulted in harm to people, damage to property, or loss to process.

IPsec Internet Protocol Security.

IT Information Technology.

LHN long haul network.

LSE LSST Systems Engineering (Document Handle).

LSST Legacy Survey of Space and Time (formerly Large Synoptic Survey Telescope).

monitoring In DM QA, this refers to the process of collecting, storing, aggregating and visualizing metrics.

MPC Minor Planet Center.

NAT Network Address Translation.

National Science Foundation primary federal agency supporting research in all fields of fundamental science and engineering; NSF selects and funds projects through competitive, merit-based review.

NIST National Institute of Standards and Technology (USA).

NSF National Science Foundation.

OOB Out Of Bound (Alternative network access).

Operations The 10-year period following construction and commissioning during which the LSST Observatory conducts its survey.

OSS Observatory System Specifications; LSE-30.

patch An quadrilateral sub-region of a sky tract, with a size in pixels chosen to fit easily into memory on desktop computers.

postage stamp Image cutouts that are 30x30 arcseconds, centered on an Object, and included in every Alert.

RSP Rubin Science Platform.

Science Platform A set of integrated web applications and services deployed at the LSST Data Access Centers (DACs) through which the scientific community will access, visualize, and perform next-to-the-data analysis of the LSST data products.

SLAC SLAC National Accelerator Laboratory.

SLAC National Accelerator Laboratory A national laboratory funded by the US Department of Energy (DOE); SLAC leads a consortium of DOE laboratories that has assumed responsibility for providing the LSST camera. Although the Camera project manages its own schedule and budget, including contingency, the Camera team's schedule and requirements are integrated with the larger Project. The camera effort is accountable to the LSSTPO..

SOC Security Operations Centre.

software The programs and other operating information used by a computer..

SSD Solid-State Disk.

SSID Service Set Identifier.

Summit The site on the Cerro Pachón, Chile mountaintop where the LSST observatory, support facilities, and infrastructure will be built.

Systems Engineering an interdisciplinary field of engineering that focuses on how to design and manage complex engineering systems over their life cycles. Issues such as requirements engineering, reliability, logistics, coordination of different teams, testing and evaluation, maintainability and many other disciplines necessary for successful system development, design, implementation, and ultimate decommission become more difficult when dealing with large or complex projects. Systems engineering deals with work-processes, optimization methods, and risk management tools in such projects. It overlaps technical and human-centered disciplines such as industrial engineering, control engineering, software engineering, organizational studies, and project management. Systems engineering ensures that all likely aspects of a project or system are considered, and integrated into a whole.

TLS Transport Layer Security.

USDF United States Data Facility.

Validation A process of confirming that the delivered system will provide its desired functionality; overall, a validation process includes the evaluation, integration, and test activities carried out at the system level to ensure that the final developed system satisfies the intent and performance of that system in operations.

VLAN Virtual Local Area Network.

VPN virtual private network.