ICESat-2 Project Controlled Document
Released by: N. Brown 02/23/2011

ICE, CLOUD, and Land Elevation Satellite (ICESat-2) Project

Mission Operations Center (MOC) Level 4 Requirements Specification ICESat-2-MOC-REQ-0537

Revision A

Effective Date: February 22, 2011

National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

CM FOREWORD

This document is an Ice, Cloud, and Land Elevation (ICESat-2) Project signature-controlled document. Changes to this document require prior approval of the applicable Product Design Lead (PDL) or designee. Proposed changes shall be submitted in the ICESat-II Management Information System (MIS) via a Signature Controlled Request (SCoRe), along with supportive material justifying the proposed change.

In this document, a requirement is identified by "shall," a good practice by "should," permission by "may" or "can," expectation by "will," and descriptive material by "is."

Questions or comments concerning this document should be addressed to:

ICESat-2 Configuration Management Office
Mail Stop 425
Goddard Space Flight Center
Greenbelt, Maryland 20771

*** Signatures are available on-line at: **https://icesat-2mis.gsfc.nasa.gov** ***

CHANGE RECORD PAGE

Document Version	Document Release Date	SCoRe Number	SCoRe Approval Date	Pages Affected	Description
Rev -	11/08/2010	CCR-0036	11/08/2010	All	Initial release of document.
Rev A	02/23/2011	0167	02/22/2011	Requirements Section	Update to include new MOC requirement flow down.

Object Identifier	Category	TBD	MOC Baseline	Verification Method	Allocation	Rationale	Trace to GRS Req
MOC27	Alert notification	N	The MOC shall automatically notify appropriate MOC personnel when user-specified events occur.	T, I	AM&AN	notification of limit violations detected by autonomous monitoring	GRS10
MOC28	Alert notification	N	The MOC shall notify appropriate Project personnel when user-specified events occur.	T, I	AM&AN	Reporting of observatory anomalies.	GRS10
MOC29	Alert notification	N	The MOC autonomous notification conditions shall be configurable without a software update.	T	AM&AN	To be able to change the conditions to monitor and the requirements for alerting personnel.	GRS4
MOC120	Archive	N	The MOC shall archive the observatory pre-launch test data used for MOC testing.	I, D	FM	Derived - Pre-launch data is needed for testing.	GRS115
MOC121	Archive	N	The MOC shall archive all mission planning products generated by the MOC, such as command files, maneuver planning files, schedules, and FDS data.	I, D	MOC	CM requirement; allows for tracing mission history	GRS37
MOC122	Archive	N	The MOC shall deliver engineering data and housekeeping trend data to a controlled archive.	T	PM&T	archive of housekeeping data and trend products	GRS35
MOC123	Archive	N	The MOC shall deliver event logs and reports to a controlled archive.	D	PM&T	To protect the integrity of the products.	GRS37
MOC124	Archive	N	The MOC shall archive all housekeeping data received from the observatory for the duration of the mission plus 30 days.	T, D	PM&T	To support trend analysis, performance monitoring, and decommissioning reporting.	GRS49
MOC125	Archive	N	The MOC shall archive history files of contact messages and uplinked data.	I, D	T&C, PM&T	CM requirement; allows for tracing mission history	GRS37
MOC126	Archive	N	The MOC shall maintain configuration control of the MOC archive for the life of the mission plus 30 days.	I, D	PM&T	Source documents and procedures will be under configuration management so the documentation system must support the configuration control process.	GRS33
MOC127	Archive	N	The MOC shall restrict access to the MOC archive to authorized personnel	I, D	PM&T	Procedures and documentation will contain sensitive information from security and IT security points of view.	GRS34
MOC20	Automation	N	The MOC autonomous operations shall run in parallel with manual, staffed operations with the	T	AM&AN	autonomous and manual operations should not inhibit each other.	GRS4

Object Identifier	Category	TBD	MOC Baseline	Verification Method	Allocation	Rationale	Trace to GRS Req
			manual operations able to override the autonomous operations.				
MOC21	Automation	N	The MOC shall automatically initiate and terminate connections to the NEN and SN based on contact schedules.	D	AM&AN	Supports lights out operations.	GRS5
MOC22	Automation	N	The MOC Telemetry and Command, Performance Monitoring, and Autonomous Monitoring and Alert Notification components shall failover automatically to redundant components within the MOC; redundant components shall not automatically failover to primary components or the bMOC.	D	AM&AN, T&C, PM&I	derived from operational availability requirements; to support autonomous operations.	GRS75
MOC141	backup MOC	N	The MOC shall provide a back-up flight operations facility, the backup MOC (bMOC), to support space asset protection.	I	bMOC, FM	The GS shall comply with GPD 7120.1A GSFC Space Asset Protection Policy.	GRS105
MOC142	backup MOC	N	The MOC backup operations (bMOC) shall be capable of performing observatory mission operations for a minimum of 31 consecutive days	D	bMOC	Redundancy - Designed such that no single credible failure permanently precludes completing the mission.	GRS105
MOC143	backup MOC	Y	The MOC backup operations (bMOC) shall control satellite mission operations within 72 hours (TBR) of loss of the primary MOC.	D	bMOC	To ensure Observatory health and safety, the backup must be capable of being operational by the time the onboard command load expires.	GRS109
MOC144	backup MOC	N	The MOC shall provide hardware, software, data and documentation to establish the bMOC at a location that is not co-located with the MOC including T&C, FDS, and the current project database (PDB) sufficient to maintain observatory health & safety	D	bMOC	To ensure the health and safety of the observatory due to catastrophic failure of the main MOC.. Since not Class A or B mission do not have to require separation distance of primary and backup MOC.	GRS105
MOC145	backup MOC	N	The MOC shall maintain the bMOC hardware, software, documentation, and project database and shall synch the bMOC to any MOC updates within 48 hours of the update.	D	bMOC	To ensure the health and safety of the observatory due to catastrophic failure of the main MOC.	GRS105
MOC146	backup MOC	N	The MOC shall ensure the bMOC meets all ICESat-2 security and network requirements as pertains to	D	bMOC	To ensure the bMOC can receive telemetry from and transmit commands to the observatory.	GRS105

Object Identifier	Category	TBD	MOC Baseline	Verification Method	Allocation	Rationale	Trace to GRS Req
			the MOC.				
MOC23	Event logging	N	The MOC shall automatically log event messages generated by the MOC subsystems.	T, I	AM&AN	This requirement is an industry best practice for system troubleshooting.	GRS10
MOC24	Event Logging	N	The MOC shall log operational and subsystem events.	T, I	FOT?	Maintain a logbook of events for reference and reporting.	GRS10
MOC25	Event Logging	N	The MOC subsystems shall generate event messages including normal and abnormal termination messages to support end-to-end troubleshooting and fault isolation.	T	AM&AN, T&C, PM&T, FDS, MP	This requirement is an industry best practice. It is necessary to alert the operations staff with the errors of all origin with the details for enabling proper and timely mitigation	GRS75
MOC26	Event logging	N	The MOC subsystems shall generate system performance information such as file space availability, CPU usage, and server usage to support end-to-end troubleshooting and fault isolation.	T	FM	This requirement is an industry best practice. It is necessary to alert the operations staff with the errors of all origin with the details for enabling proper and timely mitigation	GRS75
MOC100	External Interface	N	The MOC shall receive orbit analysis support from the GSFC FDF during the pre-launch and L&EO phases as defined in the MOC External ICD.	T	FDS	Verify and augment project flight dynamics capabilities for L&EO.	GRS29
MOC101	External Interface	N	The MOC shall receive precision orbit and pointing data from the POD/PPD Facility per the MOC External ICD.	T	FDS	Verify project flight dynamics solutions.	GRS28
MOC102	External Interface	N	The MOC shall distribute orbit and attitude data to the POD/PPD Facility per the MOC External ICD.	T	FDS	Validate project flight dynamics solutions.	GRS28
MOC104	External Interface	N	The MOC shall provide orbit events, sun-orbit plane beta angle, and maneuver prediction data to the ISF for mission planning per the MOC External ICD.	D	MP	For event planning.	GRS90
MOC105	External Interface	N	The MOC shall receive instrument plans, command requests, and status reports from the ISF for mission planning per the MOC External ICD.	D	MP	For event planning.	GRS53
MOC106	External Interface	N	The MOC shall forward real-time housekeeping telemetry to the ISF for instrument monitoring during each real-time contact per the MOC External	T, D	PM&T	IOT can monitor the state of the instrument during real-time operations	GRS45

Object Identifier	Category	TBD	MOC Baseline	Verification Method	Allocation	Rationale	Trace to GRS Req
			ICD.				
MOC107	External Interface	N	The MOC shall establish, monitor, and manage connections with the SN and NEN.	D	FM, MP	Control & Monitoring - Plan and execute all satellite housekeeping (including flight dynamics) activities	GRS52
MOC108	External Interface	N	The MOC shall receive real-time S-band observatory housekeeping data from the SN and NEN.	D	FM, MP	Control & Monitoring - Plan and execute all satellite housekeeping (including flight dynamics) activities	GRS52
MOC109	External Interface	N	The MOC shall receive playback observatory housekeeping data.	D	FM, MP	Control & Monitoring - Plan and execute all satellite housekeeping (including flight dynamics) activities	GRS52
MOC110	External Interface	N	The MOC shall implement SLE interfaces for telemetry and command functions as per the MOC to Ground ICD.	D	FM, MP	Control & Monitoring - Plan and execute all satellite housekeeping (including flight dynamics) activities	GRS52
MOC111	External Interface	N	The MOC shall be compliant with the Space Network User's Guide (SNUG) for SN interfaces.	D	FM, T&C, MP	The GS will utilize existing capabilities of the NASA Space Network (SN) Services.	GRS66
MOC112	External Interface	N	The MOC shall be compliant with the Near Earth Network User's Guide (NENUG) for NEN interfaces.	D	FM, T&C, MP	The GS will utilize existing capabilities of the NASA Near Earth Network (NEN) Services.	GRS67
MOC113	External Interface	N	The MOC shall be compliant with Space to Ground specifications contained within the SC to Ground IDD	D	FM, T&C, MP	S/c to Ground IDD defines data volume and rates, dump rates, and uplink rates.	GRS8
MOC114	External Interface	N	The MOC shall report status of activity requests to the s/c team and the ISF per the MOC External ICD.	D	MP	provide feedback	GRS88
MOC115	External Interface	N	The MOC shall provide history files of each real-time contact's message data and uplinked data to the ISF per the MOC External ICD	R, D	PM&T	To maintain record of events	GRS37
MOC98	External Interface	N	The MOC shall interface to FDOS to receive X-band data for FDS processing as defined in the MOC External ICD.	T	FDS, FM	The spacecraft attitude data and GPS data is dumped in the X-band link.	GRS21
MOC99	External	N	The MOC shall design and deploy the interfaces	D	FM, T&C,	The GS will utilize existing capabilities of the	GRS68

Object Identifier	Category	TBD	MOC Baseline	Verification Method	Allocation	Rationale	Trace to GRS Req
	Interface		between the Government provided IONet infrastructure and the MOC specific network devices within the NISN requirements.		MP	NASA Integrated Services Network (NISN) Services. NISN requirements are defined in the NISN Services Document for NISN Interfaces.	
MOC81	Facility	N	The MOC shall provide UTC clock and countdown clock displays with unobstructed visibility from the console positions	D	FM	All spacecraft operations are referenced to UTC time	GRS124
MOC82	Facility	N	The MOC shall provide a master time signal in UTC for the MOC systems.	D	FM	Both for time synchronization of workstations and time synchronization of front end processing equipment.	GRS124
MOC83	Facility	N	The MOC shall provide a redundant source of facility time signals.	D	FM	To ensure that a single failure does not preclude the time synchronization capability.	GRS124
MOC84	Facility	Y	The MOC non-critical systems shall operate continuously for 20 minutes (TBR) even during power outages.	T	FM	The uninterruptible power sources are only to provide for graceful shutdown of all hardware.	GRS17
MOC85	Facility	N	The MOC shall provide an auxiliary power source that is independent of commercial power that can keep the MOC subsystems running for up to 72 hours, in the event of a commercial power outage	D	FM	Providing an alternate power source avoids activating the backup MOC due to a short-term loss of power. In the case of a long-term power outage, having an alternate source of power that can run for 72 hours, allows the MOC team to travel to and setup at the backup MOC for planning and operations.	GRS18
MOC86	Facility	N	The MOC shall provide ten monitor-only terminals within the MOC Facility for use by the instrument and spacecraft engineering personnel during the launch and early orbit checkout period. Access to monitoring-only terminals for the instrument and spacecraft engineering teams shall be retained for the life of the mission.	D	FM	For monitoring during LEO and commissioning at the MOC.	GRS44
MOC87	Facility	N	The MOC shall provide floor space and network connections for a local ISF terminal during prelaunch testing, LEO, and commissioning. The	D	FM	To support monitoring and analysis of instrument science data during testing, LEO, and commissioning.	GRS44

Object Identifier	Category	TBD	MOC Baseline	Verification Method	Allocation	Rationale	Trace to GRS Req
			network connections shall allow for connecting to and exchanging data with the ISF and shall meet NASA security requirements.				
MOC88	Facility	N	The MOC shall backup operating systems, system configurations, software installations, and databases.	I, D	FM	This requirement is for a backup and restore capability to ensure data integrity to make sure that devices and interfaces are also backed up for complete recovery/restoring of the Ground system	GRS38
MOC89	Facility	N	The MOC shall ensure servicing of ground-based systems does not interrupt planning, command, and data downlink activities.	D	FM	Maintenance will be conducted on an ongoing as-necessary basis and it must not interfere with nominal mission ops.	GRS76
MOC90	Facility	N	The MOC shall be implemented such that software updates, data, and/or technology migration activities may be performed without interruption to ongoing mission operations.	D	FM, MP	Upgrade of hardware and software will be conducted on an ongoing as-necessary basis and it must not interfere with nominal mission ops. Technology migration includes hardware replacement	GRS77
MOC91	Facility	N	The MOC shall provide the capability to conduct FOT training activities concurrent with and without interruption of mission activities.	D	FM, MP	Supports training of new staff and testing / certification of new staff.	GRS78
MOC92	Facility	N	The MOC shall support mission operations 24-hours per day, 7 days per week.	D	FM, MP	Operations availability	GRS79
MOC93	Facility	N	The MOC shall provide the ISF with a T&C window for IOT support during real-time operations. the T&C window shall display on the ISF console real-time housekeeping data, procedures/commands that are initiated/issued from the MOC console, and system messages.	I	FM, T&C	IOT can monitor command/procedure execution and the state of the s/c during real-time operations	GRS45
MOC94	Facility	N	The MOC shall provide observatory housekeeping data trend analysis capability to the ISF.	I	FM, T&C	IOT can perform trend analysis/performance monitoring of the s/c and instrument housekeeping data.	GRS45
MOC95	Facility	N	The MOC shall supply all components of the MOC LAN.	D	FM, T&C, MP		GRS75

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MOC96	Facility	N	The MOC shall have a Contingency Plan to respond to and recover from IT security incidents.	D	FM	key, non-waiverable requirement as outlined in NPR 2810.1 A.5.1	GRS102
MOC97	Facility	N	The MOC shall have a Disaster Recovery Plan to respond to physical incidents like fire. This plan will describe failover procedures, and recovery teams to ensure continuity of operations.	D	FM	key, non-waiverable requirement as outlined in NPR 2810.1 A.5.1	GRS102
MOC48	FDS	N	The MOC shall produce orbit and attitude solutions for spacecraft pointing and orbit maneuvers.	T	FDS	Data Support - Plan and execute spacecraft maneuvers in support of calibration and nominal ops. Nominal operations include off-nadir pointing, orbit adjust maneuvers, and yaw flips.	GRS21, GRS28, GRS734
MOC49	FDS	N	The MOC shall perform attitude control subsystem calibration as needed.	D	FDS	Ensure instrument spot is located on the ground cross track with an accuracy of 45m (1-sigma) 99% of the time (TBR)	GRS28, GRS734
MOC50	FDS	N	The MOC shall be able to both manually and automatically generate and distribute flight dynamics products; it is expected during nominal operations to be an automated process.	T	FDS	To support planning of maneuvers.	GRS21
MOC51	FDS	Y	The MOC shall monitor the observatory attitude to ensure the instrument spot is located on the ground cross track with an accuracy of 45m (1-sigma) 99% of the time (TBR).	T	FDS	To ensure accuracy of science observations.	GRS28
MOC53	FDS	N	The MOC shall implement constraints in the maneuver planning software to prevent the instrument boresight from entering a cone of half-angle 30 degree to the spacecraft-to-sun line during nominal operations.	I, D	FDS, MP	During normal operations, there should be no requirement to have the sun point into the boresight of the instrument. This could damage the instrument so need to design the mission to avoid this situation	GRS23
MOC54	FDS	N	The MOC shall plan and execute maneuvers to control the ground track at the equator to an accuracy of +/-800m (East or West) relative to a referenced ground track	T	FDS, MP	Control the s/c so the laser beam is pointing within a tight box at the ground track.	GRS24, GRS21, GRS734

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MOC283	FDS	N	The MOC shall plan and execute maneuvers to point the observatory in one of two yaw positions - 0 degrees (+/-5 degrees) and 180 degrees (+/-5 degrees) as defined in the flight rules.	T	FDS, MP	Requirements for changing yaw position will be defined in the flight rules.	GRS21
MOC55	FDS	N	The MOC shall accept requests to delete or change the timing of orbit adjust maneuvers to avoid conflict with critical spacecraft or science events and in response to Space Asset Protection Requests.	T	FDS, MP	ensure FDS has mechanism to allow for rescheduling of maneuvers.	GRS24
MOC56	FDS	N	The MOC shall implement calibration scans that target a discrete number of points lying on a ground track that would be created by completely revolving a fixed instrument off-pointing angle about the nadir vector once.	T	FDS, MP	Capability to plan and schedule calibration scans.	GRS19
MOC57	FDS	N	The MOC shall implement single calibration scans that complete in 10 minutes within the constraints of the observatory.	T	FDS, MP, T&C	Capability to generate calibration scans.	GRS20
MOC58	FDS	N	The MOC shall determine the location of the observatory center of mass to 2 cm with respect to the spacecraft reference frame for each axis during all science taking operations.	D	FDS, MP	Need to know the CG this well to meet science measurement requirements	GRS100
MOC59	FDS	N	The MOC shall implement up to 40 off reference ground track pointing segments per day	T	FDS, MP	Off reference track events will be needed for vegetation segments etc. Limits the number of vegetation segments.	GRS57, GRS21
MOC284	FDS	N	The MOC shall ensure off reference ground track pointing segments are no longer than 20 minutes.	T	FDS, MP	Off reference track events will be needed for vegetation segments etc. Limits the lengthof time for each vegetation segment	GRS21, GRS57
MOC66	Flight Software	N	The MOC shall, when requested by the spacecraft or Instrument teams, uplink commands that reprogram observatory memory	T	T&C	To maintain and update observatory flight software	GRS31
MOC67	Flight	N	The MOC shall receive observatory memory dump	T	T&C	To support maintenance and troubleshooting of	GRS31

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	Software		packets and store these in files to forward to the spacecraft or Instrument teams.			observatory flight software.	
MOC68	Flight Software	N	The MOC shall maintain the approved spacecraft flight software image including any parameter tables.	T	T&C	To maintain and update observatory flight software	GRS31
MOC69	Flight Software	N	The MOC shall receive software memory loads for uplink to the observatory from flight software images provided by the FOT, S/C and instrument Flight Software vendor facilities.	T	T&C, MP	Control & Monitoring - Plan and execute all satellite housekeeping (including flight dynamics) activities	GRS30
MOC193	ITAR	Y	The MOC shall comply with the International Traffic in Arms Regulations (ITAR) as defined in the Code of Federal Regulations, Parts 120 through 130 (22 CFR 120-130) Subchapter M, Title 22.	I, D	MOC	Inst. Requirement	GRS32
MOC119	Launch Site	Y	The MOC shall be compatible with the payload interfaces, environment, design constraints, and launch operations at the launch site (TBD).	I	T&C	launch vehicle is TBD	GRS40
MOC135	Metrics	N	The MOC shall collect and report statistics for the MOC and the observatory including observatory operational availability and MOC real-time availability.	R, D	PM&T	Metrics to verify the MOC and the observatory are meeting availability requirements.	GRS9,GRS75
MOC136	Metrics	N	The MOC shall maintain statistics of the actual versus expected volume of science data collected for the life of the mission.	D	PM&T	Data collection metric for the SSR.	GRS111
MOC70	Mission Life	N	The MOC shall support 3 years of mission life plus the initial 60 days for post-launch observatory commissioning.	I, D	MOC	Support the 3-year nominal mission lifetime. Mission may be extended as resources allow.	GRS41
MOC71	Mission Life	N	The MOC shall support launch activities.	D	MOC	The MOC will be on-line and monitoring during the launch activities.	GRS44
MOC72	Mission Life	N	The MOC shall support observatory commissioning.	D	MOC	To support resource planning and scheduling.	GRS44
MOC73	Mission Life	N	The MOC shall support observatory operations - nominal science activities, observatory anomalies,	D	MOC	To support resource planning and scheduling.	GRS44

Object Identifier	Category	TBD	MOC Baseline	Verification Method	Allocation	Rationale	Trace to GRS Req
			and engineering activities.				
MOC74	Mission Life	N	The MOC shall support decommissioning of the observatory.	D	MOC	To support resource planning and scheduling.	GRS44
MOC36	Mission Planning	Y	The MOC shall receive from the ISF, 1 week (TBR) in advance, requests for observatory pointing including calibration scans (Ocean and Round-the-World), targets, and vegetation tracks.	T	FDS, MP	To meet mission planning schedule.	GRS21, GRS56, GRS57, GRS59, GRS64, GRS731
MOC285	Mission Planning	N	The MOC shall implement Ocean Scans consisting of two calibration scans performed back to back.	T	FDS, MP	Definition of an Ocean scan for mission planning	GRS21, GRS60
MOC286	Mission Planning	N	The MOC shall schedule Ocean Scans no more than 4 Ocean Scans per day.	T	FDS, MP	Limit for mission planning	GRS21, GRS61
MOC287	Mission Planning	N	The MOC shall implement Round-the-World Scans consisting of calibration scans executed back to back for an entire orbit.	T	FDS, MP	Definition of a Round-the-World scan for mission planning	GRS21, GRS62
MOC288	Mission Planning	N	The MOC shall schedule Round-the-World Scans no more than once per 8 days.	T	FDS, MP	Limit for mission planning	GRS21, GRS63
MOC38	Mission Planning	N	The MOC shall schedule all activities for the observatory except those autonomously executed by the S/C.	I, D	MP	The S/C will autonomously execute reference track pointing and observatory safing commands.	GRS53, GRS21
MOC39	Mission Planning	N	The MOC shall generate commands and command loads to execute all activities for the observatory except those autonomously executed by the S/C.	I, D	MP	The S/C will autonomously execute reference track pointing and observatory safing commands.	GRS48, GRS116, GRS21
MOC40	Mission Planning	N	The MOC shall schedule all routine, periodic and special activities based on a priority scheme.	I, D	MP	To ensure conflict-free schedule and safety of observatory.	GRS53
MOC41	Mission Planning	N	The MOC shall schedule activities based on mission events and spacecraft and instrument requests.	I, D	MP	To ensure science and s/c needs are met.	GRS53
MOC42	Mission Planning	N	The MOC shall process schedules from the NEN.	I, D	MP	To determine contact times.	GRS53
MOC43	Mission Planning	N	The MOC shall process schedules from the SN.	I, D	MP	To determine contact times.	GRS53

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MOC44	Mission Planning	N	The MOC shall generate deconflicted operations plans.	I, D	MP	MOC planning will ensure spacecraft and instrument activities don't conflict and meet observatory flight rules.	GRS53
MOC45	Mission Planning	N	The MOC shall evaluate candidate contact schedules against constraints defined in the observatory flight rules.	I, D	MP	To ensure GOLD Rules are satisfied; observatory flight rules are provided by the s/c vendor.	GRS53, GRS54, GRS55
MOC46	Mission Planning	N	The MOC shall provide short-term (72 hour) and long-term (21 day) operations schedules to the ISF.	D	MP	Provides the GS elements the planning schedules.	GRS89
MOC47	Mission Planning	N	The MOC shall plan and schedule all nominal observatory activities for a 72 hour period.	I, D	MP	allows for M-F, 8-5 staffing	GRS80
MOC289	Mission Planning	Y	The MOC shall schedule no more than 20 (TBR) target pointing requests per day.	T	FDS, MP	Limits number of target pointing events per day.	GRS56, GRS64
MOC10	Monitoring	N	The MOC shall decommutate and convert observatory housekeeping telemetry into engineering units using the calibration and conversion factors contained in the PDB.	T, D	T&C, PM&T	To monitor observatory health and safety.	GRS49
MOC11	Monitoring	N	The MOC shall autonomously monitor all spacecraft health and safety data and selected instrument heath and safety data and detect anomalies.	I, D	T&C, AM&AN	support autonomous operations and allow for monitoring both the spacecraft and instrument data.	GRS4, GRS45, GRS49
MOC12	Monitoring	N	The MOC shall autonomously monitor event messages including limit check failures and termination messages from critical MOC systems.	T	AM&AN	derived from operational availability requirements; to support autonomous operations.	GRS4
MOC13	Monitoring	N	The MOC shall autonomously monitor the aliveness of MOC subsystem critical tasks.	T	AM&AN	derived from operational availability requirements; to support autonomous operations.	GRS4
MOC14	Monitoring	N	The MOC shall process and monitor telemetry data from the observatory while at the launch processing facility.	D	T&C, PM&T	The MOC will be on-line and monitoring during the launch activities.	GRS44
MOC15	Monitoring	N	The MOC shall process and monitor telemetry data from the observatory while on the launch pad.	D	T&C, PM&T	The MOC will be on-line and monitoring during the launch activities.	GRS44
MOC16	Monitoring	N	The MOC shall autonomously detect NEN, SN,	I, D	AM&AN	derived from operational availability requirements;	GRS4

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			EDOS, and ISF interface anomalies.			to support autonomous operations.	
MOC17	Operations Support	N	The MOC shall be available 99% of the time for real-time satellite operations (command and telemetry functions), measured on a monthly basis.	I, D	T&C	Critical command and telemetry availability required for periodic, contingency, and special events. Functions include the real-time command and control within the MOC.	GRS75
MOC18	Operations Support	N	The MOC shall be nominally staffed 8-hours per day, 5 days per week after launch and early check out activities are completed.	D	FM, MP	Initially the FOT will staff the active MOC 24 hours per day. This staffing will gradually reduce down to this long-term goal of 8x5. It is expected to take some time to mature mission operations understanding and adjust automation procedures before the 8x5 staffing will be realized	GRS80
MOC19	Operations Support	N	The MOC shall maintain electronic copies of operating procedures for FOT use.	I	T&C	Allows ready and quick access to documentation from all workstations/terminals at any time	GRS47
MOC30	Project Database	N	The MOC shall identify hazardous or critical commands in the PDB.	D	T&C	Hazardous and critical commands to be defined by the spacecraft and instrument vendors.	GRS102
MOC31	Project Database	N	The MOC shall generate and manage command constraint definitions in the PDB.	D	T&C, MP	definitions generated from the observatory flight rules	GRS116
MOC32	Project Database	N	The MOC shall manage a Project Database (PDB) that consists of the observatory T&C database.	D	T&C, PM&T	The PDB enables management of all telemetry and command definitions across all development organizations. This may need modified depending on outcome of discussion on instrument command and telemetry handling.	GRS81
MOC33	Project Database	N	The MOC shall ingest and verify the spacecraft telemetry & command (T&C) database and updates provided by the Spacecraft vendor	I	T&C, PM&T	To receive definitions for all spacecraft bus T&C formats	GRS84
MOC34	Project Database	N	The MOC shall ingest and verify the ATLAS telemetry and command database and updates provided by the instrument provider.	I	T&C, PM&T	To receive ATLAS definitions for all instrument T&C formats. Need to determine if this will be a requirement	GRS85
MOC35	Project Database	N	The MOC shall maintain the Prime and bMOC copies of the PDB within a configuration	T	T&C, PM&T	The Project Database (PDB) contains the observatory telemetry and command	GRS36, GRS105

Object Identifier	Category	TBD	MOC Baseline	Verification Method	Allocation	Rationale	Trace to GRS Req
			management system. Entries and updates will be reviewed and verified prior to adoption into the PDB.			specifications. Maintaining Backup and Off-site copies ensures integrity in case of system failures.	
MOC137	Security	N	The MOC shall comply with HSPD-12	I, D	SEC, FM	Institutional requirement for security	GRS103
MOC138	Security	N	The MOC shall utilize secure file transfer protocols between external systems	T	FM	To comply with security plans.	GRS102
MOC139	Security	N	The MOC shall comply with NIST 800-53 Rev 3 for moderate data classification	I, D	FM, T&C	Institutional requirements for IT security.	GRS102
MOC140	Security	N	The MOC shall provide command authentication to ensure space asset protection in accordance with GPD 7120.1A GSFC Space Asset Protection Policy.	I,T	T&C	The GS shall comply with GPD 7120.1A GSFC Space Asset Protection Policy. At least authentication is required as defined by the Space Asset Protection plan	GRS104
MOC116	Space Asset Protection	N	The MOC shall provide ephemeris reports to the conjunction assessment system	T	FDS	space asset protection	GRS25
MOC117	Space Asset Protection	N	The MOC shall respond to conjunction alerts from the provider of conjunction assessments.	T	MP, FDS	space asset protection - a maneuver may be needed to avoid a conjunction with another object.	GRS26, GRS21
MOC118	Space Asset Protection	N	The MOC shall protect other space assets from laser beam damage.	T	MP, FDS	The laser beam may damage other space assets if pointed into their FOV so maneuvers may have to be performed or the laser powered off..	GRS27
MOC60	SSR Mgt	N	The MOC shall manage the SSR record and playback functions to dump and redump the science and housekeeping data.	T	MP	supports science data recovery req.	GRS50
MOC61	SSR Mgt	N	The MOC shall plan the Solid State Recorder (SSR) playbacks based on the contact schedule provided by the NEN.	D	MP	Data Acquisition - Build, maintain, and execute an acquisition plan	GRS50
MOC62	SSR Mgt	N	The MOC shall generate SSR retransmit commands for full or selective redump of science data upon the request of the ISF or EDOS	D	MP	supports science data recovery req.	GRS50
MOC63	SSR Mgt	Y	The MOC shall manage the SSR to ensure the mission data acquired by the observatory while in	A	MP, T&C	This should guide the MOC on making decisions of whether and how to retransmit data from the	GRS9

Object Identifier	Category	TBD	MOC Baseline	Verification Method	Allocation	Rationale	Trace to GRS Req
			nominal science mode is dumped to the ground stations.			spacecraft	
MOC64	SSR Mgt	N	The MOC shall evaluate SSR data volume and quality.	D	T&C	supports science data recovery req.	GRS50
MOC65	SSR Mgt	N	The MOC shall evaluate SSR unit status received from the spacecraft	D	T&C	supports science data recovery req.	GRS50
MOC2	T&C	N	The MOC shall uplink commands and command loads as generated by the MP subsystem.	D	T&C	MOC responsible for commanding the observatory	GRS116
MOC3	T&C	N	The MOC shall ensure only one command console has command authority.	D	T&C	Only one command console may send commands to the observatory at a time.	GRS102
MOC4	T&C	N	The MOC shall require operator confirmation prior to uplinking a hazardous or critical command.	D	T&C	Hazardous and critical commands to be defined by the spacecraft and instrument vendors and identified in the PDB.	GRS102
MOC5	T&C	N	The MOC shall perform constraint checking on command loads.	D	T&C, MP	To ensure command loads do not violate flight rules.	GRS116
MOC6	T&C	N	The MOC shall display and plot real-time S-Band data to monitor the health of the observatory.	T	T&C	To monitor the state of the observatory during contacts.	GRS45
MOC7	T&C	N	The MOC shall perform anomaly resolution in response to deviations from the expected state of the observatory.	I, D, T	T&C, PM&T	Control & Monitoring - Monitor and maintain the health and safety of the observatory.	GRS45
MOC8	T&C	N	The MOC shall support redundant strings of T&C systems	I	T&C	supports operational availability requirement	GRS75
MOC128	Testing	N	The MOC shall interface with the Operations Observatory Simulator.	D	FM, T&C	For GRT and MRT support, integration testing, as well as post-launch testing of critical command loads not tested prior to launch.	GRS117
MOC129	Testing	N	The MOC shall support mission end-to-end testing using actual hardware and software beginning 12 months prior to launch	I, D	MOC	End-to-end testing will include incremental builds as functionality is increased. End-to-end testing shall be performed using actual flight hardware and software, when practicable; taking into account what is physically achievable before	GRS43

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						launch, and within acceptable mission risk.	
MOC130	Testing	N	The MOC shall support pre-launch activities including observatory Integration and testing (I&T), ground system testing, mission readiness testing, and mission end-to-end testing and rehearsals.	D	MOC	Mission operations must be developed early to support pre-launch testing.	GRS44
MOC131	Testing	N	The MOC shall interface with the Spacecraft Vendor for testing observatory/MOC telemetry and command compatibility.	D	T&C	For GRT and MRT support as well as integration testing.	GRS117, GRS44
MOC132	Testing	N	The MOC shall interface to ground test equipment in order to send commands and receive telemetry packets during testing.	T	T&C	The MOC must be able to interface to ground test equipment during observatory I&T and other ground testing.	GRS44
MOC133	Testing	N	The MOC shall receive instrument housekeeping data from the Instrument Provider for test support.	T	T&C, PM&T	For integration testing as well as ingest and processing.	GRS118, GRS44
MOC134	Testing	N	The MOC shall be able to display, limit check, and trend telemetry output by ground test equipment and simulators.	T	T&C, PM&T	The MOC must be able to provide monitoring and trending capability during ground testing.	GRS44
MOC9	Time Basis	N	The MOC shall use the Universal Time Coordinated (UTC) or a UTC-relatable time reference frame for all ground operation commands and data products.	D	T&C, MP	A universal time reference avoids conflicts between subsystems (elements)	GRS124
MOC75	Remote Access	N	The MOC shall provide access to trending capabilities via the Internet for analysis by authorized remote users.	T	FM, PM&T	Control & Monitoring - Monitor and maintain the health and safety of the observatory.	GRS46
MOC290	Remote Access	N	The MOC shall provide access to realtime data monitoring via the Internet to authorized remote users.	T	FM, PM&T	Control & Monitoring - Monitor and maintain the health and safety of the observatory.	GRS46
MOC76	Trend Analysis	N	The MOC shall provide access to the trend analysis tool(s) at the MOC Facility.	T	FM, PM&T	Control & Monitoring - Monitor and maintain the health and safety of the observatory.	GRS44
MOC77	Trend Analysis	N	The MOC shall provide access to the trend analysis tool(s) on the instrument and s/c engineering monitor-only terminals.	T	FM, PM&T	Control & Monitoring - Monitor and maintain the health and safety of the observatory. Monitor-only terminals are defined in MOC86.	GRS44

Object Identifier	Category	TBD	MOC Baseline	Verification Method	Allocation	Rationale	Trace to GRS Req
MOC78	Trend Analysis	N	The MOC shall be able to perform trend analysis on any observatory housekeeping telemetry point for the life of the mission.	T	PM&T	Control & Monitoring - Monitor and maintain the health and safety of the observatory.	GRS45
MOC79	Trend Analysis	N	The MOC shall graphically display telemetry points over time based on user inputs.	T	PM&T	Control & Monitoring - Monitor and maintain the health and safety of the observatory.	GRS45
MOC80	Trend Analysis	N	The MOC shall provide trending plots to the S/C vendor and the ATLAS instrument team as needed prior to the end of commissioning and on a monthly basis or as requested after commissioning is completed.	T	PM&T	Control & Monitoring - Monitor and maintain the health and safety of the observatory.	GRS45
MOC292	CM	N	The MOC shall configuration control algorithms, databases, source code, and documentation for the life of the mission.	R	MP, FDS, T&C, PM&T	GOLD Rule compliance	GRS114
MOC293	Coordinate System	N	The MOC shall utilize the coordinate system X, Y & Z axes and roll, pitch and Yaw axis as defined in ICESat-2-SYS-ANYS-0474.	R	MP, FDS	Mission defined Coordinate system. Does not apply to procured components.	GRS727
MOC294	Metric System	N	The MOC shall comply with the Use of Metrics Units requirements specified in NPD 7120.4D NASA Engineering and Program/Project Management Policy.	R	MP, FDS, T&C, PM&T, AM&AN	NPD 7120.4D is mandatory, but allows exceptions. Significant cost & risk increase if we force the adoption of complete SI compliance.	GRS728
MOC295	FDS	N	The MOC shall implement reference ground tracks that repeat every 1387 orbits in the polar regions.	T	FDS	Ground tracks are repeated in support of seasonal change detection	GRS730
MOC296	FDS	N	The MOC shall monitor observatory attitude and detect any deviations that occur.	T	FDS, PM&T	Ensure the observatory remains in nominal attitude during science operations including calibration scans	GRS736
MOC297	FDS	N	The MOC shall refine the insertion orbit to meet the science orbit constraints	T	MP, FDS	After launch the initial orbit may need adjusting to meet science requirements.	GRS738
MOC298	SE	N	The MOC shall comply with the software engineering process as defined in NPR 7150.2A.	R	MP, FDS, T&C,	MAR and GOLD Rule compliance. Mission critical systems are Class B and the rest are Class	GRS739

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					PM&T, AM&AN	C.	
MOC299	Testing	N	The MOC shall have access to simulators to test observatory interface and functional capabilities.	R	T&C	To complete functional testing; GOLD rule compliance	GRS741
MOC300	Testing	N	The MOC shall participate in an extended, uninterrupted test of the fully integrated flight software and ground system including the demonstration of error free operations-like scenarios for a minimum of 48 hours (Class C mission).	R	MP, FDS, T&C, PM&T, AM&AN	GOLD rule compliance	GRS742
MOC301	CM	N	The MOC shall configuration control Observatory command procedures and/or scripts. New and updated procedures & scripts will be reviewed and validated prior to using to command the observatory.	R	MP, FDS, T&C, PM&T, AM&AN	GOLD rule compliance	GRS744
MOC302	MP	N	The MOC shall schedule test firings of all thrusters on-orbit prior to the first delta-v maneuver.	R	MP	GOLD rule compliance	GRS745
MOC303	FDS	N	The MOC shall use the GPS data to determine observatory position.	R	FDS		GRS747