

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

**Mission Operations Center
(MOC)
Contract Data Requirements List
(CDRL)**

ICESat-2-MOC-CTR-0473

Revision A

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**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 (CM)-controlled document. Changes to this document require prior approval of the applicable Configuration Control Board (CCB) Chairperson or designee. Proposed changes shall be submitted to the ICESat-2 CM Office (CMO), 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:

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

List of TBDs/TBRs

Item No.	Location	Summary	Ind./Org.	Due Date

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1.0 INTRODUCTION

This Contract Data Requirements List (CDRL) document defines the requirements for deliverable documentation to be provided by the Mission Operations Center (MOC) Contractor. Section 2.0 includes definitions and instructions for mailing and/or distribution. Table 3-1 presents the CDRL item by item, with due dates, quantity, and media format. Section 4.0 provides the Description of Required Data (DRD), which provide the use of each deliverable and the required preparation information. Except where specifically indicated to the contrary, the formats and drawing standards used shall be those normally used by the MOC Contractor and by its subcontractors.

2.0 DEFINITION OF DUE DATES/MATURITY, DEFINITION OF CATEGORIES, AND MAILING DISTRIBUTION INSTRUCTIONS

2.1 Due Dates/Maturity - Related Definitions

The following definitions apply to the "DUE DATE, MATURITY" column in Table 3-1. Unless otherwise specified, deadlines are in working days.

a) Due Date

- 1) M-SRR, M-PDR, M-CDR, GS-PDR, GS-CDR, MOR, FOR, ORR, OAR, other milestone reviews, etc: MOC System Requirements Review, MOC Preliminary Design Review, MOC Critical Design Review, Mission Operations Review, Flight Operations Review, Operations Readiness Review, On-Orbit Acceptance Review etc. Electronic distribution to be delivered to the Government 5 working days prior to review, unless otherwise stated.
- 2) As Generated, Update As Required (UAR): After each initial edition, revision, addition, etc. Items that are critical to schedule, performance, or interface shall be transmitted to GSFC by facsimile or express mail within 48 hours of generation. Where available, an electronic version shall also be provided.
- 3) Monthly: Submitted on monthly basis
- 4) T: Launch Date
- 5) DACA: (Calendar) Days After Contract Award
- 6) E: Electronic copies are due at the same time as hard copies unless otherwise specified.

b) Maturity

1. Initial: The first submission of an item that will be revised and resubmitted at a later date.
2. Preliminary: An early submission of an item. To be completed as is practicable at the time of preparation. Preliminary submittals are written with the best available current information and are resubmitted when further information becomes available.
3. Final: The complete, thorough submission of an item for approval, review, or information that, to the best of the contractor's knowledge and intention, will not require further revision or updates. However, this does not preclude updating if later found to be necessary. Any updates shall require the same "approval/review" process as was required for the original submissions.
4. Current: The delivery is written with the best up-to-date information available at the time.
5. Update: The delivery is revised with the best up-to-date information available at the time.
6. Other entries in the "DUE DATE, MATURITY" column are self-explanatory.

2.2 Quantity - Related Definitions

The quantities to be delivered shall be per the CDRL listing in column "Quantity (QTY)" in Table 3-1 of this document. If separate quantities are not specified for separate submission due date/maturity items, then the listed quantity applies to all submissions.

2.2.1 Media - Related Definitions

The following definition applies to the "MEDIA" column in Table 3-1.

- a. H – Hardcopy(s) of this documentation shall be delivered to the Contracting Officer at GSFC Code 425.
- b. E - Data items shall be delivered in electronic format to a GSFC ICESat-2 specified web portal unless otherwise noted in Table 3-1. Quantities refer to hardcopies, not electronic copies. The Contracting Officer shall be notified of electronic submission of the deliverable in writing. Electronic deliverables shall be delivered in the following formats unless otherwise approved by the government:
 - Text Documents: PDF (searchable) or MSWord
 - Presentations: PDF (searchable) or PowerPoint
 - Spreadsheets: Microsoft Excel
 - Database: Delimited ASCII files accompanied with database schema document defining tables and entries.
 - Schedules: PDF and MS Project
 - Schematics and Drawings: Design Web Format (DWF) and PDF
 - Photographs: JPEG or current industry standard.
 - Video: Any readily available open standard (e.g., AVI, MPEG)
- c. R – For Reviews, hardcopies shall be made available at the review site for government representatives. (Generally, this will be in addition to electronic copies being made available prior to the review.) The quantity specifies the number of hardcopies to be available at the review for government representatives.

If separate distribution instructions are not specified for separate submission due date/maturity items, then the listed distribution applies to all submissions.

2.3 Category - Related Definitions

The following definitions apply to "Submission Category (CAT)" column in Table 3-1. If separate approval instructions are not specified for separate submission due date/maturity items, then the listed approval instruction applies to all submissions.

A - Approval: CDRL items in this category require approval by the GSFC Contracting Officer's Technical Representative (COTR) or Contracting Officer prior to use by the contractor. Receipt by the Government shall occur within the time specified in the "Due Date" column of Table 3-1 of this document. The Contracting Officer shall specify requirements for re-submission. For most cases the contractor will be required to resubmit the document within 14 calendar days of receiving comments from the Government. If the contractor has not received

response from GSFC within 30 calendar days of delivery of a CDRL item, the contractor may proceed as if the document has been approved.

R – Review: Documents in this category require delivery to the Government prior to use and within the time period specified in the "Due Date" column of Table 3-1 of this document. They are subject to evaluation by the Government or its designated representatives to determine Contractor effectiveness in meeting contract objectives. Upon submission, the Contractor may proceed with associated work while the Government reviews the submission.

I – Information: Data in this category shall be delivered to the Government within the time period specified in the "Due Date" column of Table 3-1 for the purpose of determining current program status, progress, and future planning requirements.

3.0 ICESAT-2 CONTRACT DATA REQUIREMENTS LIST

Table 3-1 comprises the ICESat-2 Contract Data Requirements List and is in the following order:

- Program Management (PM)
- Reviews (RE)
- System Engineering (SE)
- Mission Operations (MO)

Table 3-1 Contract Data Requirements List (CDRL)

NO.	PROGRAM MANAGEMENT	DUE DATE, MATURITY	QTY	MEDIA	CAT
PM-1	Monthly Project Status Reviews (MSR)	Monthly (nominally the last Wednesday of each month) Can be combined with S/C MSR	1	E	I
PM-2	Integrated Master Schedules (IMS)	- Initial 45 DACA	1	E	I
		- Baselined 60 DACA	1	E	I
		- Update Monthly, delivered 7 days prior to MSR	1	E	I
PM-4	MOC development Final Report & Lessons Learned	Delivered incrementally at: MOC SIR Launch – 60 days Acceptance + 30 days	1	E	I
PM-5	Engineering Peer Review Plan	60 DACA, Final	1	E	A
PM-6	Mission Assurance Implementation Plan (MAIP)	60 DACA , 30 days after any subsequent updates.	1	E	A
PM-7	Security Plan	30 DACA, Final	1	E	A
		UAR	1	E	A
PM-10	Hardware and Software Configuration Management Plan	30 DACA, Final	1	E	A
PM-11	Project Management Plan	30 DACA, Final	1	E	A

PM-12	Risk Management Plan	60 DACA, Final	1	E	A
PM-13	Flight Operations Anomaly Reports	As Needed	1	E	A

NO.	REVIEWS (RE)	DUE DATE, MATURITY	QTY	MEDIA	CAT
RE-1	MOC System Requirements Review Data Packages	Electronic copy in Project library 5 days prior to review. Hard copies at review.	10	H, E	I
RE-2	MOC Preliminary Design Review Data Packages	Electronic copy in Project library 5 days prior to review. Hard copies at review.	10	H, E	I
RE-3	MOC Critical Design Review Data Packages	Electronic copy in Project library 5 days prior to review. Hard copies at review.	10	H, E	I
RE-5	MOC System Integration Review Data Packages	Electronic copy in Project library 5 days prior to review. Hard copies at review.	10	H, E	I
RE-6	Input to Project Ground System and Mission Reviews	Electronic copy in Project library 5 days prior to review. Hard copies at review.	10	H, E	I
RE-7	Engineering Peer Review Data Packages	Hard copies at review.	10	H, E	I

NO.	SYSTEMS ENGINEERING	DUE DATE, MATURITY	QTY	MEDIA	CAT
SE-1	Engineering Change Requests, Deviations, and Waivers	Class I, As Generated	1	E	A
		Class II, As Generated	1	E	I

SE-2	Contractor Generated Internal Technical Information	As Requested	2	Original format (H or E)	I
SE-6	System Performance Verification Plan and Matrix	Electronic copy 10 days prior to MOC-SRR, preliminary Electronic copy 30 days prior to MOC-CDR, Matrix updates with each major MOC review. Updates As Required	1	E	A
SE-7	Verification Reports	Within 30 days after each verification, Final	1	E	A
SE-8	Configuration Item Identification List	MOC-PDR, Preliminary MOC-CDR, Final	1 1	E E	I I
SE-13	Specification Tree	MOC-SRR, Final	1	E	I
SE-20	Trades and Analyses	Initial, MOC-PDR Update, MOC-CDR Updates summarized twice per year thereafter	1 1 1	E E E	R R R
SE-23	Acceptance Data Package	At OAR	1	E	A

NO.	MISSION OPERATIONS (MO)	DUE DATE, MATURITY	QTY	MEDIA	CAT
MO-2	Mission Operations Center Interface Control Document (ICD)	Draft version at M-PDR	3	H, E	R
		Final version at M-CDR	3	H, E	R
MO-3	Mission Operations Center Lower-Level System Requirements Document	Electronic copy 5 days prior to M- SRR	1	E	I
MO-4	MOC Test Plan(s)	Draft - electronic copy 2 weeks after MOC PDR	1	E	A
		Final - electronic copy 2 weeks prior to MOC-CDR	1	E	A
MO-5	Mission Operations Center Test Procedures Document	Final 2 weeks prior to applicable test	1	E	I
MO-6	Mission Operations Center Test Reports	3 work days after Test, Final	1	E	I
MO-9	MOC Software Development Management Plan (SDMP)	MOC-SRR	1	E	R
MO-10	MOC Software Version Description Document	With each MOC delivery	1	E	I
MO-12	MOC Design Specification and Description	Draft 2 weeks prior to M-PDR	1	E	R
		Final 2 weeks after M-CDR	1	E	R
MO-13	Flight Operations Team Training Plan	Draft 6 weeks prior to first training session	1	E	I
		Final 2 weeks prior to final MOC / Ground System Integration	1	E	I
MO-15	MOC User's Manual	With each MOC suite delivery	1	E	I
MO-18	ICESat-2 Key Management Plan input	Preliminary, MOC-PDR	1	E	R
		Draft, MOC-CDR	1	E	R

		Updates as required	1	E	R
		Final, ORR	1	E	R
MO-19	Operations Procedures Plan (Baseline of Ops Procedures)	Draft at MOC-CDR,	1	E	R
		Final at SIR	1	E	R
		Updates as Required	1	E	R
MO-20	FOT procedures review to support execution of the S/C Decommissioning Plan	Draft at MOC-MOR	1	E	A
		Final at ORR	1	E	A
		Updates as required	1	E	A
MO-21	LEO Handbook	Draft at L-6 Months	1	E	R
		Final at ORR	1	E	R
MO-22	Standard Operating Procedures (SOP's) and Contingency Operations Plan	Draft at L-6 Months	1	E	R
		Final at ORR	1	E	R
MO-23	MOC Provided Systems to the Instrument Support Facility	Review at M-CDR	1	E	A
		Delivered 90 Days Before start of Observatory I&T	1	E	A

4.0 DESCRIPTIONS OF REQUIRED DATA (DRD)

4.1 Management DRDs

Table 4-1 Program Management

1. CDRL No.:	PM-1
2. Title:	MONTHLY PROJECT STATUS REVIEWS
3. Reference:	SOW 2.1 SOW 2.2
4. Use:	To evaluate contract status. These reports will be used to provide an opportunity for discussions between the contractor and the Government regarding project status, plans and issues.
5. Preparation Information:	<p>Scope: The MPSR shall include all aspects of the contract effort.</p> <p>The Monthly Project Status Review (MPSR) will be presented at a meeting with the Government. Face-to-face meetings will take place at least every three months, alternating between the Contractor's site and a Government site, unless modified by mutual consent. The remainder of the MPSRs shall be supported via telecon or combined with other reviews such as PERs and project reviews.</p> <p>The Monthly Project Status Review shall include the following:</p> <ul style="list-style-type: none"> A. Technical status for system and subsystem design and development activities, including subcontract technical performance B. A comparison of planned versus actual accomplishments for the period of time since the prior report. C. Summary of Integrated Master Schedule Status, including a brief description of the current status of each subsystem along with descriptions of any existing or potential problems areas. The critical path and near critical paths shall be explained along with possible work-arounds being considered to maintain the schedule. The third MPSR shall include a schedule baseline review. The basis of the review shall be the Integrated Master Schedule. D. A detailed 12-month "rolling-wave" schedule (3 months of actual, plus 9 months of forecast) E. Metrics summarizing all milestones depicting planned versus actual accomplishments and explanations for variances, e.g., graphic display of planned versus actual cumulative milestone status, xx of 1000 milestones are behind plan and why, etc. F. Problems encountered during the reporting period, and anticipated approaches for resolution (including, as appropriate, technical issues, manpower and staffing, supplier and subcontractor issues, etc.) G. Status of open issues and problems from prior reporting periods H. Status of action items I. Significant plans and activities for the following month J. Identification of long-lead purchases/acquisitions/developments made prior to PDR and prior to CDR of the system in which the long lead item is a part of. K. Class I and Class II proposed and approved Configuration Control Board

	<p>Changes</p> <ul style="list-style-type: none"> L. Risk Status for top 10 risks, including risk mitigations and burn-down plans M. Software assurance reports N. Milestone events depicting critical items of project status for the succeeding month. O. Summary graphical presentation of project workforce staffing depicting planned versus actuals (3 months actual, 9 months of forecast), explanation of variances, and discussion of key vacancies and staffing issues. P. Summary of financial status Q. Business issues, including personnel changes R. CDRL Status Report that includes the following information for each document delivered in accordance with the CDRL or overdue from previous reporting periods: <ul style="list-style-type: none"> a. Document Number b. Document Title c. Scheduled Due Date d. Actual Submittal Date e. Current Status <p>The report shall also include a list of documents planned for delivery during the next reporting period listed by document number, title, and scheduled submittal date.</p> <p>The contractor shall provide paper copies of the agenda, viewgraphs and other presentation material for all Government attendees at the time of the review. The contractor shall place MPSR material on the Government-access electronic database by the day of the MPSR. Presentation material may be in contractor format.</p>
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1. CDRL No.:	PM-2
2. Title:	INTEGRATED MASTER SCHEDULE (IMS)
3. Reference:	<ul style="list-style-type: none"> • SOW 2.1 • SOW 2.3 • NPR 7120.5D, Program/Project Management Processes and Requirement
4. Use:	<p>Schedules are used to plan, monitor, communicate status, and control all activities, including pertinent resources and facilities, necessary to accomplish assigned tasks in compliance with the ICESat-2 MOC Statement of Work. The IMS will provide the contractor's time-phased plan, current status, key milestones, task interdependencies, and major development phases necessary to accomplish the total scope of work. This schedule will be used to provide management insight into contractor status, potential problem areas, and critical path identification, which will serve as the basis for evaluating contractor performance. The baseline IMS will be the basis for evaluating the impact of government-directed changes within the project.</p>
5. Preparation Information:	<p>The IMS shall be developed using the Critical Path Method-based scheduling technique. It will consist of the schedule baseline and the current schedule updated each reporting period. The IMS shall relate actual progress to the baseline and contain the current forecast for the remaining tasks. The IMS shall be developed and maintained in the current release of Microsoft Project.</p> <p>The IMS shall include tasks necessary to accomplish the total scope of work as defined in the work breakdown structure (WBS). The schedule shall also include all logical relationships (interdependencies) between tasks. Schedules shall contain the approved baseline schedule as well as current forecasted dates and shall be traceable to the approved Work Breakdown Structure (WBS). All key milestones shall be clearly identified including: contract milestones, design reviews, readiness reviews, and receivables/deliverables among subsystems/organizations (including subcontractor effort). Milestones shall be logically linked to related tasks. The project schedule shall be created and maintained in a manner that supports automated time phasing of tasks, a logic driven critical path, schedule assessment, and trend analysis capabilities.</p> <p>The Integrated Master Schedule shall include:</p> <ul style="list-style-type: none"> A. Activities detailed by task with early start and finish, and late start and finish dates B. Activity durations shall not exceed 20 work days (exceptions must be explained in the Contractor Schedule Assessment Report). C. Justification in the Contractor Schedule Assessment report for any activity or milestone not having a predecessor or successor activity, with the exception of the project start and finish milestones D. Clearly identified schedule reserve. E. Clearly identified need dates for GFE, if any. F. "As Soon As Possible" activity and milestone constraints (exceptions must be explained in the Contractor Schedule Assessment Report). G. "Finish To Start" activity relationships (exceptions must be explained in the Contractor Schedule Assessment Report). H. Realistic work calendars (indicating working and non-working periods) I. A month-end status date (i.e. "data date" or "as of date") REMARK: When the IMS is delivered on the 10th calendar day of the month, it will reflect status as of the last calendar day of the preceding month)

	<p>J. Activities associated with major items, components, or definable subsystems.</p> <p>K. Development schedules detailed to the subsystem level and showing substantive milestones.</p> <p>L. A development/test flow diagram that shows sequences of development, integration and test for subsystems and system and includes software assurance test points and associated requirements.</p> <p>The IMS deliverable shall include the following items extracted from the IMS database. All data contained in these items shall be consistent (i.e. vertically and horizontally integrated), and based on the same data/status date:</p> <ul style="list-style-type: none"> a. Summary Master Schedule – One page, top level, Gantt-type summary document arranged by WBS that reflects all contract and major/mission milestones, major project phases (i.e., design, development, integration, test, etc.) and major end item deliveries. b. IMS Database – an automated logic network database consisting of schedule data for all WBS elements. The entire scope of work shall be broken into schedule tasks and milestones at a consistent level of detail to allow discrete progress measurement and visibility into the overall development, integration, test, and delivery phase of each end item deliverable. Additionally, all schedule tasks/milestones shall be integrated with the appropriate sequence relationships to provide a total end-to-end logic network leading to each end item delivery. This database shall contain all contract and controlled milestones, key subcontractor milestones, end item delivery dates, key data delivery dates, and key Government Furnished Property (GFP) need dates. The IMS Database shall contain the appropriate task coding attributes necessary to provide sort, select, and summarization capabilities for, but not limited to, WBS element, project phase, and level-of-effort tasks. The logic network database serves as the basis for identification of project critical paths as well as critical schedule analysis. c. Total Slack/Float Report – This report shall be an extract from the IMS Database and include all tasks and milestones with 10 workdays or less of total slack (float). The report shall be submitted in a waterfall format and organized in manner such that the path with least amount of slack is delineated first and followed by each successive path according to total slack values. d. Contractor Schedule Assessment Report – This report shall contain a count of the total number of tasks, milestones and non-detail (e.g., summary, hammock, rollup, etc.) activities contained in the schedule, a count of the number of completed tasks and milestones, a count of the number of tasks and milestones to be completed, a count of the number of tasks and milestones that have no predecessor and/or successor relationships, a count of the total number of tasks and milestones that have a total float (slack) value greater than 25% of the remaining duration of the total project schedule, a count of the total number of non-detail (e.g., summary, hammock, rollup, etc.) activities that have any predecessor or successor logical relationships, and a count of the total number of tasks and milestones that have forced or fixed dates. The report shall contain narratives explaining changes and impacts to the critical path and total slack/float listed in section c above. The report shall contain narrative explanations for contract milestones, major/mission milestones and Project Control Milestones (PCMs) that have been delayed by more than 10 calendar days into the future from their baseline dates. PCMs shall be identified and negotiated with the project office. These narratives shall include a proposed work-around schedule detailing how the contractor plans to recover the lost schedule time. e. Project Control Milestone Trend Report – A PCM cumulative trend chart shall be submitted. This report shall consist of the baseline PCMs and their corresponding
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	<p>early finish dates, actual PCMs completed to date, and forecast PCMs for the remaining effort and their corresponding early finish.</p> <ul style="list-style-type: none">f. Schedule Revision Log – the contractor shall maintain and deliver a revision log documenting all IMS changes (baseline and current forecast) and their rationale (task additions, deletions, duration adjustments, changes to logic, constraints, activity relationships, etc.).g. Weekly I & T Schedule – A weekly I & T schedule shall be submitted in contractor format containing prior week and the work planned for the next two weeks.
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1. CDRL No.:	PM-4
2. Title:	MOC DEVELOPMENT FINAL REPORT And LESSONS LEARNED
3. Reference:	SOW 2.1
4. Use:	Documents a summary of the performance of the contract, and any lessons learned from those activities. The purpose of the Lessons Learned is to collect and make available for use by all who may derive benefit from the experiences of others.
5. Preparation Information:	<p>The Final Report shall document the execution of the MOC Development in terms of progress vs plan, including problems that arose and their solutions. The Final Report shall include:</p> <p>Initial Integrated Schedule and Final Schedule as of launch date MOC implementation flow, starting at subsystem integration through ORR. A table summary of all contract modifications (excluding administrative adjustments to the funding profile) All deviations and waivers All safety issues</p> <p>The Contractor shall accumulate and document a Lessons Learned History throughout the Contract and present the Lessons Learned at each major review. A Lesson Learned is knowledge or understanding gained by experience. The experience may be positive, as in a successful test or mission, or negative, as in a mishap or failure. Successes are also considered sources of lessons learned. A lesson must be significant in that it has a real or assumed impact on operations; valid in that it is factually and technically correct; and applicable in that it identifies a specific design, process, or decision that reduces or eliminates the potential for failures and mishaps, or reinforces a positive result. Each Lessons Learned entry shall include the following information:</p> <p>Lesson Date: Submitting Organization: Submitted by: Subject/Title/Topic(s): Description of Driving Event: Lesson(s) Learned: Recommendation(s): Evidence of Recurrence Control Effectiveness:</p>

1. CDRL No.:	PM-5
2. Title:	ENGINEERING PEER REVIEW PLAN
3. Reference:	SOW 2.1 GPR 8700.6A, Engineering Peer Reviews NPR 7120.5D, ICESat-2 MAR DID 8-3
4. Use:	Early in project/product formulation, the Contractor shall identify subsystems, components, software and crosscutting functions to be subject to the Engineering Peer Review (EPR) process. The Peer Review Plan is used to identify the methodology and scope of the contractor's peer review process.
5. Preparation Information:	The Engineering Peer Review Plan shall: <ol style="list-style-type: none">1. Review content and requirements.2. Definition of the members.3. Definition of the Peer Review process4. How action items and responses will be documented, tracked, and closed in compliance with the SOW. The Engineering Peer Review Plan shall be consistent with the ICESat-2 Engineering Peer Review Plan.

1. CDRL No.:	PM-6
2. Title:	MISSION ASSURANCE IMPLEMENTION PLAN (MAIP)
3. Reference:	SOW 4.0
4. Use:	The MAIP is due 60 DACA and 30 days after any subsequent update and can be combined with the S/C MAIP.
5. Preparation Information:	<p>The MAIP shall address the Mission Assurance process activities for:</p> <ul style="list-style-type: none">- The ground system that interfaces with flight equipment to the extent necessary to assure the integrity and safety of flight items- <p>The MAIP for the MOC can be a subset of the S/C MAIP.</p>

1. CDRL No.:	PM-7
2. Title:	MOC SECURITY PLAN
3. Reference:	SOW 5.1.2.1
4. Use:	Defines the contractor's plan to address operational security and Physical, Information/Information Technology (IT), Personnel, and Industrial Security aspects of the program.
5. Preparation Information:	<p>The contractor shall provide a MOC Security Plan detailing the complete approach to MOC security. This plan should address all requirements, including those contained in the MOC SOW, the DD254, the Space Network (SN) Security Classification Guide, and the Information Assurance (IA). This plan should address, Physical, Information/IT, Personnel and Industrial Security, and Asset Protection requirements of the program, and should cover the following areas:</p> <ol style="list-style-type: none"> 1. Describe your Security Organization and Responsibilities. 2. Describe how your organization will prevent Foreign National (FN) Access to Classified Information. 3. Describe your organization's compliance with the National Industrial Security Program Operating Manual (NISPOM) and the Communications Security (COMSEC) Annex. 4. Describe your organization's hiring procedures for employees requiring clearance and employees not requiring clearances. 5. Describe your Security violation and corrective action program. 6. Describe your Physical Security program (description of area and facility to include floor plans where contracted work will be performed - classified and unclassified). 7. Describe access control, badge system, guard force (if any), storage facilities, equipment and document/material controls (for classified data). 8. Describe your approach to IT security for classified and unclassified systems. 9. Address your orientation and training program to achieve an effective program. 10. Address your approach to satisfying NASA GSFC Space Asset Protection – Concepts, Guidelines and Frequently Asked Questions (FAQ's) document for protecting hardware, software, operations' products and other facilities or equipment required for successful program implementation. 11. Describe your approach to handling evolving government security requirements. 12. Describe all program phases. 13. Describe COMSEC custodianship requirements and the approach to ensuring security during sensitive COMSEC development/integration operations. 15. It should describe any risks identified and the proposed mitigation approach. 16. It should describe your approach to interfaces with NASA Security, the Defense Security Service (DSS), the National Security Agency (NSA), and the launch provider as required.

1. CDRL No.:	PM-10
2. Title:	HARDWARE AND SOFTWARE CONFIGURATION MANAGEMENT PLAN
3. Reference:	SOW 2.2
4. Use:	Defines the contractor's configuration management system (including policies and procedures) that will be implemented for MOC hardware and software.
5. Preparation Information:	<p>The contractor's hardware/software configuration management plan shall be prepared in accordance with the contractor's standards. This plan shall describe in detail all software and hardware configuration management processes, methods, and procedures the contractor intends to use during the MOC contract. This plan shall describe how hardware and software configuration management is accomplished and how consistency between product definition, the product's configuration, and the configuration management records is achieved and maintained throughout the applicable phases of the product's life cycle by the contractor.</p> <p>The configuration management plan shall describe the contractor's approach, methodology, and application of configuration management principles and practices and shall include the following:</p> <ol style="list-style-type: none"> 1. General product definition and scope 2. Description of configuration management activities and procedures for each of the following configuration management functions: <ol style="list-style-type: none"> a. Configuration planning and management b. Configuration identification c. Configuration Change management d. Configuration status accounting e. Configuration verification and audit f. Configuration management of digital data g. Configuration management of software 3. Organization, roles, responsibilities and resources 4. Definition of terms 5. Programmatic and organizational interfaces 6. Subcontract flow down of configuration management

1. CDRL No.:	PM-11
2. Title:	PROJECT MANAGEMENT PLAN
3. Reference:	SOW 2.1 NPR 7120.5 NPR 7150.2A
4. Use:	Describes how the project is organized and managed by the contractor. It provides the management structure, its system of operation, responsible lines of communications, and key personnel assignments. The organization chart identifies the contractor's project organization with names, functions, lines of authority, coordination, etc
5. Preparation Information:	<p>This plan shall address the overall organization, management approach, and structure of the contractor's project plus its interrelationships with the parent company and the subcontractors.</p> <p>Describe how and where the project will operate during all phases of the contract.</p> <p>This plan shall identify and describe interfaces with the Government.</p> <p>This plan shall include graphical displays such as flow diagrams, WBS, logic networks, etc., to reduce verbal descriptive material.</p> <p>This plan shall provide an organizational chart(s) and sufficient supplemental narrative to describe fully the following:</p> <p>a) Organization proposed for carrying out the project showing interrelationships of technical management, business management, and subcontract management, from lower level through intermediate management to top-level management with detailed explanation of:</p> <ol style="list-style-type: none"> 1. The authority of the Project Manager relative to other ongoing projects and applicable support organizations within the company structure. Discuss the Project Manager's control over essential resources and functions necessary to accomplish the work. 2. How and by whom interdepartmental work will be monitored and the authority of the Project Manager over interdepartmental work. 3. Process to be followed by the Project Manager in obtaining decisions beyond his/her authority and in resolving priority conflicts for resources and functions not under the Project Manager's direct control such as personnel, finances, and facilities. 4. The project team members with names and functions. <p>b) Implementation approach for the project. Describe in general how the requirements of the Statement of Work (SOW) will be achieved. Identify potential problems related to this work, and your approach to problem avoidance and/or solution. Identify how your risk management system and processes are integrated into the daily management, decision-making, and strategic direction of the project. Describe your schedule management process. Address the degree to which your proposed personnel and overall management procedures are proven through similar experience. Describe such things as make/buy strategies, acquisition plans, sparing philosophy, project dependencies, facility requirements, internal review strategies and plans, significant work elements on critical paths, long-lead items, and significant milestones down to at least the lowest level of the WBS.</p> <p>c) Contractual procedures proposed for the project to effect administrative and engineering changes, describing any differences from existing procedures.</p>

	<p>d) Management techniques to be employed to minimize: 1) project costs and schedule overruns, and 2) risks of violating interface requirements and agreements. Describe associated controls to be exercised over subcontractors and suppliers. Describe how issues will be surfaced in a timely manner and at the proper levels. Identify initial proposed Key Technical Parameters the project will use to monitor and report on (see CDRL PM-1) interface compliance and resource status.</p> <p>e) The proposed Safety/Security and Software Assurance organizational structure, including staffing plans, reporting channels, authority and responsibilities, and management visibility. Discuss whether the technical, test, and system safety/quality assurance/ reliability/ configuration management personnel required for this project (as indicated in your proposed labor hours) are presently on your payroll and immediately available for this work. State the number and disciplines/skills of persons who would have to be hired, and plans to obtain them.</p>
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1. CDRL No.:	PM-12
2. Title:	RISK MANAGEMENT PLAN
3. Reference:	SOW 2.1 GPR 7120.4A, Risk Management NPR 8000.4 Risk Management Procedural Requirements
4. Use:	The Risk Management Plan is the basis for identifying and managing all performance, reliability, schedule, cost, and safety risks on the contractor's project.
5. Preparation Information:	<p>The risk management plan shall clearly describe:</p> <ul style="list-style-type: none"> • Overview of the risk management process • Organizational responsibilities • Risk identification approach • Risk mitigation planning • Interface of risk management to schedule and financial/cost management • Risk tracking/documentation • Risk management list reporting <p>The plan shall include risks associated with hardware and software (e.g., technical challenges, new technology qualification, etc), COTS, system safety/security, performance, cost and schedule (i.e., programmatic risks). The plan shall identify which tools and techniques will be used to manage the risks and the plan shall use the GSFC risk 5x5 definitions as described in Figure 4-1. The plan shall also express risk statements in the condition-consequence format as expressed in the following:</p> <ul style="list-style-type: none"> • Risk Statement: For a risk to be understandable, it must be expressed clearly and include: <ul style="list-style-type: none"> - Condition: A description of the current condition that may lead to the loss or consequence. It is a single phrase that identifies possible future problems, and describes current key circumstances, situations, etc. that are causing concern, doubt, anxiety, or uneasiness. - Consequence: A description of the loss or consequence. It is a single phrase or sentence that describes the key, negative outcome (s) of the current conditions

1. CDRL No.:	PM-13
2. Title:	Flight Operations Anomaly Reports
3. Reference:	SOW 9.3 NPR 7120.5D, Program/Project Management Processes and Requirement
4. Use:	To document any on orbit anomaly that occurs which effects the MOC and overall Mission
5. Preparation Information:	Use of SOARs is required for on orbit anomalies.

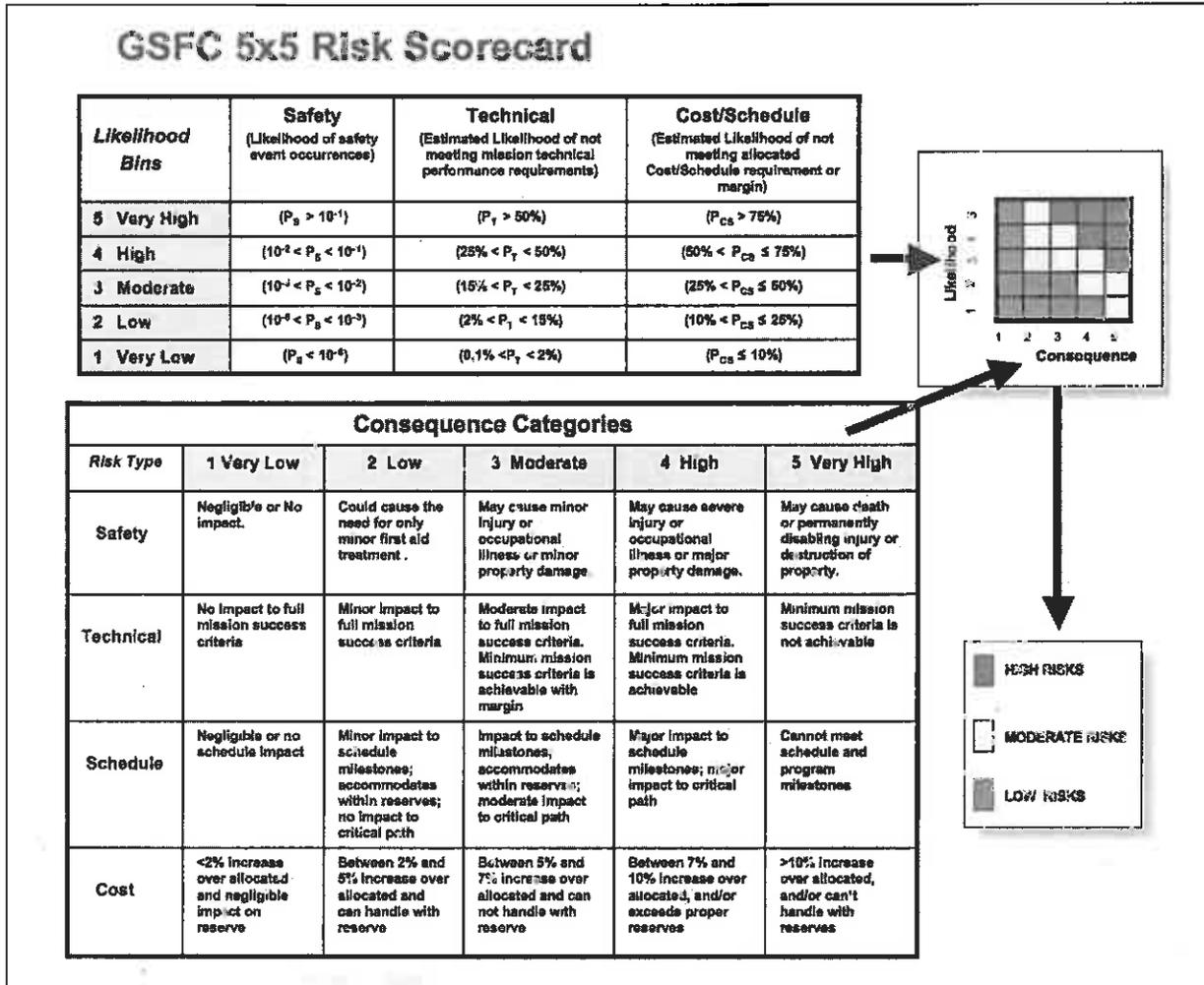


Figure 4-1 GSFC 5 x 5 Risk Definition

4.2 Review DRDs

Table 4-2 Reviews

1. CDRL No.:	RE-1
2. Title:	MOC SYSTEM REQUIREMENTS REVIEW (M-SRR) DATA PACKAGE
3. Reference:	SOW 2.1 GSFC-STD-1001
4. Use:	To evaluate the requirements, requirements flow-down, and the operational concepts and to validate the realism of the functional and performance requirements and their congruence with the system configuration selected to conduct the mission.
5. Preparation Information:	<p>The M-SRR shall contain the flow-down of requirements from the MOC Requirements Document (MOC-RD) to the MOC Lower-level System Requirements Document (CDRL MO-3) and first-order allocations.</p> <p>The M-SRR Data Package shall contain all relevant information required to satisfy paragraph 4.4 (Criteria for Successful Completion) of GSFC-STD-1001, Criteria for Project Flight Critical Milestone Reviews.</p> <p>The M-SRR Data Package shall discuss contractor system level requirements, rationale, and flow-down plans to lower level requirements.</p> <p>The M-SRR Data Package shall show the allocation and traceability of requirements to major subsystems.</p> <p>The M-SRR Data Package shall address any identified Single Point Failures.</p> <p>The M-SRR Data Package shall show how the current concept meets all government specified requirements including interface requirements.</p> <p>The M-SRR Data Package shall discuss the preliminary operations concept of the MOC.</p> <p>The M-SRR package shall contain a matrix of the status of compliance with GSFC-STD-1000. The M-SRR shall address compliance with GSFC-STD-1000.</p> <p>Results of Review - As a result of successful completion of the M-SRR, the system and its operation are well enough understood to warrant design and acquisition of the end items. Approved specifications for the system, its segments, and preliminary specifications for the design of appropriate functional elements may be released.</p>

1. CDRL No.:	RE-2
2. Title:	MOC PRELIMINARY DESIGN REVIEW (M-PDR) DATA PACKAGE
3. Reference:	SOW 2.1 GSFC-STD-1001
4. Use:	To demonstrate that the MOC design meets the documented requirements.
5. Preparation Information:	<p>The M-PDR Data Package shall address all relevant MOC information required to satisfy paragraph 5.4 (Criteria for Successful Completion) of GSFC-STD-1001, Criteria for Project Flight Critical Milestone Reviews.</p> <p>The M-PDR shall address MOC compliance with the MOC-RD.</p> <p>The M-PDR data package shall include responses to action items from previous reviews, including subsystem PDRs/Engineering Peer Reviews.</p> <p>The M-PDR data package shall include changes since the last review.</p> <p>The M-PDR data package shall address performance requirements and their flow-down to the card or equivalent level.</p> <p>The M-PDR data package shall address MOC performance budgets.</p> <p>The M-PDR data package shall address error budget determination, if any.</p> <p>The M-PDR data package shall contain a detailed report of Key Technical Parameters down to a level below the one reported in the MPSR.</p> <p>The M-PDR data package shall address interface requirements and interface designs.</p> <p>The M-PDR data package shall address life tests, if any.</p> <p>The M-PDR data package shall address software requirements, design, and development environment.</p> <p>The M-PDR data package shall address MOC design verification, test flow and test plans.</p> <p>The M-PDR data package shall address the MOC operations concept.</p> <p>The M-PDR data package shall address preliminary Failure Modes and Effects Analysis (FMEA); Fault Tree Analysis; and reliability analysis and results.</p> <p>The M-PDR data package shall address redundancy and redundancy management.</p> <p>The M-PDR data package shall address single point failures.</p> <p>The M-PDR Data Package shall address the list of long lead items/tasks, identify those items that must be procured/developed prior to M-CDR (including a list of those that were ordered/begun prior to M-PDR and M-SRR), and provide a plan for procuring/developing these items and all other items.</p> <p>The M-PDR data package shall delineate the status of each document required at PDR as to its acceptability for use as is.</p> <p>The M-PDR Data Package shall present all MOC risks and address their mitigation.</p> <p>The M-PDR Data Package shall provide the status of all sub-contracts and discuss the preliminary design status of critical assemblies and sub-assemblies.</p> <p>The M-PDR Data Package shall present a summary of testing and present the available test results.</p> <p>The M-PDR Data Package shall address the viability of the design solution.</p> <p>The M-PDR Data Package shall address mission assurance to be imposed and software assurance standards and processes imposed.</p>

1. CDRL No.:	RE-3
2. Title:	MOC CRITICAL DESIGN REVIEW (M-CDR) DATA PACKAGE
3. Reference:	SOW 2.1 GSFC-STD-1001
4. Use:	To present the MOC design and operation, and to demonstrate that all related documentation and processes are in place before significant development begins, and to demonstrate that the design meets all performance requirements.
5. Preparation Information:	<p>The M-CDR Data Package shall contain all relevant instrument information required to satisfy paragraph 6.4 (Criteria for Successful Completion) of GSFC-STD-1001, Criteria for Project Flight Critical Milestone Reviews.</p> <p>The M-CDR data package shall include responses to action items from previous reviews, including M-PDR, subsystem CDRs/Peer Reviews.</p> <p>The M-CDR data package shall include changes since the last review.</p> <p>The M-CDR data package shall address compliance with the MOC-RD.</p> <p>The M-CDR Data Package shall address the development/procurement status of long lead items/tasks.</p> <p>The M-CDR Data Package shall address development flow, and the status of development, and integration plans.</p> <p>The M-CDR Data Package shall address development procedures.</p> <p>The M-CDR Data Package shall address software assurance product checkpoints and evaluation criteria.</p> <p>The M-CDR Data Package shall address standard applicable in-house processes.</p> <p>The M-CDR Data Package shall address special/unique processes.</p> <p>The M-CDR Data Package shall address special facilities required for development, integration, or testing.</p> <p>The M-CDR Data Package shall address personnel resources (time phased).</p> <p>The M-CDR Data Package shall address the delivery schedules for the MOC.</p> <p>The M-CDR data package shall address detailed analysis from FMEA, fault tree analysis, and reliability analysis.</p> <p>The M-CDR Data Package shall address worst-case analyses of performance.</p> <p>The M-CDR data package shall contain a detailed report of Key Technical Parameters down to a level below the one reported in the MPSR.</p> <p>The M-CDR Data Package shall address integration and test plans</p> <p>The M-CDR Data Package shall address materials and processes lists</p> <p>The M-CDR Data Package shall provide a summary of deviations/waivers</p> <p>The M-CDR Data Package shall address system safety/security hazards analyses, including</p> <ol style="list-style-type: none"> a) Hazards identification matrix b) Single point failure summaries c) Risk assessment rationale <p>The M-CDR Data Package shall delineate the status of each document as to its acceptability for use as is.</p> <p>The M-CDR package shall address the operations concept.</p> <p>The M-CDR Data Package shall present any additional test results from MOC or subsystem</p>

	<p>testing.</p> <p>The M-CDR Data Package shall address the status of all program risks and their mitigation</p> <p>The M-CDR Data Package shall address the status of all sub-contractor activities and schedule for deliveries, as appropriate, and demonstrate that designs are complete and have been adequately reviewed. Where approval has been given by the Government Contracting Officer for ordering of long lead items, the Contractor shall address the design/delivery status of these items.</p>
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Released Version

1. CDRL No.:	RE-5
2. Title:	MOC SYSTEMS INTEGRATION REVIEW (M-SIR)
3. Reference:	SOW 2.1
4. Use:	To evaluate MOC performance during qualification or acceptance testing, and evaluate readiness to deliver and install in the MOC and to integrate to the ICESat-2 Ground System. This review is intended to serve as the Contractor's verification of MOC requirements (as defined in the MOC-RD) prior to delivery of the MOC for Ground System Integration.
5. Preparation Information:	<p>This data package shall address, as a minimum:</p> <p>The M-SIR Data Package shall address responses to action items generated at prior reviews.</p> <p>The M-SIR Data Package shall address the solutions to all problems encountered during the subsystem test and validation program and the solution rationale.</p> <p>The M-SIR Data Package shall address any rework/replacement of software or hardware, regression testing, and test plan changes.</p> <p>The M-SIR Data Package shall address compliance with the MOC verification plan and verification matrix (CDRL SE-6).</p> <p>The M-SIR Data Package shall address measured test margins versus requirements.</p> <p>The M-SIR Data Package shall address "could-not-duplicate failures" along with assessment of the problem and the residual risk that may be inherent in the item.</p> <p>The M-SIR Data Package shall address project assessment of any residual risk.</p> <p>The M-SIR Data Package shall address spacecraft and ground system integration plans.</p>

1. CDRL No.:	RE-6
2. Title:	INPUT TO GROUND SYSTEM AND MISSION REVIEWS
3. Reference:	SOW 2.1, GSFC-STD-1001
4. Use:	To evaluate the requirements, requirements flow-down, and the operational concepts and to validate the realism of the functional and performance requirements and their congruence with the system configuration selected to conduct the mission.
5. Preparation Information:	<p>The Inputs to the Ground System Reviews (GS-PDR and GS-CDR) and selected Mission-level Reviews (PDR, CDR, SIR) shall be a subset of the corresponding MOC reviews, with appropriate updates.</p> <p>The inputs to the following Mission Level Reviews shall be separate data packages addressing the specific review objectives.</p> <p>A. Mission Operations Review (MOR)</p> <p>The MOR Data Package shall contain the relevant MOC information required to satisfy paragraph 7.4 (Criteria for Successful Completion) of GSFC-STD-1001, Criteria for Project Flight Critical Milestone Reviews.</p> <p>The Mission Operations Review (MOR) data package shall address the following items at a minimum:</p> <ol style="list-style-type: none"> a. Closure of action items from previous reviews (e.g., Project-unique ground system, mission, or MOC reviews). b. MOC Overview and Operations Concept. c. Any remaining MOC-specific pre-launch Test Plans including: MOC Compatibility Tests, Data Flow and End-to-End Tests, Simulations and exercises, Launch Site and Pad Tests. d. Launch and early orbit activities. e. In-orbit Checkout activities. f. Project Database and Procedure Development. g. MOC Requirements, Development, and Delivery/Release Status. h. Mission Readiness Testing. i. Issues and Concerns. <p>B. Flight Operations Review (FOR)</p> <p>The FOR Data Package shall contain all relevant MOC information required to satisfy paragraph 9.4 (Criteria for Successful Completion) of GSFC-STD-1001, Criteria for Project Flight Critical Milestone Reviews.</p> <p>The Flight Operations Review Data Package should include all of the items specified for an MOR, updated to the present stage of progress, plus the following additional items:</p> <ol style="list-style-type: none"> a. Closure of actions from the MOR. b. New requirements and changes in plans. c. Test result summaries including contractor's assessment of the criticality of open problems. d. Work remaining including tests, simulations, and closure of problems. e. Personnel location for launch and early orbit and in-orbit checkout. f. Contingency procedures, development and verification/validation status.

	<p>g. Safety and mission success.</p> <p>C. Operational Readiness Review (ORR)</p> <p>The Operational Readiness Review shall address the following items:</p> <ul style="list-style-type: none"> a. Status of completion of all validation testing. b. Resolution of test failures and anomalies from validation testing and incorporation of the results into all supporting and enabling operational products. c. Status of all operational supporting and enabling products (facilities, equipment, documents, updated databases, etc) that are necessary for the nominal and contingency operations. Status of delivery/installation of these products at the site(s) necessary to support operations. d. Status of training to the users and operators on the correct operational procedures for the system. e. Status of operational contingency planning and all training of personnel. <p>The Contractor's portion of the Operational Readiness Review shall address the above items that are in scope of the Contractor's effort.</p> <p>Operations Readiness Review Success Criteria:</p> <ul style="list-style-type: none"> a. The system, including any enabling products, is determined to be ready to be placed in an operational status. b. All applicable lessons learned for organizational improvement and systems operations have been captured. c. All waivers and anomalies have been closed. d. Systems hardware, software, personnel, and procedures are in place to support operations. <p>D. On-orbit Acceptance Review (OAR)</p> <p>The On-Orbit Acceptance Review shall provide the following information:</p> <ul style="list-style-type: none"> a. Data review (in the form of data plots/tables) of the results of operational performance identified during Launch and Early Orbit (L&EO) and observatory checkout. b. Data review (in the form of data plots/tables) for all anomalies and unexpected behavior encountered by the contractor during L&EO and observatory checkout, including: <ul style="list-style-type: none"> c. Data showing the anomalous or unexpected behavior d. Descriptions of any workarounds and/or fixes e. Data illustrating response to the workarounds and/or fixes f. Current status of all anomalies, ground system problems, and database problems encountered by the contractor during L&EO and commissioning g. Measured on-orbit operations performance of the ICESat-2 MOC versus the requirements of the Mission Operations Center Requirements Document.
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1. CDRL No.:	RE-7
2. Title:	ENGINEERING PEER REVIEW DATA PACKAGES
3. Reference:	SOW 2.1 NPR 7150.2A, 5.3.3.1
4. Use:	Engineering Peer Reviews (EPRs) focus on the design and implementation details at levels that system-level reviews cannot address. They provide a resource for Design Teams to identify potential engineering design and implementation flaws, and increase the probability of success. Applying the EPR process early and throughout the product life cycle affords the maximum advantage in terms of resource efficiency as well as design confirmation and ultimate mission success. Peer review documentation represents knowledge that may prove invaluable later.
5. Preparation Information:	Engineering Peer Review documentation shall be in contractor format and include content as defined in NPR 7150.2A, Section 5.3.3.1.

4.3 Systems Engineering DRDs

Table 4-3 Systems Engineering

1. CDRL No.:	SE-1
2. Title:	CONFIGURATION CHANGE REQUESTS, DEVIATIONS, WAIVERS
3. Reference:	SOW 2.2
4. Use:	To facilitate the orderly processing of change requests to appropriate level of approval authority for disposition.
5. Preparation Information:	<p>Consistent with the Contractor's Configuration Management Plan (CMP), the contractor shall prepare and submit a Class I Configuration Change Request (CCR). In addition to the change description, the CCR shall contain sufficient information in the form of attachments, drawings, test results, etc., to allow the Government to evaluate the total impact of the proposed change. The Government Contracting Officer may direct the contractor to prepare CCRs under the "Changes" clause of the contract. The contractor shall also submit Class II changes for Government review.</p> <p>For the purposes of this DRD, a Class I CCR is a change that:</p> <ul style="list-style-type: none"> a. Affects any Government Contract specification or interface requirement. b. Affects schedules of end-item deliverables to the Government. c. Impacts Government Furnished Equipment. d. Affects configuration to the extent that changes would be required to prior deliverables in order to maintain specified performance. e. Causes a Single Point Failure. <p>A change may be classified Class II when it does not fall within the definition of a Class I change as given above. Examples of Class II changes are:</p> <ul style="list-style-type: none"> a. A change in documentation only (for example, correction of errors, addition or clarifying notes or views). b. A minor change in hardware (for example, substitution with an approved alternative material) that does not affect any item listed under Class I. c. Drawing changes that do not affect a baseline, interface, etc. <p>Class II changes normally do not require Government CCB approval unless they are written against Government CM-controlled documents.</p>

1. CDRL No.:	SE-2
2. Title:	CONTRACTOR – GENERATED INTERNAL TECHNICAL INFORMATION
3. Reference:	SOW 2.2.3
4. Use:	To document technical information and decisions related to the ICESat-2 Project.
5. Preparation Information:	These memoranda shall preferably be in electronic format. Hand-drawn sketches may be used if they preserve timeliness.

1. CDRL No.:	SE-6
2. Title:	SYSTEM PERFORMANCE VERIFICATION PLAN AND MATRIX
3. Reference:	SOW 3.3
4. Use:	Provides the overall approach for accomplishing the verification program. Defines the specific tests, analyses, hardware and software architecture and/or models, etc. that will demonstrate that the MOC complies with the mission requirements.
5. Preparation Information:	<p>The System Performance Verification Plan (SPVP) shall:</p> <ul style="list-style-type: none"> A. Be separated into sections such that it is clear which requirements are verified at the specific MOC sub-system level, at the integrated MOC level, at the integrated Ground System level, and at the mission level. B. Provide an overview of the entire MOC verification program. C. Flow performance requirements to all levels of development and describe the verification method for these tests. <p>The SPVP describes the approach (test, analysis, etc) that will be utilized to verify each Mission Operations Center Requirements Document requirement. If verification relies on measurements, tests, or analyses at lower (or other) levels of assembly, this dependence shall be described.</p> <p>This Plan includes level of development, configuration of item, objectives, facilities, safety considerations, test phases and profiles, appropriate functional operations, personnel responsibilities, and requirements for procedures and reports. For each analysis activity, include objectives, a description of the mathematical model, assumptions on which the model will be based, required output, criteria for assessing the acceptability of the results, interaction with related test activity, and requirements for reports.</p> <p>The Draft SPVP is due 15 days prior to M-CDR. The Final SPVP is due at M-CDR+ 60 days.</p> <p><u>System Performance Verification Matrix</u></p> <p>The System Performance Verification Matrix (SPVM) shall summarize the flow-down of system specification, Mission Assurance, and validation requirements verification. The SPVM shall stipulate how each requirement will be verified and summarizes current status of compliance/non-compliance with requirements. The SPVM shall list a summary description of each requirement and a summary of the measured/analyzed/demonstrated performance of the system against each requirement. It shall show each Mission Operations Center Requirements Document, MAR, and Validation Plan requirement reference source (to the specific paragraph or line item), the method of compliance, applicable procedure references, report reference numbers, etc. for each requirement set from the Mission Operations Center Requirements Document. It shall show the flow-down of requirements verification through the sub-system level.</p> <p>The SPVM shall trace requirements backwards to the next level above, i.e., a level 4 requirement shall be traced back to its level 3 parent, etc</p>

1. CDRL No.:	SE-7
2. Title:	VERIFICATION REPORTS
3. Reference:	SOW 3.3
4. Use:	Provide summary of each integration and test result, conformance, non-conformance, and trend data. A Verification Report for all verification types indicated in the System Performance Verification Plan (Test, Analysis, Inspection, Demonstration) shall be generated.
5. Preparation Information:	<p>Verification reports are required for all integration and test activities commencing at sub-systems level testing through Ground Readiness Tests. Contents of these reports shall include, as a minimum:</p> <ul style="list-style-type: none"> A. Summary of the test results of each activity and an assessment of the quality and acceptability of the item tested, including pass/fail criteria and performance against the criteria. B. Summary of non-conformances occurring during the test and the resolution and corrective actions taken C. Trends in the performance of critical components D. Actual sequence of these operations including dates and times E. Across-reference to the test procedure number(s) or analysis used in the verification. <p>Contractor format may be used for these reports as long as the required information is included.</p>

1. CDRL No.:	SE-8
2. Title:	CONFIGURATION ITEM IDENTIFICATION LIST
3. Reference:	SOW 2.2
4. Use:	To establish a structure for controlling the configuration of the ICESat-2 MOC by identifying all Configuration Items (CIs) and Computer Software Configuration Items (CSCIs) used on the program and correlating those CIs/CSCIs to their Specification and test requirements documents.
5. Preparation Information:	<p>The Configuration Item Identification List (CIIL) identifies all hardware, software, firmware, and development/sustainment CIs and CSCIs. This CIIL shall conform to the following:</p> <ul style="list-style-type: none"> a. The CIIL shall be organized and broken down as follows: <ul style="list-style-type: none"> 1) All system level CIs and CSCIs. 2) All subsystem level CIs and all CIs/CSCIs within each subsystem. b. For each CI listed, the following information shall be provided: <ul style="list-style-type: none"> 1) Assigned CI Number. 2) The CI top drawing number. 3) The CI nomenclature. 4) The applicable specification number. For those CIs not governed by a specification, the word "NONE" shall be entered in this column. 5) Acceptance test procedure number and, if qualification tested, the qualification test procedure number. If the CI is neither acceptance nor qualification tested, the functional test procedure number should be entered in this column. c. For each CSCI listed the following information shall be provided: <ul style="list-style-type: none"> 1) Assigned CSCI Number. 2) The CSCI nomenclature. 3) The applicable specification number. For those CSCIs not governed by a specification, the word "NONE" shall be entered in this column. 4) Acceptance test procedure number and, if qualification tested, the qualification test procedure number. If the CSCI is neither acceptance nor qualification tested, the functional test procedure number should be entered in this column. d. This list shall be prepared in the contractor's format.

1. CDRL No.:	SE-13
2. Title:	SPECIFICATION TREE
3. Reference:	SOW 3.3
4. Use:	To provide a reference for contractor's specification breakout.
5. Preparation Information:	The specification tree shall document the breakout of the contractor's specifications starting at the top-level ICESat-2 Mission Operations Center Design Specification, flowing down to all lower-level specifications to the CI and CSCI level.

1. CDRL No.:	SE-20
2. Title:	TRADES AND ANALYSES
3. Reference:	SOW 3.1
4. Use:	To provide a basis or rationale for the MOC design, integration, and testing.
5. Preparation Information:	The Contractor shall document all necessary system studies, analyses, trades, and risk assessments necessary to develop the MOC design, to interface the MOC to the ICESat-2 Space Segment and Ground System, and to support MOC and Ground System integration and testing. Studies, analyses, trades, and assessments can be in Contractor format shall include at a minimum any studies, analyses, trades, or assessments performed to develop the MOC software and hardware component/sub-system design or tool selection.

1. CDRL No.:	SE-23
2. Title:	ACCEPTANCE DATA PACKAGE
3. Reference:	SOW 7.2
4. Use:	To ensure that the deliverable contract end-items are in accordance with contract requirements prior to Government acceptance.
5. Preparation Information:	<p>This acceptance data package, as a minimum, shall be comprised of the following:</p> <ul style="list-style-type: none"> A. Contract End Item Specification B. As-built configuration list C. Software components lists, including third-party software D. Hardware platforms and components lists (i.e. workstations, PC's, etc.) E. Test Log Book (including total operating time and cycle records) F. Open item lists (including reasons for being open) G. Safety compliance data package H. Subsystem tests results I. On Orbit Operations Performance Report J. Anomaly reports and disposition information <p>Item A above, the Contract End Item Specification, establishes the architecture, configuration, function, and performance of the ICESat-2 MOC, and shall address design compliance with and traceability to the ICESat-2 Mission Operations Center Requirements Document, and other applicable requirements documents.</p> <p>Item I above, the On-Orbit Operations Performance Report, shall contain the following:</p> <ul style="list-style-type: none"> A. Launch and early orbit operations results B. Lessons learned <p>A copy of this package shall accompany each end item.</p>

4.4 Mission Operations Center DRDs

Description of required data:

Table 4-4 Mission Operations

1. CDRL No.:	MO-2
2. Title:	MISSION OPERATIONS CENTER INTERFACE CONTROL DOCUMENTS
3. Reference:	SOW 3.2
4. Use:	To establish interface requirements, definition and control between the ICESat-2 Mission Operations Center and ICESat-2 ground assets.
5. Preparation Information:	<p>This document(s) shall provide detailed information regarding the interface of the ICESat-2 Mission Operations Center to external interfaces. The Government will provide input, and will provide requirements for, the interfaces to Government ground systems. This document(s) shall address the following interfaces:</p> <ul style="list-style-type: none"> A. Mission Operations Center (MOC) / ICESat-2 Observatory (S/C vendor) B. MOC / ICESat-2 Observatory Simulator (OBSSIM) (S/C vendor) C. MOC / NASA Near Earth Network (Ground Network) (NGN) (input to) D. MOC / NASA Space Network (SN) (input to) E. MOC / NASA EOS Data and Operations System (EDOS) (input to) F. MOC / Observatory I&T Facility and Launch Site (MOC provided) G. MOC / Flight Dynamics Facility (FDF) (input to) H. MOC/POD/PAD (Precision Orbit Determination, Precision Attitude Determination) (MOC provided) I. MOC/Conjunction Assessment System (CAS) (input to) J. MOC / Flight Software Vendor (FSV) (S/C provider) K. MOC / Instrument Support Facility (ISF) (MOC provided) <p>The Interface Control Documents shall contain at a minimum:</p> <ul style="list-style-type: none"> a. Type of interface (API, internet, phone, physical, etc.) b. Data and media formats c. Data rates d. Duty cycles e. Protocols f. Physical interfaces g. Error conditions h. Timing i. Security

1. CDRL No.:	MO-3
2. Title:	MISSION OPERATIONS CENTER LOWER-LEVEL SYSTEM REQUIREMENTS DOCUMENT
3. Reference:	SOW 3.1
4. Use:	Stipulates functionality required of each of the Mission Operations Center Subsystems derived from the Mission Operations Center Requirements Document (MOC-RD) (NASA GSFC ICESat-2-MOC-REQ-0537) and other Government-provided requirements reference documentation.
5. Preparation Information:	<p>The Contractor shall document the detailed, integrated system and subsystem requirements of the MOC as derived from the MOC-RD and all applicable documents therein. The Contractor shall provide traceability of each requirement to the MOC-RD and all applicable documents (Level 3).</p> <p>The Mission Operations Center Lower-Level System Requirements Documents shall provide meta data for each requirement including the following:</p> <ol style="list-style-type: none"> 1. Requirement number 2. Subsystem 3. Test method 4. Author 5. Date written 6. Authorization

1. CDRL No.:	MO-4
2. Title:	MOC TEST PLANS
3. Reference:	SOW 5.2
4. Use:	The MOC Subsystem Test Plans describe integration activities planned for the contractor designed MOC Subsystems. A separate integration test plan will be written for each of the contractor's subsystems using the preparation information listed below.
5. Preparation Information:	<p>The MOC Test Plans shall describe in detail the integration test activities associated with each MOC Subsystem along with expected outcomes and results.</p> <p>Each Test Plan shall:</p> <ol style="list-style-type: none"> a. List the executables to be tested and describe the test environment in detail (so that tests may be duplicated) and the specific version of the executables to be tested b. List and describe the utilities and tools needed or recommended to setup the environment, load the database, convert output data into readable reports, generate test data, etc c. List the test cases to be run on each executable in the subsystem d. Indicate the input data to be used for each test case along with the location of the data, whether in a flat file or database table e. Indicate the name and location of output files used to verify the outcome of each test case

1. CDRL No.:	MO-5
2. Title:	MISSION OPERATIONS CENTER TEST PROCEDURES
3. Reference:	SOW 5.2
4. Use:	The Mission Operations Center Test Procedures Documents are used to define the software test procedures followed for each test case in the test plan. A separate test procedures document is written for each test plan.
5. Preparation Information:	<p>The MOC Operations Test Procedures Document shall be prepared to implement software testing as required in accordance with the MAR.</p> <p>The MOC Operations Test Procedures Document shall provide the following items:</p> <ol style="list-style-type: none"> a. A description of the overall test plan and expected results b. A description of the environment setup c. A description of each test case along with the purpose of the test case and expected results d. The full set of steps and actions needed to execute each test case e. Procedures for environment setup, test execution, and data capture f. Procedures that define the objectives, test requirements, test limits, pass/fail criteria, environment, and test recording requirements

1. CDRL No.:	MO-6
2. Title:	MISSION OPERATIONS CENTER TEST REPORTS
3. Reference:	SOW 5.2
4. Use:	The Mission Operations Center Test Reports provide a summary of the findings from each test. A separate Mission Operations Center Test Report shall be written for each Mission Operations Center Test.
5. Preparation Information:	<p>The Mission Operations Center Test Reports shall be developed for each test described in the MOC Test Plan and shall include the following, as a minimum:</p> <ul style="list-style-type: none">A. Version number of software testedB. Identity and number of planned tests that have been completedC. Conformance of test results to expected resultsD. Number, type, description, and criticality of discrepancies and defectsE. Identification of software areas testedF. Analysis of any performance requirements that the tested software could affectG. Test result summary

1. CDRL No.:	MO-9
2. Title:	MOC SOFTWARE DEVELOPMENT and MANAGEMENT PLAN
3. Reference:	SOW 2.1 SOW 4.0
4. Use:	Defines contractor activities required to develop and manage all software
5. Preparation Information:	<p>The Software Development and Management Plan shall describe processes and activities used in the development, testing, and management of the various types of software being acquired, acknowledging the fact that not all software has the same criticality level or process requirements (reference the classification requirements in SOW section 4.0).</p> <p>Topics to be included in the Software Development and Management Plan are:</p> <ul style="list-style-type: none"> A. Purpose and Description; B. Resources, Budgets, Schedules, and Organization. A description of how the software personnel structure is integrated into the overall ICESat-2 development organization; C. Acquisition Activities; D. Development methodologies and Activities; E. Sustaining Engineering and Operations Activities; F. Software Assurance Plan; G. System safety; H. Software Risk Management plan; I. Delivery and Operational Transition; J. V&V and IV&V; K. COTS, GOTS, and MOTS software; L. Subcontractor management and monitoring; M. The plan and approach for training personnel (Contractor staff, external maintainers, Flight Operation Team) in the use of all delivered software and supporting facilities. <p>Additionally, the Contractor shall evaluate all MOC software using software metrics. The metrics collected, trended, and presented monthly. Metrics shall include at a minimum:</p> <ul style="list-style-type: none"> A. Number of software requirements and their change status; B. Design/Code complexity index at CSU, CSC, and CSCI levels; C. Code production rate estimates versus actuals; D. Number of Software Change Requests/Problem Reports and their status; E. Resource margins for Utilization of memory, CPU, I/O Bandwidth and Bus traffic; F. Effort data (staffing profile) estimates versus actuals. <p>Include an alphabetized list of definitions for abbreviations and acronyms used in this document. Include an alphabetized list of definitions for special terms used in the document, i.e., terms used in a sense that differs from or is more specific than the common usage for such terms.</p> <p>Material that is too detailed or sensitive to be placed in the main body of text may be placed in an appendix or included as a reference. Include the appropriate reference in the main body of the text. Appendices may be bound separately, but are considered to be part of the document and shall be placed under configuration control as such.</p>

1. CDRL No.:	MO-10
2. Title:	MOC SOFTWARE VERSION DESCRIPTION DOCUMENT
3. Reference:	SOW 5.3
4. Use:	The Software Version Description identifies and describes a software version consisting of a suite of functional MOC subsystems. The description is used to release, track, and control software versions, including systems delivered to the bMOC and the ISF.
5. Preparation Information:	<p>The Software Version Description shall identify and provide:</p> <ol style="list-style-type: none"> a. Listing of all resolved and unresolved DRs; b. Listing of all COTS dependencies; c. New Features and Problem Resolutions; d. Full identification of the system and software (i.e., numbers, titles, abbreviations, version numbers, and release numbers); e. Executable software (i.e., batch files, command files, data files, or other software needed to install the software on its target computer); f. Software life cycle data that defines the software product; g. Archive and release data; h. Instructions for building the executable software including, for example, the instructions and data for compiling and linking and the procedures used for software recovery, software regeneration, testing, or modification; i. Data integrity checks for the executable, object code, and source code; j. Software product files (any files needed to install, build, operate, and maintain the software); k. Installation instructions to load, configure and prepare the executables for use by the operations team.

1. CDRL No.:	MO-12
2. Title:	MOC Design Specification and Description
3. Reference:	SOW 5.1
4. Use:	To ensure that the MOC design requirements flow correctly from the MOC-RD, and to present the MOC architecture and design.
5. Preparation Information:	<p>The MOC Design Specification and Description shall delineate the architecture and design of the MOC. It shall establish the top-level design and interface specification(s) placed on the MOC that flows from the MOC-RD.</p> <p>The MOC Design Specification and Description shall contain the following, at a minimum:</p> <ul style="list-style-type: none"> • Hardware architecture • Software architecture • Specifications • HCI display images and descriptions • Interface designs • Data flows

1. CDRL No.:	MO-13
2. Title:	FLIGHT OPERATIONS TEAM TRAINING PLAN
3. Reference:	SOW 6.2.1
4. Use:	<p>The Flight Operations Team Training Plan is used to train the Flight Operations Team in the operation and functionality of the MOC, use of the MOC System software and hardware and simulation activities. The Training Plan includes the use of Launch Rehearsals for FOT training.</p>
5. Preparation Information:	<p>The Flight Operations Team Training Plan shall describe course methodology and curriculum and shall include training in the following items:</p> <ul style="list-style-type: none"> a. MOC Operations concepts; b. Flight Operations Team positions and responsibilities for MOC operations; c. All modes of operation and functionality of the MOC; d. Operation and functionality of the MOC System; e. Operation and functionality of each MOC Subsystem; f. Operation and functionality of the MOC System hardware; g. Interfaces between the Ground System Elements and the MOC System; h. Interfaces between the Observatory Simulator and the MOC System; i. MOC System Anomaly scenarios and procedures; j. Lights Out Automation functionality; k. Required meetings, status reports, etc. <p>In addition, the Training Plan shall include exercises and Launch Rehearsals as part of the training curriculum.</p>

1. CDRL No.:	MO-15
2. Title:	MOC USER'S MANUAL
3. Reference:	SOW 3.3 SOW 5.3
4. Use:	To provide guidance and instruction on the use of the MOC for users and operators of the MOC.
5. Preparation Information:	<p>The MOC User's Manual shall include at a minimum:</p> <ol style="list-style-type: none"> 1. A system overview of the MOC including architecture, hardware and software descriptions, configuration, and modes of operation <ol style="list-style-type: none"> a. MOC System Overview b. High Level Architecture and Functional Flow Diagrams c. Overview of Internal and External Interfaces d. MOC operational environment e. MOC Hardware and Network f. MOC Modes of Operation 2. Overview of User Interface <ol style="list-style-type: none"> a. Bringing up and down the MOC System and each MOC functional element, including cold and warm starts if applicable b. Operation of hardware c. Logging on/off <ul style="list-style-type: none"> • Description of user access levels d. Using the startup GUI e. Basic display management f. Basic system directives g. Introduction to the scripting language h. Operation of software i. Remote access 3. System Operations <ol style="list-style-type: none"> a. Front End Configuration and Management b. Telemetry and Display Operations c. Command Operations <ul style="list-style-type: none"> • Overview of Command Control • Overview of Command Load Generation d. Planning and Scheduling Processes including discussions of external scheduling interfaces (SN, GN and ISF) e. Mission Monitor & Analysis Operations f. Flight Dynamics Processes and Products g. Flight Software Maintenance Operations h. Overview of the Central Repository, Archiving and Restoration i. Anomaly Identification, Notification and Resolution Capabilities j. Lights Out Automation Capabilities

	<ul style="list-style-type: none"> k. Overview of Simulation Operations l. Functionality, Software and Hardware in the Primary MOC and backup MOC (bMOC) <ul style="list-style-type: none"> • MOC functional data transfer and interface to the bMOC System suite m. Redundancy, Recovery and Fail Over Capabilities <ul style="list-style-type: none"> • Recovery methods for each MOC Subsystem in cases of irrevocable errors or faults n. MOC Interface Management <ul style="list-style-type: none"> • Between the MOC Subsystems and the ICESat-2 Ground System • Between the MOC Subsystems and all external interfaces <p>4. Scripting Language Guide (may be provided in Contractor format)</p> <p>5. Detailed MOC Database Descriptions (may be provided in Contractor format)</p> <ul style="list-style-type: none"> a. Database structures and locations b. Detailed database definitions c. Allowed operations d. Database query and reports e. Database modification f. Utilization of the PDB <p>6. Event, Logging And Report Operations</p> <p>7. System administration instructions/guides</p> <p>8. List of MOC system directives (may be provided in Contractor format)</p> <p>9. List of all alerts or notifications produced by each MOC Subsystem along with their meanings (may be provided in Contractor format)</p> <p>10. List of all system parameter values stored and processed by the MOC System (may be provided in Contractor format)</p> <p>11. List of all operator roles supported by each MOC Subsystem and the privileges associated with each role</p>
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1. CDRL No.:	MO-18
2. Title:	ICESat-2 KEY MANAGEMENT PLAN INPUTS
3. Reference:	SOW 5.1.2.2
4. Use:	The Key Management Plan (KMP) describes the use and control of all key management products and services used by a cryptographic application (cryptographic engine, End Cryptographic Unit (ECU), or system) throughout its lifetime. The KMP also documents the capabilities that the cryptographic application requires from the current and planned Key Management Infrastructure (KMI). This ensures that any lifecycle key management services are supportable by and available from the KMI.
5. Preparation Information:	The contractor shall work closely with the ICESat-2 Mission Systems Group and the S/C vendor to document all aspects of the KMI required to successfully command, control and operate the Observatory. The contractor shall develop MOC SOPs to manage the usage of the Keys.

1. CDRL No.:	MO-19
2. Title:	MOC Operations Procedures Plan
3. Reference:	SOW 9.2
4. Use:	To provide guidance and instruction on the use of the T&C procedures that the MOC uses to communicate with the spacecraft for users and operators of the MOC.
5. Preparation Information:	The contractor shall document all Procedures that execute on the T&C system to include off nominal paths and expected responses in both nominal and off nominal branches.

1. CDRL No.:	MO-20
2. Title:	FOT procedures review to support execution of the S/C Decommissioning Plan
3. Reference:	SOW 9.2, NPR 8715.6A NASA Procedural Requirements for Limiting Orbital Debris
4. Use:	To provide guidance and instruction on the techniques, procedures and steps required for the proper preparation and disposal of the spacecraft via controlled re-entry.
5. Preparation Information:	This plan should document the steps and procedures required to successfully decommission the ICESat-2 spacecraft. The scope should include all preparation activities prior to the de-orbit activity to include process and procedures to execute in order to fulfill the S/C Decommissioning plan and any coordination required between CAS and the Observatory during the de-orbit activities.

1. CDRL No.:	MO-21
2. Title:	ICESat-2 MOC LEO Handbook
3. Reference:	SOW 9.2
4. Use:	Describes the detailed procedures and steps to be executed during the LEO of the observatory.
5. Preparation Information:	Describes the detailed procedures and steps to be executed during the LEO of the observatory including contingency planning.

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1. CDRL No.:	MO-22
2. Title:	ICESat-2 Standard Operating Procedures (SOP's) and Contingency Operations Plan
3. Reference:	SOW 9.2
4. Use:	To document the missions SOP's and Contingency Operations Plans and procedures.
5. Preparation Information:	To document the missions SOP's and Contingency Operations Plans and procedures so that personnel of normal operations expertise can be expected to successfully execute the SOP's in a manner that minimizes risks to the mission and optimizes the return of the science data.

1. CDRL No.:	MO-23
2. Title:	MOC Provided System to the Instrument Support Facility
3. Reference:	SOW 1.1
4. Use:	To document the MOC provided elements of HW, SW and COTS provided and delivered to the ISF.
5. Preparation Information:	<p>The MOC vendor shall provide one instance of a MOC Observatory housekeeping Trending system to the ISF. Delivery of a fully tested system is required 90 days before the start of the Observatory I&T activity.</p> <p>HW, SW and COTs are to be specified, development tested and delivered no later than 90 days prior to the first Observatory Integration and Test exercise.</p>

GLOSSARY/ACRONYMS

bMOC	Backup MOC
CAS	Conjunction Assessment System
CCB	Configuration Control Board
CCR	Configuration Change Request
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CI	Configuration Item
CIIL	Configuration Item Identifier List
CMP	Configuration Management Plan
CMO	Configuration Management Office
COTR	Contracting Officer's Technical Representative
COTS	Commercial Off-The Shelf
CSCI	Computer Software Configuration Items
DACA	Days After Contract Award
DRD	Description of Required Data
ECU	End Cryptographic Unit
EPR	Engineering Peer Review
EVM	Earned Value Measurement
FDF	Flight Dynamics Facility
FOR	Flight Operations Review
FOT	Flight Operations Team
FSV	Flight Software Vendor
GFE	Government Furnished Equipment
GFP	Government Furnished Property
GN	Ground Network
GOTS	Government Off-The-Shelf
GPR	Goddard Procedural Requirements
GS	Ground System
GS-CDR	GS-Critical Design Review
GS-PDR	GS-Preliminary Design Review
GSFC	Goddard Space Flight Center
GUI	Graphical User Interface
IMS	Integrated Master Schedules

ISF	Instrument Support Facility
IV&V	Independent Verification and Validation
KMI	Key Management Infrastructure
KMP	Key Management Plan
LEO	Launch and Early Orbit
MAR	Mission Assurance Requirements
M-CDR	MOC Critical Design Review
MO	Mission Operations
MOC	Mission Operations Center
MOC-RD	Mission Operations Center Requirements Document
MOR	Mission Operations Review
MOTS	Modified Off-The-Shelf
M-PDR	MOC Preliminary Design Review
MPSR	Monthly Project Status Report
M-SIR	MOC System Integration Review
MSR	Mission Status Reviews
M-SRR	MOC System Requirements Review
NGN	Near Ground Network
NPR	NASA Procedural Requirements
OAR	Operational Acceptance Review
OBSSIM	Observatory Simulator
ORR	Operational Readiness Review
PAD	Precision Attitude Determination
PCM	Project Control Milestone
PDB	Project Database
PM	Program Management
POD	Precision Orbit Determination
RE	Reviews
SDMP	Software Development and Management Plan
SE	System Engineering
SIPS	ICESat-2 Science Investigator-led Processing System
SIR	System Integration Review
SN	Space Network
SOP	Standard Operating Procedure
SOW	Statement of Work

SPVP	System Performance Verification Plan
SRD	Systems Requirements Document
T&C	Telemetry and Command
UAR	Update As Required
WBS	Work Breakdown Schedule

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APPENDIX A Data Management List

To be supplied.

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