

AWARD/CONTRACT	1. THIS CONTRACT IS A RATED ORDER UNDER DPAS (15 CFR 700)	RATING	PAGE OF PAGES
			1 36

2. CONTRACT (Proc. Inst. Ident.) NO. 80LARC17C0001	3. EFFECTIVE DATE 07/01/2017	4. REQUISITION/PURCHASE REQUEST/PROJECT NO. See Block 14
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5. ISSUED BY NASA Langley Research Center 5 Langley Blvd., Bldg. 2101 M/S 12 Hampton VA 23681-2199	6. ADMINISTERED BY (If other than Item 5)
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7. NAME AND ADDRESS OF CONTRACTOR (No., street, city, county, State & Zip Code) OFFICE RESEARCH ADMINISTRATION 1000 ASP AVE RM 105 NORMAN OK 73019-4039	8. DELIVERY <input type="checkbox"/> FOB ORIGIN <input checked="" type="checkbox"/> OTHER (See below)
	9. DISCOUNT FOR PROMPT PAYMENT Net 30 days
	10. SUBMIT INVOICES (4 copies unless otherwise specified) TO THE ADDRESS SHOWN IN: ITEM See Clause G.3

CODE 3G168	FACILITY CODE
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11. SHIP TO/MARK FOR NASA Langley Research Center 4 South Marvin Street Bldg 1206 Hampton VA 23681-2199	12. PAYMENT WILL BE MADE BY NASA Shared Services Center (NSSC) Financial Management Division (FMD) Accounts Payable Building 1111, Jerry Hlass Road Stennis Space Center MS 39529-0001
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13. AUTHORITY FOR USING OTHER THAN FULL AND OPEN COMPETITION: <input type="checkbox"/> 10 U.S.C. 2304 (c) () <input type="checkbox"/> 41 U.S.C. 3304 (a) ()	14. ACCOUNTING AND APPROPRIATION DATA PR 4200622883; \$7,924,544 (**See note in Block 15B.**)
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15A. ITEM NO.	15B. SUPPLIES/SERVICES	15C. QUANTITY	15D. UNIT	15E. UNIT PRICE	15F. AMOUNT
	Geostationary Carbon Cycle Observatory (GeoCarb) Mission **Performance shall not begin until the funding is obligated by the Contracting Officer on Modification No. 1.**				\$161,000,000
15G. TOTAL AMOUNT OF CONTRACT					\$161,000,000

(X)	SEC.	DESCRIPTION	PAGE(S)	(X)	SEC.	DESCRIPTION	PAGE(S)
PART I - THE SCHEDULE				PART II - CONTRACT CLAUSES			
X	A	SOLICITATION/CONTRACT FORM	1	X	I	CONTRACT CLAUSES	20-35
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X	C	DESCRIPTION/SPECS./WORK STATEMENT	4	X	J	LIST OF ATTACHMENTS	36
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X	E	INSPECTION AND ACCEPTANCE	6	K	REPRESENTATIONS, CERTIFICATIONS AND OTHER STATEMENTS OF OFFERORS		
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CONTRACTING OFFICER WILL COMPLETE ITEM 17 OR 18 AS APPLICABLE

17. <input checked="" type="checkbox"/> CONTRACTOR'S NEGOTIATED AGREEMENT (Contractor is required to sign this document and return <u>1</u> copies to issuing office.) Contractor agrees to furnish and deliver all items or perform all the services set forth or otherwise identified above and on any continuation sheets for the consideration stated herein. The rights and obligations of the parties to this contract shall be subject to and governed by the following documents: (a) this award/contract, (b) the solicitation, if any, and (c) such provisions, representations, certifications, and specifications, as are attached or incorporated by reference herein. (Attachments are listed herein.)	18. <input type="checkbox"/> SEALED-BID AWARD (Contractor is not required to sign this document.) Your bid on Solicitation Number _____ including the additions or changes made by you which additions or changes are set forth in full above, is hereby accepted as to the terms listed above and on any continuation sheets. This award consummates the contract which consists of the following documents: (a) the Government's solicitation and your bid, and (b) this award/contract. No further contractual document is necessary. (Block 18 should be checked only when awarding a sealed-bid contract.)
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19A. NAME AND TITLE OF SIGNER (Type or print) Andrea Deaton, Associate Vice President for Research	20A. NAME OF CONTRACTING OFFICER Michael Kaszyca
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19B. NAME OF CONTRACTOR BY <u>Andrea Deaton</u> (Signature of person authorized to sign)	19C. DATE SIGNED 6/21/17	20B. UNITED STATES OF AMERICA Digitally signed by MICHAEL KASZYCA DN: c=US, ou=U.S. Government, ou=NASA, ou=People, cn=MICHAEL KASZYCA, 0.9.2342.19200300.100.1.1=mkaszyca Date: 2017.06.20 09:51:04 -0400 BY MICHAEL KASZYCA (Signature of Contracting Officer)	20C. DATE SIGNED 6-22-17
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PART 1 – THE SCHEDULE

SECTION B - SUPPLIES OR SERVICES AND PRICES/ COSTS

B.1. NAMING/NUMBERING SCHEME FOR CLAUSES IN FULL TEXT AND FOR CLAUSES INCORPORATED BY REFERENCE (LaRC 52.201-90) (MARCH 2012)

There are various types of clauses contained in the contract. Most clauses will reference a numbered cite such as: Federal Acquisition Regulation (FAR 52.#); NASA FAR Supplement (NFS 1852.#); or Langley Research Center (LaRC 52.#). There are also clauses that have no numbered cite designation. Those clauses were written by LaRC for this specific contract or were written as generic Agency clauses specific to this contract type.

(End of clause)

B.2. SUPPLIES AND/OR SERVICES TO BE PROVIDED

The Contractor shall provide all resources (except as may be expressly stated in the contract as furnished by the Government) necessary to perform the requirements set forth in the requirements documents incorporated into Section C of this contract. The Contract Line Item Number (CLIN) structure, requirements summary, and contract type is as follows:

CLIN Descriptions		
CLIN	Description	Contract Type
1	Phase A/B: The Phase A and Phase B activities of the Formulation Phase focus on refining the GeoCarb mission concept and also on the successful completion of a Preliminary Design Review (PDR). The Contractor's design activities shall include all necessary and required activities to result in the execution of a successful Systems Requirement Review (SRR)/Mission Definition Review (MDR) in Phase A and a successful PDR in Phase B, including support for the Key Decision Point (KDP)-B and KDP-C reviews.	Cost - Reimbursement (no fee)
2	Phase C, D, E, & F: The Implementation Phase focuses on the detailed design and development Phase (Phase C); GeoCarb payload manufacturing, verification, delivery to and integration with the host mission spacecraft, launch on a host mission provided launch vehicle, and on-orbit commissioning (Phase D); the science operations phase following spacecraft commissioning (Phase E); and mission closure and data archiving (Phase F).	Cost - Reimbursement (no fee)

(End of clause)

B.3. 1852.216-81 ESTIMATED COST (DEC 1988)

The total estimated cost for complete performance of this contract is below. See FAR clause 52.216-11, Cost Contract—No Fee, of this contract.

CLIN	Estimated Cost
1 -- Phase A/B	\$60,700,000
2 -- Phase C/D/E/F	\$102,129,446
Total Estimated Cost	\$162,829,446

(End of clause)

B.4. 1852.232-81 CONTRACT FUNDING (JUN 1990)

(a) For purposes of payment of cost, exclusive of fee, in accordance with the Limitation of Funds clause, the total amount allotted by the Government to this contract is shown in the below table. This allotment is for CLINs 1 and 2 and covers the following estimated period of performance: Contract effective date through:

CLIN	Amount	Estimated Date
1	\$60,700,000	December 31, 2019 (Fully-Funded)
2	\$8,051,544	February 29, 2020
TOTAL	\$68,751,544	

(b) An additional amount of \$0 is obligated under this contract for payment of fee.

(End of clause)

(End of Section)

SECTION C - DESCRIPTION/SPECIFICATIONS/STATEMENT OF WORK**C.1. REQUIREMENTS DOCUMENTS**

The Contractor shall provide all resources (except as may be expressly stated in the contract as furnished by the Government) necessary to meet all contract requirements as set forth in the following Exhibits included in Section J:

	TITLE OF DOCUMENT
Exhibit A	Statement of Work for Geostationary Carbon Cycle Observatory (GeoCarb) Mission
Exhibit B	GeoCarb Data Requirements List (DRL) / Data Requirements Document (DRD)
Exhibit C	GeoCarb Mission Assurance Requirements (MAR)

(End of clause)

(End of Section)

SECTION D - PACKAGING AND MARKING**D.1. CLAUSES INCORPORATED BY REFERENCE -- SECTION D**

CLAUSE NUMBER	CLAUSE TITLE (DATE)
1852.211-70	PACKAGING, HANDLING, AND TRANSPORTATION (SEP 2005)
1852.245-74	IDENTIFICATION AND MARKING OF GOVERNMENT EQUIPMENT (JAN 2011) <i>Paragraph (e) fill-in: NASA Langley Research Center, 4 South Marvin Street (Bldg. 1206), Hampton, VA 23681-2199</i>

(End of clause)

(End of Section)

SECTION E - INSPECTION AND ACCEPTANCE

E.1. CLAUSES INCORPORATED BY REFERENCE -- SECTION E

CLAUSE NUMBER	CLAUSE TITLE (DATE)
52.246-8	INSPECTION OF RESEARCH AND DEVELOPMENT—COST REIMBURSEMENT (MAY 2001) - ALTERNATE I (APR 1984)

(End of clause)

(End of Section)

SECTION F - DELIVERIES AND PERFORMANCE

F.1. CLAUSES INCORPORATED BY REFERENCE -- SECTION F

CLAUSE NUMBER	CLAUSE TITLE (DATE)
52.242-15	STOP-WORK ORDER (AUG 1989) -- ALTERNATE I (APR 1984)

(End of clause)

F.2. PERIOD OF PERFORMANCE

The period of performance of this contract is 108 months from the contract effective date. The CLIN 1 period of performance is from the contract effective date through December 31, 2019. The CLIN 2 period of performance is from January 1, 2020 through June 30, 2026, but shall not begin until the Contractor is formally notified in writing by the Contracting Officer that the GeoCarb Mission has been confirmed at KDP-C.

(End of clause)

F.3. DELIVERY AND/OR COMPLETION SCHEDULE

The Contractor shall deliver and/or complete performance of all items/reviews required by the requirements documents incorporated in contract Section C. The following represents the major reviews and the approximate schedule for occurrence.

Activity	Original Schedule	Current Schedule
CLIN 1		
System Requirements Review (SRR) / Mission Definition Review (MDR) Package	August 2017	September 2017
KDP-B	October 2017	October 2017
Preliminary Design Review (PDR)	January 2018	August 2018
Delta-PDR	N/A	February 2019
KDP-C	March 2018	July/August 2019
KDP-C Continuation	N/A	December 2019
CLIN 2		
Critical Design Review (CDR)	September 2018	January 2020
System Integration Review (SIR) / Pre-Environmental Review (PER) Package	July 2019	July 2020
Systems Acceptance Review (SAR) / Pre-Ship Review (PSR)	April 2020	May 2021
Operational Readiness Review (ORR)	January 2022	May 2022
Launch Readiness Date	June 2022	June 2022
KDP-E	December 2022	TBD*
Prime Operations Begin (Phase E)	December 2022	TBD*
Prime Operations End/Phase F Begin	December 2025	TBD*
Phase F End	June 2026	TBD*

*The TBD dates will be updated once the launch service (host) provider is confirmed and the launch schedule is finalized.

(End of clause)

(End of Section)

SECTION G - CONTRACT ADMINISTRATION DATA

G.1. CLAUSES INCORPORATED BY REFERENCE -- SECTION G

CLAUSES INCORPORATED BY REFERENCE	
CLAUSE NUMBER	CLAUSE TITLE (DATE)
52.204-19	INCORPORATION BY REFERENCE OF REPRESENTATIONS AND CERTIFICATIONS (DEC 2014)
1852.223-71	AUTHORIZATION FOR RADIO FREQUENCY USE (APR 2015)
1852.242-73	NASA CONTRACTOR FINANCIAL MANAGEMENT REPORTING (NOV 2004)
1852.245-70	CONTRACTOR REQUESTS FOR GOVERNMENT-FURNISHED PROPERTY (AUG 2015)
1852.245-75	PROPERTY MANAGEMENT CHANGES (JAN 2011)
1852.245-78	PHYSICAL INVENTORY OF CAPITAL PERSONAL PROPERTY (AUG 2015)

(End of clause)

G.2. 1852.227-72 DESIGNATION OF NEW TECHNOLOGY REPRESENTATIVE AND PATENT REPRESENTATIVE (APR 2015)

- (a) For purposes of administration of the clause of this contract entitled “New Technology—Other than a Small Business Firm or Nonprofit Organization” or “Patent Rights—Ownership by the Contractor,” whichever is included, the installation New Technology and Patent Representatives identified at http://prod.nais.nasa.gov/portals/pl/new_tech_pocs.html are hereby designated by the Contracting Officer to administer such clause for the appropriate installation:

Title	Address
New Technology Representative	NASA Langley Research Center Kimberly Middleton M/S 151 Hampton, VA 23681-2199 Email: Kimberly.J.Middleton@nasa.gov Direct all correspondence and reports to: NASA Langley Research Center New Technology Administrator Sevet Bassett M/S 151 Hampton, VA 23681-2199 e-mail: _sevet.r.bassett@nasa.gov
Patent Representative	Office of Chief Counsel 5 Langley Boulevard, Mail Stop 30 NASA Langley Research Center Hampton, VA 23681-2199

- (b) Disclosures of reportable items and of subject inventions, interim new technology summary reports, final new technology summary reports, utilization reports, and other reports required by the applicable “New Technology—Other than a Small Business Firm or Nonprofit

Organization.” or “Patent Rights—Ownership by the Contractor” clause, as well as any correspondence with respect to such matters, shall be directed to the New Technology Representative unless transmitted in response to correspondence or request from the Patent Representative. Inquiries or requests regarding disposition of rights, election of rights, or related matters shall be directed to the Patent Representative. This clause shall be included in any subcontract hereunder requiring a “New Technology—Other than a Small Business Firm or Nonprofit Organization” clause or “Patent Rights—Ownership by the Contractor” clause, unless otherwise authorized or directed by the Contracting Officer. The respective responsibilities and authorities of the aforementioned representatives are set forth in 1827.305-270 of the NASA FAR Supplement.

(End of clause)

G.3. 1852.232-80 SUBMISSION OF VOUCHERS/INVOICES FOR PAYMENT (APR 2018)

- (a) The designated payment office is the NASA Shared Services Center (NSSC) located at FMD Accounts Payable, Bldg. 1111, Jerry Hlass Road, Stennis Space Center, MS 39529.
- (b) Except for classified vouchers, the Contractor shall submit all vouchers and invoices using the steps described at NSSC's Vendor Payment information Web site at: <https://www.nssc.nasa.gov/vendorpayment>. Please contact the NSSC Customer Contact Center at 1-877-NSSC123 (1-877-677-2123) with any additional questions or comments.
- (c) Payment requests.
 - (1) The payment periods are stipulated in the payment clause(s) contained in this contract.
 - (2) Vouchers submitted under cost-type contracts and invoices submitted under fixed-price contracts shall include the items delineated in FAR 32.905(b) supported by relevant back-up documentation. Back-up documentation shall include at a minimum, the following information:
 - (i) *Vouchers.*
 - (A) Breakdown of billed labor costs and associated contractor generated supporting documentation for billed direct labor costs to include rates used and number of hours incurred.
 - (B) Breakdown of billed other direct costs (ODCs) and associated contractor generated supporting documentation for billed ODCs.
 - (C) Indirect rate(s) used to calculate the amount of billed indirect expenses.
 - (D) Progress reports, as required.
 - (ii) *Invoices.*
 - (A) Description of goods and services delivered as part of the contract's terms and conditions, including the dates of delivery/performance.
 - (B) Progress reports, as required.
 - (C) Date goods and services were performed.
 - (iii) *Fee Vouchers.*
 - (A) Listing of all provisionally-billed fee by period or date earned since contract award.
 - (B) A reconciliation of all billed and earned fee.
 - (C) A clear explanation of the fee calculations.

- (d) Non-electronic payment requests. The Contractor may submit a non-electronic voucher/invoice using the steps for non-electronic payment requests described at NSSC's Vendor Payment information through any of the means described at <https://www.nssc.nasa.gov/vendorpayment>, when any of the following conditions are met:
- (1) The Contracting Officer administering the contract for payment has determined, in writing, that electronic submission would be unduly burdensome to the Contractor.
 - (2) The contract includes provision allowing the contractor to submit vouchers using for non-electronic payment requests. In such instances, the Contractor agrees to submit non-electronic payment requests using the method or methods specified in Section G of the contract.
- (e) Improper vouchers/invoices. The NSSC Payment Office will notify the contractor of any apparent error, defect, or impropriety in a voucher/invoice within seven calendar days of receipt by the NSSC Payment Office. Inquiries regarding requests for payment should be directed to the NSSC as specified in paragraph (b) of this section.
- (f) Other payment clauses. In addition to the requirements of this clause, the Contractor shall meet the requirements of the appropriate payment clauses in this contract when submitting payment requests.
- (g) In the event that amounts are withheld from payment in accordance with provisions of this contract, a separate payment request for the amount withheld will be required before payment for that amount may be made.

(End of clause)

G.4. 1852.245-73 FINANCIAL REPORTING OF NASA PROPERTY IN THE CUSTODY OF CONTRACTORS (JAN 2017)

- (a) The Contractor shall submit annually a NASA Form (NF) 1018, NASA Property in the Custody of Contractors, in accordance with this clause, the instructions on the form and NFS subpart 1845.71, and any supplemental instructions for the current reporting period issued by NASA.
- (b) (1) Subcontractor use of NF 1018 is not required by this clause; however, the Contractor shall include data on property in the possession of subcontractors in the annual NF 1018.
- (2) The Contractor shall mail the original signed NF 1018 directly to the cognizant NASA Center Deputy Chief Financial Officer, Finance, unless the Contractor uses the NF 1018 Electronic Submission System (NESS) for report preparation and submission.
- (3) One copy shall be submitted (through the Department of Defense (DOD) Property Administrator if contract administration has been delegated to DOD) to the following address: NASA Langley Research Center, Industrial Property Officer, 9B Langley Boulevard, Mail Stop 135, Hampton, VA 23681-2199 and NASA Langley Research Center, Financial Management Office, Property Management, 5 Langley Boulevard, Mail Stop 22, Hampton, VA 23681-2199, unless the Contractor uses the NF 1018 Electronic Submission System (NESS) for report preparation and submission.
- (c) (1) The annual reporting period shall be from October 1 of each year through September 30

of the following year. The report shall be submitted in time to be received by October 31st. The information contained in these reports is entered into the NASA accounting system to reflect current asset values for agency financial statement purposes. Therefore, it is essential that required reports be received no later than October 31st.

- (2) Some activity may be estimated for the month in which the report is submitted, if necessary, to ensure the NF 1018 is received when due. However, contractors' procedures must document the process for developing these estimates based on planned activity such as planned purchases or NASA Form 533 (NF 533 Contractor Financial Management Report) cost estimates. It should be supported and documented by historical experience or other corroborating evidence, and be retained in accordance with FAR Subpart 4.7, Contractor Records Retention. Contractors shall validate the reasonableness of the estimates and associated methodology by comparing them to the actual activity once that data is available, and adjust them accordingly. In addition, differences between the estimated cost and actual cost must be adjusted during the next reporting period. Contractors shall have formal policies and procedures, which address the validation of NF 1018 data, including data from subcontractors, and the identification and timely reporting of errors. The objective of this validation is to ensure that information reported is accurate and in compliance with the NASA FAR Supplement. If errors are discovered on NF 1018 after submission, the contractor shall contact the cognizant NASA Center Industrial Property Officer (IPO) within 30 days after discovery of the error to discuss corrective action.
 - (3) In addition to an annual report, if at any time during performance of the contract, NASA-owned property in the custody of the Contractor has a value of \$10 million or more, the Contractor shall also submit a report no later than the 21st of each month in accordance with the requirements of paragraph (c)(2) of this clause.
 - (4) The Contracting Officer may, in NASA's interest, withhold payment until a reserve not exceeding \$25,000 or 5 percent of the amount of the contract, whichever is less, has been set aside, if the Contractor fails to submit annual NF 1018 reports in accordance with NFS subpart 1845.71, any monthly report in accordance with (c)(3) of this clause, and any supplemental instructions for the current reporting period issued by NASA. Such reserve shall be withheld until the Contracting Officer has determined that NASA has received the required reports. The withholding of any amount or the subsequent payment thereof shall not be construed as a waiver of any Government right.
- (d) A final report shall be submitted within 30 days after disposition of all property subject to reporting when the contract performance period is complete in accordance with paragraph (b)(1) through (3) of this clause.

(End of clause)

G.5. LARC 52.242-70 TECHNICAL DIRECTION (JUL 2015)

- (1) Performance of the work under this contract is subject to the written technical direction of the Contracting Officer's Representative (COR), who shall be specifically appointed by the Contracting Officer in writing. "Technical direction" means a directive to the Contractor that approves approaches, solutions, designs, or refinements; fills in details or otherwise completes the general description of work or documentation items; shifts emphasis among work areas or tasks; or furnishes similar instruction to the Contractor. Technical direction

includes requiring studies and pursuit of certain lines of inquiry regarding matters within the general tasks and requirements in Section C of this contract.

- (2) The COR does not have the authority to, and shall not, issue any instruction purporting to be technical direction that -
 - (1) Constitutes an assignment of additional work outside the statement of work;
 - (2) Constitutes a change as defined in the changes clause;
 - (3) Constitutes a basis for any increase or decrease in the total estimated contract cost, the fixed fee (if any), or the time required for contract performance;
 - (4) Changes any of the expressed terms, conditions, or specifications of the contract; or
 - (5) Interferes with the contractor's rights to perform the terms and conditions of the contract.
- (3) All technical direction shall be issued in writing by the COR.
- (4) The Contractor shall proceed promptly with the performance of technical direction duly issued by the COR in the manner prescribed by this clause and within the COR's authority. If, in the Contractor's opinion, any instruction or direction by the COR falls within any of the categories defined in paragraph (b) of this clause, the Contractor shall not proceed but shall notify the Contracting Officer in writing within 5 working days after receiving it and shall request the Contracting Officer to take action as described in this clause. Upon receiving this notification, the Contracting Officer shall either issue an appropriate contract modification within a reasonable time or advise the Contractor in writing within 30 days that the instruction or direction is -
 - (1) Rescinded in its entirety; or
 - (2) Within the requirements of the contract and does not constitute a change under the changes clause of the contract, and that the Contractor should proceed promptly with its performance.
- (5) A failure of the contractor and contracting officer to agree that the instruction or direction is both within the requirements of the contract and does not constitute a change under the changes clause, or a failure to agree upon the contract action to be taken with respect to the instruction or direction, shall be subject to the Disputes clause of this contract.
- (6) Any action(s) taken by the contractor in response to any direction given by any person other than the Contracting Officer or the COR shall be at the Contractor's risk.

(End of clause)

G.6. 1852.245-76 LIST OF GOVERNMENT PROPERTY FURNISHED PURSUANT TO FAR 52.245-1 (JAN 2011)

For performance of work under this contract, the Government will make available Government property identified in Exhibit G, Government-Furnished Property, of this contract "as-is" [see FAR 52.245-1(d)(2)(iii)] on a no charge-for-use basis pursuant to the clause at FAR 52.245-1, Government Property, as incorporated in this contract. The Contractor shall use this property in the performance of this contract at the Contractors and Subcontractors facilities, NASA facilities, and at other location(s) as may be approved by the Contracting Officer. Under FAR 52.245-1, the Contractor is accountable for the identified property.

(End of clause)

(End of Section)

SECTION H - SPECIAL CONTRACT REQUIREMENTS

H.1. CLAUSES INCORPORATED BY REFERENCE -- SECTION H

CLAUSE NUMBER	CLAUSE TITLE (DATE)
1852.208-81	RESTRICTIONS ON PRINTING AND DUPLICATING (NOV 2004)
1852.223-72	SAFETY AND HEALTH (SHORT FORM) (JUL 2015)
1852.223-75	MAJOR BREACH OF SAFETY OR SECURITY (FEB 2002) - ALTERNATE I (FEB 2006)
1852.225-70	EXPORT LICENSES (FEB 2000) – ALTERNATE I (FEB 2000) <i>Paragraph (b) fill-in: Any NASA installation</i>
1852.228-78	CROSS-WAIVER OF LIABILITY FOR SCIENCE OR SPACE EXPLORATION ACTIVITIES UNRELATED TO THE INTERNATIONAL SPACE STATION (OCT 2012)
1852.235-73	FINAL SCIENTIFIC AND TECHNICAL REPORTS (DEC 2006) - ALTERNATE I (FEB 2003)
1852.242-72	DENIED ACCESS TO NASA FACILITIES (OCT 2015)
1852.244-70	GEOGRAPHIC PARTICIPATION IN THE AEROSPACE PROGRAM (APR 1985)

(End of clause)

H.2. 1852.235-71 KEY PERSONNEL AND FACILITIES (MAR 1989)

- (a) The personnel and/or facilities listed below (or specified in the contract Schedule) are considered essential to the work being performed under this contract. Before removing, replacing, or diverting any of the listed or specified personnel or facilities, the Contractor shall (1) notify the Contracting Officer reasonably in advance and (2) submit justification (including proposed substitutions) in sufficient detail to permit evaluation of the impact on this contract.
- (b) The Contractor shall make no diversion without the Contracting Officer's written consent; provided, that the Contracting Officer may ratify in writing the proposed change, and that ratification shall constitute the Contracting Officer's consent required by this clause.
- (c) The list of personnel and/or facilities (shown below or as specified in the contract Schedule) may, with the consent of the contracting parties, be amended from time to time during the course of the contract to add or delete personnel and/or facilities.

Title	Name	Affiliation
Principal Investigator	Berrien Moore	University of Oklahoma
Project Manager	Dean Read	University of Oklahoma
Project Systems Engineer	Steve Merrihew	Lockheed Martin
Instrument Project Manager	Gary Kushner	Lockheed Martin

(End of clause)

H.3. 1852.235-74 ADDITIONAL REPORTS OF WORK -- RESEARCH AND DEVELOPMENT (FEB 2003)

In addition to the final report required under this contract, the Contractor shall submit the following report(s) to the Contracting Officer: The Contractor shall submit each deliverable as specified in Exhibit A, SOW; Exhibit B, DRL/DRD; and Exhibit C, MAR.

(End of clause)

H.4. 1852.242-71 TRAVEL OUTSIDE OF THE UNITED STATES (DEC 1988) – SUPPLEMENTED BY LARC 52.242-71 TRAVEL OUTSIDE OF THE UNITED STATES (APR 2017)

- (a) The Contracting Officer must authorize in advance and in writing travel to locations outside of the United States by Contractor employees that is to be charged as a cost to this contract. This approval may be granted when the travel is necessary to the efforts required under the contract and it is otherwise in the best interest of NASA.
- (b) The Contractor shall submit requests to the Contracting Officer at least 30 days in advance of the start of the travel.
- (c) The Contractor shall submit a travel report at the conclusion of the travel. The Contracting Officer's approval of the travel will specify the required contents and distribution of the travel report.
- (d) Contractor employees shall comply with the following while on any foreign travel:
 - (1) NASA Policy Directive (NPD) 2810.1, NASA information Security Policy, and NASA Interim Directive (NID) 2810-107a, Use of NASA Information and Information Systems while Outside of the U.S. and Territories, with regard to use of NASA data, Government-provided Information Technology (IT) equipment, and/or access to NASA IT systems while on travel outside of the United States (U.S.). Under no circumstances shall NASA-issued IT devices, NASA IT Systems, or nonpublic NASA information be taken (or accessed from) outside of the U.S. or its territories without prior written authorization from the Center Chief Information Officer via a Request for Foreign Travel Authorization at this site: <https://itib.ndc.nasa.gov/intranet/forms/viewform.cfm?formid=8>.

This policy applies to all NASA personnel (i.e., all persons who have an active identity in NASA's Identity Management and Account Exchange (IdMAX) system) and who are travelling outside of the U.S. and territories while performing any of the following: carrying or using NASA IT resources; carrying NASA Sensitive But Unclassified (SBU) information; using a NASA IT account; accessing NASA IT resources located in the U.S. or its territories; or visits to U.S. facilities that are under the control of non-U.S. entities. Users shall report any loss, damage, or tampering of NASA IT assets or any IT assets containing NASA information immediately to the NASA Security Operations Center (SOC) (soc@nasa.gov, 877-627-2732).
 - (2) All U.S. export control laws and regulations, including the International Traffic in Arms Regulations, 22 Code of Federal Regulations (CFR) Parts 120 through 130, and the Export Administration Regulations, 15 CFR Parts 730 through 799, in accordance NFS clause 1852.225-70, EXPORT LICENSES.

- (e) (1) If the contractor travel is to a “Designated Country” included on the listing of current designated countries at <http://oiir.hq.nasa.gov/nasaecp/index.html>, and/or Russia, in accordance with NASA Procedural Requirements 1660.1 entitled, NASA Counter Intelligence and Counter Terrorism, contractor employees are required to receive foreign travel briefings prior to official travel and a debriefing once travel is completed. These briefings include information on the threat from foreign intelligence services, the need to protect NASA classified and sensitive information, elicitation techniques and methods, the impact to NASA when classified and/or sensitive information is lost or stolen and any current State Department advisories or warnings regarding the country(ies) to be visited.
- (2) Contractor employees traveling to any designated countries, and/or Russia, on official NASA business shall contact the cognizant NASA Counter Intelligence and Counter Terrorism (CI/CT) office at least two weeks prior to traveling to schedule a personalized foreign travel briefing. Contractor employees shall also schedule a debriefing within one week of returning from travel. The cognizant NASA CI/CT Office can be reached at **757-864-3403 or 757-864-5233**. Briefings and debriefings may be done in person or by phone as necessary and no paperwork is required. In addition, if a contractor employee is traveling to a non-designated country on official NASA business, the contractor employee may contact the cognizant NASA CI/CT Office in order to arrange a telephonic or e-mail briefing. For non-official foreign travel, contractor employees are also highly encouraged to contact the cognizant NASA CI/CT Office to arrange a telephonic or e-mail briefing.

(End of clause)

H.5. LARC 52.204-91 SECURITY PROGRAM/FOREIGN NATIONAL EMPLOYEE ACCESS REQUIREMENTS (MAY 2019)

(a) Applicable Definitions:

Foreign National: Any person who is not a U.S. citizen, lawful permanent resident, or protected individual as defined by 8 U.S.C. 1101(a)(20) and 8 U.S.C. 1324b(a)(3). This also means any foreign corporation, business association, partnership, trust, or society, as well as any international organizations, any foreign government, and any agency or subdivision of foreign governments (e.g., diplomatic missions).

Lawful Permanent Resident (LPR): Any foreign person legally permitted to reside and work within the U.S., to include protected individuals. LPRs are to be afforded all the rights and privileges of a U.S. citizen with the exception of voting, holding public office, access to classified national security information, and employment in the federal sector (except for specific needs or under temporary appointment per 5 CFR, Part 7, Section 7.4). LPRs are not prohibited from accessing export controlled items and information, but must have a work-related "need-to-know" for access. LPRs are considered foreign nationals under immigration laws. LPR, as defined herein, is to replace the term “Permanent Resident Alien” (PRA) in all NASA guidance that has not yet been updated to the use of LPR.

Visit: A visit is any means by which, and any duration for which, access is obtained to non-public NASA assets.

NASA Asset: A system, item, person or any combination thereof, that has importance or value to the NASA mission. People, data, technology, buildings, property, vehicles, blueprints, contracts, records, and funds are examples of what may constitute a NASA asset.

Access: Access, with regard to NASA assets, is the explicit granting of permission to enter and/or use NASA facilities, interact with NASA personnel, and/ or use NASA information and related information processing services.

Physical Access: Physical access is the ability to touch, or walk into or up to, a NASA Asset. Physical access is controlled through the use of door locks, card readers, gates, fences, officers, walls. The purpose of these controls is to limit access to those persons who have been granted permission to access controlled assets.

Logical Access: Logical access, commonly referred to as IT access, is the ability to interact with electronic data, applications, or systems.

(b) Requirements for Physical and Logical Access for Foreign Nationals who are not LPRs:

- (1) Physical and logical access to the NASA Langley Research Center by foreign nationals who are not LPRs shall be approved in accordance with NPR 1600.4, Chapter 4, "Identity and Credential Management" and the NASA Foreign National Access Management Operations Manual (May 2016), which can be found at https://www.hq.nasa.gov/office/ops/nasaonly/internal/FNAM/docs/FNAM_OperationsManual_TAGGED.pdf.
- (2) Center access approval requires a minimum of 5 (five) working days advance notice. Designated country nationals require a minimum of 30 (thirty) working days advance notice because of additional approval requirements. Information on Designated Countries is available at: https://oiir.hq.nasa.gov/nasaecp/docs/DCList_10-24-2018.pdf.
- (3) Foreign nationals who are not LPRs shall be escorted by a NASA Civil Servant or permanently badged contractor at all times while on Center unless otherwise approved in writing by the Center Chief of Security. In exceptional cases as required by NASA Mission requirements, a waiver to the escort requirement may be granted by the Center Chief of Security.
- (4) Non-LPR Foreign Nationals must request and obtain prior approval from Joint Base Langley-Eustis prior to entering Joint Base Langley-Eustis. Access is subject to conditions imposed by Joint Base Langley-Eustis and may require a U.S. citizen escort at all times. Information is available at: <https://lms.larc.nasa.gov/admin/documents/LF295Jan2014.pdf>.

(c) Requirements for Physical and Logical Access for LPRs:

- (1) Visit requests shall be submitted directly to the Badge and Pass Office using an LF-103, NASA Langley Research Center Security Services Branch (SSB) U.S. Citizen Visitor Badge Request Form. LPRs may be sponsored for Center access by permanently badged contractor employees or NASA civil servants. Contractor LPRs shall be sponsored by the employing contractor. All LPRs must confirm their status by providing their ORIGINAL State Department Documentation (Green Card). (*Copies, facsimiles, or photographs of the State Department Documentation will NOT be accepted*).
- (2) LPRs who will be at LaRC in excess of 29 days will be processed through IdMAX.

- (3) LPRs who will be at LaRC in excess of 179 days will be processed for PIV credentials that will remain valid for 5 years.
 - (4) The Contractor is responsible for ensuring credentials issued to LPRs sponsored by the contractor are returned when the LPR no longer requires access to NASA LaRC under the contract or no longer works for the contractor.
 - (5) LPRs on a work related, "need-to-know" basis are allowed access to export-controlled commodities. It is incumbent on the Government Branch Head or Program Manager to determine who should have access to export controlled information. The Security Services Branch, the Office of Chief Counsel, and the Center Export Administrator are available for guidance to the Government Branch Head or Program Manager.
 - (6) LPRs are permitted to carry personal mobile devices on Center. Personal mobile devices are not to be used to record, store, or process NASA data and are not to be used to take photographs within NASA facilities.
 - (7) LPRs and Foreign Nationals must request and obtain prior approval from Joint Base Langley-Eustis prior to entering Joint Base Langley-Eustis. Access is subject to conditions imposed by Joint Base Langley-Eustis and may require a U.S. citizen escort at all times. Information is available at:
<https://lms.larc.nasa.gov/admin/documents/LF295Jan2014.pdf>.
- (d) Violation of security policies by personnel may result in withdrawal of Center access for the offending personnel and/or contractual actions against the contractor and possible criminal prosecution for violation of export control laws and laws regarding access to Government facilities.

(End of clause)

H.6. LARC 52.204-92 REQUIREMENTS FOR ACCESS TO NASA LANGLEY RESEARCH CENTER (MAY 2019)

- (a) Visitors seeking entry to NASA Langley Research Center using a state-issued driver's license or state-issued personal identification card are advised that identification documents must be compliant with the REAL ID Act of 2005, Public Law 109-13. Information on the REAL ID Act of 2005, Public Law 109-13, requirements can be found at: <http://www.dhs.gov/real-id-public-faqs>. Questions concerning REAL ID can be forwarded to the NASA Langley Badge and Pass Office via email at LaRC-RealId@mail.nasa.gov.
- (b) A state-issued ID that is non-compliant with the REAL ID standards cannot be used for access to the Center.
- (c) The following alternate forms of identification are accepted for NASA LaRC access:
 - (1) Federal employee badges,
 - (2) Passports,
 - (3) Military identification cards,
 - (4) Enhanced Driver's Licenses,
 - (5) U.S. Coast Guard Merchant Mariner Card,
 - (6) Native American tribal document,
 - (7) School identification accompanied by an item from List C.
- (d) Visitors without acceptable identity documents require specific authorization from the Center Chief of Security and escort by permanently badged NASA employees or permanently

badged contractor employees at all times while present on the NASA Langley Research Center.

(End of clause)

H.7. LARC 52.211-104 OBSERVATION OF REGULATIONS AND IDENTIFICATION OF CONTRACTOR'S EMPLOYEES (JAN 2013)

- (a) The Contractor shall require its employees to observe and obey all rules and regulations as prescribed by the authorities at LaRC and other installations including all applicable Federal, NASA, and Langley safety, health, environmental and security regulations.
- (b) At all times while on NASA property, the Contractor shall require its employees, subcontractors, and agents to display a valid NASA issued identification badge. Contractors shall be held accountable for these identification badges, and may be required to validate its active employees on an annual basis with the NASA Office of Security Services. Immediately upon employee termination or contract completion, the Contractor shall return NASA identification badges and facility keys to the NASA LaRC Badge and Pass Office. All NASA identification badges and facility keys remain the property of NASA and the Government reserves the right to invalidate such badges at any time.

(End of clause)

H.8. CONTRACT RESERVE

- (a) The following definitions apply to this clause:

- (1) "Reserve" - Resource not allocated to any specific task but held by the project for unexpected needs.
- (2) "Unencumbered reserve" - Reserves that are free of liens identified by proposers and are held for risks that may be realized during project execution.

The unencumbered cost reserves on the PI-Managed Mission Cost are measured as a percentage against the cost to complete through Phases A/B/C/D. The numerator is the amount of unencumbered cost reserves for Phases A/B/C/D, not including funded schedule reserve. The denominator is the PI-Managed Mission Cost to complete Phases A/B/C/D, including the cost of technical design margin, including funded schedule reserve, and encumbered cost reserve, but not including unencumbered cost reserve.

- (b) The Earth Venture Mission - 2 (EVM-2) Announcement of Opportunity (AO) NNH15ZDA011O required Offerors to include cost reserves, adequate for full mission development and operations. Section 5.6.2 of the AO stipulated adequate unencumbered cost reserves for Phases A/B/C/D were to be a minimum of 25%. Adequate unencumbered reserves were also required for Phases E and F, but the specific percentage was to be proposed by the Offeror.
- (c) The contractor shall maintain a minimum of 25% (based on un-incurred contract value through Phases A/B/C/D) unencumbered cost reserves for Phases A/B/C/D; as well as adequate unencumbered reserves for Phases E and F of not less than 5%.

- (d) The Contractor shall manage the distribution and release of the reserves throughout contract performance. The Contractor shall not distribute reserve allocations for 'profit or fee' for any subcontracted effort, unless it is for a 'change,' pursuant to FAR 52.243-2. The Contractor shall coordinate (and provide a liens list that includes incorporated liens, threats, and unencumbered reserves) with the Contracting Officer prior to the allocation of any reserve amounts to contract costs.
- (e) The contract value includes all unencumbered cost reserves, allocated across CLINs 1 and 2. Upon written request, following the conclusion of all CLIN 1 work, NASA will consider reallocating any uncosted residual value, should any exist, to CLIN 2.
- (f) The Contractor shall report the status of reserve usage on a monthly basis in the Monthly Project Status Report. Upon Government request, the Contractor shall discuss and support any specific lien, including delivery of supplemental documentation, as may be required.

(End of clause)

H.9. TITLE TO PROPERTY UNDER FAR 52.245-1 ALTERNATE II – NO TITLE RETAINED (MAY 2017)

- (a) In furtherance of Title 31 United States Code section 6306 and as provided in FAR 52.245-1(e)(3), Alternate II, the requirements for title to property purchased by the Contractor with funds obligated under this contract are as follows:
 - (1) Title to property purchased by the Contractor with funds obligated under this contract, not otherwise required to be delivered to the U.S. Government, and having a unit acquisition cost of less than \$5,000 shall vest in the Contractor upon acquisition. This clause provides the Contracting Officer's approval before each acquisition as required in FAR 52.245-1(e)(3), Alternate II.
 - (2) Title to property purchased by the Contractor with funds obligated under this contract, not otherwise required to be delivered to the U.S. Government, and having a unit acquisition cost of \$5,000 or more, shall vest in the Contractor upon acquisition.
 - (3) Should this contract be terminated, within 30 calendar days after termination of this contract the Contractor shall submit to the Contracting Officer a complete list of all equipment with a unit acquisition cost of \$5,000 or more acquired under the contract during the entire contract period. This list and the list of property required in FAR 52.245-1(e)(3), Alternate II, shall include a description, manufacturer and model number, date acquired, cost, and condition information.
 - (4) Title to the property specified in paragraph (a)(2) of this clause vests in the Contractor, but the Government retains the right to direct transfer of title to property specified in paragraph (a)(2) of this clause to the Government or to a third party within 12 months after completion or termination of the contract. Such transfer shall not be the basis for any claim by the Contractor.
- (b) Subject to the rights under paragraph (a)(4), the Government is not taking title upon acquisition to any property purchased by the Contractor with funds obligated under this contract; therefore such property does not become "Government property" as defined in FAR 52.245-1.

(End of clause)

(End of Section)

PART II – CONTRACT CLAUSES

SECTION I - CONTRACT CLAUSES

I.1. CLAUSES INCORPORATED BY REFERENCE -- SECTION I

CLAUSE NUMBER	CLAUSE TITLE (DATE)
52.202-1	DEFINITIONS (NOV 2013)
52.203-3	GRATUITIES (APR 1984)
52.203-5	COVENANT AGAINST CONTINGENT FEES (MAY 2014)
52.203-6	RESTRICTIONS ON SUBCONTRACTOR SALES TO THE GOVERNMENT (SEP 2006)
52.203-7	ANTI-KICKBACK PROCEDURES (MAY 2014)
52.203-8	CANCELLATION, RESCISSION, AND RECOVERY OF FUNDS FOR ILLEGAL OR IMPROPER ACTIVITY (MAY 2014)
52.203-10	PRICE OR FEE ADJUSTMENT FOR ILLEGAL OR IMPROPER ACTIVITY (MAY 2014)
52.203-12	LIMITATION ON PAYMENTS TO INFLUENCE CERTAIN FEDERAL TRANSACTIONS (OCT 2010)
52.203-13	CONTRACTOR CODE OF BUSINESS ETHICS AND CONDUCT (OCT 2015)
52.203-14	DISPLAY OF HOTLINE POSTER(S) (OCT 2015) <i>Paragraph (b)(3) Fill In: https://oig.nasa.gov/hotline.html</i>
52.203-19	PROHIBITION ON REQUIRING CERTAIN INTERNAL CONFIDENTIALITY AGREEMENTS OR STATEMENTS (JAN 2017)
52.204-4	PRINTED OR COPIED DOUBLE-SIDED ON POSTCONSUMER FIBER CONTENT PAPER (MAY 2011)
52.204-10	REPORTING EXECUTIVE COMPENSATION AND FIRST-TIER SUBCONTRACT AWARDS (OCT 2016)
52.204-13	SYSTEM FOR AWARD MANAGEMENT MAINTENANCE (OCT 2016)
52.204-18	COMMERCIAL AND GOVERNMENT ENTITY CODE MAINTENANCE (JUL 2016)
52.204-23	PROHIBITION ON CONTRACTING FOR HARDWARE, SOFTWARE, AND SERVICES DEVELOPED OR PROVIDED BY KASPERSKY LAB AND OTHER COVERED ENTITIES (JUL 2018)
52.209-6	PROTECTING THE GOVERNMENT'S INTEREST WHEN SUBCONTRACTING WITH CONTRACTORS DEBARRED, SUSPENDED, OR PROPOSED FOR DEBARMENT (OCT 2015)
52.209-9	UPDATES OF PUBLICLY AVAILABLE INFORMATION REGARDING RESPONSIBILITY MATTERS (JUL 2013)
52.215-2	AUDIT AND RECORDS-NEGOTIATION (OCT 2010) – ALTERNATE II (AUG 2016)
52.215-8	ORDER OF PRECEDENCE--UNIFORM CONTRACT FORMAT (OCT 1997)
52.215-10	PRICE REDUCTION FOR DEFECTIVE CERTIFIED COST OR PRICING DATA (AUG 2011)
52.215-11	PRICE REDUCTION FOR DEFECTIVE CERTIFIED COST OR PRICING DATA - MODIFICATIONS (AUG 2011)
52.215-12	SUBCONTRACTOR CERTIFIED COST OR PRICING DATA (OCT 2010)
52.215-13	SUBCONTRACTOR CERTIFIED COST OR PRICING DATA-MODIFICATIONS (OCT 2010)
52.215-14	INTEGRITY OF UNIT PRICES (OCT 2010) – ALTERNATE I (OCT 1997)
52.215-15	PENSION ADJUSTMENT AND ASSET REVERSIONS (OCT 2010)

52.215-18	REVERSION OR ADJUSTMENT OF PLANS FOR POST RETIREMENT BENEFITS (PRB) OTHER THAN PENSIONS (JUL 2005)
52.215-19	NOTIFICATION OF OWNERSHIP CHANGES (OCT 1997)
52.215-21	REQUIREMENTS FOR CERTIFIED COST OR PRICING DATA AND DATA OTHER THAN CERTIFIED COST OR PRICING DATA--MODIFICATIONS (OCT 2010)
52.215-23	LIMITATIONS ON PASS-THROUGH CHARGES (OCT 2009)
52.216-7	ALLOWABLE COST AND PAYMENT (JUN 2013) - ALTERNATE II (AUG 2012) <i>Paragraph (a)(3) fill-in: 30th</i>
52.216-11	COST CONTRACT – NO FEE (APR 1984) – ALTERNATE I (APR 1984)
52.219-8	UTILIZATION OF SMALL BUSINESS CONCERNS (NOV 2016)
52.219-28	POST AWARD SMALL BUSINESS PROGRAM REPRESENTATION (JUL 2013)
52.222-1	NOTICE TO THE GOVERNMENT OF LABOR DISPUTES (FEB 1997)
52.222-2	PAYMENT FOR OVERTIME PREMIUMS (JUL 1990) <i>Paragraph (a) fill-in: \$0</i>
52.222-3	CONVICT LABOR (JUN 2003)
52.222-21	PROHIBITION OF SEGREGATED FACILITIES (APR 2015)
52.222-26	EQUAL OPPORTUNITY (SEP 2016)
52.222-35	EQUAL OPPORTUNITY FOR VETERANS (OCT 2015)
52.222-36	EQUAL OPPORTUNITY FOR WORKERS WITH DISABILITIES (JUL 2014)
52.222-37	EMPLOYMENT REPORTS ON VETERANS (FEB 2016)
52.222-40	NOTIFICATION OF EMPLOYEE RIGHTS UNDER THE NATIONAL LABOR RELATIONS ACT (DEC 2010)
52.222-50	COMBATING TRAFFICKING IN PERSONS (MAR 2015)
52.222-54	EMPLOYMENT ELIGIBILITY VERIFICATION (OCT 2015)
52.223-6	DRUG-FREE WORKPLACE (MAY 2001)
52.223-18	ENCOURAGING CONTRACTOR POLICIES TO BAN TEXT MESSAGING WHILE DRIVING (AUG 2011)
52.225-1	BUY AMERICAN —SUPPLIES (MAY 2014)
52.225-8	DUTY-FREE ENTRY (OCT 2010)
52.225-13	RESTRICTIONS ON CERTAIN FOREIGN PURCHASES (JUN 2008)
52.227-1	AUTHORIZATION AND CONSENT (DEC 2007) – ALTERNATE I (APR 1984)
52.227-2	NOTICE AND ASSISTANCE REGARDING PATENT AND COPYRIGHT INFRINGEMENT (DEC 2007)
52.227-11	PATENT RIGHTS—OWNERSHIP BY THE CONTRACTOR (MAY 2014) - AS MODIFIED BY NFS 1852.227-11 (APR 2015)
52.227-16	ADDITIONAL DATA REQUIREMENTS (JUN 1987)
52.230-5	COST ACCOUNTING STANDARDS – EDUCATIONAL INSTITUTION (AUG 2016)
52.230-6	ADMINISTRATION OF COST ACCOUNTING STANDARDS (JUN 2010)
52.232-9	LIMITATION ON WITHHOLDING OF PAYMENTS (APR 1984)
52.232-22	LIMITATION OF FUNDS (APR 1984)
52.232-23	ASSIGNMENT OF CLAIMS (MAY 2014)
52.232-25	PROMPT PAYMENT (JAN 2017)
52.232-33	PAYMENT BY ELECTRONIC FUNDS TRANSFER-SYSTEM FOR AWARD MANAGEMENT (OCT 2018)
52.232-39	UNENFORCEABILITY OF UNAUTHORIZED OBLIGATIONS (JUN 2013)
52.232-40	PROVIDING ACCELERATED PAYMENTS TO SMALL BUSINESS SUBCONTRACTORS (DEC 2013)
52.233-1	DISPUTES (MAY 2014) – ALTERNATE I (DEC 1991)
52.233-3	PROTEST AFTER AWARD (AUG 1996) – ALTERNATE I (JUN 1985)

52.233-4	APPLICABLE LAW FOR BREACH OF CONTRACT CLAIM (OCT 2004)
52.242-1	NOTICE OF INTENT TO DISALLOW COSTS (APR 1984)
52.242-3	PENALTIES FOR UNALLOWABLE COSTS (MAY 2014)
52.242-4	CERTIFICATION OF FINAL INDIRECT COSTS (JAN 1997)
52.242-13	BANKRUPTCY (JUL 1995)
52.243-2	CHANGES—COST REIMBURSEMENT (AUG 1987) – ALTERNATE V (APR 1984)
52.243-6	CHANGE ORDER ACCOUNTING (APR 1984)
52.243-7	NOTIFICATION OF CHANGES (JAN 2017) <i>Paragraph (b) fill-in: 7</i> <i>Paragraph (d) fill-in: 14</i>
52.244-2	SUBCONTRACTS (OCT 2010) <i>Paragraph (d) fill-in: Any subcontract to replace any of the subcontracts noted in Paragraph (j) of this clause <u>AND</u> before placing any subcontract with SES Government Solutions (or any other resultant host launch provider). The Contractor shall provide the required notification and information to the Contracting Officer a minimum of 30 calendar days prior to the planned subcontract award date.</i> <i>Paragraph (j) fill-in: Lockheed Martin Space Systems Company, Civil Space (CS) and Advanced Technology Center (LMATC); Colorado State University</i>
52.244-5	COMPETITION IN SUBCONTRACTING (DEC 1996)
52.244-6	SUBCONTRACTS FOR COMMERCIAL ITEMS (JAN 2017)
52.245-1	GOVERNMENT PROPERTY (JAN 2017) – ALTERNATE II (APR 2012)
52.245-9	USE AND CHARGES (APR 2012)
52.246-24	LIMITATION OF LIABILITY—HIGH-VALUE ITEMS (FEB 1997)
52.249-5	TERMINATION FOR CONVENIENCE OF THE GOVERNMENT (EDUCATIONAL AND OTHER NONPROFIT INSTITUTIONS) (AUG 2016)
52.251-1	GOVERNMENT SUPPLY SOURCES (APR 2012)
52.253-1	COMPUTER GENERATED FORMS (JAN 1991)
1852.203-70	DISPLAY OF INSPECTOR GENERAL HOTLINE POSTERS (JUN 2001)
1852.203-71	REQUIREMENT TO INFORM EMPLOYEES OF WHISTLEBLOWER RIGHTS (AUG 2014)
1852.204-76	SECURITY REQUIREMENTS FOR UNCLASSIFIED INFORMATION TECHNOLOGY RESOURCES (JAN 2011)
1852.215-84	OMBUDSMAN (NOV 2011)
1852.216-89	ASSIGNMENT AND RELEASE FORMS (AUG 2016)
1852.223-74	DRUG-AND ALCOHOL-FREE WORKFORCE (NOV 2015)
1852.228-82	INSURANCE — TOTAL IMMUNITY FROM TORT LIABILITY (SEP 2000)
1852.235-70	CENTER FOR AEROSPACE INFORMATION (DEC 2006)
1852.237-72	ACCESS TO SENSITIVE INFORMATION (JUN 2005)
1852.237-73	RELEASE OF SENSITIVE INFORMATION (JUN 2005)
1852.242-78	EMERGENCY MEDICAL SERVICES AND EVACUATION (APR 2001)

I.2. 52.204-21 BASIC SAFEGUARDING OF COVERED CONTRACTOR INFORMATION SYSTEMS (JUN 2016)

(a) Definitions. As used in this clause–

“Covered contractor information system” means an information system that is owned or operated by a contractor that processes, stores, or transmits Federal contract information.

“Federal contract information” means information, not intended for public release, that is provided by or generated for the Government under a contract to develop or deliver a product or service to the Government, but not including information provided by the Government to the public (such as on public websites) or simple transactional information, such as necessary to process payments.

“Information” means any communication or representation of knowledge such as facts, data, or opinions, in any medium or form, including textual, numerical, graphic, cartographic, narrative, or audiovisual (Committee on National Security Systems Instruction (CNSSI) 4009).

“Information system” means a discrete set of information resources organized for the collection, processing, maintenance, use, sharing, dissemination, or disposition of information (44 U.S.C. 3502).

“Safeguarding” means measures or controls that are prescribed to protect information systems.

(b) Safeguarding requirements and procedures.

- (1) The Contractor shall apply the following basic safeguarding requirements and procedures to protect covered contractor information systems. Requirements and procedures for basic safeguarding of covered contractor information systems shall include, at a minimum, the following security controls:
 - (i) Limit information system access to authorized users, processes acting on behalf of authorized users, or devices (including other information systems).
 - (ii) Limit information system access to the types of transactions and functions that authorized users are permitted to execute.
 - (iii) Verify and control/limit connections to and use of external information systems.
 - (iv) Control information posted or processed on publicly accessible information systems.
 - (v) Identify information system users, processes acting on behalf of users, or devices.
 - (vi) Authenticate (or verify) the identities of those users, processes, or devices, as a prerequisite to allowing access to organizational information systems.
 - (vii) Sanitize or destroy information system media containing Federal Contract Information before disposal or release for reuse.
 - (viii) Limit physical access to organizational information systems, equipment, and the respective operating environments to authorized individuals.
 - (ix) Escort visitors and monitor visitor activity; maintain audit logs of physical access; and control and manage physical access devices.
 - (x) Monitor, control, and protect organizational communications (i.e., information transmitted or received by organizational information systems) at the external boundaries and key internal boundaries of the information systems.
 - (xi) Implement subnetworks for publicly accessible system components that are physically or logically separated from internal networks.
 - (xii) Identify, report, and correct information and information system flaws in a timely manner.

- (xiii) Provide protection from malicious code at appropriate locations within organizational information systems.
- (xiv) Update malicious code protection mechanisms when new releases are available.
- (xv) Perform periodic scans of the information system and real-time scans of files from external sources as files are downloaded, opened, or executed.

(2) Other requirements. This clause does not relieve the Contractor of any other specific safeguarding requirements specified by Federal agencies and departments relating to covered contractor information systems generally or other Federal safeguarding requirements for controlled unclassified information (CUI) as established by Executive Order 13556.

(c) Subcontracts. The Contractor shall include the substance of this clause, including this paragraph (c), in subcontracts under this contract (including subcontracts for the acquisition of commercial items, other than commercially available off-the-shelf items), in which the subcontractor may have Federal contract information residing in or transiting through its information system.

(End of clause)

I.3. 52.223-3 HAZARDOUS MATERIAL IDENTIFICATION AND MATERIAL SAFETY DATA (JAN 1997) - ALTERNATE I (JUL 1995)

- (a) "Hazardous material," as used in this clause, includes any material defined as hazardous under the latest version of Federal Standard No. 313 (including revisions adopted during the term of the contract).
- (b) The offeror must list any hazardous material, as defined in paragraph (a) of this clause, to be delivered under this contract. The hazardous material shall be properly identified and include any applicable identification number, such as National Stock Number or Special Item Number. This information shall also be included on the Material Safety Data Sheet submitted under this contract.

Material (If none, insert "None")	Identification No.
Helium	001025
Ammonia	001003

- (c) This list must be updated during performance of the contract whenever the Contractor determines that any other material to be delivered under this contract is hazardous.
- (d) The apparently successful offeror agrees to submit, for each item as required prior to award, a Material Safety Data Sheet, meeting the requirements of 29 CFR 1910.1200(g) and the latest version of Federal Standard No. 313, for all hazardous material identified in paragraph (b) of this clause. Data shall be submitted in accordance with Federal Standard No. 313, whether or not the apparently successful offeror is the actual manufacturer of these items. Failure to submit the Material Safety Data Sheet prior to award may result in the apparently successful offeror being considered nonresponsible and ineligible for award.
- (e) If, after award, there is a change in the composition of the item(s) or a revision to Federal Standard No. 313, which renders incomplete or inaccurate the data submitted under

paragraph (d) of this clause, the Contractor shall promptly notify the Contracting Officer and resubmit the data.

- (f) Neither the requirements of this clause nor any act or failure to act by the Government shall relieve the Contractor of any responsibility or liability for the safety of Government, Contractor, or subcontractor personnel or property.
- (g) Nothing contained in this clause shall relieve the Contractor from complying with applicable Federal, State, and local laws, codes, ordinances, and regulations (including the obtaining of licenses and permits) in connection with hazardous material.
- (h) The Government's rights in data furnished under this contract with respect to hazardous material are as follows:
 - (1) To use, duplicate and disclose any data to which this clause is applicable. The purposes of this right are to—
 - (i) Apprise personnel of the hazards to which they may be exposed in using, handling, packaging, transporting, or disposing of hazardous materials;
 - (ii) Obtain medical treatment for those affected by the material; and
 - (iii) Have others use, duplicate, and disclose the data for the Government for these purposes.
 - (2) To use, duplicate, and disclose data furnished under this clause, in accordance with paragraph (h)(1) of this clause, in precedence over any other clause of this contract providing for rights in data.
 - (3) The Government is not precluded from using similar or identical data acquired from other sources.
- (i) Except as provided in paragraph (i)(2), the Contractor shall prepare and submit a sufficient number of Material Safety Data Sheets (MSDS's), meeting the requirements of 29 CFR 1910.1200(g) and the latest version of Federal Standard No. 313, for all hazardous materials identified in paragraph (b) of this clause.
 - (1) For items shipped to consignees, the Contractor shall include a copy of the MSDS's with the packing list or other suitable shipping document which accompanies each shipment. Alternatively, the Contractor is permitted to transmit MSDS's to consignees in advance of receipt of shipments by consignees, if authorized in writing by the Contracting Officer.
 - (2) For items shipped to consignees identified by mailing address as agency depots, distribution centers or customer supply centers, the Contractor shall provide one copy of the MSDS's in or on each shipping container. If affixed to the outside of each container, the MSDS's must be placed in a weather resistant envelope.

(End of clause)

I.4. 52.227-14 RIGHTS IN DATA – GENERAL (MAY 2014) – ALTERNATE II (DEC 2007) AND ALTERNATE IV (DEC 2007) - AS MODIFIED BY NFS 1852.227-14 (APR 2015)

- (a) Definitions. As used in this clause—

“Computer database” or “database means” a collection of recorded information in a form capable of, and for the purpose of, being stored in, processed, and operated on by a computer. The term does not include computer software.

“Computer software”—

(1) Means

- (i) Computer programs that comprise a series of instructions, rules, routines, or statements, regardless of the media in which recorded, that allow or cause a computer to perform a specific operation or series of operations; and
- (ii) Recorded information comprising source code listings, design details, algorithms, processes, flow charts, formulas, and related material that would enable the computer program to be produced, created, or compiled.

(2) Does not include computer databases or computer software documentation.

“Computer software documentation” means owner’s manuals, user’s manuals, installation instructions, operating instructions, and other similar items, regardless of storage medium, that explain the capabilities of the computer software or provide instructions for using the software.

“Data” means recorded information, regardless of form or the media on which it may be recorded. The term includes technical data and computer software. The term does not include information incidental to contract administration, such as financial, administrative, cost or pricing, or management information.

“Form, fit, and function data” means data relating to items, components, or processes that are sufficient to enable physical and functional interchangeability, and data identifying source, size, configuration, mating and attachment characteristics, functional characteristics, and performance requirements. For computer software it means data identifying source, functional characteristics, and performance requirements but specifically excludes the source code, algorithms, processes, formulas, and flow charts of the software.

“Limited rights” means the rights of the Government in limited rights data as set forth in the Limited Rights Notice of paragraph (g)(3) if included in this clause.

“Limited rights data” means data, other than computer software, that embody trade secrets or are commercial or financial and confidential or privileged, to the extent that such data pertain to items, components, or processes developed at private expense, including minor modifications.

“Restricted computer software” means computer software developed at private expense and that is a trade secret, is commercial or financial and confidential or privileged, or is copyrighted computer software, including minor modifications of the computer software.

“Restricted rights,” as used in this clause, means the rights of the Government in restricted computer software, as set forth in a Restricted Rights Notice of paragraph (g) if included in this clause, or as otherwise may be provided in a collateral agreement incorporated in and made part of this contract, including minor modifications of such computer software.

“Technical data” means recorded information (regardless of the form or method of the recording) of a scientific or technical nature (including computer databases and computer software documentation). This term does not include computer software or financial, administrative, cost or pricing, or management data or other information incidental to contract administration. The term includes recorded information of a scientific or technical nature that is included in computer databases (See 41 U.S.C. 116).

“Unlimited rights” means the rights of the Government to use, disclose, reproduce, prepare derivative works, distribute copies to the public, and perform publicly and display publicly, in any manner and for any purpose, and to have or permit others to do so.

(b) Allocation of rights.

(1) Except as provided in paragraph (c) of this clause, the Government shall have unlimited rights in—

- (i) Data first produced in the performance of this contract;
- (ii) Form, fit, and function data delivered under this contract;

- (iii) Data delivered under this contract (except for restricted computer software) that constitute manuals or instructional and training material for installation, operation, or routine maintenance and repair of items, components, or processes delivered or furnished for use under this contract; and
 - (iv) All other data delivered under this contract unless provided otherwise for limited rights data or restricted computer software in accordance with paragraph (g) of this clause.
- (2) The Contractor shall have the right to—
- (i) Assert copyright in data first produced in the performance of this contract to the extent provided in paragraph (c)(1) of this clause;
 - (ii) Use, release to others, reproduce, distribute, or publish any data first produced or specifically used by the Contractor in the performance of this contract, unless provided otherwise in paragraph (d) of this clause;
 - (iii) Substantiate the use of, add, or correct limited rights, restricted rights, or copyright notices and to take other appropriate action, in accordance with paragraphs (e) and (f) of this clause; and
 - (iv) Protect from unauthorized disclosure and use those data that are limited rights data or restricted computer software to the extent provided in paragraph (g) of this clause.
- (c) Copyright—

- (1) Data first produced in the performance of the contract. Except as otherwise specifically provided in this contract, the Contractor may assert copyright in any data first produced in the performance of this contract. When asserting copyright, the Contractor shall affix the applicable copyright notice of 17 U.S.C. 401 or 402, and an acknowledgment of Government sponsorship (including contract number), to the data when such data are delivered to the Government, as well as when the data are published or deposited for registration as a published work in the U.S. Copyright Office. For data other than computer software, the Contractor grants to the Government, and others acting on its behalf, a paid-up, nonexclusive, irrevocable, worldwide license for all such data to reproduce, prepare derivative works, distribute copies to the public, and perform publicly and display publicly, by or on behalf of the Government. For computer software, the Contractor grants to the Government and others acting on its behalf, a paid-up, nonexclusive, irrevocable, worldwide license for all such computer software to reproduce, prepare derivative works, and perform publicly and display publicly (but not to distribute copies to the public), by or on behalf of the Government. The contractor shall mark each scientific and technical article based on or containing data first produced in the performance of this contract and submitted for publication in academic, technical or professional journals, symposia proceedings or similar works with a notice, similar in all material respects to the following, on the cover or first page of the article, reflecting the Government's non-exclusive worldwide license in the copyright.

GOVERNMENT RIGHTS NOTICE

This work was authored by employees of [insert the name of the Contractor] under Contract No. [insert contract number] with the National Aeronautics and Space Administration. The United States Government retains and the publisher, by accepting the article for publication, acknowledges that the United States Government retains a non-exclusive, paid-up, irrevocable, worldwide license to reproduce, prepare derivative works, distribute copies to the public, and perform publicly and display publicly, or allow

others to do so, for United States Government purposes. All other rights are reserved by the copyright owner.

(End of Notice)

- (2) Data not first produced in the performance of this contract. The Contractor shall not, without the prior written permission of the Contracting Officer, incorporate in data delivered under this contract any data not first produced in the performance of this contract unless the Contractor—
 - (i) Identifies the data; and
 - (ii) Grants to the Government, or acquires on its behalf, a license of the same scope as set forth in paragraph (c)(1) of this clause or, if such data are restricted computer software, the Government shall acquire a copyright license as set forth in paragraph (g)(4) of this clause (if included in this contract) or as otherwise provided in a collateral agreement incorporated in or made part of this contract.
 - (3) Removal of copyright notices. The Government will not remove any authorized copyright notices placed on data pursuant to this paragraph (c), and will include such notices on all reproductions of the data.
- (d) Release, publication, and use of data. The Contractor shall have the right to use, release to others, reproduce, distribute, or publish any data first produced or specifically used by the Contractor in the performance of this contract, except—
- (1) As prohibited by Federal law or regulation (e.g., export control or national security laws or regulations);
 - (2) As expressly set forth in this contract; or
 - (3) If the Contractor receives or is given access to data necessary for the performance of this contract that contain restrictive markings, the Contractor shall treat the data in accordance with such markings unless specifically authorized otherwise in writing by the Contracting Officer.
 - (4)
 - (i) The Contractor agrees not to assert claim to copyright, publish or release to others any computer software first produced in the performance of this contract unless the Contracting Officer authorizes through a contract modification.
 - (ii) The prohibition on "release to others", as set forth in (d)(4)(i), does not prohibit release to another Federal Agency for its use or its contractors' use, as long as any such release is consistent with any restrictive markings on the software. Any restrictive markings on the software shall take precedence over the aforementioned release. Any release to a Federal Agency shall limit use to the Federal Agency or its contractors for Government purposes only. Any other release shall require the Contracting Officer's prior written permission.
 - (iii) If the Government desires to obtain copyright in computer software first produced in the performance of this contract and permission has not been granted as set forth in paragraph (d)(4)(i) of this clause, the Contracting Officer may direct the contractor to assert, or authorize the assertion of, a claim to copyright in such data and to assign, or obtain the assignment of, such copyright to the Government or its designated assignee.
- (e) Unauthorized marking of data.
- (1) Notwithstanding any other provisions of this contract concerning inspection or acceptance, if any data delivered under this contract are marked with the notices

specified in paragraph (g)(3) or (g) (4) if included in this clause, and use of the notices is not authorized by this clause, or if the data bears any other restrictive or limiting markings not authorized by this contract, the Contracting Officer may at any time either return the data to the Contractor, or cancel or ignore the markings. However, pursuant to 41 U.S.C. 4703, the following procedures shall apply prior to canceling or ignoring the markings.

- (i) The Contracting Officer will make written inquiry to the Contractor affording the Contractor 60 days from receipt of the inquiry to provide written justification to substantiate the propriety of the markings;
 - (ii) If the Contractor fails to respond or fails to provide written justification to substantiate the propriety of the markings within the 60-day period (or a longer time approved in writing by the Contracting Officer for good cause shown), the Government shall have the right to cancel or ignore the markings at any time after said period and the data will no longer be made subject to any disclosure prohibitions.
 - (iii) If the Contractor provides written justification to substantiate the propriety of the markings within the period set in paragraph (e)(1)(i) of this clause, the Contracting Officer will consider such written justification and determine whether or not the markings are to be cancelled or ignored. If the Contracting Officer determines that the markings are authorized, the Contractor will be so notified in writing. If the Contracting Officer determines, with concurrence of the head of the contracting activity, that the markings are not authorized, the Contracting Officer will furnish the Contractor a written determination, which determination will become the final agency decision regarding the appropriateness of the markings unless the Contractor files suit in a court of competent jurisdiction within 90 days of receipt of the Contracting Officer's decision. The Government will continue to abide by the markings under this paragraph (e)(1)(iii) until final resolution of the matter either by the Contracting Officer's determination becoming final (in which instance the Government will thereafter have the right to cancel or ignore the markings at any time and the data will no longer be made subject to any disclosure prohibitions), or by final disposition of the matter by court decision if suit is filed.
- (2) The time limits in the procedures set forth in paragraph (e)(1) of this clause may be modified in accordance with agency regulations implementing the Freedom of Information Act (5 U.S.C. 552) if necessary to respond to a request thereunder.
 - (3) Except to the extent the Government's action occurs as the result of final disposition of the matter by a court of competent jurisdiction, the Contractor is not precluded by paragraph (e) of the clause from bringing a claim, in accordance with the Disputes clause of this contract, that may arise as the result of the Government removing or ignoring authorized markings on data delivered under this contract.
- (f) Omitted or incorrect markings.
- (1) Data delivered to the Government without any restrictive markings shall be deemed to have been furnished with unlimited rights. The Government is not liable for the disclosure, use, or reproduction of such data.
 - (2) If the unmarked data has not been disclosed without restriction outside the Government, the Contractor may request, within 6 months (or a longer time approved by the Contracting Officer in writing for good cause shown) after delivery of the data, permission to have authorized notices placed on the data at the Contractor's expense. The Contracting Officer may agree to do so if the Contractor—
 - (i) Identifies the data to which the omitted notice is to be applied;
 - (ii) Demonstrates that the omission of the notice was inadvertent;

- (iii) Establishes that the proposed notice is authorized; and
 - (iv) Acknowledges that the Government has no liability for the disclosure, use, or reproduction of any data made prior to the addition of the notice or resulting from the omission of the notice.
- (3) If data has been marked with an incorrect notice, the Contracting Officer may—
- (i) Permit correction of the notice at the Contractor's expense if the Contractor identifies the data and demonstrates that the correct notice is authorized; or
 - (ii) Correct any incorrect notices.
- (g) Protection of limited rights data and restricted computer software.
- (1) The Contractor may withhold from delivery qualifying limited rights data or restricted computer software that are not data identified in paragraphs (b)(1)(i), (ii), and (iii) of this clause. As a condition to this withholding, the Contractor shall—
 - (i) Identify the data being withheld; and
 - (ii) Furnish form, fit, and function data instead.
 - (2) Limited rights data that are formatted as a computer database for delivery to the Government shall be treated as limited rights data and not restricted computer software.
 - (3) Notwithstanding paragraph (g)(1) of this clause, the contract may identify and specify the delivery of limited rights data, or the Contracting Officer may require by written request the delivery of limited rights data that has been withheld or would otherwise be entitled to be withheld. If delivery of that data is required, the Contractor shall affix the following "Limited Rights Notice" to the data and the Government will treat the data, subject to the provisions of paragraphs (e) and (f) of this clause, in accordance with the notice:

LIMITED RIGHTS NOTICE (DEC 2007)

- (a) These data are submitted with limited rights under Government Contract No. _____ (and subcontract _____, if appropriate). These data may be reproduced and used by the Government with the express limitation that they will not, without written permission of the Contractor, be used for purposes of manufacture nor disclosed outside the Government; except that the Government may disclose these data outside the Government for the following purposes, if any; provided that the Government makes such disclosure subject to prohibition against further use and disclosure:
 - (i) Use (except for manufacture) by support service contractors.
 - (ii) Evaluation by nongovernment evaluators.
 - (iii) Use (except for manufacture) by other contractors participating in the Government's program of which the specific contract is a part.
- (b) This notice shall be marked on any reproduction of these data, in whole or in part.

(End of notice)

- (h) Subcontracting. The Contractor shall obtain from its subcontractors all data and rights therein necessary to fulfill the Contractor's obligations to the Government under this contract. If a subcontractor refuses to accept terms affording the Government those rights, the Contractor shall promptly notify the Contracting Officer of the refusal and shall not proceed with the subcontract award without authorization in writing from the Contracting Officer.

- (i) Relationship to patents or other rights. Nothing contained in this clause shall imply a license to the Government under any patent or be construed as affecting the scope of any license or other right otherwise granted to the Government.

(End of clause)

I.5. 52.227-23 RIGHTS TO PROPOSAL DATA (TECHNICAL) (JUN 1987)

Except for data contained on pages NONE, it is agreed that as a condition of award of this contract, and notwithstanding the conditions of any notice appearing thereon, the Government shall have unlimited rights (as defined in the “Rights in Data—General” clause contained in this contract) in and to the technical data contained in the proposal (OU-X150206P), dated December 2015 [submitted in response to Announcement of Opportunity (AO) NNH15ZDA011O-EVM2], and proposal “OU GeoCarb April 2017” dated April 21, 2017, upon which this contract is based.

(End of clause)

I.6. 52.252-2 CLAUSES INCORPORATED BY REFERENCE (FEB 1998)

This contract incorporates one or more clauses by reference, with the same force and effect as if they were given in full text. Upon request, the Contracting Officer will make their full text available. Also, the full text of a clause may be accessed electronically at this/these address(es):

For Federal Acquisition Regulation (FAR) provisions, see
<https://www.acquisition.gov/?q=browsefar>

For NASA FAR Supplement (NFS) provisions, see
<http://www.hq.nasa.gov/office/procurement/regs/nfstoc.htm>

(End of clause)

I.7. 52.252-6 AUTHORIZED DEVIATIONS IN CLAUSES (APR 1984)

- (a) The use in this solicitation or contract of any Federal Acquisition Regulation (48 CFR Chapter 1) clause with an authorized deviation is indicated by the addition of "(DEVIATION)" after the date of the clause.
- (b) The use in this solicitation or contract of any NASA FAR Supplement (48 CFR 18) clause with an authorized deviation is indicated by the addition of "(DEVIATION)" after the name of the regulation.

(End of clause)

I.8. 1852.225-71 RESTRICTION ON FUNDING ACTIVITY WITH CHINA (DEVIATION) (FEB 2012)

- (a) Definition - “China” or “Chinese-owned company” means the People’s Republic of China, any company owned by the People’s Republic of China or any company incorporated under the laws of the People’s Republic of China.

- (b) Public Laws 112-10, Section 1340(a) and 112-55, Section 539, restrict NASA from contracting to participate, collaborate, coordinate bilaterally in any way with China or a Chinese-owned company using funds appropriated on or after April 25, 2011. Contracts for commercial and non-developmental items are exempted from the prohibition because they constitute purchase of goods or services that would not involve participation, collaboration, or coordination between the parties.
- (c) This contract may use restricted funding that was appropriated on or after April 25, 2011. The contractor shall not contract with China or Chinese-owned companies for any effort related to this contract except for acquisition of commercial and non-developmental items. If the contractor anticipates making an award to China or Chinese-owned companies, the contractor must contact the contracting officer to determine if funding on this contract can be used for that purpose.
- (d) Subcontracts - The contractor shall include the substance of this clause in all subcontracts made hereunder.

(End of clause)

I.9. 1852.231-70 PRECONTRACT COSTS (JUN 1995)

The contractor shall be entitled to reimbursement for costs incurred on or after February 22, 2017 in an amount not to exceed \$2,600,000 that, if incurred after this contract had been entered into, would have been reimbursable under this contract.

(End of clause)

I.10. 1852.234-2 EARNED VALUE MANAGEMENT SYSTEM (DEVIATION) (NOV 2015)

- (a) In the performance of this contract, the Contractor shall use--
 - (1) An Earned Value Management System (EVMS) that has been determined by the Cognizant Federal Agency to be compliant with the EVMS guidelines specified in the American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA) – 748 Standard, Industry Guidelines for Earned Value Management Systems (current version at the time of award) to manage this contract; and
 - (2) Earned Value Management (EVM) procedures that provide for generation of timely, accurate, reliable, and traceable information for the Contract Performance Report (CPR) and the Integrated Master Schedule (IMS) required by the data requirements descriptions in the contract.
- (b) If, at the time of award, the Contractor's EVMS has not been determined by the Cognizant Federal Agency to be compliant with the EVMS guidelines, or the Contractor does not have an existing EVMS that is compliant with the guidelines in the ANSI/EIA-748 Standard (current version at the time of award), the Contractor shall apply the system to the contract and shall take timely action to implement its plan to obtain compliance/validation. The Contractor shall follow and implement the approved compliance/validation plan in a timely fashion. The Government will conduct a Compliance Review to assess the contractor's compliance with its plan, and if the Contractor does not follow the approved implementation schedule or correct all resulting system deficiencies identified as a result of the compliance

review within a reasonable time, the Contracting Officer may take remedial action, that may include, but is not limited to, a reduction in fee.

- (c) The Government will conduct Integrated Baseline Reviews (IBRs). Such reviews shall be scheduled and conducted as early as practicable, and if a pre-award IBR has not been conducted, a post-award IBR should be conducted within 180 calendar days after contract award, or the exercise of significant contract options, or within 60 calendar days after distribution of a supplemental agreement that implements a significant funding realignment or effects a significant change in contractual requirements (e.g., incorporation of major modifications). The objective of IBRs is for the Government and the Contractor to jointly assess the Contractor's baseline to be used for performance measurement to ensure complete coverage of the statement of work, logical scheduling of the work activities, adequate resourcing, and identification of inherent risks. See the NASA IBR Handbook (<http://evm.nasa.gov/handbooks.html>) for guidance.
- (d) Unless a waiver is granted by the Cognizant Federal Agency, Contractor proposed EVMS changes require approval of the Cognizant Federal Agency prior to implementation. The Cognizant Federal Agency shall advise the Contractor of the acceptability of such changes within 30 calendar days after receipt of the notice of proposed changes from the Contractor. If the advance approval requirements are waived by the Cognizant Federal Agency, the Contractor shall disclose EVMS changes to the Cognizant Federal Agency at least 14 calendar days prior to the effective date of implementation.
- (e) The Contractor agrees to provide access to all pertinent records and data requested by the Contracting Officer or a duly authorized representative. Access is to permit Government surveillance to ensure that the Contractor's EVMS complies, and continues to comply, with the EVMS guidelines referenced in paragraph (a) of this clause, and to demonstrate—
 - (1) Proper implementation of the procedures generating the cost and schedule information being used to satisfy the contract data requirements;
 - (2) Continuing application of the accepted company procedures in satisfying the CPR required by the contract through recurring program/project and contract surveillance; and
 - (3) Implementation of any corrective actions identified during the surveillance process.
- (f) The Contractor shall be responsible for ensuring that its subcontractors, identified below, comply with the EVMS requirements of this clause as follows:
 - (1) For subcontracts with an estimated dollar value of \$100 million or more, the following subcontractors shall comply with the requirements of this clause.

N/A
 - (2) For subcontracts with an estimated dollar value of less than \$100 million, the following subcontractors shall comply with the requirements of this clause except for the requirement in paragraph (b), if applicable, to obtain compliance/validation.

Lockheed Martin Space Systems Company, Civil Space (CS) and Advanced Technology Center (LMATC)
- (g) If the contractor identifies a need to deviate from the agreed baseline by working against an Over Target Baseline (OTB) or Over Target Schedule (OTS), the contractor shall submit to

the Contracting Officer a request for approval to begin implementation of an OTB or OTS. This request shall include a top-level projection of cost and/or schedule growth, whether or not performance variances will be retained, and a schedule of implementation for the reprogramming adjustment. The Government will approve or deny the request within 30 calendar days after receipt of the request. Failure of the Government to respond within this 30-day period constitutes approval of the request. Approval of the deviation request does not constitute a change, or the basis for a change, to the negotiated cost or price of this contract, or the estimated cost of any undefinitized contract actions.

(End of clause)

I.11. 1852.239-74 INFORMATION TECHNOLOGY SYSTEM SUPPLY CHAIN RISK ASSESSMENT (SEP 2018) (DEVIATION)

(a) Definitions, as used in this clause.

“Acquire” means to procure with appropriated funds by and for the use of NASA through purchase or lease.

“Information Technology (IT) System” is defined as any equipment or system that is used in the acquisition, storage, retrieval, manipulation and/or transmission of data or information. This includes computers, ancillary and peripheral equipment, software and firmware.

“High-impact information system” means a system for which the loss of confidentiality, integrity, or availability could be expected to have a severe or catastrophic adverse effect on organizational operations, organizational assets, or individuals. A “severe or catastrophic adverse effect” means the loss of confidentiality, integrity, or availability might (1) cause a severe degradation in or loss of mission capability to an extent and duration that the organization is not able to perform one or more of its primary functions; (2) result in major damage to organizational assets; (3) result in major financial loss; or (4) result in severe or catastrophic harm to individuals involving loss of life or serious life threatening injuries.”

“Moderate-impact information system” means a system for which the loss of confidentiality, integrity, or availability could be expected to have a serious adverse effect on organizational operations, organizational assets, or individuals. A “serious adverse effect” means the loss of confidentiality, integrity, or availability might (1) cause a significant degradation in mission capability to an extent and duration that the organization is able to perform its primary functions, but the effectiveness of those functions is significantly reduced; (2) result in significant damage to organizational assets; (3) result in significant financial loss; or (4) result in significant harm to individuals that does not involve loss of life or serious life threatening injuries.

(b) NASA HQ OCIO IT Security Division will review the contractor’s supply chain for the risk of cyber-espionage or sabotage before acquiring any high-impact or moderate- impact IT systems. The OCIO will use the security categorization in the National Institute of Standards and Technology’s (NIST) Federal Information Processing Standard Publication 199, “Standards for Security Categorization of Federal Information and Information Systems” to determine whether an IT system is high-impact or moderate-impact.

(c) The Contractor shall provide the following information for any IT system, or component thereof, to be provided in performance of the contract:

- (1) A brief description of the item(s).
- (2) The vendor/manufacturer’s company name and address.
- (3) If known, the manufacturer’s web site, and the Commercial and Government Entity (CAGE) code.

(d) The Contracting Officer (CO) will provide the information referenced in paragraph (c) of this section to the NASA HQ OCIO IT Security Division, who will assess the risk of cyber-espionage or sabotage and make a determination if the acquisition of the proposed system is in the national interest. NASA shall reject any IT system the NASA HQ OCIO IT Security Division deems to be high impact or moderate impact unless the HQ OCIO determines the acquisition is in the national interest of the United States. NASA reserves the right to make this decision, without providing any detailed explanation to the Contractor. The CO will advise the Contractor when any IT system, or components thereof, to be provided in performance of the contract represents an unacceptable risk to national security and may provide the Contractor with an opportunity to submit an alternative IT system.

(e) The Contractor shall insert the substance of this clause, including this paragraph (e), in all subcontracts involving the development or delivery of any IT system, or components thereof.

(End of clause)

I.12. ADDITIONAL DATA RIGHTS

(a) All data delivered under this contract shall be delivered with unlimited rights as defined in FAR clause 52.227-14, Rights in Data – General, as modified by NFS 1852.227-14 and this clause, unless otherwise specified in this clause.

(b) Pursuant to FAR clause 52.227-14, Rights in Data – General (Alternate II), paragraph (g)(3), the following data shall be delivered with limited rights:

Item Use	Technical Data to be Furnished with Restrictions	Corresponding Item, Component, or Process	Basis for Assertion	Entity Asserting Rights
Thermal Mechanical Unit	Compressor designs resulting from TRW Independent Research and Development Project Nos. 95324144, 96324144, and its first reduction to practice under IRAD project 96310428, Advanced Cryocooler Research.	Thermal Mechanical Unit - Compressor	Developed exclusively at private expense.	Northrop Grumman Systems Corporation, a 2 nd Tier Subcontractor with Lockheed Martin
Thermal Mechanical Unit	Coaxial pulse tube cold heads, cold head technology, and compressor technology based on those developed under the continuing “Advanced Cryocooler Research” TRW IR&D project nos. 95324144, 96324144, 97324144, 98324144, the	Thermal Mechanical Unit – Pulse Tube Cold Head, Compressor Integrated TMU	Developed exclusively at private expense.	Northrop Grumman Systems Corporation, a 2 nd Tier Subcontractor with Lockheed Martin

	continuing “Advanced Cryocooler Development” Projects, 99324706, 00324706, 01324706, and the continuing “Cryocooler Testing” Projects 02335119, 03335119, 04335119, 05335119, 09335119, 10335119, and 33511913 may be used during the performance of the program.			
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(End of clause)

(End of Section)

PART III - LIST OF DOCUMENTS, EXHIBITS, AND OTHER ATTACHMENTS**SECTION J - LIST OF DOCUMENTS, EXHIBITS, AND OTHER ATTACHMENTS****J.1. LIST OF EXHIBITS AND ATTACHMENTS**

The following documents are attached hereto and made a part of this contract:

	TITLE OF DOCUMENT
Exhibit A	Statement of Work (SOW) for Geostationary Carbon Cycle Observatory (GeoCarb) Mission, Version 1.2
Exhibit B	GeoCarb Data Requirements List (DRL) / Data Requirements Document (DRD), Version 1.4
Exhibit C	GeoCarb Mission Assurance Requirements (MAR), Version 1.0
Exhibit D	RESERVED
Exhibit E	IT Security Management Plan, Version 2.0 REDACTED
Exhibit F	Organization Conflicts of Interest (OCI) Plan, Version 1.0 REDACTED
Exhibit G	Government-Furnished Property (GFP), Version 3.0

(End of clause)

(End of Section)

**80LARC17C0001
EXHIBIT A**

Statement of Work

For

**Geostationary Carbon Cycle
Observatory (GeoCarb) Mission**

Version 1.2

August 16, 2019

80LARC17C0001
Exhibit A – Statement of Work (SOW) (Version 1.2)

Document Change Record

Revision	Date	Description of Change
1.0	07/01/2017	Basic version at contract effective date.
1.1	12/20/2017	i. Modify section 1.2, Definitions, to update Mission Control Center (MCC) to Satellite Control Center (SCC), to add GeoCarb Data Operations Center (GDOC), and to add Host Teleport. ii. Modify sections 7.2, Baseline Science Requirements, and 7.3, Threshold Science Requirements, based on the approved Program Level Requirements Appendix (PLRA).
1.2	08/16/2019	Updated via modification 13 to reflect changes based on the extended Phase B and KDP-C activities and to make several administrative changes.

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1.0 Introduction and Definitions

1.1 Introduction

This Statement of Work (SOW) details the work to be performed by the Geostationary Carbon Cycle Observatory (GeoCarb) Contractor and its team members for the NASA Life Cycle Formulation and Implementation Phases A through F. The GeoCarb proposal was selected under the NASA Announcement of Opportunity (AO) NNH15ZDA011O for the Earth Venture Mission - 2 (EVM-2) element of the Earth System Science Pathfinder (ESSP) Program Offices' Earth Venture line.

The primary goals of the GeoCarb mission are to monitor plant health and vegetation stress throughout the Americas, to probe, in unprecedented detail, the natural sources, sinks and exchange processes that control carbon dioxide (CO₂), carbon monoxide (CO), and methane (CH₄) in the atmosphere, and to provide observations and demonstrate methods to realize a transformational advance in the scientific understanding of the global carbon cycle.

1.2 Definitions

GeoCarb Mission	<p>The GeoCarb mission is a Class D science investigation with the primary objective of significantly improving knowledge of terrestrial fluxes of CO₂ and CH₄ at science- and policy-relevant scales. The GeoCarb mission utilizes a multi-channel slit-scan spectrometer based payload that will measure absorption spectra in sunlight reflected from the ground to infer the atmosphere-column concentrations of CO₂, CH₄, and CO. The payload will also measure Solar-Induced Fluorescence (SIF), which provides direct information about photosynthesis.</p> <p>Includes Contractor project management, science investigation, development and deployment of science payload, procurement of host and access to space, algorithm development, science data processing, dissemination and archival, mission operations, public communications program, and end of mission closeout.</p>
GeoCarb Payload	Complete 4-channel spectrograph with warm and cold optics bench, scanning optics, control electronics, thermal control system, and pointing knowledge. Elements include: 4-channel infrared (IR) spectrometer; 2 star trackers.
Satellite Control Center (SCC)	Host provided control center for uploading instrument commands to the Host Teleport and receiving ephemeris and housekeeping data from the Host Teleport.
Host Teleport	Host provided ground communications station for downloading data from the spacecraft, including telemetry, tracking, and command (TT&C) information; housekeeping, science, and ephemeris data. Also, uploads instrument commands received from the SCC to the host spacecraft.
Instrument Operations Center (IOC)	Operations Center located at the instrument development subcontractor that receives commands from the Science Operations Center and sends them to the SCC. Also receives Housekeeping data from the SCC.

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Science Operations Center (SOC)	Operations Center located at the Contractor’s facility that develops the commands and sends them to the IOC to be provided to the SCC; processes Level 1 and Level 2 data; distributes data products to scientific community.
GeoCarb Data Operations Center (GDOC)	Performs all science data processing in order to produce Level 0, Level 1a, Level 1b, and Level 2 data products.

2.0 Scope of Work

The Contractor shall apply the necessary personnel, expertise, materials, services, equipment, facilities, institutional systems and software, and technical and management processes to accomplish the requirements contained herein. The SOW is organized with the following Contract Line Item Number (CLIN) structure:

- CLIN 1 - Phase A and B: The Phase A and Phase B activities of the Formulation Phase focus on refining the GeoCarb mission concept and also on the successful completion of a PDR. Based on the content and results of the PDR, the GeoCarb mission will undergo a confirmation review by NASA Headquarters for final authorization to proceed with the subsequent development phases leading to launch and on-orbit operations. This section defines the requirements of both the Phase A Concept Development and Phase B Preliminary Design effort for the GeoCarb mission. The Contractor’s GeoCarb design activities shall cover all mission implementation activities, including those relevant to integration, test, launch, and operations on a Contractor-provided host mission spacecraft and launch vehicle. The Contractor’s design activities shall include all necessary and required activities to result in the execution of a successful Systems Requirement Review (SRR)/Mission Definition Review (MDR) in Phase A and a successful PDR in Phase B, including support for the Key Decision Point (KDP)-B and KDP-C reviews.
- CLIN 2 - Phases C, D, E, and F: This section details the work to be performed by the Contractor and its team members for the NASA Life Cycle Implementation Phase. The Implementation Phase focuses on the detailed design and development Phase (Phase C); GeoCarb payload manufacturing, verification, delivery to and integration with the Contractor-provided host mission spacecraft, launch on a Contractor-provided host mission launch vehicle, and on-orbit commissioning (Phase D); the science operations phase following spacecraft commissioning (Phase E); and mission closure and data archiving (Phase F). The Contractor shall develop/provide access to the Host Teleport, SCC, IOC, SOC, and GDOC. The Contractor shall provide for the integration of the GeoCarb payload onto a Contractor-provided host mission spacecraft and launch vehicle. Following launch, the Contractor shall provide the necessary engineering and science resources to perform initial on-orbit checkout and characterization of the GeoCarb payload and shall conduct science operations for the duration of the mission.

All other SOW sections herein, unless specifically defined as CLIN 1 or CLIN 2, apply to both CLINs.

3.0 Applicable Documents, Reference Documents, Documentation and Contract Data Requirements List

3.1 Applicable Documents

The following documents are applicable to this SOW to the extent specified herein:

ESSP Program Plan, Appendix II	Program Level Requirements Appendix (PLRA), GeoCarb Project
Goddard Space Flight Center (GSFC) Standard (STD) 1000 Rev G	Goddard Technical Standard: Rules for the Design, Development, Verification, and Operation of Flight Systems (Gold Rules)
NASA Procedural Requirement (NPR) 7120.5E	NASA Space Flight Program and Project Management Requirements
NPR 7123.1B	NASA Systems Engineering Processes and Requirements
NPR 7150.2B	NASA Software Engineering Requirements

When requirements conflicts exist between this SOW and these applicable documents, the Contractor shall notify the Contracting Officer that there is such a conflict and request direction from the Contracting Officer as to how to proceed.

3.2 Reference Documents

The Contractor GeoCarb Proposal (OU-X150206P) selected under the EVM-2 AO NNH15ZDA0110 is the basis on which this contract award is made and is utilized as the basis upon which the requirements of this contract are based. However, the requirements of this SOW and its associated contract establish the contractual obligations of the parties.

3.3 Documentation and Contract Data Requirements List

The Contractor shall develop, deliver, and maintain all documentation required by contract Exhibit B, Data Requirements List (DRL)/Data Requirements Description (DRD), even if not otherwise referenced within this SOW. The Contractor shall preserve, for a period of three (3) years after acceptance of all deliverable items (see FAR 52.227-16, Additional Data Requirements), all appropriate documentation required to maintain a traceable record of engineering and programmatic decisions and hardware characteristics and performance, whether formal or informal. The Government reserves the right to review this documentation upon written request by the Contracting Officer.

4.0 Management

The Contractor shall provide the management functions necessary to perform the contract tasks for Phases A through F, including the planning, organizing, staffing, directing, and controlling of all contract activities so that the requirements can be achieved in the most efficient manner.

The Contractor shall deliver a Formulation Agreement (DRL/DRD PM-1) to establish the technical and acquisition work that must be conducted during formulation and to define the schedule and funding requirements during Phase A and Phase B for that work. The Contractor shall also deliver and maintain a Project Management Plan (DRL/DRD PM-7).

4.1 Work Breakdown Structure

The Contractor shall develop and use a Contract Work Breakdown Structure (CWBS) and CWBS dictionary (DRL/DRD PM-4) to organize the project effort into manageable work elements to organize, manage the execution, and report of the status of the GeoCarb mission. The Contractor shall deliver and utilize a CWBS with a clear breakdown of the effort for the generation and monitoring of costs and lower level schedules. The Contractor shall deliver the CWBS and companion element descriptions to CWBS level 3 except for CWBS 5.0 Payload which shall be provided at level 4. The Contractor shall provide insight within level 4 Payload elements if there are major procurements or subcontracts within that element. CWBS levels for this effort are as follows:

- Level 1: Contract
- Level 2: CLIN
- Level 3: All CWBS
- Level 4: CWBS 5.0 (Payload) Elements

4.2 Schedule Management

The Contractor shall generate and status an Integrated Master Schedule (IMS) (DRL/DRD PM-3), which incorporates tasks and dependencies/logic for all project elements and provides a top level summary of key project events across the span of the project. The Contractor shall include and highlight the critical path in the IMS. The Contractor shall prepare and maintain a one page Project Summary Master Schedule (PSMS) showing the major reviews, the major milestones, high level linkage of tasks, and the critical path; this PSMS shall be provided to the Government upon request.

The Contractor shall include in the IMS the lower level detailed schedules, consistent with the structure of the GeoCarb CWBS. The Contractor shall ensure the density of milestones incorporated into the task schedules include a minimum of two milestones per month at the rolled-up top level of the schedule. The Contractor shall establish task linkages and incorporate the linkages into these schedules to support what-if analyses and critical path analysis. The Contractor shall incorporate work progress indicators in the task schedules.

The Contractor shall control changes to the schedule baselines to preserve the accuracy of the planning. The Contractor shall status the master schedule in Gantt chart format with the Monthly Project Status Report (MPSR) (DRL/DRD PM-2), to include critical milestones and schedule reserve tracking.

4.3 Financial Management

The Contractor shall use a financial management, control, and reporting system, which shall apply to all financial resources allocated to the GeoCarb mission. The Contractor shall institute the necessary procedures and controls to establish a financial methodology for budget planning and revision, budget and account control, account authorization, accurate cost accrual recording, routine management monitoring, plan vs. actual reporting to level in alignment with CWBS levels stated in Section 4.1 (above), status reporting and, as necessary, timely intercession and correction. Financial status shall be reported to the Government on a monthly basis in accordance with the requirements of NASA Form 533M Financial Management Reports (DRL/DRD PM-5).

4.4 Configuration Management Plan

The Contractor shall develop, document, and maintain a configuration management system to manage and control hardware, software, and documentation for the entire GeoCarb Payload and ground system. The Contractor shall submit a Configuration Management Plan (DRL/DRD PM-6).

4.5 Risk Management Plan

The Contractor shall develop and utilize a Risk Management Plan (DRL/DRD PM-8) for the GeoCarb Mission to ensure successful achievement of the mission objectives within the established resource, funding, and schedule constraints. The Contractor's risk methodology shall provide for regularly scheduled continuous risk assessments and provide a risk summary in the MPSR.

4.6 Descope Plan

The Contractor shall develop and maintain a Descope Plan (included in the Project Management Plan, DRL/DRD PM-7) which identifies pre-defined prioritized actions to recover substantial cost or schedule savings through a prudent reduction or deletion of requirements, science objectives, technical content, or other effort. The Contractor's descope plan shall stipulate the specific descope actions, specify the schedule decision points for the effective execution of the descope, and estimate the projected cost and schedule savings associated with each action. The Contractor shall not execute any descope actions unless implemented in writing by the Contracting Officer.

4.7 Reviews and Meetings

The Contractor shall participate in and support a variety of formal and informal reviews and meetings as set forth below.

4.7.1 Formal Contractor Reviews

4.7.1.1 CLIN 1 (Phases A/B)

The Contractor shall conduct a SRR/MDR at the Contractor's specified location and shall prepare all materials (DRL/DRD RE-1) for this review in accordance with NPR 7120.5E and NPR 7123.1B. The Contractor shall document any planned tailoring of NPR 7120.5E and NPR 7123.1B requirements in the Formulation Agreement.

The Contractor shall conduct a PDR at the Contractor's specified location on the preliminary design status of the GeoCarb Mission. The Contractor shall prepare all materials (DRL/DRD RE-2) for this review in accordance with NPR 7120.5E and NPR 7123.1B. The Contractor shall document any planned tailoring of NPR 7120.5E and NPR 7123.1B requirements in the Formulation Agreement.

NOTE: NASA will designate a chair for the SRR/MDR and PDR reviews. Independent technical experts and other specialists from NASA and non-government organizations will populate the review panel. The Contractor shall coordinate detailed review agendas among the panel

chairman, the Contractor, and NASA.

4.7.1.2 CLIN 2 (Phases C, D, E, and F)

The Contractor shall conduct the following reviews: a Critical Design Review (CDR) (DRL/DRD RE-3); a System Integration Review/Pre-Environmental Review (SIR/PER) (DRL/DRD RE-4); a Systems Acceptance Review (SAR)/Pre-Ship Review (PSR) (DRL/DRD RE-5); an Operational Readiness Review (ORR) (DRL/DRD RE-6); and a Post Launch Assessment Review (PLAR) (DRL/DRD RE-7). The Contractor shall prepare all materials for these reviews in accordance with NPR 7120.5E and NPR 7123.1B (and as tailored for the GeoCarb mission in the DRL/DRD PM-7, Project Management Plan, as applicable).

NOTE: NASA will designate a chair for the reviews. Independent technical experts and other specialists from NASA and non-government organizations will populate the review panel. The Contractor shall coordinate detailed review agendas among the panel chairman, the Contractor, and NASA.

4.7.2 Formal NASA led Project Reviews

4.7.2.1 CLIN 1 (Phase A/B)

The Contractor shall support the preparations and present, as required, at the GeoCarb KDP B and KDP C Reviews.

4.7.2.2 CLIN 2 (Phases C, D, E, and F)

The Contractor shall support the preparations and present, as required by NASA, at the GeoCarb KDPs D, E, and F, the Flight Readiness Review (FRR), the Launch Readiness Review (LRR), Decommissioning Review (DR), End of Prime Mission Review, and Disposal Readiness Review.

4.7.3 Informal Meetings

The Contractor shall prepare technical and programmatic data packages for distribution and presentation at informal meetings.

- For CLIN 1 (Phases A/B), the Contractor shall plan on an average of two (2) trips per year to meet at a TBD NASA facility.
- For CLIN 2 (Phases C, D, E, and F), the Contractor shall plan on an average of four (4) trips per year to meet at a TBD NASA facility.

Note that there may be additional meetings through the use of teleconference or other means that don't require travel.

4.7.4 Weekly and Monthly Progress Briefings

The Contractor shall status mission progress and performance in a weekly telecon with the ESSP Program Office.

The Contractor shall present (telephonically or in person) a Monthly Progress Briefing covering all aspects of the mission including the project cost and schedule status, technical status, peer review results, staffing plans, and subcontractors' cost, schedule, technical, and staffing status (See DRL/DRD PM-2, MPSR, for more detailed content description).

4.8 Earned Value Management

The Contractor shall establish (in Phase A/B), maintain, and use in the performance of this contract, an Earned Value Management System (EVMS), in accordance with contract clause I.8, 1852.234-2, Earned Value Management System (Deviation), that complies with the guidelines in EIA-748, Standard for Earned Value Management Systems (DRL/DRD PM-9, EVMS Plan), including flowing down EVMS requirements to applicable subcontractors. The correlation and integration of these systems and processes shall provide for early indication of cost and schedule problems, and their relation to technical achievement [DRL/DRD PM-10, Contract Performance Report (CPR)].

The Contractor shall present its Performance Measurement Baseline (PMB) plan [DRL/DRD RE-8, Integrated Baseline Review (IBR) Data Package] to the Government prior to PDR (in Phase A/B), and subsequently, when required, following major changes to the baseline. The Government will verify during the IBR, and follow-on IBRs when required, that the Contractor has established and maintains a reliable PMB. The Contractor shall include in the baseline the entire technical scope of work consistent with contract schedule requirements and assigns adequate resources. The Contractor shall utilize effective earned value methods to accurately status contract cost, schedule, and technical performance. The IBR will be used to achieve a mutual understanding of the baseline plan, cost and schedule risk, and the underlying management processes used for planning and controlling the project. The PMB shall be baselined by KDP-C.

5.0 Systems Engineering and Management

The Contractor shall implement and utilize a systems engineering and management approach to manage and verify requirements, perform risk assessments, conduct systems analyses and trade studies, sponsor peer reviews, manage interface control documentation, manage systems budgets, and guide an integrated design and test process, including flow-down, integration, and systems management for related subcontractor efforts. The Contractor shall document systems analyses performed during the execution of these efforts, including the development (in Phases A/B) and utilization of a Systems Engineering Management Plan (SEMP) (DRL/DRD SE-8) that documents how the Contractor plans to perform the systems engineering and management functions.

5.1 Requirements Development, Analysis, Documentation, Verification and Control

The Contractor shall account for all interrelated design, interface, test and operational considerations including electrical, structural, mechanical, thermal, optical, calibration, test, mission operations and data subsystems, as well as interfaces within the GeoCarb payload, between the GeoCarb payload and the spacecraft, between the observatory and launch vehicle, and between the observatory and ground systems. The Contractor shall, as necessary, formulate and conduct trade studies to objectively compare and optimize key requirements options.

The Contractor shall generate a traceability matrix (or other equivalent documentation) to capture the flow-down and hierarchal relationships of requirements from Level I to Level II and from Level II to level III (DRD SE-11, Requirements Verification Matrix). The Contractor shall, based on the traceability matrix, generate a verification matrix (or other equivalent documentation) to document the plan and method of verifying all controlled technical requirements (A variety of verification methods may be employed by the Contractor, including inspection, analysis, demonstration, and test.). The Contractor shall develop and maintain a verification and validation (V&V) plan that documents the V&V approach for meeting GeoCarb mission requirements (DRL/DRD SE-1).

The Contractor shall perform sufficient design analysis to derive lower-tiered requirements, resolve requirements conflicts, confirm predicted performance, evaluate operational margins, and assess design compatibility with expected launch and on-orbit environmental conditions.

5.2 Systems Budgets

The Contractor shall generate, maintain, and control systems budgets for critical technical resources and critical performance margins. The Contractor shall adhere to the Gold Rules contingency guidelines for these budgets and shall provide monthly budget updates with the Contractor's MPSR. An equivalent contingency guideline may be proposed as a substitute by the Contractor, but may not be implemented unless accepted by the Contracting Officer Representative.

6.0 Safety and Mission Assurance

The Contractor shall provide the personnel, materials, and facilities necessary to develop, implement, and maintain a comprehensive Safety and Mission Assurance (SMA) Program in accordance with the Mission Assurance Requirements (MAR) in Contract Exhibit C. The Contractor shall develop a Mission Assurance Plan (MAP) (DRL/DRD MA-1) that addresses the requirements stipulated in the MAR.

The Contractor's SMA program shall apply to the Contractor's efforts, including requirements definition and verification, design and development, procurement, manufacturing and fabrication, assembly, integration and test, ground operations and testing, and launch support, and shall encompass ancillary support functions such as handling and shipping, test record keeping and associated documentation of test data analyses, and all aspects of configured flight article control. The Contractor shall comply with all SMA DRL/DRD requirements (i.e., DRL/DRD MA-1 through MA-21).

7.0 Science

The Contractor shall provide the personnel, materials, equipment and facilities necessary to achieve the science requirements of the GeoCarb mission. The GeoCarb Principal Investigator (PI) shall oversee and direct the science elements of the GeoCarb mission and is wholly responsible to accomplish the GeoCarb mission objectives.

7.1 Science Team

The Contractor shall form a GeoCarb Science Team. The Science Team shall be led by the GeoCarb PI. The purpose of the GeoCarb Science Team is to provide a working forum for the

GeoCarb scientists with the common goal of maximizing the scientific return of the mission within the existing resources. The GeoCarb Science Team provides a forum to address open issues and conflicts resulting from ongoing mission analyses and trade studies. The Contractor shall hold and chair periodic Science Team meetings and shall define and develop the working agendas for this group.

7.2 Baseline Science Requirements

The Contractor shall support the development of the PLRA. The Contractor shall mature the GeoCarb mission that meets the following Baseline Science Requirements:

The GeoCarb Baseline Mission shall provide daily high precision measurements of X_{CO_2} , X_{CH_4} , X_{CO} , and SIF from GEO, which will enable breakthrough improvements in the estimation of CO_2 and CH_4 terrestrial fluxes estimation and resulting science. The measurement requirements include:

- A. Retrieve estimates of the column-averaged dry air mole fractions of X_{CO_2} , X_{CH_4} , X_{CO} , and SIF from space-based measurements collected over all available cloud-free (atmospheric scattering opacity less than 0.3 optical depth), terrestrial sunlit regions between 50° N and 50° S latitude, and within +/-40° E-W longitude of the geostationary placement for 3 years.
- B. Evaluate space-based and ground-based X_{CO_2} , X_{CH_4} , and X_{CO} retrievals from cloud-free soundings collected during scans of at least 3 Total Carbon Column Observing Network (TCCON) sites every three months. Retrieval products for at least 100 cloud-free soundings shall be compared to TCCON column observations to quantify biases and to demonstrate multi-sounding precision of better than:
 1. 0.3% for X_{CO_2} as measured against time integrated TCCON observations at multiple sites,
 2. 0.6% for X_{CH_4} as measured against time integrated TCCON observations at multiple sites, and
 3. 10% or 12 parts per billion (ppb) (whichever is greater) for X_{CO} as measured against time integrated TCCON observations at multiple sites.
- C. GeoCarb shall retrieve estimates of SIF with a Noise Equivalent Spectral Radiance (NESR) that is better than 0.75 W/m²/sr/μm.
- D. Record, validate, publish, and deliver science data records and calibrated geophysical data products to the NASA-assigned Distributed Active Archive Center(s) (DAAC(s)) for use by the scientific community. Characterize the precision and accuracy of all publically delivered and archived science data.

7.3 Threshold Science Requirements

The Contractor shall meet or exceed the following Threshold Science Requirements in the event of a GeoCarb mission descope. (Note: Threshold Science Requirements constitute the minimal acceptable science content for the GeoCarb Mission.).

- A. Retrieve estimates of the column-averaged dry air mole fractions of X_{CO_2} and SIF from space-based measurements collected over all available cloud-free, terrestrial sunlit regions between 50° N and 50° S latitude, and within +/-40° E-W longitude of the

- geostationary placement for 1 year.
- B. Evaluate space-based and ground-based X_{CO_2} retrievals from cloud-free soundings collected during scans of at least 1 TCCON site every three months. Retrieval products for at least 100 cloud-free soundings shall be compared to TCCON observations to quantify biases and demonstrate multi-sounding precision better than 0.6% for X_{CO_2} as measured against ground-based column observations at multiple sites.
 - C. GeoCarb shall retrieve estimates of SIF with a NESR that is better than $1.0 \text{ W/m}^2/\text{sr}/\mu\text{m}$.
 - D. Record, validate, publish, and deliver science data records and calibrated geophysical data products to the NASA assigned DAAC(s) for use by the scientific community. Characterize the precision and accuracy of all publically delivered and archived science data.

7.4 Science Operations

7.4.1 CLIN 1 (Phases A/B)

The Contractor shall perform a preliminary design of the elements that implement the acquisition and routing of the raw science data stream and any temporary buffering of this data in order to minimize the risk of data loss once on the ground.

The Contractor shall perform a preliminary design of the elements that implement the conversion of the raw data into valid research quality data and data products.

The Contractor shall perform a preliminary design of the elements that implement the acquisition, validation, data processing, and eventual data distribution to a designated NASA Earth Science Division (ESD) assigned data center and archiving of the investigation's science data including public access.

7.4.2 CLIN 2 (Phases C, D, E, and F)

The Contractor shall develop, implement, and operate the GeoCarb elements that implement the acquisition and routing of the raw science data stream.

The Contractor shall convert the raw data into valid research quality data and data products.

The Contractor shall develop, implement, and operate the elements that implement the acquisition, validation, data processing, data distribution, and data archiving to a designated NASA ESD assigned data center.

7.5 Payload Calibration Program

7.5.1 CLIN 1 (Phases A/B)

The Contractor shall perform a preliminary design of the elements used to calibrate the GeoCarb payload during ground testing and to monitor and analyze the on-orbit calibration (reference DRD SE-2, Characterization and Calibration Plan).

7.5.2 CLIN 2 (Phases C, D, E, and F)

The Contractor shall calibrate the GeoCarb payload during ground testing and monitor and

analyze the on-orbit calibration (reference DRD SE-2, Characterization and Calibration Plan).

8.0 GeoCarb Payload

8.1 CLIN 1 (Phases A/B)

The Contractor shall provide the personnel, materials, equipment, and facilities necessary to mature the proposed GeoCarb payload to a preliminary design. The GeoCarb payload shall be mounted on a geostationary communications satellite with an appropriate longitude to address a minimum of science objectives 1, 2, and 4 as contained in Section 2.1 of the PLRA. In order to fulfill the Baseline Level 1 Science Requirements (see Section 7.2, above) the specific GeoCarb payload elements shall include: a 4-channel IR spectrometer; 2 star trackers; and an on-board GPS receiver.

8.2 CLIN 2 (Phases C, D, E, and F)

The Contractor shall build, qualify, and provide the GeoCarb payload satisfying all Baseline Science Requirements (see Section 7.2, above). The Contractor shall deliver the GeoCarb payload for integration onto the Contractor-provided host spacecraft and then to the launch integration facility for integration with the launch vehicle. The Contractor shall mount the GeoCarb payload on a geostationary communications satellite with an appropriate longitude to address a minimum of science objectives 1, 2, and 4 as contained in Section 2.1 of the PLRA. In order to fulfill Baseline Level 1 science requirements the specific GeoCarb payload elements shall include: a 4-channel IR spectrometer; 2 star trackers; and an on-board GPS receiver. The Contractor effort shall include the following:

- A. Procure and/or fabricate all required flight-grade parts, components, and subassemblies, including required thermal blanketing.
- B. Perform all required subsystem-level alignment, functional, performance, calibration, and qualification tests.
- C. Perform system-level assembly, integration, alignment, test, calibration, and environmental qualification.
- D. Implement and conduct a verification and test program that verifies and demonstrates the GeoCarb payload's full compliance with functional, performance, and environmental requirements.
- E. Control, record, and archive build records, including photographic records.
- F. Prepare and document the required integration and test planning, including test objectives, test scenarios, and objective success criteria.
- G. Prepare, document, and archive the as-run test procedures and/or test reports including associated data analysis.
- H. Capture and archive all relevant test data.

9.0 Mission Operations and Ground Systems

9.1 CLIN 1 (Phases A/B)

The Contractor shall conduct the necessary requirements development and preliminary design efforts required to mature the design of the IOC, including involvement of all engineering disciplines required to address the various physical and functional design elements of the IOC and GDOC, and the interfaces to the host provided SCC and Host Teleport. The Contractor

shall perform sufficient design analysis to derive lower-tiered requirements, resolve requirements conflicts, confirm predicted performance, evaluate operational margins, and assess design compatibility with expected launch and on-orbit environmental conditions. The Contractor shall address, at a minimum, the following specific aspects in the preliminary design: the layout and interconnect of the mission operations components and operational facilities, staffing strategy, data buffering and archival strategies, observation planning, and coordination with providers of data necessary for the operation of the GeoCarb payload.

The Contractor shall clarify and refine baseline observation plans including, but not limited to, routine (hands-off) operations, initial commissioning and approach to on-orbit checkout, and any unique maintenance, target of opportunity, and on-orbit calibration operations.

9.2 CLIN 2 (Phases C, D, E, and F)

The Contractor Mission Operations and Ground Systems shall focus primarily on managing and operating the GeoCarb payload and processing its science dataset with dependence on the Host Teleport, SCC, IOC, SOC, and GDOC.

The Contractor shall define the instrument-appropriate requirements for the SCC and the interface requirements linking the Host Teleport and SCC with the IOC and GDOC for the purposes of supporting launch operations, on-orbit checkout, and operation of the GeoCarb payload.

The Contractor shall develop, test, and operate the IOC for the purposes of supporting launch operations, on-orbit checkout, and science operations planning of the GeoCarb elements that provide for the acquisition, processing, storing, and distributing of GeoCarb science data. The Contractor shall provide all of the required operator interfaces at the IOC to display, monitor, and analyze the GeoCarb payload operating state, operating condition, and trended behavior; support the mission operation and observation planning; the build of associated commands and command loads; and provide effective communication means for contact and coordination between the Host Teleport and SCC and IOC and GDOC, and between the IOC and SOC and GDOC.

The Contractor shall develop, test, and operate the SOC for the purposes of mission management, mission science requirements, and applications requirements; for final verification of all science products and determination of science campaign objectives; and to host weekly virtual meetings of the Science Team to evaluate/prioritize observations, taking into consideration practical constraints of Earth lighting conditions, seasonal effects, and host constraints to develop the timeline/size for the scan block (The timelines are developed at the IOC.).

The Contractor shall develop and implement nominal observation plans including routine (hands-off) operations, initial commissioning and approach to on-orbit checkout, and any unique maintenance, target of opportunity and on-orbit calibration operations. The Contractor shall develop reports on the status of commissioning activities and shall provide those reports upon request of the Government. Initially these reports shall be on a daily basis and will transition to weekly after two weeks into the commissioning phase assuming operations are nominal. If operations are not nominal, then daily reports shall continue until the operations become nominal. Once the commissioning phase is complete, the Contractor shall develop weekly status reports including the payload on-orbit health and status as well as key payload

performance parameters.

The Contractor shall develop and prepare for implementation, plans and procedures for anomalous operation of the GeoCarb flight or ground systems. The Contractor shall report anomalous operations within 24-hours and non-conformances to NASA in accordance with the GeoCarb Concept of Operations (CONOPS) Document (DRL/DRD SE-5).

10.0 Host Mission

10.1 CLIN 1 (Phases A/B)

The Contractor shall utilize a Contractor-provided host spacecraft and launch provider and coordinate all necessary requirements and studies, including Level II requirements definition, critical GeoCarb payload to host mission and ground systems to host Interface Control Documents (ICDs), environmental and test requirements, and design and analyses requirements for the GeoCarb PDR. The Contractor shall report the status of the host mission activities in the MPSR and at all formal Contractor reviews (reference Section 4.7.1). Status shall include current and planned activities and issues and risks that adversely affect the capability of the spacecraft or launch vehicle to reliably meet GeoCarb requirements.

10.2 CLIN 2 (Phases C, D, E, and F)

The Contractor shall design the GeoCarb payload for integration onto a Contractor-provided host spacecraft. The Contractor shall provide the launch vehicle and onsite and offsite support for the GeoCarb payload launch processing, including, but not limited to, all required safety, integration, testing, and engineering support to process the GeoCarb payload through the launch processing facilities, launch facility, and on the launch vehicle; final flight preparations; launch readiness testing, rehearsals, and simulations, including associated test review and analyses; and monitoring the health and welfare of the GeoCarb payload (coordinated through host provided Host Teleport and SCC) through the launch and subsequent GeoCarb payload on-orbit initializations. The Contractor shall launch the GeoCarb payload to geosynchronous orbit (reference section 8.0, GeoCarb Payload) for operations through the 3-year mission duration.

The Contractor shall report status of the host mission activities in the MPSR and all formal Contractor reviews (reference Section 4.7.1). Status shall include current and planned activities and any issues and risks that adversely affect the capability of the spacecraft or launch vehicle to reliably meet GeoCarb requirements. Additionally, as the launch date approaches, the Contractor shall provide the results of the various launch readiness reviews and the status of any issues affecting the readiness of the spacecraft or launch vehicle to launch.

11.0 Ground Support Equipment

11.1 CLIN 1 (Phases A/B)

The Contractor shall conduct the necessary requirements development and preliminary design efforts required to mature the design of the mechanical and electrical Ground Support Equipment (GSE) required for handling, operating, testing, checking, calibrating, storing, and shipping the GeoCarb payload, including handling and alignment fixtures; test fixtures; calibration targets, other stimulus, and their controllers; GSE required to operate and test the

GeoCarb payload with the spacecraft and the observatory with the launch vehicle; interface simulators; purge equipment; and shipping containers. The Contractor shall include the involvement of all engineering disciplines required to address the various physical and functional design elements of the GSE.

11.2 CLIN 2 (Phases C, D, E, and F)

The Contractor shall design, build, assemble and validate GSE required for handling, operating, testing, calibrating, storing, and shipping the GeoCarb payload, including handling and alignment fixtures, test fixtures, calibration targets and other stimulus and their controllers, GSE required to operate and test the GeoCarb payload, interface simulators, purge equipment and shipping containers. NOTE: Any Contractor GSE directly interfacing with flight interfaces shall satisfy the applicable requirements of the MAR.

The Contractor shall provide the personnel, materials, and facilities necessary to accomplish the following tasks for all GSE developed:

- A. Design, procure, fabricate, and assemble all required GSE parts, components, and assemblies.
- B. Validate, certify, and maintain suitability of GSE for use with flight hardware per the MAR.
- C. Train personnel in the operation and use of the GSE and in the applicable constraints and restrictions related to that use.
- D. Prepare, document, and configuration control operational procedures for use of the GSE with flight hardware.

12.0 Software Development – CLIN 1 (Phases A/B)

The Contractor shall perform a preliminary design of the flight and ground support software required for the functional operation of the GeoCarb payload, Host Teleport, SCC, IOC, GDOC, and GSE required to test out the flight and ground systems. The Contractor shall develop a GeoCarb mission Software Management and Development Plan (SMDP) (DRL/DRD SW-1) that documents the compliance with and applicable tailoring of NASA's NPR 7150.2B to the various mission software elements.

13.0 Flight and Ground Software – CLIN 2 (Phases C, D, E, and F)

The Contractor shall design, implement, and verify all required flight and ground support software required for the functional operation of the GeoCarb payload, the Host Teleport, SCC, IOC, GDOC, and GSE required to test out the flight and ground systems.

The Contractor shall develop a SMDP (DRL/DRD SW-1) for the GeoCarb mission in accordance with NPR 7150.2B and the MAR. The SMDP shall identify each of the flight and ground computer software configuration items (CSCIs), and define software reuse levels [e.g. new development, significant flight heritage, design reuse, commercial off-the-shelf (COTS), modified-off-the-shelf (MOTS)], and specify how the software processes (including NPR 7150.2B) shall be applied or tailored for each CSCI and reuse level.

13.1 Flight Software

The Contractor shall design, implement, and verify the flight software in accordance with the

SMDP (DRL/DRD SW-1) and as stipulated in the Contractor's MAP.

The Contractor shall handle embedded firmware and code executing on processor cores in Field Programmable Gate Arrays (FPGAs) as software and, therefore, are covered by the SMDP (NOTE: FPGAs alone are not strictly treated as software, however certain software engineering practices such as source code control, coding standards, styles and naming conventions, code walkthroughs, shall be applied to FPGAs.). The Contractor shall be compliant with NASA Procedures and Guidelines 500-PG-8700.2.8, Field Programmable Gate Array (FPGA) Development Methodology, issued by GSFC. An equivalent methodology may be proposed as a substitute by the Contractor, but may not be implemented unless accepted by the Contracting Officer Representative.

13.2 Ground Support Software

The Contractor shall design and provide all ground support software necessary to operate, monitor, test, and calibrate the GeoCarb payload. The GSE software shall provide an effective operator interface for the operation and control of the GeoCarb payload, provide algorithms and other computational means to analyze and interpret payload housekeeping and science telemetry, and provide means for capture and archival of all relevant test data.

13.3 Software Test Plan and Test Readiness Review

The Contractor shall develop and implement a Software Test Plan, including documented test procedures and test reports consistent with the software test requirements defined in the SMDP (DRD SW-1).

13.4 Software Test Bed

The Contractor shall establish and maintain a software test bed to verify and validate flight code revisions prior to uploading to the GeoCarb payload and shall be used to verify code prior to installation in the GeoCarb payload and before each upload during the flight phase.

14.0 End-to-End Test – CLIN 2 (Phases C, D, E, and F)

The Contractor shall conduct a functional end-to-end test of the entire GeoCarb payload, including the host spacecraft and the Host Teleport, SCC and ground systems and including input to the GeoCarb payload, through the spacecraft, transmission to Host Teleport, and through the SCC and ground systems to the IOC and GDOC.

15.0 Communications and Public Outreach Program

The Contractor shall develop a Communications and Public Outreach Plan that shall describe a plan and budget for communications and outreach to include print, electronic, and visual media opportunities. This plan shall include participation at NASA booths during conferences and outreach activities during launch. The ability to adapt to new opportunities and to coordinate with and support NASA events shall also be addressed.

15.1 CLIN 1 (Phases A/B)

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Exhibit A – Statement of Work (SOW) (Version 1.2)

The Contractor shall define and document its approach and plans (including content) for a Communications and Public Outreach program to foster community and public awareness of the benefits of the PI's science program.

15.2 CLIN 2 (Phases C, D, E, and F)

The Contractor shall implement the Communication and Public Outreach program developed by the Contractor and approved by NASA during Phase A/B.

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Data Requirements List (DRL) / Data Requirements Description (DRD)

For

Geostationary Carbon Cycle Observatory (GeoCarb) Mission

Version 1.4

August 16, 2019

Document Change Record

Revision	Date	Description of Change
1.0	07/01/2017	Basic version at contract effective date.
1.1	12/20/2017	Various updates to align requirements to NPR 7120.5E.
1.2	03/15/2018	Updates to Safety and Mission Assurance DRL Table 3-6.
1.3	9/14/2018	Updated via modification 6 to modify SE-1 and SE-11 to replace Science and Mission Requirements Document (SMRD) with Mission Definition Requirements Agreement (MDRA) and to modify PM-1 to clarify NASA approval of long lead procurements.
1.4	08/16/2019	Updated via modification 13 to reflect changes based on the extended Phase B and KDP-C activities and to make several administrative changes.

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1.0 INTRODUCTION

This Data Requirements List (DRL) / Data Requirements Description (DRD) document defines the requirements for deliverable documentation to be provided by the Contractor. Section 2.0 includes definitions and instructions for delivery. Section 3.0 presents the DRL item by item, including due dates, quantity, and media format. Section 4.0 provides the DRD for each item listed in the DRL. Each DRD includes use and preparation information. **NOTE:** DRL/DRDs that contain a CLIN reference are only applicable to work performed under that CLIN.

2.0 DEFINITIONS

2.1 DUE DATES/MATURITY – RELATED DEFINITIONS

The following definitions apply to the "DUE DATE, MATURITY." Unless otherwise specified, deadlines are in calendar days.

(a) DUE DATE:

- (1) DACA: (Calendar) Days After Contract Award.

(b) MATURITY:

- (1) Preliminary: An early submission of an item. To be completed as is practicable at the time of preparation. Preliminary submittals are based on the best available current information and are resubmitted when required. Major changes are expected.
- (2) Baseline: The submission of an item 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.
- (3) Final: The complete submission of an item that does not require further revision or updates.
- (4) Update: The item is revised with the best up-to-date information available at the time. Updates require the same "approval/review/information" process as was required for the most recent submission.

2.2 MEDIA - RELATED DEFINITIONS

The following definition applies to the "MEDIA" column of this document. If separate distribution instructions are not specified for separate submission due date/maturity items, then the listed distribution applies to all submissions.)

E Electronic: The Contractor shall deliver data items to a Government specified web portal unless otherwise noted. The Contractor shall notify the Contracting Officer (CO) and Contracting Officer's Representative (COR) of electronic submission of the data item via electronic mail. The Contractor shall provide electronic deliverables in the following Contractor's standard electronic formats unless otherwise approved by the CO or COR:

- Text Documents: PDF (searchable) or Microsoft Word.
- Presentations: PDF (searchable) or Microsoft PowerPoint.
- Spreadsheets: Microsoft Excel.
- Database: Delimited ASCII (American Standard Code for Information Interchange) text files accompanied with database schema document defining

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tables and entries.

- Schedules: PDF and native scheduling software file format (e.g., Microsoft Project, Primavera, etc.).
- 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).

CD/DVD Compact Disc / Digital Video Disc (readable).

O Other: See DRD for additional distribution instructions.

Access The Contractor shall maintain and provide access to data items (including documentation that is produced in the normal business of carrying out the contracted work) in a Government specified web portal, unless otherwise noted in the DRD. Material shall be available for access to NASA representative or delivered for review upon request to the Government utilizing one of the other media selections noted above. NOTE: There is no specific contract requirement or action for delivery of such material and the DRD formats are suggestions for document generation to ensure all required items are addressed.

2.3 CATEGORY - RELATED DEFINITIONS

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

- A Approval: Documentation items in this category require Government approval. The Contractor shall wait until Government approval is provided to begin implementation of the document. If the Contractor has not received approval within 30 calendar days of delivery of a DRD item, the Contractor may proceed as if the document has been approved. If the item is rejected (not approved) and returned with comments for revision, the Contractor shall follow the requirements specified by the CO or COR. For most cases, the Contractor shall resubmit the document within 14 calendar days of receiving comments from the Government.
- R Review: Documentation items in this category require Government review. The Contractor may implement the document if not notified of corrective actions within 14 calendar days after receipt by the Government. If corrective actions are identified, their resolution will be mutually agreed upon and specified by the CO or COR.
- I Information: Documentation items in this category are provided for Government information only. No formal feedback will be provided. Any issues or questions arising from review of the documentation will be addressed at regular oversight meetings.

3.0 DATA REQUIREMENTS LIST

Tables 3-1 through 3-6 comprise the DRL.

Table 3-1 Review DRL

No.	DOCUMENT	DUE DATE, MATURITY	MEDIA	CAT
RE-1	System Requirements Review (SRR) / Mission Definition Review (MDR) Package – CLIN 1	Entrance Products: 14 days prior to SRR/MDR, Final Review Charts: 7 days prior to SRR/MDR, Preliminary Review charts:1 day prior to SRR/MDR, Final	E E E	R R I
RE-2	Preliminary Design Review (PDR) Package – CLIN 1	Entrance Products: 14 days prior to PDR, Final Review Charts: 7 days prior to PDR, Preliminary Review Charts: 1 day prior to PDR, Final	E E E	R R I
RE-3	Critical Design Review (CDR) Package – CLIN 2	Entrance Products: 14 days prior to CDR, Final Review Charts: 7 days prior to CDR, Preliminary Review Charts: 1 day prior to CDR, Final	E E E	R R I
RE-4	System Integration Review (SIR) / Pre-Environmental Review (PER) Package – CLIN 2	Entrance Products: 14 days prior to SIR/PER, Final Review Charts: 7 days prior to SIR/PER, Preliminary Review Charts: 1 day prior to SIR/PER, Final	E E E	R R I
RE-5	System Acceptance Review (SAR) / Pre-Ship Review (PSR) Package – CLIN 2	Entrance Products: 14 days prior to SAR/PSR Final Review Charts: 7 days prior to SAR/PSR, Preliminary Review Charts: 1 day prior to SAR/PSR, Final	E E E	R R I
RE-6	Operational Readiness Review (ORR) Package – CLIN 2	Entrance Products: 14 days prior to ORR Review Charts: 7 days prior to ORR, Preliminary Review Charts: 1 day prior to ORR, Final	E E E	R R I
RE-7	Post Launch Assessment Review (PLAR) Package – CLIN 2	5 days prior to PLAR, Final	E	R
RE-8	Integrated Baseline Review (IBR) Data Package – CLIN 1	14 days after IBR, Baseline Update if re-baseline occurs	E	R

Table 3-2 Project Management DRL

No.	DOCUMENT	DUE DATE, MATURITY	MEDIA	CAT
PM-1	Formulation Agreement – CLIN 1	Baselined by SRR/MDR	E	A
PM-2	Monthly Project Status Report (MPSR)	Monthly, no later than the 15 th calendar day	E	I
PM-3	Integrated Master Schedule (IMS)	Preliminary: 30 DACA	E	R
		Baseline: 30 days prior to PDR	E	A
		Submission Frequency: Monthly, no later than the 15 th calendar day to start in conjunction with PM-1	E	I
PM-4	Contract Work Breakdown Structure (CWBS) and CWBS Dictionary	30 DACA, Baseline Update, as needed	E	A
PM-5	Financial Management Reports	Baseline: 30 DACA Monthly (NF 533M), no later than the 15 th calendar day	E, O	I
PM-6	Configuration Management Plan	21 days prior to SRR, Baseline Update, as needed	E	R
PM-7	Project Management Plan	30 days prior to SRR, Preliminary	E	R
		30 days prior to PDR, Baseline	E	A
		Update, as needed	E	A
PM-8	Risk Management Plan	21 days prior to SRR, Baseline Update, as needed	E	A
PM-9	Earned Value Management System (EVMS) Plan	60 days prior to PDR, Preliminary 14 days after IBR, Baseline Update, as needed if EVMS Architecture changes	E	A
PM-10	Contract Performance Report (CPR)	Draft Reports (1,3,5) for the final 3 Months of Phase A/B (CLIN 1)	E, O	I
		Formats 1,3,5 Monthly (25 th calendar day of the month or next business day) commencing with the start of Phase C through the end of Phase D (CLIN 2)		
PM-11	IT Security Management Plan	See instructions in DRD	E	A
PM-12	Financial Reporting of NASA Property in the Custody of Contractors	See instructions in DRD	E, O	I
PM-13	RESERVED			
PM-14	Patent Rights and Invention Reporting	See instructions in DRD	E, O	A

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No.	DOCUMENT	DUE DATE, MATURITY	MEDIA	CAT
PM-15	Conflicts of Interest Avoidance Plan	See instructions in DRD	E	A
PM-16	Contract Final Report	60 days after Post Mission Data Analysis Period	E, O	A

Table 3-3 Systems Engineering DRL

No.	DOCUMENT	DUE DATE, MATURITY	MEDIA	CAT
SE-1	Verification and Validation (V&V) Plan	30 days prior to SRR/MDR, Preliminary 30 days prior to PDR, Baseline Update, as needed	Access	I
SE-2	Characterization and Calibration Plan	30 days prior to PDR, Preliminary 30 days prior to CDR, Baseline Update, as needed	Access	I
SE-3	Characterization and Calibration Report	30 days prior to SAR/PSR, Baseline Update as needed	Access	I
SE-4	Contamination Control Plan	30 days prior to SRR, Preliminary 30 days prior to PDR, Instrument Content, Baseline; Satellite Content, Preliminary 30 days prior to SAR/PSR, Satellite Content, Baseline Update, as needed	Access	I
SE-5	Concept of Operations (CONOPS) Document	14 days prior to SRR/MDR, Preliminary 14 days prior to PDR, Baseline Update, as needed	Access	I
SE-6	End Item Data Package	30 days after SAR/PSR, Final	Access	I
SE-7	Algorithm Theoretical Basis Document	30 days prior to SRR/MDR, Preliminary 30 days prior to ORR, Baseline Update, as needed	Access	I
SE-8	System Engineering Management Plan (SEMP)	30 days prior to SRR/MDR, Baseline	E	A
SE-9	RESERVED			
SE-10	Interface Control Documents	Upon Request	Access	I
SE-11	Requirements Verification Matrix	30 days prior to PDR, Preliminary 30 days prior to SAR/PSR, Baseline Update, as needed	E	I

Table 3-4 Software DRL

No.	DOCUMENT	DUE DATE, MATURITY	MEDIA	CAT
SW-1	Software Management and Development Plan	30 days prior to SRR, Preliminary 30 days prior to PDR, Baseline Update, as needed	E	R
SW-2	Flight Software (FSW) Test Plan	30 days prior to PDR, Preliminary 30 days prior to CDR, Baseline 30 days prior to Software Test Readiness Review (SWTRR), Final Update, as needed	Access	I
SW-3	Software Compliance Matrix	30 days prior to SRR, Preliminary 30 days prior to PDR, Baseline 30 days prior to CDR, Final Update, as needed	Access	I
SW-4	Software Design Document	30 days prior to PDR, Preliminary 30 days prior to CDR, Baseline 30 days prior to SWTRR, Final Update, as needed	Access	I
SW-5	Software Test Procedures	30 days prior to CDR, Preliminary 30 days prior to SWTRR, Baseline Update, as needed	Access	I
SW-6	Software Test Reports	10 days after test completion	Access	I
SW-7	Software Test Readiness Review (SWTRR) Package	14 days prior to SWTRR, Baseline 7 days prior to SAR, Final	Access	I
SW-8	Software Acceptance Readiness Review (SARR) Package	14 days prior to SARR, Baseline 7 days prior to SARR, Final	Access	I

Table 3-5 Integration and Test DRL

No.	DOCUMENT	DUE DATE, MATURITY	MEDIA	CAT
IT-1	Payload Assembly, Integration, and Test Plan	30 days prior to PDR, Preliminary 30 days prior to CDR, Baseline Update, as needed	Access	I
IT-2	Test Reports	30 days after test completion	Access	I

Table 3-6 Safety and Mission Assurance DRL

No.	DOCUMENT	DUE DATE, MATURITY	MEDIA	CAT
MA-1	Mission Assurance Plan (MAP)	30 days prior to SRR/MDR, Baseline Update, as needed	E	A
MA-2	Quality Manual	60 DACA Update, as needed	Access	I
MA-3	Reporting of Non-Conformances	Monthly	Access	I
MA-4	Reporting of Failures	24 hours after occurrence, Preliminary 2 weeks after determination of root cause, Final Closure Report (Type 1 only)	E	I
MA-5	Tailored Payload Safety Requirements & Compliance Checklist	30 days prior to PDR, Preliminary 30 days prior to SAR/PSR, Baseline	E E	R A
MA-6	Request for a Safety Variance	30 days after identifying variance need	E	A
MA-7	System Safety Program Plan	30 days prior to PDR, Preliminary 30 days prior to SAR/PSR, Baseline	E E	R A
MA-8	Preliminary Hazard Analysis – CLIN 1	30 days prior to PDR	E	A
MA-9	Critical Lift Equipment Safety Analysis	30 days prior to planned critical lifts	Access	I
MA-10	Safety Data Package	30 days prior to PDR, Preliminary 30 days prior to CDR, Update 30 days prior to SAR/PSR, Baseline	E E E	R R A
MA-11	Hazardous Procedures for Payload Integration and Test and Pre-launch Processing – CLIN 2	30 days prior to host SAR/PSR	E	R
MA-12	Orbital Debris Assessment Report (ODAR)	Preliminary Design - 30 days prior to PDR Detailed Design - 45 days prior to CDR Final - 30 days prior to RE-6, ORR	E	A
MA-13	Mishap Preparedness and Contingency Plan	Preliminary - 30 days prior to PDR Interim Update - 60 days prior to Host SIR Baseline - 60 days prior to RE-6, ORR Update, as needed	E	R

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No.	DOCUMENT	DUE DATE, MATURITY	MEDIA	CAT
MA-14	Failure Mode and Effects Analysis (FMEA)	30 days prior to PDR, Preliminary 30 days prior to CDR, Baseline Update, as needed	E	R
MA-15	Parts Stress Analysis	45 days prior to CDR, Baseline 30 days after changes	E	R
MA-16	Limited-Life Items List	30 days prior to PDR, Preliminary 30 days prior to CDR, Baseline 30 days after changes	E	I
MA-17	Monthly Parts List Submittal	Monthly until no more changes are made; starting as soon as available, but no later than 6 months prior to PDR	E	I
MA-18	As Built Parts List (ABPL) – CLIN 2	30 days prior to SIR/PSR	E	R
MA-19	Material Usage Agreement (MUA)	30 days prior to CDR, All MUAs prepared to that date 30 days after identification, Update 15 days prior to SIR/PSR, Final	E	A
MA-20	Material Identification and Usage List (MIUL)	30 days prior to PDR 30 days prior to CDR 30 days after identification of changes	Access	I
MA-21	End of Mission Plan (EOMP) – CLIN 2	Pre-launch - 30 days prior to RE-6, ORR Pre-Decommissioning - 30 days prior to Decommissioning Review Pre-Disposal EOMP - 30 days prior to Disposal Review	E	A

4.0 DESCRIPTION OF REQUIRED DATA (DRD)

4.1 REVIEW DRDS

<p><u>Title:</u> System Requirements Review (SRR) / Mission Definition Review (MDR) Package – CLIN 1</p>	<p><u>DRD No.:</u> RE-1</p>
<p><u>Reference:</u> NASA Procedural Requirement (NPR) 7123.1B, NASA Systems Engineering Processes and Requirements; NPR 7120.5E, NASA Space Flight Program and Project Management Requirements; Statement of Work (SOW) Section 4.7.1</p>	
<p><u>Use:</u> The combined SRR/MDR evaluates whether the functional and performance requirements defined for the system are responsive to the program’s requirements on the project and represent achievable capabilities.</p> <p>The SRR/MDR also evaluates the credibility and responsiveness of the proposed mission/system architecture to the program requirements and constraints, including available resources. The review will assess whether the maturity of the project’s mission/system definition and associated plans are sufficient to begin Phase B.</p>	
<p><u>Related Documents:</u> N/A</p>	
<p><u>Preparation Information:</u> The Contractor shall prepare an SRR/MDR briefing package which shall contain the flow-down of requirements from the GeoCarb Baseline Requirements defined in SOW Section 7.2 down to the major subsystem level and shall satisfy the following entrance and success criteria.</p> <p>Entrance Criteria:</p> <ol style="list-style-type: none"> 1. Programmatic products are ready for review Error! Bookmark not defined. at the maturity levels stated in the governing program/project management NPR. 2. The following primary technical products for hardware and software system elements are available to the cognizant participants prior to the review: <ol style="list-style-type: none"> a. Requirements for system being reviewed and allocation to the next lower level are ready to be baselined after the review comments are incorporated. b. The SEMP is ready to be baselined after review comments are incorporated. 3. Other SRR/MDR work products (as applicable) for hardware and software elements have been made available to the cognizant participants. <ol style="list-style-type: none"> a. Updated* concept definition/architecture, including major trade studies completed and ready to be baselined after review comments are incorporated. b. Risk management plan ready to be baselined after review comments are incorporated. c. Updated risk assessment and mitigations. d. Configuration management plan ready to be baselined after review comments are incorporated. e. Initial document tree or model structure. f. Preliminary verification and validation method identified for each requirement. g. Preliminary system safety analysis. h. Preliminary Technical Performance Measures (TPM) and other key driving requirements. i. Updated* cost and schedule estimates for the project implementation. 	

- j. Updated* documentation of Basis of Estimate (cost and schedule).
- k. Updated* Technology Development Plan.
- l. Updated* technology readiness that has been assessed and documented with technology assets, heritage products, and gaps identified.
- m. Logistics documentation (e.g., preliminary maintenance plan).
- n. System safety and mission assurance plan ready to be baselined after review comments are incorporated.
- o. Preliminary operations concept.
- p. Preliminary engineering development assessment and technical plans to achieve what needs to be accomplished in the next phase.

*Items updated from information provided in the proposal, if needed.

Success Criteria:

1. The proposed mission/system architecture and functional/performance requirements defined for the system are responsive to the parent requirements and the resulting overall concept is achievable with acceptable technical and programmatic margins (cost, schedule, mass, power).
2. The maturity of the requirements definition and associated plans is sufficient to begin Phase B.
3. System and subsystem design approaches and operational concepts exist and are consistent with the requirements set.
4. The project utilizes a sound process for the allocation and control of requirements throughout all levels, and a plan has been defined to complete the requirements definition at lower levels within schedule constraints.
5. Interfaces with external entities and between major internal elements have been identified.
6. Preliminary approaches have been determined for how requirements will be verified and validated.
7. Major risks have been identified and technically assessed, and viable mitigation strategies have been defined.
8. Adequacy of the project's schedule and financial status has been demonstrated.

<u>Title:</u> Preliminary Design Review (PDR) Package – CLIN 1	<u>DRD No.:</u> RE-2
<u>Reference:</u> NPR 7123.1B, NASA Systems Engineering Processes and Requirements; NPR 7120.5E, NASA Space Flight Program and Project Management Requirements; SOW Section 4.7.1	
<u>Use:</u> To evaluate the completeness/consistency of the planning, technical, cost, and schedule baselines developed during formulation. To demonstrate that the preliminary design meets all system requirements (consistent with GeoCarb SOW Section 7.2) with acceptable risk and within the cost and schedule constraints and establishes the basis for proceeding with the detailed design. It will show that the correct design options have been selected, interfaces have been identified, and verification methods have been described.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The Contractor shall prepare a PDR briefing package for the GeoCarb Mission which shall satisfy the following entrance and success criteria.	
<p>Entrance Criteria:</p> <ol style="list-style-type: none"> 1. Programmatic products are ready for review at the maturity levels stated in the governing program/project management NPR. 2. The following primary products are ready for review: <ol style="list-style-type: none"> a. A preliminary design that can be shown to meet requirements and key technical performance measures. b. Updated trending information on the mass margins (for projects involving hardware), power margins (for projects that are powered), and closure of review actions (Requests for Action (RFAs)/Action Items). 3. Other PDR technical products (as applicable) for hardware, software, and human system elements have been made available to the cognizant participants prior to the review: <ol style="list-style-type: none"> a. Subsystem design specifications (hardware and software), with supporting trade-off analyses and data, as required, that are ready to be baselined after review comments are incorporated. b. Updated technology readiness assessment. c. Updated Technology Development Plan. d. Updated risk assessment and mitigation. e. Life-Cycle Cost and IMS that are ready to be baselined after review comments are incorporated. When required, the Joint Confidence Level (JCL) analysis. f. Baseline Integrated Logistics Support Plan (ILSP). g. Applicable technical plans that are ready to be baselined after review comments are incorporated (e.g., technical performance measurement plan, contamination control plan, parts management plan, environments control plan, Electromagnetic Interference/ Electromagnetic Compatibility (EMI/EMC) control plan, payload-to-carrier integration plan, producability/manufacturability program plan, reliability program plan, quality assurance plan). h. Applicable standards that have been identified and incorporated. i. Updated safety analyses and plans. j. Preliminary engineering drawing tree. 	

- k. Interface control documents that are ready to be baselined after review comments are incorporated.
- l. Verification/validation plan that is ready to be baselined after review comments are incorporated.
- m. Plans to respond to regulatory requirements (e.g., Environmental Impact Statement), as required, that are ready to be baselined after review comments are incorporated.
- n. Preliminary Disposal Plan.
- o. Updated technical resource utilization estimates and margins.
- p. Baseline operations concept.

Success Criteria:

1. The top-level requirements—including mission success criteria, TPMs, and any sponsor-imposed constraints—are agreed upon, finalized, stated clearly, and consistent with the preliminary design.
2. The flow down of verifiable requirements is complete and proper or, if not, an adequate plan exists for timely resolution of open items. Requirements are traceable to mission goals and objectives.
3. The program cost, schedule, and JCL analysis (when required) are credible and within program constraints and ready for NASA commitment.
4. The preliminary design is expected to meet the requirements at an acceptable level of risk.
5. Definition of the technical interfaces (both external entities and between internal elements) is consistent with the overall technical maturity and provides an acceptable level of risk.
6. Any required new technology has been developed to an adequate state of readiness, or backup options exist and are supported to make them viable alternatives.
7. The project risks are understood and have been credibly assessed, and plans, a process, and resources exist to effectively manage them.
8. Safety and mission assurance (e.g., safety, reliability, maintainability, quality, and Electrical, Electronic, and Electromechanical (EEE) parts) have been adequately addressed in preliminary designs and any applicable S&MA products (e.g., PRA, system safety analysis, and failure modes and effects analysis) meet requirements, are at the appropriate maturity level for this phase of the program's life cycle, and indicate that the program safety/reliability residual risks will be at an acceptable level.
9. Adequate technical and programmatic margins (e.g., mass, power, memory) and resources exist to complete the development within budget, schedule, and known risks.
10. The operational concept is technically sound, includes (where appropriate) human systems, and includes the flow down of requirements for its execution.
11. Technical trade studies are mostly complete to sufficient detail and remaining trade studies are identified, plans exist for their closure, and potential impacts are understood.
12. The program/project has demonstrated compliance with applicable NASA and implementing Center requirements, standards, processes, and procedures.
13. To Be Determined (TBD) and To Be Reviewed (TBR) items are clearly identified with acceptable plans and schedule for their disposition.
14. Preliminary analysis of the primary subsystems has been completed and summarized, highlighting performance and design margin challenges.
15. Appropriate modeling and analytical results are available and have been considered in the design.
16. Heritage designs have been suitably assessed for applicability and appropriateness.

<u>Title:</u> Critical Design Review (CDR) Package – CLIN 2	<u>DRD No.:</u> RE-3
<u>Reference:</u> NPR 7123.1B, NASA Systems Engineering Processes and Requirements; NPR 7120.5E, NASA Space Flight Program and Project Management Requirements; SOW Section 4.7.1	
<u>Use:</u> The CDR demonstrates that the maturity of the design is appropriate to support proceeding with full-scale fabrication, assembly, integration, and test. CDR determines that the technical effort is on track to complete the flight and ground system development and mission operations, meeting mission performance requirements within the identified cost and schedule constraints.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The Contractor shall prepare a CDR briefing package for the GeoCarb Mission which shall satisfy the following entrance and success criteria. Entrance Criteria: <ol style="list-style-type: none">1. Successful completion of the PDR and responses made to all PDR Requests for Action RFAs or a timely closure plan exists for those remaining open.2. Programmatic products are ready for review at the maturity levels stated in the governing program/project management NPR.3. The following primary products are ready for review:<ol style="list-style-type: none">a. A baselined detailed design that can be shown to meet requirements and key technical performance measures.b. Updated trending information on the mass margins (for projects involving hardware), power margins (for projects that are powered), and closure of review actions (RFA, Review Item Discrepancy (RID), and/or Action Items).4. Other CDR technical work products (as applicable) for hardware, software, and human system elements have been made available to the cognizant participants prior to the review:<ol style="list-style-type: none">a. Product build-to specifications along with supporting trade-off analyses and data that are ready to be baselined after review comments are incorporated.b. Fabrication, assembly, integration, and test plans and procedures are being developed and are ready to be baselined after review comments are incorporated.c. Technical data package (e.g., integrated schematics, spares provisioning list, interface control documents, engineering analyses, and specifications).d. Defined operational limits and constraints.e. Updated technical resource utilization estimates and margins.f. System Acceptance Plans that are ready to be baselined after review comments are incorporated.g. Command and telemetry list.h. Updated verification plan.i. Updated validation plan.j. Preliminary launch site operations plan.k. Preliminary checkout and activation plan.l. Preliminary disposal plan (including decommissioning or termination).m. Updated technology readiness assessment (if accepted at PDR, not required here).n. Updated Technology Development Plan.	

- o. Updated risk assessment and mitigation.
- p. Updated reliability analyses and assessments.
- q. Updated Life-Cycle Costs and IMS.
- r. Updated ILSP.
- s. Previously developed products are compliant with requirements.
- t. Subsystem-level and preliminary operations safety analyses that are ready to be baselined after review comments are incorporated.
- u. Systems and subsystem certification plans and requirements (as needed) that are ready to be baselined after review comments are incorporated.
- v. System safety analysis with associated verifications that is ready to be baselined after review comments are incorporated.

Success Criteria:

1. The detailed design is expected to meet the requirements with adequate margins.
2. Interface control documents are sufficiently mature to proceed with fabrication, assembly, integration, and test, and plans are in place to manage any open items.
3. The program cost and schedule estimates are credible and within program constraints.
4. High confidence exists in the product baseline, and adequate documentation exists or will exist in a timely manner to allow proceeding with fabrication, assembly, integration, and test.
5. The product verification and product validation requirements and plans are complete.
6. The testing approach is comprehensive, and the planning for system assembly, integration, test, and launch site and mission operations is sufficient to progress into the next phase.
7. Adequate technical and programmatic margins (e.g., mass, power, memory) and resources exist to complete the development within budget, schedule, and known risks.
8. Risks to mission success are understood and credibly assessed, and plans and resources exist to effectively manage them.
9. Safety and mission assurance (e.g., safety, reliability, maintainability, quality, and EEE parts) have been adequately addressed in system and operational designs, and any applicable S&MA products (e.g., Probabilistic Risk Assessment (PRA), system safety analysis, and failure modes and effects analysis) meet requirements, are at the appropriate maturity level for this phase of the program's life cycle, and indicate that the program safety/reliability residual risks will be at an acceptable level.
10. The program/project has demonstrated compliance with applicable NASA and implementing Center requirements, standards, processes, and procedures.
11. TBD and TBR items are clearly identified with acceptable plans and schedule for their disposition.
12. Engineering test units, life test units, and/or modeling and simulations have been developed and tested per plan.
13. Material properties tests are completed along with analyses of loads, stress, fracture control, contamination generation, etc.
14. EEE parts have been selected, and planned testing and delivery will support build schedules.
15. The operational concept has matured, is at a CDR level of detail, and has been considered in test planning.

<u>Title:</u> System Integration Review (SIR) / Pre-Environmental Review (PER) Package – CLIN 2	<u>DRD No.:</u> RE-4
<u>Reference:</u> NPR 7123.1B, NASA Systems Engineering Processes and Requirements; NPR 7120.5E, NASA Space Flight Program and Project Management Requirements; SOW Section 4.7.1	
<u>Use:</u> The SIR ensures that the system including the segments, components, and subsystems are available and ready to be integrated into the system. Integration facilities, support personnel, and integration plans and procedures are ready for integration with acceptable risk and within cost and schedule constraints. The PER ensures that the test article (hardware/software), test facility, support personnel, and test procedures are ready for testing and data acquisition, reduction, and control.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The Contractor shall prepare a SIR/PER briefing package for the GeoCarb Mission which shall satisfy the following entrance and success criteria.	
Entrance Criteria:	
SIR	
<ol style="list-style-type: none"> 1. The following primary products are ready for review: <ol style="list-style-type: none"> a. Integration plans baselined at PDR that have been updated and approved. b. Updated trending information on the mass margins (for projects involving hardware), power margins (for projects that are powered), and closure of review actions (RFA, RID, and/or Action Items). c. Preliminary V&V results from any lower tier products that have been verified. 2. Programmatic products are ready for review at the maturity levels stated in the governing program/project management NPR. 3. Integration procedures have been identified and are scheduled for completion prior to their need dates. 4. Segments and/or components are on schedule to be available for integration. 5. Mechanical and electrical interfaces for hardware necessary to start system integration have been verified against the interface control documentation and plans for verification of remaining hardware exist. 6. All functional, unit-level, subsystem, and qualification testing has been conducted successfully or is on track to be conducted prior to scheduled integration. 7. Integration facilities, including clean rooms, ground support equipment, handling fixtures, overhead cranes, and electrical test equipment, are ready or will be available when required. 8. Support personnel are trained. 9. Handling and safety requirements have been documented. 10. All known system discrepancies have been identified, dispositioned, and are on schedule for closure. 11. The quality control organization is ready to support the integration effort. 12. Other SIR technical products (as applicable) for hardware, software, and human system elements have been made available to the cognizant participants prior to the review: <ol style="list-style-type: none"> a. Updated Life-Cycle Costs and IMS. b. Updated design solution definition. 	

- c. Updated interface definition(s).
- d. Updated verification and validation plans.
- e. Final transportation criteria and instructions.
- f. Preliminary mission operations plans.
- g. Preliminary decommissioning plans.
- h. Preliminary disposal plans.

PER

1. The objectives of the testing have been clearly defined and documented, and all of the test plans, procedures, environment, and configuration of the test item(s) support those objectives.
2. Configuration of the system under test has been defined and agreed to. All interfaces have been placed under configuration management or have been defined in accordance with an agreed to plan, and a version description document has been made available to PER participants prior to the review.
3. All applicable functional, unit-level, subsystem, system, and qualification testing has been conducted successfully.
4. All PER-specific materials, such as test plans, test cases, and procedures, have been available to all participants prior to conducting the review.
5. All known system discrepancies have been identified and dispositioned in accordance with an agreed-upon plan.
6. All previous design review success criteria and key issues have been satisfied in accordance with an agreed-upon plan.
7. All required test resources people (including a designated test director), facilities, test articles, test instrumentation, and other test enabling products have been identified and are available to support required tests.
8. Roles and responsibilities of all test participants are defined and agreed to.
9. Test contingency planning has been accomplished, and all personnel have been trained.

Success Criteria:

SIR

1. Integration plans and procedures are on track for completion and approval to support system integration.
2. Previous component, subsystem, and system test results form a satisfactory basis for proceeding to integration.
3. The program cost and schedule estimates are credible and within program constraints.
4. Risks are identified and accepted by program/project leadership, as required.
5. The program/project has demonstrated compliance with applicable NASA and implementing Center requirements, standards, processes, and procedures.
6. TBD and TBR items are clearly identified with acceptable plans and schedule for their dispositions.
7. The integration procedures and work flow have been clearly defined and documented or are on schedule to be clearly defined and documented prior to their need date.
8. The review of the integration plans, as well as the procedures, environment, and configuration of the items to be integrated, provides a reasonable expectation that the integration will proceed successfully.
9. Integration personnel have appropriate training in the integration and health and safety procedures.

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1. Adequate test plans are completed and approved for the system under test.
2. Adequate identification and coordination of required test resources are completed.
3. Previous component, subsystem, and system test results form a satisfactory basis for proceeding into planned tests.
4. Risk level is identified and accepted by program/competency leadership as required.
5. Plans to capture any lessons learned from the test program are documented.
6. The objectives of the testing have been clearly defined and documented, and the review of all the test plans, as well as the procedures, environment, and configuration of the test item, provide a reasonable expectation that the objectives will be met.
7. The test cases have been reviewed and analyzed for expected results, and the results are consistent with the test plans and objectives.
8. Test personnel have received appropriate training in test operation and safety procedures.

<u>Title:</u> System Acceptance Review (SAR) / Pre-Ship Review (PSR) Package – CLIN 2	<u>DRD No.:</u> RE-5
<u>Reference:</u> NPR 7123.1B, NASA Systems Engineering Processes and Requirements; NPR 7120.5E, NASA Space Flight Program and Project Management Requirements; SOW Section 4.7.1	
<u>Use:</u> The SAR/PSR verifies the completeness of the specific end products in relation to their expected maturity level and assesses compliance to the GeoCarb Baseline requirements in SOW Section 7.2. The SAR/PSR examines the system, its end products and documentation, and test data and analyses that support verification. It also ensures that the system has sufficient technical maturity to authorize its shipment to the designated operational facility or launch site.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The mission SAR/PSR data package shall meet the following entrance and success criteria. Entrance Criteria: <ol style="list-style-type: none">1. The following SAR/PSR technical products have been made available to the cognizant participants prior to the review:<ol style="list-style-type: none">a. Results of the SAR/PSRs conducted at the major suppliersb. Product verification resultsc. Product validation resultsd. Documentation that the delivered system complies with the established system acceptance criteriae. Documentation that the system will perform properly in the expected operational environmentf. Technical data package updated to include all test resultsg. Final Certification packageh. Updated risk assessment and mitigation; residual risks are well defined and acceptablei. Successfully completed previous milestone reviewsj. Remaining liens or unclosed actions and plans for closurek. Safe shipping, handling, checkout, and operational plans and procedures Success Criteria: <ol style="list-style-type: none">1. Required tests and analyses are complete and indicate that the system will perform properly in the expected operational environment2. Risks are known and manageable3. System meets the established system acceptance criteria4. Required safe shipping, handling, checkout, and operational plans and procedures are complete and ready for use5. Technical data package is complete and reflects the delivered system6. All applicable lessons learned for organizational improvement and system operations are captured	

<u>Title:</u> Operational Readiness Review (ORR) Package – CLIN 2	<u>DRD No.:</u> RE-6
<u>Reference:</u> NPR 7123.1B, NASA Systems Engineering Processes and Requirements; NPR 7120.5E, NASA Space Flight Program and Project Management Requirements; SOW Section 4.7.1	
<u>Use:</u> The ORR evaluates the readiness of the project to operate the flight system and associated ground system(s) in compliance with defined project requirements and constraints during the operations/sustainment phase of the project life cycle. It examines the actual system characteristics and the procedures used in the system or end products operation and ensure that all system and support (flight and ground) hardware, software, personnel, procedures, and user documentation accurately reflect the deployed state of the system.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The Contractor shall prepare an ORR briefing package for the GeoCarb Mission which shall satisfy the following entrance and success criteria.	
Entrance Criteria: <ol style="list-style-type: none">1. All planned ground-based testing has been completed.2. Test failures and anomalies from verification and validation testing have been resolved, and the results/mitigations/work-arounds have been incorporated into supporting and enabling operational products.3. All operational supporting and enabling products (e.g., facilities, equipment, documents, software tools, databases) that are necessary for nominal and contingency operations have been tested and delivered/installed at the site(s) necessary to support operations.4. Programmatic products are ready for review at the maturity levels stated in the governing program/project management NPR.5. Operations documentation (handbook, procedures, etc.) has been written, verified, and approved.6. Users/operators have been trained on the correct operation of the system.7. Operational contingency planning has been completed, and operations personnel have been trained on their use.8. The following primary products are ready for review:<ol style="list-style-type: none">a. Updated operations plans.b. Updated operational procedures.c. Preliminary decommissioning plan.9. Other ORR technical products have been made available to the cognizant participants prior to the review:<ol style="list-style-type: none">a. Updated cost and schedule.b. Updated as-built hardware and software documentation.c. Preliminary V&V results.d. Preliminary disposal plan.e. Preliminary certification for flight/use.	
Success Criteria: <ol style="list-style-type: none">1. The system, including all enabling products, is determined to be ready to be placed in an operational status.	

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2. All applicable lessons learned for organizational improvement and systems operations have been captured.
3. All waivers and anomalies have been closed.
4. Systems hardware, software, personnel, and procedures are in place to support operations.
5. Operations plans and schedules are consistent with mission objectives.
6. Mission risks have been identified, planned mitigations are adequate, and residual risks are accepted by the program/project manager.
7. Testing is consistent with the expected operational environment.

<u>Title:</u> Post Launch Assessment Review (PLAR) Package – CLIN 2	<u>DRD No.:</u> RE-7
<u>Reference:</u> NPR 7123.1B, NASA Systems Engineering Processes and Requirements; NPR 7120.5E, NASA Space Flight Program and Project Management Requirements; SOW Section 4.7.1	
<u>Use:</u> The PLAR is a post-deployment evaluation of the readiness of the observatories to proceed with full, routine operations. The review evaluates the status, performance, and capabilities of the project evident from the flight operations experience since launch. The review also evaluates the status of the project plans and the capability to conduct the mission with emphasis on near-term operations and mission-critical events. This review is typically held after the early flight operations and initial checkout.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The Contractor shall prepare a PLAR briefing package for the GeoCarb Mission which shall satisfy the following entrance and success criteria.	
Entrance Criteria: <ol style="list-style-type: none">1. The launch and early operations performance, including (when appropriate) the early propulsive maneuver results, are available.2. The observed spacecraft and science payload performance, including payload calibration plans and status, are available.3. The launch vehicle performance assessment and mission implications, including launch sequence assessment and launch operations experience with lessons learned, are completed.4. Programmatic products are ready for review at the maturity levels stated in the governing program/project management NPR.5. The mission operations and ground data system experience, including tracking and data acquisition support and spacecraft telemetry data analysis is available.6. The mission operations organization, including status of staffing, facilities, tools, and mission software (e.g., spacecraft analysis and sequencing), is available.7. In-flight anomalies and the responsive actions taken, including any autonomous fault protection actions taken by the spacecraft or any unexplained spacecraft telemetry, including alarms, are documented.8. The need for significant changes to procedures, interface agreements, software, and staffing has been documented.9. Documentation is updated, including any updates originating from the early operations experience.10. Plans for post-launch development have been addressed.	
Success Criteria: <ol style="list-style-type: none">1. The observed spacecraft and science payload performance agrees with prediction, or if not, is adequately understood so that future behavior can be predicted with confidence.2. All anomalies have been adequately documented and their impact on operations assessed. Further, anomalies impacting spacecraft health and safety or critical flight operations have been properly dispositioned.3. The mission operations capabilities, including staffing and plans, are adequate to accommodate the actual flight performance.	

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4. The program/project has demonstrated compliance with applicable NASA and implementing Center requirements, standards, processes, and procedures.
5. Open items, if any, on operations identified as part of the ORR have been satisfactorily dispositioned.

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<u>Title:</u> Integrated Baseline Review (IBR) Data Package – CLIN 1	<u>DRD No.:</u> RE-8
<u>Reference:</u> SOW Section 4.8; NPR 7120.5E, NASA Space Flight Program and Project Management Requirements; NASA FAR Supplement (NFS) Part 1834; NFS 1852.234-2; Department of Defense Earned Value Management Implementation Guide (EVMIG) (http://guidebook.dema.mil/79/EVMIG.doc) October 2006, Part 2, Section 4	
<u>Use:</u> An IBR is a joint assessment conducted by the Government Program Manager and the Contractor to verify the completeness, realism and accuracy of the Contractor Performance Measurement Baseline. This involves verifying the technical content of the baseline and assessing the realism and accuracy of the related resources (performance budget and IMS.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> IBR Data Packages shall support the IBR objectives stated above for each review. Data packages will be developed and submitted electronically prior to each IBR. The Contractor shall ensure proper flow-down of this requirement to subcontractors per NPR 7120.5E. The IBR Data Package(s) shall contain the following: <ol style="list-style-type: none">1. Program/Business Management and Control Account (CA) Notebooks2. IMS3. Project Risk Register4. EVMS description and related business process descriptions5. Contractor EVMS process documentation6. Control Account Plans (CAP), Basis of Estimates (BOE), Assumptions, and Risks7. CWBS and Dictionary to the CA level8. Organizational Breakdown Structure to the Control Account Manager (CAM) level9. Responsibility Assignment Matrix showing dollars allocated by CA10. Work Authorization Documents (all levels)11. Subcontractor listing by CWBS element and value of subcontracts12. Contractor/Subcontractor EVMS flow-down requirements13. Latest Estimate at Completion (EAC) and supporting documentation14. Baseline Change Requests approved thus far, if applicable15. Baseline Control Logs (Management Reserve, Undistributed Budget, Budget Base)16. All Contract Performance Reports to date17. Control Account/Work Package summary showing:<ol style="list-style-type: none">a. Number of work packages and total value by type of earned value method (overall summaries and by Control Account)b. Number of Planning packages and total Planning Package budgetc. All contract changes to date	

4.2 PROJECT MANAGEMENT DRDS

<u>Title:</u> Formulation Agreement (FA) – CLIN 1	<u>DRD No.:</u> PM-1
<u>Reference:</u> NPR 7120.5E, NASA Space Flight Program and Project Management Requirements, Appendix F.2 & 3; SOW Section 4.0	
<u>Use:</u> The FA represents the project’s response to the Formulation Authorization Document. It establishes technical and acquisition work that needs to be conducted during Formulation and defines the schedule and funding requirements during Phase A and Phase B for that work.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The FA shall include all aspects of the contract effort but shall focus on Phase A-B. The FA shall include a title page with signature block and the following for Phase A-B (note that the FA can also include information about Phases C-F but the FA should focus on the formulation phase): <ol style="list-style-type: none"> 1. Purpose of the project 2. Project formulation framework 3. Project program plan and program control plans milestones and rationale for any differences from the requirements in Table I-4 and I-5 of NPR 7120.5E 4. Project system and subsystem requirements flow down milestones and rationale for any differences from the requirements in Table I-4 and I-5 of NPR 7120.5E 5. Mission scenario, architecture and interfaces milestones and rationale for any differences from the requirements in Table I-4 and I-5 of NPR 7120.5E 6. Trade studies 7. Top risks and their mitigation plans 8. Technology readiness assessment and development 9. Engineering development assessment, prototyping and software models 10. Heritage assessment and validation 11. Acquisition strategy and long lead procurements (The Contractor shall not procure any long lead items not specifically identified in the NASA-approved FA without formal written direction from the Contracting Officer.) 12. Formulation phase reviews 13. Formulation phase cost and schedule estimates 14. Leading indicators (e.g., mass; power) 15. Acronyms 16. Definitions 17. 7120.5E Compliance Matrix 	

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<u>Title:</u> Monthly Project Status Report	<u>DRD No.:</u> PM-2
<u>Reference:</u> SOW Sections 4.2; 4.5; 4.7.4; 5.2; 10.1; 10.2	
<u>Use:</u> These reports will be used to provide an opportunity for monthly discussions between the Contractor and the Government regarding plans and issues and to evaluate contract status.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The Monthly Project Status Report (MPSR) shall be provided in Microsoft PowerPoint charts. The MPSR shall cover all aspects of the contracted effort and include the following for Phases A, B, C, and D: A. <u>Programmatic:</u> <ol style="list-style-type: none">1. Project Status Summary for three months, 2 previous months (historical performance) plus current month (forward looking, reporting month). The “stoplight” chart should give a visual (Green, Yellow, Red) summary for overall technical, schedule, programmatic, and resources. A short status description and action plan should be developed for categories that are identified yellow or red.2. Problems encountered during the reporting period, and anticipated approaches for resolution (including, as appropriate, technical issues, manpower and staffing, supplier and subcontractor issues, etc.).3. Summary of programmatic or technical risks related to the payload design elements that may impact the GeoCarb mission.4. Subcontractor/supplier status (performance, issues, risks, plans, surveillance audits).5. Status of assigned actions.6. Summary report of IMS current activities, critical path(s) and status. The report shall contain a narrative analysis of the schedule status, progress (accomplishments), issues, and schedule reserve status. The Contractor shall base the report on data extracted from the accompanying IMS and shall organize the report in a manner consistent with the CWBS. At a minimum the report shall contain charts and narratives explaining:<ol style="list-style-type: none">a. Scheduled items accomplished since the last reportb. Schedule items forecasted for the next reporting periodc. Narrative explaining changes and impacts to the critical, secondary and tertiary pathsd. A brief description of the current status of each subsystem (consistent with the CWBS) along with descriptions of any existing or potential problems arease. Variances, impacts and workarounds for contract milestones delayed from their baseline datesf. Tasks, activities, and milestones that are constrained within the IMS.g. List of Baseline change requests.h. List of key milestones. Project key milestones are significant milestones in the IMS, the completion of which represent a major accomplishment or the retirement of risk. Examples of key milestones include successful completion of: design reviews, subsystem deliveries to integration & test, release of software builds, etc. The key milestones shall be documented in the IMS through the use of a coding/flagging scheme. The Contractor and government scheduling and project management offices should jointly coordinate establishing the key milestone list for the contract.	

- i. Metrics summarizing all contract milestones, key milestones, and significant project milestones depicting planned versus actual and explanations for variances, e.g., graphic display or tabular report of planned versus actual cumulative milestone status.
7. DRL/DRD products status.
8. Project Financial Summary for three months, 2 previous months (historical performance) plus current month (forward looking, reporting month). The “stoplight” chart should give a visual (Green, Yellow, Red) summary for overall financial, schedule, funding, and reserves. A short status description and action plan/forecast should be developed for categories that are identified yellow or red.
9. Summary of financial liens and threats.
10. Summary and explanation of key Earned Value Management (EVM) parameter performance and trends.

B. Technical:

1. Report of Key Technical Parameters (KTPs) that include status of technical resources and performance budgets based on program design activity and updates driven by those activities. The KTP Report emphasizes updates to KTPs, if any. The fidelity and accuracy of the KTP Report shall be mutually agreed upon. The KTP Report shall include status of current best estimate and contingency based on maturity. KTPs shall include:
 - a. Mass
 - b. Volume (i.e., size/envelope)
 - c. Operational Power, average and peak
 - d. Survival Power
 - e. Data rate for commanding
 - f. Data rate for telemetry, including science data rate, science support data rate, and health and status data rate.
 - g. CPU, memory, I/O bandwidth, and bus traffic utilization
 - h. Programmable logic device utilization
 - i. Radiometric parameters
 - j. End-to-end performance parameters
 - k. Pointing control and knowledge
2. Technical status for system and subsystem design and development activities, including subcontract technical performance.
3. A summary of trend data planning, trending methodology descriptions, and trend data at a level of maturity commensurate with the state of the design and test program.
4. List of the Configuration Control Board proposed and approved changes for Class I changes, as defined in DRL/DRD PM-6, Configuration Management Plan.
5. Risk assessment and status for top risks (amount agreed upon by the Government). Risk assessment and mitigations and opportunities contain data extracted from the Contractor’s Risk Management Database. This item shall provide the results of the risk assessment (the list of identified risks) and the plans, if any, for mitigating each risk. Identify, categorize, and document the risks and mitigation steps per the Contractor’s Risk Management Plan.
6. Identification and status of long-lead purchases/acquisitions or high risk items.

C. Safety and Mission Assurance:

1. The overall Safety and Mission Assurance (S&MA) progress to date broken down in a separate description of each S&MA element in the Mission Assurance Plan (MAP DRD

MA-1). Each description shall include pertinent data and/or graphs to explain any significant results achieved. Each description shall include a list of MA milestones with current status, and a summary of assessment/audit reports, including subcontractors/suppliers and any S&MA risks or concerns.

2. Non-Conformance Summary Lists - See DRD MA-3, Reporting of Non-Conformances.
3. Government-Industry Data Exchange Program (GIDEP) review status/results or information payload and any GIDEP reports generated by the contractor.
4. Organization and key personnel changes.
5. Software and Complex Electronics Assurance metrics and status, including the following:
 - a. Assurance accomplishments and resulting assurance metrics, if any (e.g., for activities such as inspection and test, reviews, Contractor/subcontractor surveys, and audits).
 - b. Subcontractor assurance accomplishments, if any.
 - c. Trends in quality and reliability metric data (e.g., total number of problem reports, including the number of problem reports that were opened and closed in that reporting period).
 - d. Significant problems or issues, if any.
 - e. Plans for upcoming assurance activities, if any.
 - f. Recommendations for Lessons Learned

The MPSR shall cover all aspects of the contracted effort and include the following for Phase E:

- A. Project Status Summary for three months, 2 previous months (historical performance) plus current month (forward looking, reporting month). The “stoplight” chart should give a visual (Green, Yellow, Red) summary for overall technical, schedule, programmatic, and resources. A short status description and action plan should be developed for categories that are identified yellow or red. Significant plans and activities for the following month, including upcoming milestone events depicting critical items of mission status.
- B. Report of KTPs.
- C. Project Financial Summary for three months, 2 previous months (historical performance) plus current month (forward looking, reporting month). The “stoplight” chart should give a visual (Green, Yellow, Red) summary for overall financial, schedule, funding, and reserves. A short status description and action plan/forecast should be developed for categories that are identified yellow or red.
- D. Lien list that includes a summary of encumbrances (realized liens) and liens (both soft and hard liens). The list should include the dollar value associated with the liens and the impact to reserves.
- E. Problems encountered during the reporting period, and anticipated approaches for resolution (including, as appropriate, technical issues, manpower and staffing, supplier and subcontractor issues, etc.).
- F. Status of open issues and problems from prior reporting periods.

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Exhibit B –DRL/DRD (Version 1.4)

<u>Title:</u> Integrated Master Schedule (IMS)	<u>DRD No.:</u> PM-3
<u>Reference:</u> SOW Section 4.2; NPR 7120.5E	
<u>Use:</u> <p>This schedule will provide the contractor’s time-phased plan, in the form of a Critical Path Method (CPM)-based IMS.</p> <p>The IMS conveys the contractor’s current status including actual work accomplishment, forecast to complete for the work remaining, key milestones, task interdependencies, and development phases necessary to accomplish the total scope of work from Authority to Proceed (ATP) to Launch.</p> <p>This IMS will be used to provide and facilitate management insight into contractor baseline establishment, critical path identification, project status, schedule forecasting, schedule risk, and change management to support the evaluation of contractor performance within an integrated cost and schedule environment.</p>	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> <p>The project schedule shall include tasks necessary to accomplish the total scope of work as defined in the CWBS. 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 CWBS. All key milestones shall be clearly identified and logically linked to related tasks. The project schedule shall be created and maintained in management software that supports automated time phasing of tasks, a logic driven critical path, schedule assessment, and trend analysis capabilities.</p> <p>The contract IMS shall be reported through delivery of the following products. All schedule reporting shall be derived from, and traceable to, the contractor’s IMS based on the Contractor’s accounting month. All data contained in the sections shall be consistent, statused monthly, and based on the same cutoff date.</p> <ol style="list-style-type: none"> 1. Summary Schedule – One page, top level, Gantt-type summary document arranged by CWBS that summarizes the contract effort including period of performance and major milestones, critical path, schedule margin, major project phases (e.g., design, fabrication, integration, assembly, etc.), end item deliveries, and current forecast-to-complete. A legend identifying the Contractor’s schedule symbols used and their meaning shall be provided. The Summary Schedule may be incorporated into the MPSR (PM-2) at the Contractor’s discretion. 2. IMS File/Database – an automated logic network database consisting of schedule data for all CWBS 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, fabrication, integration, assembly, 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 key milestones, key subcontractor milestones, end item delivery dates, key data delivery dates, 	

and key Government Furnished Property (GFP) need dates. The database shall contain the appropriate task coding attributes necessary to provide sort, select, and summarization capabilities for, but not limited to, CWBS element, project phase, contract and key milestones, 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.

3. Critical Path Report – This report may be incorporated into the MPSR (PM-2) at the Contractor's discretion. This report shall be an extract or set of views from the contract IMS and identify the critical path, secondary path and tertiary path and include all associated tasks and milestones. The report shall be submitted in a waterfall format and organized in manner such that the path with least amount of slack/float is delineated first and followed by each successive path according to total slack values. This report shall contain a narrative explaining changes and impacts to the critical, secondary and tertiary paths.
4. Schedule Health Report – This report may be incorporated into the Monthly Project Status Report (PM-2) at the Contractor's discretion. This report shall include the output of an automated schedule health check tool that includes, at minimum, 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.

FORMAT:

Submission of IMS deliverables shall be by electronic media. Electronic media submittals of the IMS File/Database shall be in native file format utilizing schedule management software. Narrative reports or assessments shall be in Microsoft Word or PowerPoint and may be included as part of the MPSR (DRD PM-2).

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<u>Title:</u> Contract Work Breakdown Structure (CWBS) and CWBS Dictionary	<u>DRD No.:</u> PM-4
<u>Reference:</u> SOW Section 4.1; NPR 7120.5E	
<u>Use:</u> The CWBS is an organizing structure for: project technical planning and scheduling; cost estimation and budget formulation; defining the scope of SOWs and specifications for contract efforts; project status reporting; and documentation products. The CWBS Dictionary provides a documented vocabulary that describes every element within the CWBS.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> Contents: The CWBS and CWBS Dictionary are two distinct project documents used for defining the approved project scope of work. The contents of each document are detailed in the following paragraphs: <ol style="list-style-type: none">1. CWBS - A logical, hierarchical display of the subdivision of all project work to be completed. The CWBS shall include the approved element title and element number.2. CWBS Dictionary - The CWBS dictionary shall describe and document the work content of every WBS element and relevant efforts associated with each element (e.g., design, development, manufacturing). The CWBS dictionary shall be arranged in the same order as the CWBS. The CWBS dictionary shall include the following for each CWBS element:<ol style="list-style-type: none">a. CWBS element title.b. CWBS element code.c. CWBS element content description (including quantities, relevant associated work, and contract end items where applicable).d. SOW paragraph number.e. Date, revision number, revision authorization and approved changes.f. Contract Identification Number. Format: The CWBS shall be in a chart format showing element relationships, arranged in the same order as the CWBS provided in the Request for Proposal. The CWBS Dictionary shall be ordered in consonance with the CWBS index and shall reference each CWBS element by its identifier and name.	

<u>Title:</u> Financial Management Reports	<u>DRD No.:</u> PM-5
<u>Reference:</u> SOW Section 4.3; NFS 1852.242-73, NASA Contractor Financial Management Reporting; NASA Policy Directive (NPD) 9501.1I, NASA Contractor Financial Management Reporting System; NPR 9501.2E, NASA Contractor Financial Management Reporting	
<u>Use:</u> The NASA Form (NF) 533M provides monthly contractual planned and actual expenditure data as defined by the Government, including subcontractor data. This data is necessary for: Projecting costs and hours to ensure dollar and labor resources realistically support project schedules; Evaluating Contractors' actual cost data in relation to negotiated contract value, estimated costs, and budget forecast data; Planning, monitoring, and controlling project resources; and Accruing cost in NASA's accounting system.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> NASA is required by law to use accrual accounting, which requires cost to be reported in the period in which benefits are received, without regard to time of payment. To facilitate this process, NASA requires its Contractors to report accrued costs on NF 533 reports on cost type contracts. The Baseline and Monthly Financial Management Reports shall include all actual costs for the pre-contract phase as authorized by the Contracting Officer on February 22, 2017.	
Baseline Financial Management Report	
<ul style="list-style-type: none"> A. The Contractor shall prepare a time-phased Baseline Financial Management Report, detailing by month how it plans to incur costs for CLINs 1 and 2 utilizing the NF 533Q format. The Contractor shall prepare and submit the report in accordance with instructions set forth on the reverse side of the NF 533Q Form and NPR 9501.2E. The total estimated cost reflected in the report must equal the contract value unless otherwise directed by the Contracting Officer. B. The Contractor shall submit the Baseline Financial Management Report within 30 calendar days after the effective date of the contract. The Contractor shall revise the report each time a contract modification is executed which increases or decreases the contract estimated cost for a reason other than an overrun, or as otherwise directed by the Contracting Officer; the report shall not be revised to include overrun costs. 	
Monthly Contractor Financial Management Report	
<ul style="list-style-type: none"> A. The Contractor shall submit a Monthly Contractor Financial Management Report in accordance with NFS 1852.242-73. The Contractor shall prepare and submit the form in accordance with the instructions set forth on the reverse side of the form and NPR 9501.2E. B. The Contractor shall submit the report not later than the 15th calendar day of the month following the month being reported. C. The Contractor shall complete Columns 8.a and b using estimates (forecasts) for the succeeding two months. D. The Contractor shall ensure that estimates (forecasts) are the best projection of the actual costs to be reported in column 7.a of the subsequent month's NF 533M. Since NASA uses the Contractor's estimate for the current month (column 8.a of the NF 533M) as accrued costs in its monthly financial statements, the accuracy of these projections are critical to 	

the integrity of NASA’s financial data.

- E. The Contractor shall report costs on the basis of the Contractor’s most current data for actual rates experienced at the time the report is prepared, rather than on the basis of Defense Contract Audit Agency (DCAA) approved provisional billing or bidding rates, or similar. In addition, the Contractor shall make adjustments as needed for actual cost experience to reflect rates reported in its final indirect cost rate proposal submitted after the end of each of its fiscal years in accordance with paragraph (d) of FAR 52.216-7, Allowable Cost and Payment. The Contractor shall explain in the footnotes on the NF 533M report any adjustments made for actual rates as determined by the Contractor in its annual final indirect cost rate proposal.
- F. The Contractor shall include a narrative explanation for variances exceeding plus or minus 10 percent (±10%) between estimated costs shown in the prior month and actual costs shown in the current month at the contract level. (For example, the estimated costs shown for June in column 8.a in the May 533M and the actual June costs shown in column 7.a in the June 533M.)
- G. The 533 reporting for CLINs 1 and 2 shall be consistent with the GeoCarb CWBS at the following levels:
 - (1) Level 1: Contract
 - (2) Level 2: CLIN
 - (3) Level 3: All CWBS
 - (4) Level 4: CWBS 5.0 (Payload) Elements
- H. The Government will consider the Contractor’s accuracy of financial reporting when evaluating the Contractor’s performance in the Contractor Reporting Assessment Reporting System (CPAR).
- I. Column 6 of this report shall include the minimum reporting categories indicated below.

Hours:
Direct Labor Hours (Prime)
Direct Labor Hours (Significant Subcontractor)
<i>Breakdown by significant subcontractor</i>
Total Direct Labor Hours
Labor Cost:
Direct Labor Cost (Prime)
Fringe/Overhead Cost for Labor
Total Direct Labor Cost
Significant Subcontracts:
<i>Breakdown by significant subcontractor</i>
Significant Subcontractor X Labor Cost
Total Significant Subcontractor X Labor Cost
Total Labor Costs
Other Direct Cost – Prime and Significant Subcontractors:
Material
Supplies
Equipment
Software Licenses

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Training
Travel
Other (including all other subcontract costs)
Total ODC:
Overhead
G&A
Reserve
Total Estimated Cost

Additional Distribution Requirements for the Financial Reports: The Contractor shall email all reports to LaRC-DL-NF533@mail.nasa.gov

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<u>Title:</u> Configuration Management Plan	<u>DRD No.:</u> PM-6
<u>Reference:</u> SOW Section 4.4	
<u>Use:</u> Defines the Contractor's configuration management (CM) system (including policies and procedures) that will be implemented for the payload flight hardware and software, and documentation. To facilitate the orderly processing of change requests to specifications or requirements, changes to plans or procedures, specification deviations, waivers, to appropriate level of review, classification, and approval authority for disposition.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The Contractor shall develop and maintain a GeoCarb Configuration Management Plan to address both hardware and software configuration controls. This plan shall explain how the project intends to perform configuration control on flight, mission operations, and ground support equipment. The Contractor shall use the reference documents as a guide in the preparation of the Configuration Management Plan, tailored to meet the Class D program requirements. The plan shall provide the following from both the hardware and software perspective: A. Organization, responsibilities, interfaces, and relationships to the hardware and software life cycle. B. Configuration Management Activities: (1) Configuration Identification, (2) Configuration Control, (3) Configuration Status Accounting, (4) Configuration Audits and Reviews, (5) Interface Control, and (6) Subcontractor Control C. Documentation to be controlled.	

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<u>Title:</u> Project Management Plan	<u>DRD No.:</u> PM-7
<u>Reference:</u> SOW Sections 4.0, 4.6; NPR 7120.5E, NASA Space Flight Program and Project Management Requirements.	
<u>Use:</u> The Project Management Plan defines, at a high level, the scope of the project, the implementation approach, the environment within which the project operates, and the baseline commitments of the program and project.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The Project Management Plan shall include all aspects of the contract effort but shall focus on Phases C-F. Note that documents listed below can be stand alone or included as part of the Project Plan. The Project Plan shall include a title page with signature block and the following for Phase C-F: A. Project overview including: 1. Introduction 2. Project objectives 3. Mission description and technical approach 4. Project authority, governance structure, management structure and implementation approach 5. Stakeholder definition B. Project baselines including: 1. Requirements baseline 2. CWBS baseline 3. Schedule baseline 4. Funding, workforce and infrastructure resource requirements C. Project control plans including: 1. Technical, schedule and cost control plan 2. Safety and Mission Assurance Plan 3. Risk Management Plan 4. Acquisition plan 5. Technology development plan 6. Systems Engineering Management Plan (SEMP) 7. Information technology plan 8. Software management plan 9. Verification and validation plan 10. Review Plan 11. Mission Operations Plan (i.e., CONOPS Document) 12. Environmental Management plan 13. Integrated Logistics Support Plan 14. Science Data Management plan 15. Integration Plan (included in the Payload Assembly, Integration, and Test Plan)) 16. Configuration Management Plan 17. Security Plan 18. Project Protection Plan	

- 19. Technology Transfer (formerly Export) Control plan
- 20. Lessons Learned plan
- 21. Human Rating Certification Package
- 22. Planetary Protection Plan
- 23. Nuclear Safety Launch Approval Plan
- 24. Range Safety Risk Management Process Documentation
- 25. Expendable Launch Vehicle Payload Safety Process Deliverables
- 26. Education Plan
- 27. Communications plan
- D. Descope Plan, as follows:
 - 1. Identify each specific descope option.
 - 2. Specify the impact to the science and non-science aspects of the project.
 - 3. Identify the savings (cost, schedule, mass, power) as a result of implementing each descope and when the descope needs to be implemented to achieve the savings.
- E. Waiver or deviation log
- F. Change log
- G. Acronyms
- H. Definitions
- I. 7120.5E Compliance Matrix

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<u>Title:</u> Risk Management Plan	<u>DRD No.:</u> PM-8
<u>Reference:</u> SOW Section 4.5; NPR 7120.5E, NASA Space Flight Program and Project Management Requirements; NPR 8000.4A, Agency Risk Management Procedural Requirements	
<u>Use:</u> The Risk Management Plan is the basis for identifying and managing all performance, reliability, schedule, cost, and safety risks and opportunities on the Contractor's project.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The Risk Management Plan shall include: A. Description of contract requirements B. Purpose and Scope -Assumptions, Constraints, and Policies C. Reference Documents and Standards D. Risk Management Process Summary (Philosophy, Integration) E. Risk Management Organization 1. Roles and Responsibilities 2. Risk Management Review Board 3. Standard Practices 4. Communication F. Risk Attributes that will be used to classify risks 1. At a minimum, attributes shall be defined for safety, cost, schedule, and technical or performance areas G. Risk burn chart (waterfall chart) H. Criteria for prioritization of risks I. Mitigation plan content J. Process Details 1. Baselines 2. Database (Use, Access, Updates, Responsibilities, etc.) 3. Identifying Risks 4. Analyzing Risks 5. Planning, Actions 6. Tracking (metrics and their use) 7. Control 8. Documentation and Reporting.	

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<u>Title:</u> Earned Value Management System (EVMS) Plan	<u>DRD No.:</u> PM-9
<u>Reference:</u> SOW Section 4.8; NFS 1852.234-2, Earned Value Management System; ANSI/EIA 748-B, Earned Value Management Systems	
<u>Use:</u> To describe the Contractor's proposed EVMS implementation, and how it complies with the provisions in ANSI/EAI 748-B.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> A. The EVMS Plan shall address processes for managing technical scope, schedule, cost and risk; for conducting variance analysis; and for developing ongoing and comprehensive estimates at completion. B. The Plan shall ensure that the system provides for the results of all analyses based on EVM to be linked to or associated with the Contractor's Risk Management System (as applicable). Any cost and/or schedule risk being managed by the Contractor's Project Manager shall correlate the results of the EVM analysis process to track, manage, and mitigate risk. C. Revision to the EVMS Plan may be required at the Government's request if a change in the EVMS architecture occurs or in the event of a major contract modification.	

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<u>Title:</u> Contract Performance Report (CPR)	<u>DRD No.:</u> PM-10
<u>Reference:</u> SOW Section 4.8; NFS 1852.234-2, Earned Value Management System; DI-MGMT-81466A, Cost Performance Report (https://evm.nasa.gov/reports.html)	
<u>Use:</u> To provide information for: (1) integrating cost and schedule performance data with technical performance measures, (2) assessing the magnitude and impact of actual and potential problem areas causing significant cost and schedule variances, and (3) providing valid, timely project status information to higher management.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The CPR shall include data pertaining to all authorized contract work, including both priced and unpriced effort that has been authorized at a not-to-exceed amount in accordance with the Contracting Officer's direction. The CPR shall separate direct and indirect costs and identify elements of cost for all direct reporting elements. The CPR shall consist of: <ul style="list-style-type: none"> A. Format 1, Work Breakdown Structure (WBS): Format 1 shall provide data to measure cost and schedule performance by summary level CWBS elements, and the hardware, software, and services NASA is buying. B. Format 3, Baseline: Format 3 provides the budget baseline plan against which performance is measured. It is the baseline report used to track all changes to the Performance Measurement Baseline. Format 3 shall contain the time-phased budget for two 3-month periods (columns 10 and 11), two subsequent 12-month periods (columns 12 and 13), and the remainder of the contract for the last period (column 14). C. Format 5, Explanations and Problem Analyses: Format 5 shall be a narrative report used to explain significant cost and schedule variances and other identified contract problems. Subcontractor variance analyses (determined by the prime contractor) and a discussion of the prime contractor's analysis of the subcontractor's performance shall be provided in Format 5. In the initial submission of the CPR (Format 5), the contractor shall rank, in descending order of criticality (i.e., the most critical elements will be at the top of the list and the least critical will be at the bottom), all reporting level CWBS elements anticipated (as determined by the contractor project manager) to be schedule drivers, and all CWBS elements (in a similar ranking) anticipated to be the cost drivers on the project. The contractor shall submit an updated list of the rankings every six months, based on performance to date. The Government reserves the right to modify this ranking based on Government perception of criticality. If the contractor uses "critical path" scheduling techniques, identification of the critical path by CWBS element shall meet the schedule drivers' requirement. Ranking of the critical path cost drivers shall also be provided. These critical elements shall reconcile to the Master Schedule submitted to the Government. D. Variance Analysis: The Variance Analysis shall be a narrative report addressing the following (or as proposed and approved in the EVM Plan): <ul style="list-style-type: none"> 1. Reporting elements that equate to 50% of the list of the schedule drivers (i.e., if 20 schedule drivers are listed, the 10 most critical schedule driver variances over \$100k shall be addressed). If there are 10 or less schedule driver variances, all variances over \$100k shall be addressed. 2. Reporting elements that comprise the top 50% of the cost drivers (i.e., if 20 cost drivers are listed, the top 10 most critical cost driver variances over \$100K). If there are 10 or less cost driver variances, all cost variances over \$100K shall be addressed. 	

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3. Impact to the contract Estimate-at-Complete (EAC) for all cost and schedule driver variances addressed.
 4. Explanation for all variances at completion over \$500K.
 5. Corrective Action Plan, as applicable.
- E. Subcontractor CPRs: All subcontractor performance data will be integrated into the Prime's CPR. Additionally, the subcontractor CPRs shall be submitted as an attachment to the Prime's CPR.
- F. CPR formats shall be completed according to the instructions outlined in DI-MGMT-81466 and the following forms: Format 1 (DD Form 2734/1); Format 2, N/A; Format 3 (DD Form 2734/3); Format 4, N/A; and Format 5 (DD Form 2734/5). Contractor format shall be substituted for CPR formats whenever they contain all the required data elements at the specified reporting levels in a form suitable for NASA management use. The CPR shall be submitted electronically using the American National Standards Institute (ANSI) X12 standards (transaction sets 839) or XML using WINST.DTD format (format can be found at <http://evm.nasa.gov/reports.html>) or the UN/EDIFACT standard (PROCST message) and followed up with a signed paper copy.

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<u>Title:</u> IT Security Management Plan	<u>DRD No.:</u> PM-11
<u>Reference:</u> NFS Clause 1852.204-76, Security Requirements for Unclassified Information Technology Resources	
<u>Use:</u> To identify how the requirements for Information Technology (IT) security will be met.	
<u>Related Documents:</u> See Paragraph D, below.	
<u>Preparation Information:</u> A. The Contractor shall submit an IT Security Management Plan within 30 calendar days after contract award for review and approval in accordance with NFS 1852.204-76. B. The Contractor shall maintain the IT Security Management Plan throughout the term of the contract. The Contractor's plan shall: 1. Identify how the requirements for IT security will be complied with (including developing and maintaining IT system security plans, contingency plans, and performing information system security assessment). 2. Identify how the requirements for which NASA directives specifically mandate compliance with respect to security of NASA IT resources will be met. 3. Describe how the Contractor intends to hold its employees and subcontractors accountable for meeting all the requirements relative to the NPR 2810.1, Security of Information Technology, IT Security Handbooks, and CIO directives. The documents can be found at: http://www.nasa.gov/offices/ocio/itsecurity/index.html . 4. Describe how the Contractor will meet future or changing IT security requirements as directed by Federal Law or NASA requirements. 5. Describe how the Contractor plans to protect their corporate IT resources to ensure that they pose no adverse impact on NASA resources. 6. Describe how the Contractor will protect NASA or contract-specific information and data under their control. 7. Describe how the Contractor plans to provide documentation for any required IT security-related deliverable, 8. Describe how the Contractor will ensure compliance with all NASA IT security training and awareness requirements. 9. Describe how the Contractor will ensure compliance with NASA-established physical security requirements as they relate to IT security requirements. 10. Describe how the Contractor will ensure compliance with personnel screening requirements including assurance that employees with privileged access have the appropriate background screening. 11. Describe the Contractor's procedures for termination of employees including assurance that all access privileges (e.g., network, remote access, virtual private network (VPN), campus computing, and other application access) are terminated. C. The IT Security Management Plan will be made part of this contract and will be updated as required by changes in the Federal Law or NASA regulations. D. Specific guidance for can be found in the following documents. These documents can be located at http://www.nasa.gov/offices/ocio/itsecurity/index.html or http://csrc.nist.gov/publications/PubsSPs.html 1. Federal Information Security Management Act (FISMA), title 44 United States Code section 3541, <i>et. seq.</i> 2. NPD 1600.2, NASA Security Policy 3. NPR 1600.1, NASA Security Program Procedural Requirements	

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4. NPR 1620.2, Facility Security Assessments
5. NPD 2810.1, NASA Information Security Policy
6. NPR 2810.1, Security of Information Technology
7. NIST Special Publication (SP) 800-18 Revision 1, Guide for Developing Security Plans for Federal Information Systems
8. NIST SP 800-35, Guide to Information Technology Security Services
9. NIST SP 800-36, Guide to Selecting Information Security Products
10. NIST SP 800-64 Revision 2, Security Considerations in the System Development Life Cycle

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<u>Title:</u> Financial Reporting of NASA Property in the Custody of Contractors	<u>DRD No.:</u> PM-12
<u>Reference:</u> NFS 1852.245-73, Financial Reporting of NASA Property in the Custody of Contractors	
<u>Use:</u> To annually report any Government owned/Contractor held property that has been furnished or that has been acquired by the Contractor under the terms of this contract.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> A. The Contractor shall submit annually a NF 1018, NASA Property in the Custody of Contractors, in accordance with NFS 1852.245-73. The Contractor shall comply with the instructions on the Form and NFS 1845.71 and any supplemental instructions for the current reporting period issued by NASA. B. Subcontractor use of NF 1018 is not required by this clause; however, the Contractor shall include data on property in the possession of subcontractors in the annual NF 1018. C. The Contractor shall submit the NF 1018 no later than October 15 th of each year for the period October 1 through September 30. D. The Contractor shall submit a final report within 30 calendar days after disposition of all property when contract performance is complete.	

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<u>Title:</u> RESERVED	<u>DRD No.:</u> PM-13
<u>Reference:</u>	
<u>Use:</u>	
<u>Related Documents:</u>	
<u>Preparation Information:</u>	

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<u>Title:</u> Patent Rights and Invention Disclosure Reporting	<u>DRD No.:</u> PM-14
<u>Reference:</u> FAR 52.227-11, Patent Rights-Ownership by the Contractor (as modified by NFS 1852.227-11, Patent Rights-Ownership by the Contractor)	
<u>Use:</u> To provide the Government with technical information concerning any invention, discovery, improvement or innovation made by a Contractor in the performance of work under this contract for the purpose of determining title and rights.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> A. Interim Patent Rights Report - The Contractor shall submit an annual list of inventions required to be disclosed as set forth in FAR 52.227-11, Patent Rights-Ownership by the Contractor (as modified by NFS 1852.227-11, Patent Rights-Ownership by the Contractor). B. Final Patent Rights Report –The Contractor shall submit a listing of all inventions required to be disclosed or certify that there were none as set forth in FAR 52.227-11 Patent Rights- Ownership by the Contractor (as modified by NFS 1852.227-11, Patent Rights-Ownership by the Contractor). C. Invention Disclosure Reporting - The Contractor shall disclose each invention under the contract as set forth in FAR 52.227-11, Patent Rights-Ownership by the Contractor (as modified by NFS 1852.227-11, Patent Rights-Ownership by the Contractor). The electronic and paper version of NF 1679, Disclosure of Invention and New Technology (Including Software), shall be used for this reporting. Both the electronic and paper versions of this form may be accessed at http://invention.nasa.gov . Disclosures are required within two months after the inventor discloses it in writing to Contractor personnel who are responsible for patent matters.	

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Exhibit B –DRL/DRD (Version 1.4)

<u>Title:</u> Conflicts of Interest Avoidance Plan	<u>DRD No.:</u> PM-15
<u>Reference:</u> NFS 1852.237-72, Access to Sensitive Information	
<u>Use:</u> To meet requirements for identifying, mitigating, and/or avoiding Organizational Conflicts of Interest (OCI).	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> A. The Contractor shall provide a plan within 30 calendar days after contract award for complying with the requirements of NFS 1852.237-72. The Contractor shall explain its approach to identifying, mitigating and/or avoiding OCIs that may arise under this contract. The Contractor shall include, at a minimum: (i) an assessment of the potential risk for various types of conflicts such as access to sensitive, non-public information; (ii) the Contractor process for identifying OCIs, including the Contractor's coordination with each of its parent, subsidiaries, affiliates, office locations, divisions and/or other similar entities (collectively, the "Business Units") to determine whether OCIs currently exist; (iii) the approach for maintaining communication with each Business Unit during the performance of this contract to identify potential OCIs arising during such performance period; (iv) the approach to training and refresher training for its employees, (v) once identified, the methods the Contractor will utilize to mitigate the various types of OCIs; and (vi) the approach for ensuring the processes and procedures included herein will be applied to each of its subcontractors and/or consultants (including their respective Business Units). B. The plan and subsequent revisions will be reviewed and approved by the Contracting Officer. The approved plan will be incorporated into the contract as a compliance document.	

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Exhibit B –DRL/DRD (Version 1.4)

<u>Title:</u> Contract Final Report	<u>DRD No.:</u> PM-16
<u>Reference:</u> NFS 1852.235-73, Final Scientific and Technical Reports (Alternate I)	
<u>Use:</u> To provide a final report that comprehensively explains the results achieved under the contract.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> <ul style="list-style-type: none">A. All requirements if NFS 1852.235-73B. Overview of the payload development history (major events and timeline)C. Overview of contract cost and schedule performanceD. Document index organized by:<ul style="list-style-type: none">1. Conceptual design trades2. Final design and analysis3. As-built configurationE. Development challenges and solutionsF. Calibration and performance summaryG. Out-of-specification items<ul style="list-style-type: none">1. SOW waivers and deviations2. Specification Document waivers and deviations3. Interface waivers and deviations4. Technical issuesH. Lessons learned<ul style="list-style-type: none">1. Technical2. Programmatic	

4.3 SYSTEMS ENGINEERING DRDS

<u>Title:</u> Verification and Validation (V&V) Plan	<u>DRD No.:</u> SE-1
<u>Reference:</u> SOW Section 5.1	
<u>Use:</u> To provide the overall approach, plan, and methods for executing the V&V program.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The V&V Plan shall, at a minimum: A. Provide an overview of the entire V&V program. B. Describe the approach (test, analysis, inspection, demonstration) that will be utilized to verify each requirement in the GeoCarb Mission Definition Requirements Agreement (MDRA), each task in the GeoCarb Mission Assurance Requirements (MAR), and each task in the GeoCarb SOW. If verification to any of the requirements or tasks relies on verifications at lower (or other) levels of assembly, the V&V Plan shall describe how the lower level verification are used in verifying the parent requirements. C. Document plans (e.g., to verify the proper polarity, orientation, and position of all components that are sensitive to such conditions). D. Describe the process for waivers or deviations, including timeliness requirements. E. Describe the process for closure of verifications and requirements, including timeliness requirements. F. Include tracking of any waiver requests and Government approvals/disapprovals.	

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Exhibit B –DRL/DRD (Version 1.4)

<u>Title:</u> Characterization and Calibration Plan	<u>DRD No.:</u> SE-2
<u>Reference:</u> SOW Section 7.5	
<u>Use:</u> To provide the definition of characterization and calibration planning, methods, and equipment, including stray light measurement and mitigation.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The Characterization and Calibration Plan shall describe the approach for characterizing and calibrating the GeoCarb payload, thereby ensuring that the GeoCarb payload will satisfy the contract performance requirements. The Characterization and Calibration Plan shall incorporate, at a minimum, a description of planned tests and analyses including: <ol style="list-style-type: none"> A. What is being tested or analyzed and how it relates to GeoCarb payload performance. B. The theoretical basis for the test or analysis, i.e., how the test is performed, how the data are reduced and the method rationale supported by fundamental physics principles and equations. C. The resolution, precision, and accuracy of the results and their relation to the expected results. D. Integration level for test or analysis model, i.e., Part, subassembly, assembly, GeoCarb payload, etc. E. Test configuration, i.e., test equipment, test equipment calibration, and test setup. F. Reference Standards and their calibration traceability. G. Environmental conditions for test, e.g., ambient, thermal-vacuum, on-orbit. H. Operational phase of testing, i.e., pre-delivery, Host Spacecraft testing, on-orbit I. Description of test or analysis results usage, i.e., processing algorithms that use test or analysis results or calibration parameters generated by the test or analysis. J. Sampling methods and their statistical validity. K. A test and analysis schedule and flow chart that includes Government access and participation and when test/analysis results will be available. L. A description of the GeoCarb payload on-orbit characterization and calibration approach, including plans for any solar and lunar calibrations. M. Radiometric measurement uncertainty analysis that includes both on-orbit calibration uncertainties and on-orbit measurement uncertainties. 	

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Exhibit B –DRL/DRD (Version 1.4)

<u>Title:</u> Characterization and Calibration Report	<u>DRD No.:</u> SE-3
<u>Reference:</u> SOW Section 7.5; DRL/DRD SE-2	
<u>Use:</u> Summarizes the results of the prelaunch tests described in the Characterization and Calibration Plan (DRL/DRD SE-2).	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The Characterization and Calibration test report shall incorporate the results of all tests outlined in the Characterization and Calibration Plan (DRL/DRD SE-2).	

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Exhibit B –DRL/DRD (Version 1.4)

<u>Title:</u> Contamination Control Plan	<u>DRD No.:</u> SE-4
<u>Reference:</u> SOW Section 3.3; MAR 10.0; GSFC-STD-7000A, General Environmental Verification Standard (GEVS); GSFC-STD-1000G, Rules for the Design, Development, Verification, and Operation of Flight Systems; ASTM E595, Standard Test Method for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment; Outgassing Data for Selecting Spacecraft Materials – found at: http://outgassing.nasa.gov/	
<u>Use:</u> To outline the plan for controlling payload contamination to acceptable levels over the payload lifecycle. To establish contamination allowances/budgets, plans/methods and schedules for controlling contamination to those allowances/budgets, and plans for recording/tracking/trending contamination measurement/testing results.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The Contamination Control Plan shall incorporate, at a minimum, the following: <ul style="list-style-type: none">A. Beginning of Life and End of Life requirements for contamination sensitive surfaces or subsystems.B. Methods and procedures used to prevent degradation and meet these requirements while on the ground, including ground/test support and storage equipment and facility controls (e.g., prohibited materials, protective covers, environmental constraints, purges, cleaning/monitoring procedures and equipment).C. Methods and procedures used to prevent degradation and meet these requirements while on orbit (e.g., predict and manage on-orbit contamination from payload and non- payload sources, and recover from it as needed).D. Methods and procedures used to measure and maintain the levels of cleanliness required during each of the various phases of the payload’s lifetime.E. Methods and procedures used to assess on-orbit performance as affected by contamination deposits.F. Materials selection, outgassing, and outgassing rate (if needed) requirements as a function of temperature and time, and how those requirements are established and informed.G. Areas (if needed), weight, location, and view factors of critical surfaces.H. Venting: size, location, and relation to critical surfaces.I. Thermal vacuum test contamination monitoring plan, to include test temperature/pressure profile, temperature data of critical test chamber, test equipment, and payload surfaces, and verification of chamber cleanliness prior to test.	

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Exhibit B –DRL/DRD (Version 1.4)

<u>Title:</u> Concept of Operations (CONOPS) Document	<u>DRD No.:</u> SE-5
<u>Reference:</u> SOW Section 9.2	
<u>Use:</u> To provide information on the CONOPS derived from unique aspects of the Contractor's design. The document covers GeoCarb ground systems and science data processing. This document also serves as the payload user's guide, and is a self-contained document such that a reader not familiar with GeoCarb can obtain a reasonably complete understanding of GeoCarb without recourse to another document or drawing. The document is meant to be a reference document for GeoCarb and data users during operations, including: payload operators, Government personnel, scientists, and the general public.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The CONOPS shall include the operation of the payload in all modes, including any and all payload unique operational features. The CONOPS shall incorporate, at a minimum, the following: <ul style="list-style-type: none"> A. A non-proprietary description of the system, subsystems, functions and operations, and payload performance with illustrations, block diagrams, and Payload to Host interfaces. B. A description of the payload modes of operation, science data collection sequence. C. The assumed role(s) and responsibilities of, and services provided by the Host and Host operations center. D. The payload operational environment and any commensurate limitations. E. Operational requirements over and above existing payload requirements necessary to accommodate payload design unique factors. F. The approach and CONOPS for on-orbit characterization and calibration. G. Ground command and data handling and any other support operations. H. How payload parameter, flight software, and flight firmware changes are made. How contingency and emergency payload operational scenarios are addressed, including reporting. I. In-flight anomalies and the responsive actions taken, including any autonomous fault protection actions taken by the spacecraft or any unexplained spacecraft telemetry, including alarms, are documented and reported to NASA within 24-hours. The content of the Anomaly Report shall include at a minimum following information: <ul style="list-style-type: none"> 1. Anomaly Report Title 2. Date 3. Project 4. Date of Incident 5. Location of Incident 6. Description of Incident 7. Current Status 8. Planned Action 9. Impact on Project/Experiment and Schedule 10. Anticipated Next Update 11. Report Filed By 	

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Exhibit B –DRL/DRD (Version 1.4)

<u>Title:</u> End Item Data Package	<u>DRD No.:</u> SE-6
<u>Reference:</u> SOW Section 3.3; MAR 4.4, 8.5, 9.4, 9.6, 13.0; Langley Procedural Requirements (LPR) 7600.1C, Photographic Documentation of Hardware	
<u>Use:</u> To ensure that the deliverable end-items are in accordance with contract requirements prior to delivery to the Contractor-provided host mission spacecraft and launch vehicle provider. The End Item Data Package (delivered to the Government) documents the design, fabrication, assembly, test, and integration of the hardware and software being delivered to the host and is included with the end item delivery to the host.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The End Item Data Package, at a minimum, shall include: A. The deliverable item name, serial number, part number, and classification status (e.g., flight, non-flight, ground support, etc.). B. List of shortages or open items at the time of acceptance with supporting rationale. C. As-built configuration. D. Drawing List and/or Tree. E. Specification List and/or Tree. F. As-built Engineering Drawings. G. As-built Final Assembly Drawings. H. As-built EEE parts lists. I. As-built materials and processes lists. J. Printed Wiring Board coupon analysis/results. K. Test Log Book (including total operating time and cycle records). L. Chronological history, including: 1. Total operating hours of operation. 2. Total failure-free hours of operation. M. Limited life items listings and status, including “life used and remaining” data. N. Non-conformance, Anomaly/Problem, and Failure Database and Reports with root cause and corrective action dispositions (including reasons/justifications and plan to close for any item that is open). O. Test procedures. P. Functional test results and reports. Q. Performance tests results and reports. R. Performance analysis results and reports. S. Environmental test results and reports. T. Characterization and Calibration tests results and reports. U. Trend data and reports. V. Correlated models and supporting documentation. W. Spare parts list and status. X. Technical Budgets and Metrics, including final mass properties Y. Performance Budgets and Metrics Z. Photographic documentation of hardware compliant with LPR 7600.1C (pre- and post-conformal coating for printed wiring assemblies, box or unit, subsystem, system, harness, structure, etc.). AA. All verification artifacts/documents, including waivers (listed in the V&V Matrix), and the final V&V Matrix.	

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Exhibit B –DRL/DRD (Version 1.4)

- BB. Certificate of Compliance (properly executed) for any COTS flight subsystems.
- CC. Documentation delivered under a separate DRD is not expected to be include in the Payload End Item Data Package.
- DD. Science data processing source code and executables (Level 0 and Level 1 data products)

The following items shall be included in this package upon request:

- A. Flight software source code and executables
- B. Flight firmware source code and executables

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Exhibit B –DRL/DRD (Version 1.4)

<u>Title:</u> Algorithm Theoretical Basis Documents	<u>DRD No.:</u> SE-7
<u>Reference:</u> SOW Section 3.3	
<u>Use:</u> To document Level 1 data processing algorithms.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> Provide the theoretical basis, physical theory, mathematical procedures and assumptions for the processing of the Level 1 data products. The document shall include calibrated and geo-located Earth measurements (nadir and inter-calibration payload modes).	

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Exhibit B –DRL/DRD (Version 1.4)

<u>Title:</u> System Engineering Management Plan (SEMP) Document	<u>DRD No.:</u> SE-8
<u>Reference:</u> SOW Section 5.0; NPR 7123.1B, NASA Systems Engineering Processes and Requirements	
<u>Use:</u> To document system engineering practices.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> Describe practices, procedures, roles and responsibilities used in performing the systems management and systems engineering functions. The SEMP shall provide plan description for: A. Systems Engineering Implementation and Management 1. Systems Engineering team management and work integration 2. Organizing structure for the technical teams including definition of roles, responsibilities, and authorities of the systems engineering team 3. Systems Engineering toolset integration and management 4. Technical processes implementation 5. Development planning context as it relates to milestone decision gates, major technical reviews, key intermediate events life-cycle phase, event entry and exit criteria, and other deliverable work products 6. Product assurance flow-down 7. Technical risk management 8. Configuration management B. System Development and Verification 1. Overall system structure development 2. Interface definition and control (physical, functional, and electronic) 3. System Review Plan 4. Peer Review Plan 5. System trades, analyses, and their management 6. Technology heritage review and new technology insertion 7. System safety analysis and management 8. Specialty engineering requirements and management (e.g., Reliability engineering, safety environmental analysis and impact analyses, EMI/EMC/Electrostatic Discharge (ESD), contamination control) 9. Technical performance management and resource margin allocation 10. System integration and verification (includes environmental verification)	

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Exhibit B –DRL/DRD (Version 1.4)

<u>Title:</u> RESERVED	<u>DRD No.:</u> SE-9
<u>Reference:</u>	
<u>Use:</u>	
<u>Related Documents:</u>	
<u>Preparation Information:</u>	

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Exhibit B –DRL/DRD (Version 1.4)

<u>Title:</u> Interface Control Documents	<u>DRD No.:</u> SE-10
<u>Reference:</u> SOW Section 3.3	
<u>Use:</u> Interface specifications for the GeoCarb and science data products.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> Upon request the Contractor shall deliver interface control documents generated during the design and development of the GeoCarb and science data products.	

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Exhibit B –DRL/DRD (Version 1.4)

<u>Title:</u> Requirements Verification Matrix	<u>DRD No.:</u> SE-11
<u>Reference:</u> SOW Section 3.3	
<u>Use:</u> To provide the traceability and status of the requirements verification activities.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The Requirements Verification Matrix shall, at a minimum: A. Provide the traceability for the verifications for each requirement in the GeoCarb Mission Definition Requirements Agreement (MDRA). B. Define the verification method (test, analysis, inspection, demonstration) for each requirement in the MDRA. If verification to any of the requirements relies on verifications at lower (or other) levels of assembly, the Matrix shall define the traceability for this dependence and the verification approach for any lower level requirements/specifications. C. Define the event and date that will generate the verification artifact for each requirement. D. Define the artifact that will be used to close each verification. E. Define the status of each verification (not yet planned, planned, in progress, closed, waiver) F. Name the verification engineer and the requirement owner. G. Be sortable in a manner that allows for determining verification status and metrics. Documentation shall be accompanied with a result summary. Acceptable documentation includes one or more of the following: A. Analysis reports B. Test Reports C. Test procedures D. Demonstration report E. Inspection reports	

4.4 SOFTWARE DRDS

<u>Title:</u> Software Management and Development Plan	<u>DRD No.:</u> SW-1
<u>Reference:</u> SOW Sections 12.0, 13.0, 13.1, 13.3; NPR 7150.2B, NASA Software Engineering Requirements.	
<u>Use:</u> To define the activities required to develop and manage all software for all flight and ground elements within the contract scope.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The Software Management and Development Plan (SMDP) shall describe Contractor's software management approaches, processes, and activities for software analysis, design, development, documentation, version control, test, verification, risk management, metric collection, and assurance of all software products utilized in contract performance. A. The SMDP shall include a description of the process for performing sustaining engineering of the software to address modifications implemented to correct errors and requirements changes. B. The SMDP shall incorporate, at minimum, the following: <ol style="list-style-type: none"> 1. Purpose and Description. 2. The anticipated software configuration items (per NPR 7150.2B). 3. The safety criticality of each of the systems and subsystems containing software (per NPR 7150.2B). 4. Any security and safety requirements, as applicable, that will be allocated to software. 5. Software reuse levels - including new development, significant flight heritage, design reuse, commercial off-the-shelf (COTS), modified-off-the-shelf (MOTS), Government-Off-the-Shelf (GOTS), and how the software processes will be applied or tailored for each. 6. The anticipated software documentation, data interface control documents (ICDs) and database(s) required, when those documents are due, and assign responsibility for the preparation of each document, ICD, or database. 7. A software configuration plan (referencing DRL/DRD PM-6, Configuration Management Plan) describing the systematic method by which software will be configuration controlled, including the change control procedures for lifecycle software development and operation. 8. The various software test and verification phases (e.g. development, integration and verification), and the responsibilities for each test phase. 9. An overview of the facilities and equipment required for software activities (e.g. software test beds, simulators/emulators, ground and support systems, etc.), and responsibilities for facility and equipment planning, acquisition, and configuration. 10. The plan for major software milestones and reviews (requirement reviews, design reviews, acceptance reviews, etc.), define completion criteria, review checklists, and approval authority for these milestones and reviews, and establish the lines of responsibility for each phase of development. 11. Software metrics definition, collection method, and frequency and method of reporting for each phase of development. Metrics shall include, at a minimum: <ol style="list-style-type: none"> a. Number of flight software requirements and their change status 	

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Exhibit B –DRL/DRD (Version 1.4)

- b. Design/Code complexity index at Computer Software Unit, Computer Software Component, and Computer Software Configuration Item levels
 - c. Source lines of code actuals versus estimates
 - 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
12. Software resources, budgets, schedules, and organization.
 13. Software acquisition activities.
 14. Software development methodologies and activities.
 15. Subcontractor management and monitoring.
 16. Software V&V.
 17. The software risk management process (referencing DRL/DRD PM-8, Risk Management Plan).
 18. Software lifecycle (flight, ground, support) maintenance/sustainment plans.
 19. Software delivery and operational transition plans, including:
 - a. The approach for training developers, maintainers, and payload operations personnel in the use of all software and supporting facilities.
 - b. How instructions will be provided to allow for payload operations personnel to make and implement software modifications.
 20. Assurance that all software developed and delivered meets Section 508 of the Rehabilitation Act of 1973 as implemented by the applicable accessibility standards at 36 CFR 1194.21, unless at the time of development the Contracting Officer determines that compliance would pose an undue burden on the Agency per FAR 39.204(e) and NFS 1839.203-70.

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Exhibit B –DRL/DRD (Version 1.4)

<u>Title:</u> Flight Software Test Plan	<u>DRD No.:</u> SW-2
<u>Reference:</u> SOW Section 3.3; NPR 7150.2B, NASA Software Engineering Requirements.	
<u>Use:</u> To provide an overall view of the software acceptance test program detailing test philosophy objectives and rationale for all software testing and hardware/software integration activities planned for the program. The software test plan also describes how software will be tested and verified.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The Flight Software Test Plan shall incorporate, at minimum, the following: A. Tests to be accomplished to demonstrate that the software meets requirements including test levels, test types, and test coverage. B. Bidirectional traceability matrix that maps all software requirements to their corresponding test cases, analyses, inspections, and test procedures/scripts. C. The test environment, simulators, and tools needed. D. Required test data, data recording, data reduction, and data analysis. E. Expected (qualitative) results. F. Test schedules. G. Special operating conditions (if required). H. Any required support from other organizations.	

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Exhibit B –DRL/DRD (Version 1.4)

<u>Title:</u> Software Compliance Matrix	<u>DRD No.:</u> SW-3
<u>Reference:</u> SOW Section 3.3; NPR 7150.2B, NASA Software Engineering Requirements.	
<u>Use:</u> To documents the program/project's compliance or intent to comply with the requirements of NPR 7150.2B or justification for tailoring.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> A. The Contractor shall complete a tailored matrix that demonstrates compliance of its software development and management processes with each of the applicable Software Engineering (SWE) entries in Appendix C of NPR 7150.2B. The following software classes apply: <ol style="list-style-type: none">1. Flight Software: Class B.2. Payload Simulator software: Class C.3. Payload GSE software that directly interfaces with flight equipment: Class C.4. Payload GSE software that does not directly interface with flight equipment: Class D5. Science Data Processing: Class C B. The Tailored Compliance Matrix shall be completed based on the Contractor's institutional and program processes applied to the CPF development work. This information will be used by the Government to assess the Contractor's process compliance. C. For Class B safety critical functions, NPR 7150.2B, section 3.7 shall be followed.	

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Exhibit B –DRL/DRD (Version 1.4)

<u>Title:</u> Software Design Document	<u>DRD No.:</u> SW-4
<u>Reference:</u> SOW Section 3.3; NPR 7150.2B, NASA Software Engineering Requirements.	
<u>Use:</u> To documents the software design.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The Contractor shall develop and deliver a software design document in accordance with its institutional procedures. The document shall cover software for all flight and ground systems associated with the development of GeoCarb. The document shall include: <ul style="list-style-type: none">A. Software architectureB. Block diagramsC. Subsystem descriptionsD. OperationE. The Flight Software Design Document (FSW SDD) is used to describe the architecture and components of the FSW and explain how they will be structured and implemented in order to meet the<ul style="list-style-type: none">1. FSW requirements,2. Design Studies,3. Design IssuesF. The FSW SDD shall include a FSW design overview that describes the overall structure of the FSW, the relationships between the various FSW components, internal and external interfaces, and dependencies among FSW entities and resources.G. For each FSW component, the FSW SDD shall contain a detailed software design description.H. The FSW SDD shall include a Requirements Traceability Matrix showing bi-directional traceability between the FSW Requirements and the FSW Design and test plan.	

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Exhibit B –DRL/DRD (Version 1.4)

<u>Title:</u> Software Test Procedures	<u>DRD No.:</u> SW-5
<u>Reference:</u> SOW Section 3.3; NPR 7150.2B, NASA Software Engineering Requirements.	
<u>Use:</u> To provide formal instruction and guidance for performing testing and operations for testing flight and ground based software including acceptance testing	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The Contractor shall develop and deliver test procedures in accordance with its institutional procedures. The document shall cover procedures to test software for all flight and ground systems associated with the development and testing of GeoCarb. The Software Test Procedures shall, at a minimum, incorporate the following: A. Description of the test objective and test method and test identifier. B. Description of the test configuration, including the test environment, software configuration prerequisite conditions, test input, and instructions for conducting procedure. C. Pass criteria. D. Expected results in telemetry and associated caution and warning levels, including assumptions and constraints. E. Data recording requirements, media, forms, and tables. F. Description of the required personnel and their responsibilities. G. Description of red-line and chain-of-command authority for test execution. H. Software requirements to be verified at each step, cross referenced to the Software Requirement Test Verification Matrix.	

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Exhibit B –DRL/DRD (Version 1.4)

<u>Title:</u> Software Test Reports	<u>DRD No.:</u> SW-6
<u>Reference:</u> SOW Section 3.3; NPR 7150.2B, NASA Software Engineering Requirements.	
<u>Use:</u> To report the results of all software tests.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The Contractor shall document and deliver test results in accordance with its institutional procedures. The documents shall cover software testing for all flight and ground systems associated with the development of GeoCarb. Test Reports shall, at a minimum, incorporate the following: A. Description of each test objective and method. B. Reference information, including applicable test plans, test requirements, test procedures, test configuration(s), test log including the dates of the testing, and photographs of test setup(s) and test personnel. C. Description of any anomalies encountered during the test (with reference to any anomaly reports). D. Test results and discussion that describe if the expected results did or did not meet the pass criteria specified in the test procedures. E. Test results and discussion that describe any data variances, including those that were within specified tolerances. F. Identification of any planned test objective or requirement for which results were not obtained (including rationale/explanation for why and a plan to resolve the gap). G. Identification of any change requests tested H. Identification of any anomalies closed by the test I. Requirements verified as a result of the test, cross referenced to the Software Requirement Verification Test Matrix.	

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Exhibit B –DRL/DRD (Version 1.4)

<u>Title:</u> Software Test Readiness Review Package	<u>DRD No.:</u> SW-7
<u>Reference:</u> SOW Section 3.3; NPR 7150.2B, NASA Software Engineering Requirements.	
<u>Use:</u> Review material for the Software Test Readiness Review.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The Contractor shall deliver review material for the Software Test Readiness Review. The Package shall incorporate, at minimum, the following: A. All documentation as called for in the Software Management and Development Plan. B. Relevant integration and test descriptions and results. C. Software Dry Run test results. D. Compatibility of payload software with ground support equipment. E. Demonstration that the test environment and ground support equipment adequately represents external interfaces. F. Non-conformance, Anomaly/Problem, and Failure Database and Reports with root cause and corrective action dispositions (including reasons/justifications and plan to close for any that is open). G. Completed, reviewed, and approved software test procedures. H. Clearly identified TBD and TBR items (such as open Nonconformance Reports (NCRs)) with acceptable plans for their disposition. I. Identified, credibly assessed, and appropriately mitigated risks associated with performing the test. J. As-built documentation summary.	

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<u>Title:</u> Software Acceptance Readiness Review Package	<u>DRD No.:</u> SW-8
<u>Reference:</u> SOW Section 3.3; NPR 7150.2B, NASA Software Engineering Requirements.	
<u>Use:</u> Review material for the Software Acceptance Readiness Review.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The Contractor shall deliver review material for the Software Acceptance Readiness Review. The Package shall incorporate, at minimum, the following: A. Results of the formal flight software acceptance test program B. Final test reports C. Test procedures D. Baseline version description document E. Configuration controlled software F. Non-conformance, Anomaly/Problem, and Failure Database and Reports with root cause and corrective action dispositions (including reasons/justifications and plan to close for any that is open) G. Interface concerns, problems, and solutions. H. Comparison of measured performance with requirements and discussion of the effect of any variance and waivers I. Software metrics	

4.5 INTEGRATION AND TEST DRDS

<u>Title:</u> Payload Assembly, Integration, and Test Plan	<u>DRD No.:</u> IT-1
<u>Reference:</u> SOW Section 3.3	
<u>Use:</u> To provide information on the assembly, integration and testing (AIT) of the payload, and an overview of the entire AIT flow and its relation to verification.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u>	
<p>A. The payload AIT Plan describes the series of activities required to integrate the various payload components into the final flight configuration and verify its readiness for delivery to the host for integration onto the Launch Vehicle. The payload AIT Plan shall include the information required to plan and inform testing, provide information sufficient to understand the purpose and methodology of all tests to be performed, and provide the required environmental and configuration controls necessary for successful completion of all tests.</p> <p>B. The payload AIT Plan shall, at a minimum, incorporate the following:</p> <ol style="list-style-type: none"> 1. The payload AIT sequence and schedule. 2. Description of each activity or test in the sequence. 3. Description of any testing at lower levels of assembly to be accomplished prior to proceeding to testing at higher levels of assembly. 4. Description of each test and verification objective and method, including the appropriateness of the test method versus the required accuracy/precision. 5. Description of the required procedures and post-test reports and activities. 6. The approach for when and how to utilize/implement safe-to-mate procedures. 7. Top Level description of each test configuration, including the facility (how it will be qualified and/or determined acceptable for use prior to test, and any special, non-standard facility needs), layout and interconnection of test fixtures, equipment, and instrumentation, grounding scheme, any special handling requirements, and any pertinent differences from the flight configuration. 8. Top Level description of the required personnel and their responsibilities and chain-of-command authority for test performance. 9. Top Level description of environmental and/or other conditions to be tracked and maintained, including contamination controls. 10. Top Level description of any necessary functional operations required during each test (i.e., a performance test at hot and cold plateaus during a thermal vacuum testing, or aliveness vs. full functional tests between phases or axes of vibration testing). 11. Safety provisions and cautions, including identification of hazardous and potentially hazardous situations and operations and abort conditions. 12. Contingency operations plans, including for loss of facility power and test equipment failure. 13. Rationale for retest determination that does not invalidate previous verification activities. When appropriate, this shall describe the interaction of any related analysis activities. 14. Requirements and opportunities to take photographs during the integration process. 15. Limitations in the environmental verification program which preclude the verification by 	

test of any environmental requirement. Examples of limitations in the ability to demonstrate requirements include:

- a. Inability to deploy hardware in a 1-g environment.
- b. Facility limitations which do not allow testing at system level of assembly.
- c. Inability to perform certain tests because of contamination control requirements.
- d. Inability to perform powered testing because of the risk of damage (e.g., ESD or voltage breakdown).

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<u>Title:</u> Test Reports	<u>DRD No.:</u> IT-2
<u>Reference:</u> SOW Section 3.3	
<u>Use:</u> To report the results of all tests.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> Test Reports shall, at a minimum, incorporate the following: A. Description of each test report objective and method. B. Reference information, including applicable test plans, test requirements, test procedures, test configuration(s), test log including the dates of the testing, and photographs of test setup(s). C. Description of any anomalies encountered during the test (with reference to any anomaly reports). D. Test results and discussion that describe if the expected results did or did not meet the pass criteria specified in the test procedures. E. Test results and discussion that describe any data variances, including those that were within specified tolerances. F. Identification of any planned test objective or requirement for which results were not obtained (including rationale/explanation for why and a plan to resolve the gap). G. Payload level requirements verified at a result of the test, cross referenced to the V&V Plan and Matrix (DRL/DRD SE-1).	

4.6 SAFETY AND MISSION ASSURANCE (S&MA) DRDS

<u>Title:</u> Mission Assurance Plan (MAP)	<u>DRD No.:</u> MA-1
<u>Reference:</u> SOW Section 6.0; MAR 1.1; NPR 8735.2B, Management of Government Quality Assurance Functions for NASA Contracts; NPR 8715.3C, NASA General Safety Program Requirements; NPR 8705.4, Risk Classification for NASA Payloads; NPD 8730.5B, NASA Quality Assurance Program Policy; NASA-STD-8739.8, Software Assurance Standard; NPD 8720.1C, NASA Reliability and Maintainability (R&M) Program Policy; GSFC EEE-INST-002, Instructions for EEE Parts Selection, Screening, Qualification, and De-rating; SAE AS5553B, Counterfeit Electrical, Electronic, and Electromechanical (EEE) Parts; Avoidance, Detection, Mitigation, and Disposition; NASA-STD-6016A, Standard Materials and Processes Requirements for Spacecraft	
<u>Use:</u> Documents that Contractor or/and all subcontractor(s), responsible for the design and development of the GeoCarb hardware and software, plan for implementing a system safety and mission assurance program consistent with contract SOW and the MAR.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The MAP scope shall cover: <ul style="list-style-type: none"> (A) All flight hardware and software that is designed, built, or provided by the Contractor and its subcontractors, or furnished by the Government, from project initiation through launch and mission operations. (B) The Ground system equipment that interfaces with flight equipment to the extent necessary to assure the integrity and safety of flight items (includes electrical, mechanical, software, and test facilities) and ground operations of products. <p>The MAP shall include reference to the Contractor’s internal procedure for each Product Assurance function/element and deliverable and have brief description of the respective procedure. The MAP shall include a more detailed description for the following areas as a minimum:</p> <ul style="list-style-type: none"> (A) Material Review Board (B) Review/disposition/approval of failure reports (C) Reliability Program (D) Software and Complex Electronics Assurance Plan shall, at a minimum, cover: <ul style="list-style-type: none"> (i) Purpose; (ii) Reference documents and definitions; (iii) Management; (iv) Documentation; (v) Standards, practices, conventions, and metrics; (vi) Software Reviews; (vii) Tests; (viii) Problem Reporting and Corrective Action; (ix) Tools, techniques, and methodologies; (x) Media control; 	

- (xi) Supplier control;
 - (xii) Records, collection, maintenance, and retention;
 - (xiii) Training; and
 - (xiv) Risk Management.
- (E) Workmanship equivalency (if applicable)
- (F) EEE Parts Control Plan (PCP) shall, at a minimum, cover:
- (i) Parts control process, including Parts Control Board (PCB) charter, roles, and responsibilities as applicable (includes meeting schedule, notices, distribution of data and agenda, review and approval process);
 - (ii) Shelf life control;
 - (iii) Parts application de-rating;
 - (iv) Supplier and manufacturer surveillance;
 - (v) Qualification;
 - (vi) ASICs, Gate Arrays, System-on-chip, Custom ICs;
 - (vii) Incoming inspection and test;
 - (viii) Destructive Physical Analysis;
 - (ix) Defective parts controls program;
 - (x) Radiation hardness assurance;
 - (xi) Handling, preservation, and packing;
 - (xii) Contamination control;
 - (xiii) Alternate quality conformance inspection and small lot sampling;
 - (xiv) Traceability and lot control;
 - (xv) Failure analysis; and
 - (xvi) Counterfeit parts control plan per AS5553B.
- (G) Materials and Processes (M&P) Selection, Control, and Implementation Plan shall, at a minimum, cover:
- (i) Materials and Processes Control process, including Materials and Processes Control Board charter, roles, and responsibilities, as applicable (or similar proposed Contractor process);
 - (ii) Organizational authority and responsibility for review and approval of M&P specified prior to release of engineering documentation;
 - (iii) Identification, tracking, and documentation of Materials and Processes;
 - (iv) Conformance to the requirements of NASA-STD-6016A and identification of process specifications used to implement requirements and document the tailoring in the M&P Plan to provide the degree of conformance with and the method of implementation of the requirements in NASA-STD-6016A;
 - (v) Procedures and data documentation for proposed test programs to support materials screening and verification testing; and
 - (vi) Details of the Contractor's Fastener Control Program Next Level of Assembly & Next Level of Assembly serial number.
- (H) Life Test Plan and Reports for Lubricated Mechanisms shall, at a minimum, cover:
- (i) Table of Contents;
 - (ii) Description of lubricated mechanisms, performance functions, summary of subsystem specification, and life requirements;
 - (iii) Heritage of identical mechanisms and descriptions of identical applications;
 - (iv) Design, drawings, and lubrication system used by the mechanism;

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- (v) Test plan, if applicable, including vacuum, temperature, and vibration test environmental conditions;
- (vi) Criteria for a successful test (if applicable); and
- (vii) The final report shall include (at minimum) the following information for each lubricated mechanism test if a test is done in lieu or in addition to an analysis:
 - (a) Test plan;
 - (b) Test data;
 - (c) Narrative on test results; and
 - (d) Summary of test conclusions.

- (I) Nondestructive Evaluation Plan shall, at a minimum, cover:
 - (i) Hardware Design;
 - (ii) Manufacturing Planning;
 - (iii) Personnel Training;
 - (iv) NDE Reliability Requirements for Fracture Critical Parts; and
 - (v) NDE Reporting.

- (J) Red Plague Control Plan (if applicable)

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<u>Title:</u> Quality Manual	<u>DRD No.:</u> MA-2
<u>Reference:</u> SOW Section 6.0; MAR 2.1; ISO 10013:2001, Guidelines for Quality Management System Documentation; NPR 8735.2B, Management of Government Quality Assurance Functions for NASA Contracts; SAE AS9100D, Quality Management Systems – Requirements for Aviation, Space, and Defense Organizations	
<u>Use:</u> Documents the Contractor's quality management system.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> Prepare a Quality Manual addressing applicable requirements of AS9100D; refer to ISO 10013:2001, Guidelines for Quality Management System Documentation, for guidelines on preparation of a quality manual.	

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<u>Title:</u> Reporting of Non-Conformances	<u>DRD No.:</u> MA-3
<u>Reference:</u> SOW Section 6.0; MAR 2.2.2; SAE AS9100D, Quality Management Systems – Requirements for Aviation, Space, and Defense Organizations	
<u>Use:</u> Report Non-conformances for information and review of classification.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> Relevant information on an Excel Spreadsheet or non-conformance system report shall include at least the following: (A) Identification of project, system, or sub-system; (B) Identification of item (e.g., assembly, sub-assembly, or part, to include serial number or part number as applicable); (C) Description of affected item; (D) Description of anomaly, including activities leading up to the anomaly; (E) Status of item; (F) Date of original submission; and (G) Actions taken to close. The spreadsheet or report should be a cumulative list and status and actions taken to close information will be filled in to closure.	

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<u>Title:</u> Reporting of Failures	<u>DRD No.:</u> MA-4
<u>Reference:</u> SOW Section 6.0; MAR 2.2.3; SAE AS9100D, Quality Management Systems – Requirements for Aviation, Space, and Defense Organizations	
<u>Use:</u> Document failures, investigative activities, rationale for closure, and corrective and preventive actions.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> Documents failures, anomalies, changes in status, or purposed closure to identify the following information: (A) Identification of project, system, or sub-system; (B) Identification of failed item (e.g., assemble, sub-assembly, or part); (C) Description of item; (D) Description of anomaly, including activities leading up to anomaly, if known; (E) Names of individuals involved in anomaly; (F) Date and time of anomaly; (G) Status of item; (H) Personnel who originated the report; (I) Date of original submission; (J) Anomaly cause; (K) Corrective actions implemented; (L) Retesting performed and results; (M) Other items affected; and (N) Risk ratings-mission impact and certainty in corrective actions.	

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<u>Title:</u> Tailored Payload Safety Requirements & Compliance Checklist	<u>DRD No.:</u> MA-5
<u>Reference:</u> SOW Section 6.0; MAR 3.2.1; AFSPCMAN 91-710, Range Safety User Requirements; NPR 8715.3C, NASA General Safety Program Requirements; Host provider range safety requirements	
<u>Use:</u> The overall intent of the Expendable Launch Vehicle (ELV) payload safety requirements tailoring process and compliance checklist is to ensure appropriate inclusion of applicable Range Safety requirements into the Project safety tasks, and compliance status of those requirements. For the purposes of the GeoCarb safety process, tailoring is defined as the process of assessing the applicability of safety requirements within the host provided range safety requirements, using AFSPCMAN 91-710 for a space flight instrument as a guide, and evaluating the project's potential implementation in order to generate a set of specific safety requirements for the contract.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> Tailored Payload Safety Requirements shall, at a minimum: (A) Document all safety requirements that apply to a payload mission; (B) In the event of conflicting requirements, incorporate the more stringent; (C) Document the applicability of safety requirements to specific situations within a mission. (D) Document the interpretation of requirements as needed; (E) Address any recommendations, interpretations, or resolutions of safety concerns provided by the Project Team and each authority involved in the mission; (F) Identify any change to a requirement (i.e., any addition or deletion from the source requirement) and include sufficient rationale for the tailored change; (G) Identify potential areas of noncompliance with applicable requirements; and (H) Reference any waivers identified during the tailoring The compliance checklist indicates for each requirement whether the proposed design is compliant, non-compliant but meets intent, non-compliant, or if the requirement is not applicable. An indication other than compliant shall include rationale. The compliance checklist shall include all design, test, analysis, and data submittal requirements required to support the Safety Data Package (DRD MA-10). The checklist shall include, at a minimum: (A) Criteria and requirement; (B) System; (C) Indication of compliance, non-compliance, or not applicable; (D) Resolution; (E) Reference; (F) Copies of all Range Safety approved non-compliances, including waivers and equivalent levels of safety certifications.	

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<u>Title:</u> Request for a Safety Variance	<u>DRD No.:</u> MA-6
<u>Reference:</u> SOW Section 6.0; MAR 3.2.2; AFSPCMAN 91-710, Range Safety User Requirements; NPR 8715.3C, NASA General Safety Program Requirements; Host provider range safety requirements	
<u>Use:</u> A Safety Waiver documents a safety requirement that cannot be met and the rationale for approval of a waiver, as defined by the host provider's range safety requirements.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> Information from the review of a waiver request shall include: (A) A statement of the specific safety requirement and its associated source document name and paragraph number for which a waiver is requested. (B) A technical justification for the waiver. (C) Analyses to show the mishap potential of the proposed alternate requirement, method, or process as evaluated against the specified requirement. (D) An assessment of the risk involved in accepting the waiver; when it is determined that there are no hazards, the basis for such determination should be provided. (E) A narrative on possible ways of reducing hazards severity and probability and existing compliance activities. (F) Starting and expiration for waiver, if applicable. Note: a waiver may require Range Safety concurrence.	

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<u>Title:</u> System Safety Program Plan	<u>DRD No.:</u> MA-7
<u>Reference:</u> SOW Section 6.0; MAR 3.2.3; NPR 8715.7A, Expendable Launch Vehicle (ELV) Payload Safety Program; AFSPCMAN 91-710, Range Safety User Requirements; NPR 8715.3C, NASA General Safety Program Requirements; Host provider range safety requirements	
<u>Use:</u> The System Safety Program Plan (SSPP) describes the tasks and activities of system safety management and engineering required to identify, evaluate, and eliminate or control hazards to the hardware, software, and system design by reducing the associated risk to an acceptable level throughout the system life cycle, including launch range safety requirements.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The SSPP shall describe the Contractors' portion of the GeoCarb system safety program utilizing the content contained in NPR 8715.7A as a guide. The SSPP shall: (A) Define the roles and responsibilities of personnel (B) Define required documents, applicable documents, and completion schedules for analyses, reviews, and safety packages. (C) Address support for Reviews, Safety Working Group Meetings, and Technical Interchange Meetings (TIMs). (D) Provide for early identification and control hazards to personnel, facilities, support equipment, and the flight system during product development, including design, fabrication, test, transportation, and ground activities. (E) Address compliance with the launch range safety requirements. (F) Include safety review process that meets the intent of NPR 8715.7A. (G) Address compliance with industrial safety requirements imposed by NASA and Occupational Safety and Health Administration (OSHA) design and operational needs (e.g., NASA-STD-8719.9, Lifting Standard) and contractually imposed mission unique obligations. (H) Address software safety to identify and mitigate safety-critical software products by the following: (i) Identification of software related hazards; (ii) Identification of hazard controls that are implemented with software; (iii) Identification and tracking of software safety requirements; (iv) Verification results and approved waivers and expectations for software safety requirements; and (v) Verification of safety discrepancy disposition approvals.	

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<u>Title:</u> Preliminary Hazard Analysis – CLIN 1	<u>DRD No.:</u> MA-8
<u>Reference:</u> SOW Section 6.0; MAR 3.2.4; MIL-STD-882, Standard Practice for System Safety; AFSPCMAN 91-710, Range Safety User Requirements; NPR 8715.3C, NASA General Safety Program Requirements; Host provider range safety requirements	
<u>Use:</u> The Preliminary Hazard Analysis (PHA) is used to obtain an initial risk assessment and identify safety critical areas of concept system. It is based on the best available data, including mishap data from similar systems and other lessons learned. The PHA is used to evaluate hazards associated with the proposed design or function for security, probability, and operational constraints. The PHA is also used to identify safety provisions and alternatives needed to eliminate hazards or reduce their associated risk to an acceptable level.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The PHA shall identify safety critical areas, provide an initial assessment of hazards, and identify requisite hazard controls and follow-on actions. The PHA results provide guidance for the tailoring of host provider range safety requirements and the Safety Data Package (SDP) deliverable. The PHA shall incorporate on the best available data, including mishap data from similar systems and other lessons learned, The PHA shall include evaluations of the hazards associated with the proposed design or function for hazards severity, hazard probability, and operational constraint. The PHA shall include safety studies identifying provisions and alternatives needed to eliminate hazards or reduce their associated risk to an acceptable level. At a minimum the PHA shall include the following, as applicable: <ul style="list-style-type: none"> (A) Hazardous components such as fuels, propellants, lasers, explosives, toxic substances, hazardous construction materials, pressure systems, and other energy sources. (B) Safety related interface considerations among various elements of the system such as material compatibility, electromagnetic interference, inadvertent activation, fire and explosive initiation and propagation, and hardware and software controls. This shall include consideration of the potential contribution by software, including software developed by other contractors and sources, to subsystem and system mishaps. (C) Identification of safety design criteria to control safety-critical software commands and responses such as inadvertent command, failure to command, untimely command or responses, inappropriate magnitude, or designated undesired events and appropriate action taken to incorporate them in the software and related hardware specifications. (D) Environmental constraints including the operating environments such as drop, shock, vibration, extreme temperatures, humidity, noise, exposure to toxic substances, health hazards, fire, electrostatic discharge, lightning, electromagnetic environmental effects, ionizing and non-ionizing radiation including laser radiation. (E) Operating, test, maintenance, built-in-tests, diagnostics, and emergency procedures (human factors engineering, human error analysis of operator functions, tasks, and requirements; effect of factors such as equipment layout, lighting requirements, potential exposures to toxic materials, effects of noise or radiation on human performance; explosive ordnance render safe and emergency disposal procedures; life support requirements and their safety implications in manned systems, crash safety, egress, rescue, survival, and salvage). (F) Those test unique hazards that will be a direct result of the test and evaluation of the article or vehicle. 	

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- (G) Facilities, real property installed equipment, support equipment such as provisions for storage, assembly, checkout, proof testing of hazardous systems and assemblies that may involve toxic, flammable, explosive, corrosive, or cryogenic materials and wastes; radiation or noise emitters; and electrical power sources.
- (H) Training and certification pertaining to hazardous and safety critical operations and maintenance of hazardous and safety critical systems.
- (I) Safety related equipment, safeguards, and possible alternate approaches such as interlocks; system redundancy; fail-safe design considerations using hardware or software controls; subsystem protection; fire detection and suppression systems; personal protective equipment; heating, ventilation, and air-conditioning; and noise or radiation barriers.
- (J) Specify each malfunction to the system, subsystems, or software, the cause and resulting sequence of events determined, and the degree of hazard.
- (K) Identify Government Mandatory Inspections Points (GMIP) for all safety critical attributes that support hazard control/mitigation verifications.

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<u>Title:</u> Critical Lift Equipment Safety Analysis	<u>DRD No.:</u> MA-9
<u>Reference:</u> SOW Section 6.0; MAR 3.2.6; NASA-STD-8719.9, Lifting Standard	
<u>Use:</u> Required by NASA for critical lifts to ensure maximum safety for the hardware.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> Critical Lift Equipment Analysis shall include: (A) A recognized Safety Hazard Analysis for Critical Lifts, such as a fault tree analysis, FMEA or Operation & Support Hazard Analysis (O&SHA). (B) Supporting documentation showing compliance with NASA-STD-8719.9 for critical lift hardware, personnel and procedures. (C) Contractor format for the above analyses is acceptable.	

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<u>Title:</u> Safety Data Package	<u>DRD No.:</u> MA-10
<u>Reference:</u> SOW Section 6.0; MAR 3.2.7; AFSPCMAN 91-710, Range Safety User Requirements; Host provider range safety requirements	
<u>Use:</u> The payload Safety Data Package (SDP) documents the comprehensive evaluations of hazards and the risk being assumed prior to the testing or operations of a payload. The Host spacecraft provider will use the SDP as an input to the equivalent Range Safety document. The verification portion of the SDP provides documentation of Hazard Control Verification status at time of payload delivery to the host.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The SDP will identify hardware, and software related hazards that may be present in the payload and operations and the safety feature, hazard controls and inhibits to control the identified hazards. This includes specific procedural controls and precautions. The SDP will include the following information: Safety criteria and methodology used to classify and rank hazards, including assumptions upon which the criteria or methodologies were based or derived, to include the definition of acceptable risk as specified by Range Safety. The SDP delivered shall contain: (A) Hazard Analysis Summaries, Hazard Reports, and safeguards and mitigation strategies pertaining to the following: (i) Flight payload; (ii) Critical Payload Ground Support Equipment, including software; (iii) Payload Lifting Hardware; (iv) Payload and Ground Support Equipment Hazardous Materials and Processes; (v) Hazards to the Observatory, resulting from presence of payload; and (vi) Personnel. (B) Utilization of an Operations/Operations and Support Hazard Analysis to identify and document payload-related hazardous or safety-critical operations that are or may potentially be used during the following: (i) Payload fabrication and testing; (ii) Observatory integration and testing; (iii) Launch site operations; and (iv) On-orbit operations. (C) The results of the Software Safety Analysis. (D) The results of hazard analyses and tests used to identify hazards in the system including those hazards that still have a residual risk, actions that have been taken to reduce the associated risk to a level contractually specified as acceptable, results of tests conducted to validate safety criteria, requirements, and analyses of any hazardous materials generated by or used in the system. (E) Recommendations applicable to hazards at the interface of Range User systems with other systems, as required. (F) Identification of the hazardous operations and procedures. (G) The final submission of the SDP shall contain hazard verification information. The	

verification information shall provide documentation that demonstrates the process of verifying the control of all hazards by test, analysis, inspection, similarity to previously qualified hardware, or any combination of these activities. All verifications that are listed on the hazard reports shall reference the tests/analyses/inspections. The Contractor shall submit results of these tests/analyses/inspections for review in accordance with the contract schedule and applicable launch site range safety requirements. The Verification Tracking Log (VTL) shall contain the following information in tabular format:

- (i) Hazard Report Number.
- (ii) Safety Verification Number.
- (iii) Description (Identify procedures/analyses by number and title).
- (iv) Constraints on Launch Site Operations.
- (v) Independent Verification Required (e.g., mandatory inspection points).
- (vi) Scheduled Completion Date.
- (vii) Completion Date.
- (viii) Method of Closure

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<u>Title:</u> Hazardous Operations Procedures for Payload Integration and Test and Pre-launch Processing – CLIN 2	<u>DRD No.:</u> MA-11
<u>Reference:</u> SOW Section 6.0; MAR 3.2.8; NPR 8715.3C, NASA General Safety Program Requirements; AFSPCMAN 91-710, Range Safety User Requirements; Host provider range safety requirements	
<u>Use:</u> Documents hazardous procedures and associated safeguards that the Contractor will use for launch vehicle payload integration and test activities and pre-launch activities that comply with the applicable safety requirements of the installations where the activities are performed.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> Operational Procedures for hazardous systems shall include provisions for the hazard controls, and verifications identified in the SDP. The following list is to be considered when determining if hazardous procedures need to be developed. The list is typical of space flight hazardous systems, but is not all inclusive: (A) Pressurized propellant systems - pressurization (pneumatic and hydrostatic), loading and unloading, sampling, leak testing, venting. (B) Launch vehicle and payload systems - pressurization, loading and unloading, leak test, erection and lifting with ordnance and/or propellant, application of power with ordnance and/or propellant, safe and arm pin removal, mate and de-mate operation. (C) Hazardous facilities - high pressure systems, propellant flows in ground systems, propellant cart loading, ordnance checkout and installation, X-ray operations, cryogenic operations, fixture proof tests, emergency blackout procedures. (D) Ordnance - bore scope, X-ray, continuity test, propellant trimming, installation, electrical connection and disconnection. (E) Work involving lasers, high energy radio frequency emissions, radioactive materials, and hazardous materials. (i) Date of original submission; (ii) Anomaly cause; (iii) Corrective actions implemented; (iv) Retesting performed and results; (F) Other items affected; and Risk ratings—mission impact and certainty in corrective actions	

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<u>Title:</u> Orbital Debris Assessment Report (ODAR)	<u>DRD No.:</u> MA-12
<u>Reference:</u> SOW Section 6.0; MAR 3.2.9; NPR 8715.6B, NASA Procedural Requirements for Limiting Orbital Debris and Evaluating the Meteoroid and Orbital Debris Environments; NASA-STD-8719.14. Process for Limiting Orbital Debris	
<u>Use:</u> Ensure NASA requirements for post mission orbital debris control are met.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The assessment shall be done in accordance with NPR 8715.6B and NASA-STD-8719.14. The preliminary assessment is conducted to identify areas where the project may contribute debris and to assess this contribution relative to the guidelines. The final assessment is conducted shall include comments on changes made since the preliminary assessment. The detail should be consistent with the available information of design and operations. The developer shall submit updates to the final assessment for design changes after CDR that impact the potential for debris generation. NOTE: Orbital Debris Assessment Software is available for download from NASA Johnson Space Center at URL: https://orbitaldebris.jsc.nasa.gov/ .	

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<u>Title:</u> Mishap Preparedness and Contingency Plan	<u>DRD No.:</u> MA-13
<u>Reference:</u> SOW Section 6.0; MAR 3.2.10; NPR 8621.1C, NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping	
<u>Use:</u> Ensure NASA requirements for mishap reporting are met.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The Mishap Preparedness and Contingency Plan shall address all applicable requirements of NPR 8621.1C and include a call list.	

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Exhibit B –DRL/DRD (Version 1.4)

<u>Title:</u> Failure Mode and Effects Analysis (FMEA)	<u>DRD No.:</u> MA-14
<u>Reference:</u> SOW Section 6.0; MAR 4.2; NPR 8705.4, Risk Classification for NASA Payloads	
<u>Use:</u> Used to evaluate design for failure modes at the payload/spacecraft interfaces.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The FMEA Report Shall include the following as applicable: (A) Objectives. (B) Level of the analysis. (C) Ground rules. (D) Functional description. (E) Functional block diagrams. (F) Reliability block diagrams. (G) Equipment analyzed. (H) Data sources used. (I) Problems identified (J) Interface failure analysis to include the root cause, mitigations and retention rationale (K) Corrective actions. (L) Work sheets identifying failure modes, causes, severity, detection methods, and mitigating provisions (M) Appropriate retention rationale may include design features, historical performance, acceptance testing, manufacturing product assurance, elimination of undesirable failure modes, and failure detection methods.	

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Exhibit B –DRL/DRD (Version 1.4)

<u>Title:</u> Parts Stress Analysis	<u>DRD No.:</u> MA-15
<u>Reference:</u> SOW Section 6.0; MAR 4.3; GSFC EEE-INST-002 (http://nepp.nasa.gov/DocUploads/FFB52B88-36AE-4378-A05B2C084B5EE2CC/EEE-INST-002_add1.pdf); NASA Parts Selection List (http://nepp.nasa.gov/npsl/index.htm)	
<u>Use:</u> Provides EEE Parts stress analyses for verifying circuit design conformance to de-rating requirements, demonstrates that environmental operational stresses on parts comply with project de-rating requirements.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The Parts Stress Analysis shall contain: (A) Analysis ground rules (B) Reference documents and data used (C) Results and conclusions (D) Design trade study results (E) Parts stress analysis results impacting design or risk decisions (F) Analysis worksheets; the worksheets at a minimum shall include: (i) Part identification (traceable to circuit diagrams) (ii) Assumes environmental (consider all expected environments) (iii) Rated stress (iv) Applied stress (consider all significant operating parameter stresses at the extremes of anticipated environments) (v) Ratio of applied-to-rated stress	

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Exhibit B –DRL/DRD (Version 1.4)

<u>Title:</u> Limited-Life Items List	<u>DRD No.:</u> MA-16
<u>Reference:</u> SOW Section 6.0; MAR 4.4; NASA-STD-6016A, Standard Materials and Processes Requirements for Spacecraft	
<u>Use:</u> Tracks the selection and application of limited-life items and the predicted impact on mission operation including mission and safety critical functions.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The Limited–Life Items List shall include expected life, require life, duty cycles, and rationale for selection and using the item. The list may include such items as structures, thermal control surfaces, solar arrays, electromechanical mechanism, batteries, compressors, seals, bearings, valves, tape recorders, momentum wheels, gyros, actuators and scan devices. The environmental or application factors that may affect the items include such things as atomic oxygen, solar radiation, shelf-life, extreme temperatures, thermal cycling, wear, and fatigue.	

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Exhibit B –DRL/DRD (Version 1.4)

<u>Title:</u> Monthly Parts List Submittal	<u>DRD No.:</u> MA-17
<u>Reference:</u> SOW Section 6.0; MAR 8.4	
<u>Use:</u> A list of EEE parts that are used in the flight hardware for government insight and review leading to delivery of the As-Built Parts List (DRD MA-18).	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> EEE Part Reporting information shall include all data fields listed below known at the time of each monthly submittal: (A) Flight component identity to the circuit board level; (B) Complete part number (i.e., DSCC part number, SCD part number, with all suffixes); (C) Manufacturer's Generic Part number; (D) Manufacturer (not distributor); (E) Part Description (please include meaningful detail); (F) Federal Supplier Code (FSC); (G) Procurement Specification; (H) Comments and clarifications, as appropriate; (I) Estimated Quantity Required; (J) Procurement Part Number; (K) Flight Part Number (if different from the procurement part number); (L) Package Style/Designation; (M) Single Event Latch-up (SEL) Hardness/Tolerance and Data Source; (N) Single Event Upset (SEU) Hardness/Tolerance and Data Source; (O) Total Ionizing Dose (TID) Hardness/Tolerance and Data Source; (P) Displacement Damage Hardness/Tolerance and Data Source; (Q) Proton Hardness/Tolerance and Data Source; (R) PCB Status; (S) PCB Approval Date; (T) PCB Required Testing/Evaluations; (U) GIDEP Alert information review status; (V) Assembly Name/Number; (W) Next level of Assembly; (X) Need Quantity; (Y) Reference Designator(s); and (Z) Item number (if applicable).	

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Exhibit B –DRL/DRD (Version 1.4)

<u>Title:</u> As Built Parts List (ABPL) – CLIN 2	<u>DRD No.:</u> MA-18
<u>Reference:</u> SOW Section 6.0; MAR 8.5	
<u>Use:</u> A final list of EEE parts that are used in the flight hardware.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The ABPL shall contain all the fields/data included in the Monthly Parts List submittal (DRD MA-17) plus the following minimum information: (A) Assembly Name/name & Assembly serial number (B) Item revision (C) Next Level of Assembly & Next Level of Assembly serial number (D) Lot/Date/Batch/Heat/Manufacturing Code, as applicable (E) Manufacturer's CAGE Code (specific plant location preferred) (F) Distributor/supplier, if applicable (G) Part number (H) Part serial number (if applicable)	

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Exhibit B –DRL/DRD (Version 1.4)

<u>Title:</u> Material Usage Agreement (MUA)	<u>DRD No.:</u> MA-19
<u>Reference:</u> SOW Section 6.0; MAR 9.3; NASA-STD-6016A, Standard Materials and Processes Requirements for Spacecraft; MSFC-STD-3029, Guidelines for the Selection of Metallic Materials for Stress Corrosion Cracking Resistance in Sodium Chloride Environments; Materials and Processes Technical Information System (MAPTIS) - MAPTIS is accessible via the Internet at http://maptis.nasa.gov	
<u>Use:</u> Establishes the process for submitting an MUA for material or process that does not meet the requirements of NASA-STD-6016A (or Government approved equivalent) and does not affect reliability or safety when used per the Materials and Processes Selection, Control, and Implementation Plan.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The MUA package shall include the technical information required by the Related Documents listed above to justify the application. MUAs for stress corrosion shall include a Stress Corrosion Cracking Evaluation Form per MSFC-STD-3029 and a stress analysis (see NASA-STD-6016A). The MUA shall include the results of acceptance testing on selected sample lots of procedure materials per approved procedure.	

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Exhibit B –DRL/DRD (Version 1.4)

<u>Title:</u> Material Identification and Usage List (MIUL)	<u>DRD No.:</u> MA-20
<u>Reference:</u> SOW Section 6.0; MAR 9.4; NASA-STD-6016A, Standard Materials and Processes Requirements for Spacecraft	
<u>Use:</u> Establishes the MIUL including Material Selection List for Metals, Fasteners, Plastic Films, Foams, and Adhesive Tapes submitted to Launch Range Safety for assessment of flammability.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> The Contractor shall deliver the MIUL in a MAPTIS compatible form (or Contractor equivalent). The MIUL shall identify the following information as applicable to the material process: <ul style="list-style-type: none"> (A) Material form; (B) Material manufacturer and manufacturer's designation; (C) Material specification; (D) Process specification; (E) Environment; (F) Weight; (G) MAPTIS Material code (if data are to be provided in a form compatible with MAPTIS); (H) Standard/commercial part number; (I) System and subsystem; (J) Maximum and minimum temperature (required based on requests by the Government); (K) Fluid type; (L) Surface Area and thickness; (M) Project; (N) Cure schedule; and (O) GIDEP Alert Information (P) Detailed drawing and dash number (Q) Next Assembly and dash number (R) Change letter designation (S) Drawing source (T) Contractor (supplier) (U) Overall evaluation (V) Overall Configuration Test (W) MUA # or rationale (X) Materials rating 	

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Exhibit B –DRL/DRD (Version 1.4)

<u>Title:</u> End of Mission Plan (EOMP) – CLIN 2	<u>DRD No.:</u> MA-21
<u>Reference:</u> SOW Section 6.0; MAR 3.2.9; NPR 8715.6B, NASA Procedural Requirements for Limiting Orbital Debris and Evaluating the Meteoroid and Orbital Debris Environments; NASA-STD-8719.14, Process for Limiting Orbital Debris	
<u>Use:</u> Ensure NASA requirements for assessing and limiting the risk associated with the end of mission (EOM) of a space object are met.	
<u>Related Documents:</u> N/A	
<u>Preparation Information:</u> An EOMP is developed for limiting debris generation and limiting risk to the public and other active spacecraft during decommissioning, and disposal of all space objects. The EOMP shall be done in accordance with NPR 8715.6B and NASA-STD-8719.14 (The EOMP shall be organized using Appendix B, Section B.1.). An EOMP may include other aspects of the end of mission process (final disposition of data and hardware, for example) if the program finds that the EOMP is the most convenient means of recording this information. Other applicable sections may be placed after the sections specified in Appendix B. The “Prelaunch EOMP” 30 days prior to the RE-6, ORR. Formal acceptance of the risk associated with the nonconformance’s remaining in the EOMP is included as a part of the prelaunch risk acceptance. The “Pre-Decommissioning EOMP” is delivered at 30 days prior to the expected Decommissioning Review. The approved version is included in the Pre-Decommissioning Review data package. NOTE: This is approximately the same time that the notice of intent to shut down the spacecraft is delivered to the NASA Associate Administrator per NPD 8010.3A, Notification of Intent to Decommission or Terminate Operating Space Systems and Terminate Missions. It is desired that the EOMP accompany this letter. The “Pre-Disposal EOMP” is delivered at 30 days prior to the Disposal readiness Review. The approved version is included in the Disposal Readiness Review data package.	

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EXHIBIT G**

**Government-Furnished Property
(GFP)**

For

**Geostationary Carbon Cycle
Observatory (GeoCarb) Mission**





Version 3.0

September 14, 2018

Document Change Record

Revision	Date	Description of Change
1.0	12/20/2017	Incorporated into contract via modification 4.
2.0	03/15/2018	Updated to add additional items via modification 5.
3.0	9/14/2018	Updated via modification 6 to modify the Residual Interface Region Imaging Spectrograph (IRIS) Items (Lockheed Martin) DD1149 and to add the Euclid Land Grid Arrays DD1149 (JPL to Lockheed Martin).

GFP Summary

Item No.	Description	Total Cost	Exhibit G Version
1	Tropospheric Infrared Mapping Spectrometer (TIMS) Instrument Test Bed and Residual Hardware (Lockheed Martin)  DD1149 for TIMS Items	\$296,113.50	1.0
2	Residual Solar Ultraviolet Imager (SUVI) Items (Lockheed Martin)  DD1149 for SUVI Items	\$2,894.00	2.0
3	Residual Interface Region Imaging Spectrograph (IRIS) Items (Lockheed Martin) – REVISION 1  DD1149 for IRIS Items	\$1,053,357.36	3.0
4	Euclid Land Grid Arrays Items (JPL to Lockheed Martin)  DD1149 for Euclid	\$54,375.94	3.0
Total		\$1,406,740.80	