

ORDER FOR SUPPLIES OR SERVICES

PAGE 1 OF 7 PAGES

IMPORTANT: Mark all packages and papers with contract and/or order numbers.

1. DATE OF ORDER NOV 24 1997		2. CONTRACT NO. (If any) NAS5-97251		6. SHIP TO:		
3. ORDER NO. 002		4. REQUISITION/REFERENCE NO.		a. NAME OF CONSIGNEE n/a		
5. ISSUING OFFICE (Address correspondence to) NASA Goddard Space Flight Ctr., Code 210				b. STREET ADDRESS		
7. TO:				c. CITY		e. ZIP CODE
a. NAME OF CONTRACTOR Ball Aerospace and Technologies Corp.				f. SHIP VIA		
b. COMPANY NAME				8. TYPE OF ORDER		
c. STREET ADDRESS 1600 Commerce Street				<input type="checkbox"/> a. PURCHASE REF YOUR: _____ Please furnish the following on the terms and conditions specified on both sides of this order and on the attached sheet, if any, including delivery as indicated.		<input checked="" type="checkbox"/> b. DELIVERY -- Except for billing instructions on the reverse, this delivery order is subject to instructions contained on this side only of this form and is issued subject to the terms and conditions of the above-numbered contract.
d. CITY Boulder		e. STATE	f. ZIP CODE 80306-1062			
9. ACCOUNTING AND APPROPRIATION DATA See Continuation Pages				10. REQUISITIONING OFFICE Jet Propulsion Lab		
11. BUSINESS CLASSIFICATION (Check appropriate box(es))						
<input type="checkbox"/> a. SMALL <input checked="" type="checkbox"/> b. OTHER THAN SMALL <input type="checkbox"/> c. DISADVANTAGED <input type="checkbox"/> d. WOMEN-OWNED						
12. F.O.B. POINT Destination		14. GOVERNMENT B/L NO.		15. DELIVER TO F.O.B. POINT ON OR BEFORE (Date)		16. DISCOUNT TERMS
13. PLACE OF						
a. INSPECTION		b. ACCEPTANCE On-orbit				

17. SCHEDULE (See reverse for Rejections)

ITEM NO. (a)	SUPPLIES OR SERVICES (b)	QUANTITY ORDERED (c)	UNIT (d)	UNIT PRICE (e)	AMOUNT (f)	QUANTITY ACCEPTED (g)
1	Core System Spacecraft & all associated hardware, software & documentation for the QuickSCAT Mission	1	ea		(b) (4)	
3	Mission Specific Modifications including 2 years of Mission Operations	1	ea		(b) (4)	
5	Flight Software & Source Code as required by SOW and the Delivery Order Requirements	1	ea		(b)	
7	CDRL Documentation as required by Attachment E of this Delivery Order Launch Date: November 1, 1998	1	ea		(b) (4)	

SEE BILLING INSTRUCTIONS ON REVERSE	18. SHIPPING POINT		19. GROSS SHIPPING WEIGHT		20. INVOICE NO.		17(h) TOT. (Cont. pages) 17(i) GRAND TOTAL
	21. MAIL INVOICE TO:						
	a. NAME NASA Goddard Space Flight Center, Financial Management Division						
	b. STREET ADDRESS (or P.O. Box) Accounts Payable Section, Code 151.3A						
c. CITY Greenbelt			d. STATE MD	e. ZIP CODE 20771		\$39,279K	

22. UNITED STATES OF AMERICA BY (Signature)



23. NAME (Typed)
Jeffrey C Lamke
TITLE: CONTRACTING/ORDERING OFFICER

Contractor's Agreement

The contractor agrees to furnish and deliver all items or perform all the services set forth or otherwise identified in this delivery order for the consideration stated herein. The rights and obligations of the parties to this delivery order shall be subject to and governed by the following documents: (a) the basic contract, (b) this delivery order, (c) the solicitation, if any, and (d) such provisions, representations, certifications and specifications, as are attached or incorporated by reference herein.

(The Contractor is required to sign this document and return five copies to the issuing office.)

Ed. L. Vande Noord, Senior V.P. and General Manager, Ball Aerospace Systems Division
Name and Title of Signer (*Type or Print*)

E. L. Vande Noord / 11/24/97
Signature of Person Authorized to Sign Date

1. All terms and conditions of Master Contract NAS5-97251 apply to this delivery order (D.O.) for the QuickSCAT Mission except as noted below:

B.4, PERFORMANCE-BASED EVENTS AND COMPLETION CRITERIA, is revised for this D.O. to incorporate the Performance Based Payment Events as specified in Attachment F to this D.O.

H.2, LIMITATION OF FUNDS (FIXED-PRICE CONTRACT) (18-52.232-77) (MAR 1989), applies to this D.O.

(a) Of the total price of items 1, 3, 5 & 7, the sum of \$9,500,000 is presently available for payment and allotted to this contract. It is anticipated that from time to time additional funds will be allocated to the contract in accordance with the following schedule, until the total price of said item is allotted:

SCHEDULE FOR ALLOTMENT OF FUNDS

Date	Amounts
November 1997	\$ 6,200,000
January 1998	\$24,100,000
October 1998	\$ 4,000,000

(b) The Contractor agrees to perform or have performed work on the items specified in paragraph (a) above up to the point at which, if this contract is terminated pursuant to the Termination for Convenience of the Government clause of this contract, the total amount payable by the Government (including amounts payable for subcontracts and settlement costs) pursuant to paragraphs (f) and (g) if that clause would, in the exercise of reasonable judgment by the Contractor, approximate the total amount at the time allotted to the contract. The Contractor is not obligated to continue performance of the work beyond that point. The Government is not obligated in any event to pay or reimburse the Contractor more than the amount from time to time allotted to the contract, anything to the contrary in the Termination for Convenience of the Government clause notwithstanding.

(c) (1) It is contemplated that funds presently allotted to this contract will cover the work to be performed until January 17, 1998.

(2) If funds allotted are considered by the Contractor to be inadequate to cover the work to be performed until that date, or an agreed date substituted for it, the Contractor shall notify the Contracting Officer in writing when within the next 60 days the work will reach a point at which, if the contract is terminated pursuant to the Termination for Convenience of the Government clause of this contract, the total amount payable by the Government (including amounts payable for subcontracts and settlement costs) pursuant to paragraphs (f) and (g) of that clause will approximate 75 percent of the total amount then allotted to the contract.

(3) (i) The notice shall state the estimated date when the point referred to in subparagraph (2) above will be reached and the estimated amount of additional funds required to continue performance to the date specified in subparagraph (1) above, or an agreed date substituted for it.

(ii) The Contractor shall, 60 days in advance of the date specified in subparagraph (1) above, or an

agreed date substituted for it, advise the Contracting Officer in writing as to the estimated amount of additional funds required for the timely performance of the contract for a further period as may be specified in the contract or otherwise agreed to by the parties.

(4) If, after the notification referred to in subdivision (3)(ii) above, additional funds are not allotted by the date specified in subparagraph (1) above, or an agreed date substituted for it, the Contracting Officer shall, upon the Contractor's written request, terminate this contract on that date or on the date set forth in the request, whichever is later, pursuant to the Termination for Convenience of the Government clause.

(d) When additional funds are allotted from time to time for continued performance of the work under this contract, the parties shall agree on the applicable period of contract performance to be covered by these funds. The provisions of paragraphs (b) and (c) above shall apply to these additional allotted funds and substituted date pertaining to them, and the contract shall be modified accordingly.

(e) If, solely by reason of the Government's failure to allot additional funds in amounts sufficient for the timely performance of this contract, the Contractor incurs additional costs or is delayed in the performance of the work under this contract, and if additional funds are allotted, an equitable adjustment shall be made in the price or prices (including appropriate target, billing, and ceiling prices where applicable) of the items to be delivered, or in the time of delivery or both.

(f) The Government may at any time before termination, and, with the consent of the Contractor, after notice of termination, allot additional funds for this contract.

(g) The provisions of this clause with respect to termination shall in no way be deemed to limit the rights of the Government under the Default clause of this contract. The provisions of this Limitation of Funds clause are limited to the work on and allotment of funds for the items set forth in paragraph (a) above. This clause shall become inoperative upon the allotment of funds for the total price of said work except for rights and obligations then existing under this clause.

(h) Nothing in this clause shall affect the right of the Government to terminate this contract pursuant to the Termination for Convenience of the Government clause of this contract.

(End of clause)

I.1, LIST OF SECTION I CLAUSES INCORPORATED BY REFERENCE, is revised to delete from this D.O. (52.230-2) Cost Accounting Standards (Apr 1996) and (52.230-6) Administration of Cost Accounting Standard (Apr 1996), and to add (52.225-10) Duty-Free Entry (Apr 1994).

J.1, LIST OF ATTACHMENTS, Attachment A, Statement of Work, is replaced with the attached QuickSCAT Statement of Work (DO Attachment A) for this D.O.

J.1, LIST OF ATTACHMENTS, Attachment B(a), Performance Specification, is replaced with the attached QuickSCAT Performance Specification (DO Attachment D) for this D.O.

J.1, LIST OF ATTACHMENTS, Attachment B(b), Mission Implementation Specification, is replaced with the attached QuickSCAT Mission Implementation Specification (DO Attachment C) for this D.O.

J.1, LIST OF ATTACHMENTS, Attachment B(c), Interim Performance Based Payment Events & Completion Criteria, is replaced with the attached QuickSCAT Interim Performance Based Payment Events & Completion Criteria (DO Attachment E) for this D.O.

J.1, LIST OF ATTACHMENTS, Attachment D, Contract Data Requirements List, is replaced with the attached QuickSCAT Contract Data Requirements List (DO Attachment B) for this D.O.

2. Additional QuickSCAT Requirements that apply to this DO are as follows:

Spacecraft Storage Option

In the event the Government exercises the option for spacecraft storage as defined in 4.3.4.3 of the SOW, the spacecraft ground storage line item prices set forth below represent the monthly spacecraft price for storage.

The Government may order the spacecraft into storage by providing the contractor notification of the decision to exercise the spacecraft storage option at least 30 calendar days prior to spacecraft shipment to the launch site. The option for storage for the spacecraft shall not exceed 6 months. If storage exceeds 6 months the contractor shall be entitled to an equitable adjustment to the delivery order price, such price to be negotiated between the contractor and the Government. After notification by the Government of a required launch of a stored spacecraft, the Contractor shall have 20 calendar days to be ready for spacecraft shipment to the launch facility. The contractor shall provide the Government access to the spacecraft prior to placement in storage and after removal from storage. The monthly storage rate for spacecraft storage is:

<u>MONTHS</u>	<u>MONTHLY RATE</u>
1-6	\$134,000

Scheduled

Launch Date

November 1, 1998

In addition the above monthly storage rate the contractor shall perform all necessary testing, following the removal of the spacecraft from storage, to ensure the spacecraft is ready for launch. Should testing result in the need for repair or replacement of parts, components, subsystems or the like the Contractor shall bear the expense of such effort and items. The one time price for this testing is \$72,000, and is in addition to the above monthly storage rate.

Payment for storage, if exercised, shall be on a monthly basis, and following the completion of the month being billed for. The one-time price for any and all retesting shall be payable following mutual agreement between the Contractor and the Government that the spacecraft is ready for launch. Placement of any spacecraft into storage under this clause shall in no way affect the Contractor's responsibilities to meet the spacecraft performance requirements of this delivery order.

(End of Clause)

Mission Operations (Option for Third Year)

In the event the Government exercises the option for the third year mission operations, the mission operations line item price set forth below represents the price for mission operations.

The Government may order the third year of mission operations by issuing a modification to this delivery order prior to the expiration of the delivery order; provided, that the Government shall give the contractor preliminary notification of the decision to exercise the mission operations option at least 60 days prior to the delivery order expiring. The preliminary notice does not commit the Government to an extension of the mission operations.

If mission operations exceed one option year the contractor shall be entitled to an equitable adjustment to the delivery order price, such price to be negotiated between the contractor and the Government. The rate for one optional year of mission operation is \$825,425.

Payment for mission operations, if exercised, shall be on a quarterly basis, and following the completion of the quarter being billed.

(End of Clause)

Contracting Office Delegation

The administration of this this D.O. is transferred to:

NASA Goddard Space Flight Center
Code 214.3, EOS/GGS/LANDSAT/TRMM Office
Attn: Ms. Theresa Becker
Greenbelt, MD 20771
Phone: 301-286-0838 FAX: 301-286-0383

The above office will administer all changes, funding requirements, and payment requirements and will ensure that the terms and conditions of the delivery order are met by the contractor and the Government.

(End of Clause)

Contracting Officer's Technical Representative Delegation

The Contracting Officer's Technical Representative (COTR) for the purposes of monitoring and coordinating the technical requirements of this delivery order is Mr. Kenneth Schwer.

Specific duties and responsibilities of the COTR are those delegated in the Contracting Officer's Technical Representative Delegation Letter (NASA Form 1634) for this delivery order.

(End of Clause)

Delivery Schedule

<u>Item</u>	<u>Description</u>	<u>Number of Months</u>
1	Core Sytem Spacecraft & all associated hardware, software & documentation for the QuickSCAT mission	Launch Date November 1,1997
3	Misison Specific Modifications including 2 years of Misison Operations	As Required
5	Flight Software & Source Code as required by SOW and the Delivery Order Requirements	As Required
7	CDRL Documentation as required by Attachment B of this Delivery Order	As Required

(End of Clause)

Period of Performance

The period of performance of this delivery order shall be from the effective date of the delivery order through completion of mission operations.

(End of Clause)

Accounting and Appropriation Data

PCN: 408-52172A (1C)

JON: 408-670-02-01-87

APP: 807/80110(97)

OC: 40-2550

BLI: A701

AMT: \$3,300,000

B/NC: 01

3. The following attachments constitute part of this delivery order:

<u>Attachment</u>	<u>Description</u>
A	QuickSCAT Statement of Work
B	QuickSCAT Contract Data Requirements List
C	QuickSCAT Mission Implimentation Specification
D	QuickSCAT Performance Specification
E	QuickSCAT Interim Performance Based Payment Events and Completion Criteria
F	QuickSCAT Payment Schedule

END OF DELIVERY ORDER

QSSOW

STATEMENT OF WORK

FOR

THE NASA QUICK SCATTEROMETER (QuikSCAT) MISSION

NOVEMBER 3, 1997

Rev. A: 11/18/97

**NASA/GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND 20771**

QuikSCAT
STATEMENT OF WORK

Prepared by: Original Signed 11/3/97
Kenneth O. Schwer Date
QuikSCAT Observatory Manager

Approved by: Original Signed 11/3/97
James E. Graf Date
QuikSCAT Project Manager

Revision Letter	Reason	Date	Approval
A	Update for Delivery Order. Add requirement for storage option (section 4.3.4.3)	11/18/97	K. O. Schwer

1.0 Introduction

The NASA GSFC is participating with the NASA JPL in performing the NASA Quick Scatterometer (QuikSCAT) Mission. This mission is a science driven mission to restart the ocean wind vector data stream. The Goddard Space Flight Center (GSFC) has been given responsibility for procuring the spacecraft and support services to meet the mission requirements as specified herein.

This Statement of Work (SOW) defines the contractor's efforts required to implement the QuikSCAT Mission which include providing the spacecraft bus, integrating the JPL Scatterometer, and performing two years of observatory on-orbit operations. Instrument operations and science data processing will be provided by NASA's JPL and operational data processing will be provided by NOAA. NASA's ground tracking network will be provided for spacecraft tracking and communications.

The government furnished equipment (GFE) instrument for the QuikSCAT mission will be JPL's Scatterometer and its associated ground support equipment (GSE) and analytical models. The Scatterometer and GSE will be delivered to the contractor on May 22, 1998. The Scatterometer will be available for observatory integration after the Scatterometer post shipment stand alone test.

The QuikSCAT observatory shall be launched from the Vandenberg Airforce Base on November 1, 1998 on a Government provided Titan II launch vehicle. The performance and interface requirements for the QuikSCAT Mission are defined in the QuikSCAT Performance Specification.

2.0 Scope

The contractor shall furnish the necessary personnel, facilities, services, and materials to design, fabricate, integrate, test, support launch activities, orbit raise, and perform observatory operations for the QuikSCAT observatory developed under this delivery order. This work shall be performed in accordance with the requirements of this document and all attachments to the QuikSCAT delivery order.

In accomplishing the development and delivery of the QuikSCAT observatory, the contractor shall:

1. Provide the spacecraft bus.
2. Receive the Scatterometer and related ground support equipment (GSE), then integrate them with the spacecraft bus and perform observatory level testing.
3. Provide all required spacecraft/observatory mechanical and electrical GSE.
4. Perform combined observatory testing, ground system compatibility testing, and end-to-end testing before launch.
5. Support the launch vehicle mission integration process, launch base coordination and safety, observatory/launch vehicle integration and checkout, and launch.
6. Provide all services (except those services provided by the NASA ground network) associated with operations beginning with launch vehicle/observatory separation and continuing through observatory positioning in orbit.
7. Provide all services (except those services provided by the NASA ground network) associated with the on-orbit observatory checkout.
8. Provide all services (except those services provided by the NASA ground network) associated with spacecraft bus on-orbit operations.

3.0 Applicable and Reference Documentation

The documents listed in this section apply directly to the performance of the QuikSCAT Contract. These documents establish detailed specifications, requirements, and interface information necessary for the performance of this delivery order. Unless otherwise specified, the document version in effect at the

time this delivery order is executed shall apply.

QuikSCAT Performance Specification, QSPERF
QuikSCAT CDRLs, QSCDRL
JPL QuikSCAT Mission Operations Anomaly Reporting, PD XXX-XXX, October 1997.

4.0 Work to be Performed by the Contractor

4.1 System Implementation

The effort to produce a specified core system, with the selected options, and the mission-unique modifications required in the QuikSCAT delivery order in accordance with the mission implementation specification, shall result in a product called the "Spacecraft Bus". The effort to integrate the Scatterometer instrument, and qualify the combined instrument and spacecraft bus in accordance with the mission implementation specification, shall result in a system called an "Observatory".

4.1.1 Core System

As necessary, the contractor shall develop, implement, test, and qualify a spacecraft bus ready for Scatterometer integration. The spacecraft shall conform to the QuikSCAT Performance Specification and Mission Implementation Specification.

4.1.2 Core System Option(s)

Intentionally left blank.

4.1.3 Mission-Specific Modifications

In order to meet the QuikSCAT mission requirements, the contractor shall modify their spacecraft bus (core system), as necessary.

4.2 Non-Standard Services

Intentionally left blank.

4.2.1 Non-Mission-Specific Non-Standard Services

Intentionally left blank.

4.2.2 QuikSCAT Specific Non-Standard Services

4.2.2.1 NASA Resident Office Support

The contractor shall provide office space, furniture, copier(s), facsimile machine(s), and phones for NASA representatives at their facilities as follows:

1. Spacecraft assembly plant - two NASA residents and six visiting representatives.
2. Spacecraft/observatory integration and test - three NASA residents and six visiting representatives.

These offices are required to support the Government insight team and the Scatterometer integration and test team.

4.2.2.2 Special Studies

The contractor shall perform task assignments relating to the development, implementation, characterization, and operation of the QuikSCAT mission requirements, as authorized by NASA and in accordance with contract clause B6. Each task will be initiated by written direction from the NASA contracting officer. NASA will coordinate with the spacecraft contractor to define each task in detail, and establish manpower ceilings and performance schedules.

4.2.2.3 Electronic Distribution

To the maximum extent possible, the contractor shall distribute CDRLs and other QuikSCAT documentation, etc. to NASA GSFC and JPL electronically in a format mutually agreed upon.

4.2.2.4 Video Conferencing

The contractor shall develop or make readily available to their QuikSCAT team video conferencing capability. The contractor's video conference machinery shall be compatible with Picture Tel Venue 2000, Model 50. The contractor shall conduct videocons with NASA GSFC and JPL as requested.

4.3 Standard Services

The contractor shall provide all facilities, services, and personnel necessary for the successful and on-time implementation of all of the efforts necessary to meet the QuikSCAT delivery order requirements.

4.3.1 Program Management

The contractor shall provide a program management function that is responsible for the control of the QuikSCAT effort. The contractor's Program Management function shall provide to the Government reporting and real-time insight into program status, as well as technical and programmatic performance of all of the contractor's responsibilities performed under this delivery order. Since this delivery order is fixed price, cost reporting to NASA is not required. The contractor shall provide all facilities, services, and personnel necessary to maintain management control over the development of the entire QuikSCAT program and assure that the delivery order requirements are fully met.

The contractor shall use their resource management system for planning, authorizing, and controlling resources and for providing timely and adequate visibility into manpower and schedule performance.

The contractor shall establish, implement, and maintain an integrated scheduling system consistent with their corporate procedures. The contractor shall provide to NASA timely updates of the master and detailed program phasing/milestone schedule and observatory/spacecraft/Scatterometer integration/subsystem schedules.

The contractor shall provide the necessary resources for monitoring, controlling, executing, and administering the QuikSCAT delivery order and subcontracts to ensure compliance with all contractual requirements.

All systems delivered under this delivery order shall be Year 2000 compliant.

The contractor shall be responsible for the rapid submission/negotiation of all change order proposals as required by this delivery order. Refer to CDRL 15.

4.3.1.1 Quality Management System

The contractor will maintain and adhere to a Quality Management System which meets the intent of ANSI/ASQC Q9001-1994 or as modified and agreed to by the Government.

The Quality Management System shall include the following augmentation to ANSI/ASQC Q9001-1994, Paragraph 4.13.2.

4.3.1.1.1 Quality Assurance Management Requirements

Once the spacecraft begins comprehensive performance test in demonstration of readiness for Scatterometer integration, a system of written problem/failure reports (PFR's) will be used through launch. The PFR's will be written for any departure from design, performance, testing, or handling requirements which affect the function of the flight system, or ground support system which interfaces with the flight system, or that could compromise mission objectives.

4.3.1.1.2 Pre-Launch Reports

The contractor shall report failure reports in accordance with company standards. However, these failure reports shall include risk rating of the problem in order to identify significant problems/failures. Contractor format, generation, review, disposition and/or approval of failure reports will be described in applicable procedure(s) included or referenced in the contractor's Quality Manual.

4.3.1.1.3 Post Launch Reports

Following launch, flight hardware and software anomalies, problems and/or failures will be reported using the JPL QuikSCAT Mission Operations Anomaly Reporting in accordance with PD XXX-XXX, Draft October 1997. The contractor shall demonstrate proper use of this reporting system prior to the FRR.

4.3.1.2 Documentation

The contractor shall develop, produce, deliver, and maintain all documentation required by the QuikSCAT CDRL and necessary to implement the QuikSCAT delivery order. All efforts including the performance of tests and analyses not otherwise explicitly stated in other parts of this SOW, but determined jointly by the contractor and NASA to be mission critical, shall be performed and documented by the contractor. All documentation, data, and analyses generated for, or applicable to, the effort, whether formal or informal, shall be made available to the Government upon request at the contractor's facility.

The contractor shall prepare and provide the following configuration control documentation:

1. Engineering Change Proposals (ECPs), deviations, and waivers as described in CDRL 15.
2. The As Built Bus Configured Item List in accordance with CDRL 7.

4.3.1.3 Reviews

The contractor shall conduct usual and customary internal reviews and provide for timely reporting of program status to the Government with discussions on problem areas, and a timely transfer of technical information to the Government, of major program milestones. The contractor shall provide technical and management support to certify spacecraft bus or observatory readiness at the following program reviews:

Review	# of Days
Mission Design Review (MDR)	3
Instrument Design Review (IDR)	2
Pre-Environmental Review (PER)	2
Pre-Ship/Operational Readiness Review (PSR & ORR)	3
Flight Readiness Review (FRR)	1
Monthly Management Meeting (MMM)	0.5

The IDR shall be held at NASA JPL and the FRR shall be held at the launch site, all other reviews shall be held at the contractor's location. The contractor shall ensure that appropriate personnel attend each review. With the exception of the IDR, the contractor shall chair these reviews with co-chair support from NASA GSFC/JPL representatives. The minutes and action items that result from these reviews shall be documented by the contractor and made available to the Government. If any deficiencies are found at the reviews, the contractor will be required to develop a corrective action plan for the deficiencies prior to proceeding with the affected program development.

4.3.1.3.1 Mission Design Review (MDR) Requirements

The contractor shall conduct a MDR which will be a combined requirements review, heritage review, spacecraft design review, and a instrument accommodation review to review all hardware and software final designs. The MDR will consist of two days of "peer reviews" and a third day of formal reviews. The MDR shall be considered complete upon satisfactory close-out of mission critical MDR action items.

The contractor shall provide the following data and information:

System Level:

1. Mission design overview showing a mature understanding of the mission objectives and the approaches that will be used to carry out the mission together with definition of roles and responsibilities.
2. Mission performance requirements allocation and subsystem flow-down.
3. Resource allocations and margins (telemetry, commands, power, weight, data storage, processor capability, propellant, etc.).
4. Preliminary instrument and ground system ICDs.
5. Performance verification approach and rationale.
6. Spacecraft bus integration and test sequence rationale.
7. Observatory integration and test sequence and rationale.
8. QA program applications, status, issues.
9. Flight operations approach to meeting requirements and status of development.
10. Mission ground support equipment (GSE) design and development status.
11. Approach for the next milestone review.
12. I&T software requirements, description, status, verification.
13. Flight software requirements, description, development and verification plan, status.

14. Hardware/software heritage.
15. Hardware/software availability and procurements.
16. Description, prior history, and compatibility with QuikSCAT requirements and environments of inherited products that will be used.

Subsystem level (includes hardware, flight software, and ground software)

1. Requirements flow-down specifications to each subsystem.
2. Performance verification and validation.
3. Design details of mission-specific elements.
4. GSE.

Specific Analysis and Margins

1. Stress and dynamics.
2. Loads determination.
3. Communication links.
4. Thermal flight predictions.
5. Power balance (end-of-life and battery DOD).
6. Worse case and electronic parts stress analysis.
7. Data flow, Storage and loading.
8. Pointing budgets including attitude control simulation results.
9. Attitude control system stability analyses.
10. Flight dynamics, orbit insertion, maintenance, disposal.
11. Design guidelines for radiation, EMC, ESD, magnetics and summary of component level compliance.
12. System level failure mode and effects analysis (FMEA) down to the box level in order to identify single point failures for the operational mission phase, covering analysis of interfaces and redundancy. However, for new designs and add-on assembly interfaces, reliability analyses and FMEA's shall be performed to the component level.

4.3.1.3.2 Scatterometer Instrument Design Review (IDR) Requirements

The contractor shall participate in an IDR at JPL to review all instrument hardware and software designs. The IDR shall be considered complete for the contractor upon satisfactory close-out of all contractor IDR action items.

4.3.1.3.3 Pre-Environmental Review (PER) Requirements

The contractor shall conduct a PER to review all hardware and software test configurations, test plans, procedures, facilities and responsibilities to ensure that the environmental testing will proceed in a controlled manner and that all the necessary requirements and procedures are documented and understood. The PER shall be considered complete upon satisfactory close-out of PER action items critical to proceeding with testing.

The contractor shall present the following at the PER:

1. The results of Scatterometer integration and the status of the observatory development and test.
2. A resolution plan for all failures, anomalies, and malfunctions encountered during Scatterometer integration.
3. Status against performance specification and margins.
4. Status of development of spacecraft operations system.
5. Review of all environmental test plans and procedures.

6. Present detailed thermal vacuum and thermal balance test plans showing the observatory in the chamber, the hot and cold plates and shrouds, test targets, RF coupling, test simulators, QCMs, cold finger, planned test profile, cleaning and outgassing plan.
7. The structural qualification/acceptance plan, showing the final modal analyses and coupled loads analyses results.
8. Define the predicted test limits for the components of the spacecraft bus and Scatterometer for:
 - Vibration
 - Thermal-Vacuum, Balance
9. Verify that the planned test environments adequately demonstrate the observatory performance requirements without presenting a hazard, and without degrading observatory performance and lifetime by analysis to compliance with the QuikSCAT Specifications and ICDs.
10. Present the plans to proceed to PSR (e.g. tests, activities, facilities, staffing, resources, schedule, flow).

4.3.1.3.4 Pre-Ship/Operational Readiness Review (PSR & ORR) Requirements

The contractor shall conduct a PSR & ORR to verify and document that the spacecraft, operations system, and flight and ground software are performing in accordance with the QuikSCAT Performance Specification and Mission Implementation Specification. The PSR and ORR shall be considered complete upon satisfactory close-out of all PSR and ORR action items.

The contractor shall present the following at the PSR/ORR:

1. Results of all the environmental tests, end-to-end tests, and the latest observatory comprehensive performance test and comparison against requirements.
2. A resolution plan for all failures, anomalies, and malfunctions remaining open.
3. Flight software verification results.
4. Any remaining open issues under the delivery order and their proposed resolution.
5. Shipping plans and documentation status (e.g. shipping lists, manifests, containers, handling, transport, etc.).
6. Observatory documentation status (e.g. final configuration lists, trend data, test reports, mass properties, system safety plan, life-limited items, equipment logs, cleanliness certification, and any other necessary documents).
7. Receiving point plans - arrival time and place, storage, handling, points-of-contact, mechanical and electrical test plans and procedures.
8. Detailed plans of the launch support (e.g. activities, facilities, staffing, resources, schedule, flow).
9. Readiness of flight operations procedures and personnel.
10. Ground network compatibility RF test results and open issues with plan for closure.
11. Overview of mission & launch simulations plans.

4.3.1.3.5 Mission Flight Readiness Review (FRR) Requirements

The contractor shall conduct a mission FRR to verify that testing is complete with no unresolved problems and to evaluate readiness of the hardware, software, and ground system for launch. The launch vehicle FRR will be conducted by the Government. The FRR shall be considered complete upon satisfactory close-out of mission critical FRR action items.

4.3.1.3.6 Monthly Management Meetings (MMM) Requirements

The contractor shall conduct MMMs to review project status in terms of schedule, technical issues, performance (and margin), manpower, and to identify problem areas and assign action items for their solution. To save time and travel, these meetings should be combined with other reviews, videocons, or

telecons at the discretion of the Government. Minutes of these meetings with a copy of the review hand-outs shall be submitted as the monthly status report.

The contractor shall present the following information at the MMMs:

1. Status of work being performed including appropriate metrics.
2. Detail status of schedule.
3. Status of project staffing and any shortages.
4. Milestone Monitoring - The contractor shall report on the status of progress made toward accomplishing each of his major milestones. Each report shall include a listing of major accomplishments and a discussion of any problems associated with each milestone as well as their resolution.
5. Status of technical issues.
6. Changes to design parameters such as weight, power profile, communications, system performance, etc.
7. Descriptions and status of technical problems and the resolutions.
8. Subcontract technical performance.
9. Performance assurance status including non-conformance and failure report dispositions.

4.3.1.4 Audits

The contractor shall support a Government audit of the contractor's activities, processes, products, documentation and data in order to provide assurance to the Government that the program is being implemented according to all requirements and specifications. All audits will be performed in parallel with design, development, integration, and test activities.

4.3.1.5 Government Insight

All contractor and subcontractor internal data, reviews, audits, meetings and other activities pertinent to the execution of the contract shall be open to Government attendance. The contractor shall provide the Government with reasonable and timely notification, to facilitate Government attendance. Government support contractors may also attend these reviews, audits, and meetings at the Government's discretion.

4.3.2 Systems Engineering

The contractor has overall system engineering responsibility for the spacecraft and mission. The contractor shall perform the necessary systems engineering required to ensure that the spacecraft bus and modifications meet all of the performance, interface, and implementation requirements of the QuikSCAT contract. The systems engineering effort shall comprise the analyses of technical requirements, allocation of derived system, spacecraft bus, ground system, and lower level requirements, definition and maintenance of interfaces, verification of all defined and derived requirements, risk management, and tradeoff analyses. The systems engineering effort shall be on-going through all stages of the QuikSCAT program, including the allocation of the system performance specification, design, development, fabrication, qualification and acceptance testing, launch operations, post launch checkout, on-orbit anomaly resolution, integration into the science and operational systems, and mission operations.

The contractor shall perform a fully integrated systems engineering management effort. This support shall include the following activities:

1. Providing technical direction and oversight throughout all phases of the program.
2. Supporting reviews as defined in section 4.3.1.3. The support shall include responsibility for the

- preparation of responses to all action items assigned to the contractor during the reviews.
3. Attending and supporting Scatterometer instrument reviews/meetings at JPL (assume 1 review/meeting per quarter).
 4. Conducting interface working group meetings (assume 4 meetings to be held early in the delivery order).
 5. Performing all necessary system studies, trades, and risk assessments determined jointly by the contractor and NASA to be necessary to meet the mission requirements as defined in the QuikSCAT specifications.

4.3.2.1 Requirements Analyses and Allocations

The contractor shall conduct complete analyses of the mission requirements which fully establish, define, maintain, and control allocations. Budget allocations shall include mass properties, angular momentum, disturbance torque, power, radio frequency transmission channels, alignment, pointing control, pointing knowledge, pointing stability, on-board processor resources, and propellant capacities. An appropriately updated index of analyses and allocations shall be maintained by the contractor. The results of all analyses shall be made available by the contractor for Government review at each subsequent major program review. Tasks include the following:

1. Developing and verifying the QuikSCAT operations concepts and perform the launch-to-orbit and on-orbit mission analyses.
2. Conducting the analyses required to confirm the integrity of the QuikSCAT design to ensure the performance requirements of the applicable specifications will be met over the observatory specified mission end-of-life.
3. Conducting the analyses required to verify that the spacecraft provides the interface and environment necessary for the Scatterometer to meet its functional and performance requirements.
4. Performing and maintaining RF link calculations.
5. Providing the telemetry and command handbook in accordance with CDRL 9.

4.3.2.2 Interface Definition, Verification and Control

Using the results of the analyses and allocations of technical parameters performed in support of the efforts described in section 4.3.2.1, the contractor shall specify all interfaces not explicitly defined by Government specifications. These interfaces shall then be defined, documented, verified, and controlled for the duration of the contract, by the contractor.

A mission performance verification plan shall be prepared in accordance with CDRL 1. External interfaces, models, and analysis shall be documented as described in CDRL 2.

4.3.2.2.1 Scatterometer Instrument Interfaces

The contractor shall perform systems engineering and analysis in support of designing, documenting, and implementing all interfaces between the spacecraft subsystems and the Scatterometer, and spacecraft GSE-to-Scatterometer instrument GSE. This support shall include the following:

1. Generating and maintaining configuration management of the instrument interface control document in accordance with CDRL 3.
2. Addressing Scatterometer instrument accommodations/status as part of each spacecraft review.
3. Identifying cognizant engineer(s) responsible for the Scatterometer instrument interfaces.
4. Providing technical support for interface design, documentation, and verification.
5. Performing mechanical, thermal, power, contamination, radiation shielding, and other analyses as necessary to ensure spacecraft to Scatterometer compatibility.

A detailed Nevada and/or Sinda format thermal model(s) of the Scatterometer instrument will be supplied by the government for use in designing the spacecraft-instrument interfaces. The contractor shall combine the instrument model with their analytical nodal model of the spacecraft to form a combined comprehensive spacecraft-instrument analytical model. The combined comprehensive spacecraft-instrument model shall be correlated with spacecraft level test data $\pm 5^{\circ}\text{C}$ for spacecraft components and interfaces. Deviations greater than 5°C shall be documented in the model correlation report along with an explanation of the deviation. The combined comprehensive spacecraft-instrument analytical model shall be used to design the Scatterometer instrument interfaces and for instrument and/or spacecraft BOL and EOL temperature predictions to show compliance with requirements. The spacecraft contractor shall provide temperature predictions from lift-off through placement on-orbit.

In addition, a NASTRAN finite element model (FEM) of the Scatterometer instrument (in NASTRAN bulk data format with a preferred size of less than 200 nodes) will be supplied by the government for use in designing the spacecraft-instrument interfaces. The contractor shall combine the instrument FEM with the spacecraft FEM to form a combined comprehensive spacecraft-instrument FEM for launch and on-orbit configurations.

The contractor shall provide spacecraft design/assembly/integration support to the Government so that the Government can produce the Scatterometer interconnect harness and thermal blankets. The Government will provide the Scatterometer connectors and waveguide for the spacecraft.

The contractor shall develop, in cooperation with the Government, the mechanical mount designs for the Scatterometer. The Government will provide a Scatterometer mass simulator for the contractor's use in developing the mechanical interface.

4.3.2.3 Observatory/Launch Vehicle Interface

The contractor shall define and maintain all design interface information between the observatory and the Government provided launch vehicle. The contractor shall submit launch vehicle documentation in accordance with CDRL 4. In addition, the contractor shall participate in the preparation and maintenance of the Observatory-to-launch vehicle Interface Control Documents (ICD). The responsibility for writing, maintaining, and gaining approval of this ICD shall reside with the Government. The contractor shall develop, maintain and provide all technical and programmatic documentation required to ensure a successful launch activity. This includes all observatory level safety-related documentation as required by the launch site and launch range organizations. The Government shall provide all necessary safety information relative to the Scatterometer to the contractor for incorporation in these documents. The contractor shall submit the missile system prelaunch data package (MSPSP) in accordance with CDRL 13.

The Government will provide a match drill template for the observatory/Titan II mechanical interface. The contractor shall provide the observatory/Titan II separation system.

The contractor shall provide mission integration support for launch services, analytic and test support for launch services, pre-launch integration and test, launch simulations, and launch operations as defined in section 4.3.5.1. This effort is required to ensure proper electrical, mechanical, thermal, and operational compatibility between the observatory and the Government provided launch vehicle and launch vehicle environments.

4.3.2.4 Design and Performance Verification Analyses

The contractor shall perform and document all analyses of the data and information from the design, qualification testing, acceptance testing, compatibility testing, on-orbit testing of the contractor's hardware and software which are required to ensure that the program will meet its specifications and objectives. These tasks include the following:

1. Preparing and maintaining the mission performance verification plan (CDRL 1).
2. Preparing and maintaining verification test procedures for use at the component, subsystem, spacecraft, and observatory level of assembly, including instrument integration and interface verification.
3. Providing the effort required for data reduction and analysis of test results at the component and subsystem levels of assembly during spacecraft/observatory integration and testing, and during verification of Scatterometer interfaces.
4. Providing the necessary effort for data reduction and analysis during ground system compatibility testing, end-to-end testing, and during on-orbit testing. The Government shall provide the necessary personnel and equipment to support data reduction and analysis of the Scatterometer data.
5. Performing systems engineering and analysis in support of the development and execution of Scatterometer tests at the observatory level and launch base.
6. Developing the necessary observatory launch site operations and test plans as described in CDRL 11.
7. Developing the necessary observatory launch site operations and test procedures as described in CDRL 12.
8. Preparing a debris generation analysis report in accordance with CDRL 16.

4.3.3 Spacecraft Bus

The contractor shall produce and verify a spacecraft bus which meets all of the requirements, specifications, and interfaces in accordance with the QuikSCAT delivery order. Prior to Scatterometer integration the spacecraft bus shall undergo a comprehensive performance test to demonstrate readiness for observatory level integration. The contractor shall conduct either a telecon, videocon, or a meeting with the Government to discuss spacecraft readiness and receive Government concurrence prior to Scatterometer integration.

4.3.4 Implementation

The contractor shall prepare a spacecraft and observatory integration and test plan in accordance with CDRL 6.

The contractor shall perform verification testing with on-orbit test methodologies to the maximum extent possible.

The contractor shall provide the necessary clean room area and support to aid in the effort associated with the post-ship/pre-integration functional testing of the Scatterometer.

The contractor shall provide NASA two copies of their spacecraft photographs and video tapes taken during integration, testing, and close-outs.

4.3.4.1 Spacecraft Bus Integration and Test (I&T)

The contractor shall integrate and test all spacecraft bus and Scatterometer interface hardware and software. The spacecraft bus shall be tested with calibrated and maintained ground support equipment and shall be compatibility tested with the ground control system.

4.3.4.1.1 Scatterometer Ground Support Equipment

The Government will provide all equipment necessary to transport the Scatterometer to the contractor's integration and test site. The Government will also provide the instrument electrical ground support equipment (EGSE) and software necessary to support testing of the Scatterometer at the observatory level. In principal, once the flight Scatterometer is delivered to the observatory system, the Scatterometer EGSE is not required except to support testing using instrument direct access or providing receiver input for special tests. The Scatterometer EGSE is also referred to as the "instrument ground support equipment" or IGSE.

The Scatterometer IGSE has the following components and requirements for space, power, environment, and internet access:

- 10 Equipment Racks
 - SES-SE RBS
 - SES-SE RF
 - SES-SE DPA
 - SES-SE DATE
 - CDS-SE #1
 - CDS-SE #2
 - SAS-SE
 - 20 KVA Ups (2 racks)
 - SDATE (Direct Access Test Equipment)
 - pc DAS (pc Direct Access System)
- 9 Workstations
- 2 Printers
- 1 system working surface
- 1 repair table

The space requirements for the IGSE racks and workstations is 5 meters by ten meters. All IGSE are class 100,000 clean room compatible but need not all be located within a clean room.

The two flight work tables require another 5 meter by 6 meter work area located within 50 meters of the IGSE.

SDATE distance from SES is < 2 meters.

The facility must provide a minimum 75 Amp 5-wire 3-phase 220V connection for the UPS unit. The frequency must be 50 to 60 Hz. This connection must be within 20 meters of the UPS, on a separate breaker. An earth ground connection must be available at the panel.

The IGSE operating environment is specified as 23 C +/- 5 degrees C.

Three Internet IP addresses are required with FTP and Telnet privileges. The contractor shall accommodate the Scatterometer instrument test equipment: floor space, facility power, and other routine resources for the instrument EGSE and support equipment.

The contractor shall support the validation of Scatterometer GFE thermal/vacuum test equipment by assisting with the installation of the GFE thermal/vacuum equipment in the chamber, along with any spacecraft fixtures or equipment needed to support the Scatterometer equipment, and executing a thermal

cycle in vacuum in order to verify heater and GFE equipment operation. If the fixtures/equipment can be verified without the observatory in place, the observatory is not required to support this validation test.

The contractor shall provide facilities to store the GFE test equipment delivered to its facility when the equipment is not in use.

4.3.4.2 Observatory Integration and Test (I&T)

4.3.4.2.1 Integration

The contractor shall plan and conduct integration of the spacecraft bus and Scatterometer to form an observatory. The contractor shall develop, test, and maintain GSE necessary to integrate the Scatterometer. The Government shall provide test procedures for the Scatterometer portion of the integrated system functional and performance tests which are the contractor's responsibility. Once integrated to form the observatory all tests will be conducted through the spacecraft and its associated GSE (i.e., spacecraft EGSE to spacecraft then to Scatterometer). Special tests may be requested by either the spacecraft contractor or the Government which would require the use of IGSE, e.g., tests necessitating the use of Scatterometer direct access or receiver RF input, but usual observatory level testing should not depend on the use of IGSE. Real-time monitoring of Scatterometer command and telemetry will be made available to Scatterometer analyst supporting the observatory system level testing. As mutually agreed to, the contractor shall provide all Scatterometer test data, in mutually agreed to format and media, after completion of testing. The contractor shall store the instrument when not in use on board the spacecraft.

All electrical interfaces shall be verified prior to any first time connection. Safe-to-mate procedures shall be implemented for all interfaces between any two of the following: spacecraft, GFE, EGSE, pyrotechnics, electrical explosive devices, and any facility power. EGSE shall be under configuration control prior to the demonstration, and prior to use for observatory tests. ONLY JPL PERSONNEL SHALL EXERCISE THE SCATTEROMETER ANTENNA V-BAND.

4.3.4.2.2 Test

The contractor shall plan, manage and execute observatory level interface verification, system testing, and environmental testing as defined in the QuikSCAT Performance Specification. In addition, the contractor shall support QuikSCAT specific tests as defined in the following paragraphs. Durations for Scatterometer testing at the various system level test phases are indicated in the following paragraphs. The contractor shall provide access to the observatory, observatory GSE, and personnel as required to support the testing. Observatory testing may be conducted in parallel if it does not interfere with or compromise Scatterometer testing.

TEST NAME	OBJECTIVE	DURATION (8 hr. days)	CONFIGURATION
Scatterometer Stand Alone	Post shipment verification	5	Scatterometer stand alone
Scatterometer Elect. Integration	Power-off & initial power-on testing	4	Scatterometer to spacecraft with breakout boxes
Baseline Integrated System Test	a. Verify observatory T&C & data systems. Test of on-orbit sequences.	Determined by contractor	Observatory flight config., no RF thru antenna
	b. Verify Scatterometer functionality including all modes & redundant config.	2	Observatory flight config., no RF thru antenna
	c. Fault protection tests	Determined by contractor	Observatory flight config.
Alignment	Pre environ. test program & post environ. test program alignment verification	3 ea. (6 total)	Observatory flight config., oriented so cubes are visible
Environmental Tests*	a. Pre & post vibration functional test	0.5 ea. (1 total)	No Scatterometer ops. During vib. No RF thru antenna
	b. Pre & post acoustics functional test	0.5 ea. (1 total)	No Scatterometer ops. During acoustics. No RF thru antenna
	c. Pre & post pyro shock functional test	0.5 ea. (1 total)	Pyro shock includes V-band release. No RF thru antenna
	d. Pre & post T/V functional test (@ ambient)	0.5 ea. (1 total)	Observatory flight config., no RF thru antenna
	e. During T/V functional tests	3 hrs/test	@ temp. plateaus, IGSE hookup, no RF thru antenna
	f. EMI/EMC	Determined by contractor	Observatory flight config., RF thru antenna @ full power
Final Integrated System Test	Preship test	2	Observatory flight config., no RF thru antenna
Post Shipment Stand Alone	Only required if Scatterometer was separated from s/c for shipment	4	Scatterometer stand alone
Launch Base Integrated System Test	Post shipment test	2	Observatory flight config., no RF thru antenna.
Launch Preps.	Final preps including V-Band servicing	TBD	Observatory flight config.
Launch Check-out	TBD	TBD	On launch vehicle

* Depending on sequence at time between tests, some of the Pre & Post tests may be combined.

Note: Mission Operations tests defined in section 4.3.5 are also required.

4.3.4.2.3 Contamination Control

The contractor shall provide all personnel, facilities, services, and materials necessary to assure appropriate contamination control is maintained through all phases of integration and test. The Scatterometer does not require a purge.

4.3.4.3 Observatory Storage (option)

Upon completion of all integration activities and the environmental test program, the contractor shall provide appropriate ground storage for the observatory prior to launch. This includes the storage and maintenance of observatory GSE and storage of Scatterometer GSE. The storage period will not exceed six months. This storage activity shall encompass storage, storage maintenance, and post-storage activities necessary to ensure the readiness of the observatory for shipment to the launch site. Prior to, and after storage, the Government requires four hours with access to the Scatterometer antenna to adjust the V-band.

During the storage period, the contractor shall ensure the continuity and readiness of the project, system/subsystem engineers, integration and test team, and mission operations team to perform the remaining phases of the program.

4.3.4.4 Spacecraft Bus, Observatory and Ground Support Equipment Shipment

The contractor shall be responsible for the shipment of the spacecraft bus and of the observatory between the places of manufacture, integration and test, storage, and launch in appropriate shipment containers. The contractor shall provide for the shipment of necessary ground support equipment required to support the spacecraft bus/observatory during each phase of test, integration, and launch preparation. This includes the Scatterometer GSE after initial delivery to the contractor. Observatory shipping transporters (including trailers, shipping containers, and environmental control systems) for QuikSCAT shall be provided by the contractor. Government Scatterometer containers are available for use by the contractor. If these Government containers are used, they shall be returned upon completion in their original configuration. The contractor shall prepare a spacecraft transportation and handling plan in accordance with CDRL 14. The Government is responsible for the planning, preparation, and shipment of the Scatterometer GSE after launch.

The contractor shall obtain any necessary shipping permits and hazardous material exemptions, etc. The contractor shall be responsible for obtaining airlift certification, if applicable, for shipment to the launch base. In addition, the spacecraft contractor shall be responsible for the loading and unloading of the aircraft. The Government shall provide the transportation from the landing facility to the observatory launch processing facility. Observatory transportation shall also be compatible with ground transportation. During all shipments the contractor shall perform real-time monitoring of the shipping and handling environment for all controlled conditions (shock, temperature, air cleanliness, air and/or nitrogen purge, and humidity) while the observatory is in the shipping container.

The contractor shall reassemble, as required, and check out all GSE after each shipment, verifying that they are all operating within normal specification limits before their use with the spacecraft/observatory. However, the Government will reassemble and check-out GFE GSE.

4.3.5 Launch & Operations

The Government will provide the observatory processing facility(s).

4.3.5.1 Launch Support

The contractor shall provide launch support for the completed observatory. This shall include launch vehicle interface definition, design verification and management, observatory launch preparation and launch support. The Government will make the final go/no-go decision for launch. The launch support activity shall include the following efforts:

1. Mission Integration Support for Launch Services - The contractor shall provide management and engineering support for all spacecraft activities associated with the launch vehicle/services. This includes: systems integration, interface definitions, interface verification, spacecraft to launch vehicle integration, ground processing facilities and GSE integration/readiness, and launch support effort. The contractor shall be responsible for assuring that compatible interfaces between hardware and software are defined, coordinating launch vehicle interface requirements definitions, and supporting and/or conducting design and safety reviews, Technical Interchange Meetings (TIMs), and working group and ad-hoc meetings. The contractor shall support all activities related to the development of interface documentation and provide concurrence that all requirements have been

satisfactorily implemented by the government-provided launch services contractor.

2. Analytic and Test Support for Launch Services - The contractor shall provide management and engineering support for all analytic efforts conducted by the government-provided launch services contractor necessary for the assessment of launch vehicle environments, interfaces, and ground processing on the spacecraft design. This support includes development of detailed spacecraft analytic models analysis of ground processing facility compatibility, compliance with interface safety requirements, and compatibility with launch vehicle flight environments and flight design. The Government is responsible for obtaining valid coupled loads analysis results from the launch organization. The contractor shall compare the results of one coupled loads analysis cycle to the design loads used in spacecraft structural analyses to confirm that the resulting loads are within the design requirements as specified in the launch vehicle ICD. In addition, the contractor shall support any tests (e.g., fit checks, shock tests) as required to ensure that spacecraft requirements are satisfied.
3. Pre-launch Integration and Test - The contractor shall perform all tasks necessary to integrate, test, and prepare observatory for launch at the launch site. This includes developing observatory /launch vehicle integration test plans, procedures, and services; checkout of interfaces with the launch vehicle and launch facilities; and end-to-end tests involving the observatory, launch vehicle, and ground system.
4. Launch Simulations - This effort encompasses the conduct, analyses, and evaluation of pre-launch training and simulations of the launch (through orbit insertion). Two training simulations plus one launch rehearsal are to be conducted.
5. Launch Operations - The contractor shall provide all required integration, safety, and engineering support to process the observatory through the ground processing facilities, launch facility, and the launch vehicle. In addition, this effort shall encompass the contractor's efforts necessary to support the actual launch, post-launch orbit insertion, perform observatory initialization, deployments, and preparation for on-orbit performance verification testing. This activity will be under Government direction from launch through separation of the observatory from the launch vehicle.

4.3.5.2 Flight Operations Interfaces and Support

4.3.5.2.1 Ground System Interface Definition

The contractor shall prepare a ground system interface control document in accordance with CDRL 5. The contractor shall work closely with Government mission engineers to design a system which meets all of the specified mission requirements .

The contractor shall provide all necessary documentation for the ground command, control and data system associated with QuikSCAT. This is to include all necessary system documentation, interface control documents, databases and test efforts.

4.3.5.2.1.1 Ground System Compatibility Testing

The contractor shall perform observatory compatibility testing with the QuikSCAT's Observatory Operations Control Center, JPL's Instrument Operations Control Center, Launch Control center, NASA Ground Network, and NOAA Suitland Maryland station. The Government will provide the necessary ground network interface equipment to link to the control centers. The Government will provide the necessary ground communication links to link the observatory operations control center to the necessary Government centers. The contractor shall provide the necessary equipment to link to the Government

provided communication links. The government will provide the necessary NASA ground network resources. The purpose of these tests are to ensure the ground system and distribution systems are compatible with the observatory telemetry, command, and ranging system.

4.3.5.2.1.2 End-to-End (ETE) Testing

The contractor shall perform ETE compatibility tests. The ETE tests shall be designed to:

1. Validate observatory/Scatterometer telemetry and command databases, command procedures, and ground system processing.
2. Validate data displays and archival.
3. Perform data flows.
4. Validate normal and contingency procedures.
5. Fully demonstrate operational compatibility among the spacecraft and Scatterometer operations control centers.
6. Familiarize the operations teams (contractor's observatory team and JPL's instrument team) with the observatory.

The desire is to utilize actual flight hardware to the maximum extent possible. The Government realizes that some components may present risk if operated on the observatory while in the contractor's facility. The contractor shall provide a list of those components which it deems unsafe to operate during end-to-end tests. For any items on this list, the contractor may support the test with government-approved simulated or emulated components.

To accomplish any given ETE test, the contractor shall perform the following activities:

1. Devise the test goals and requirements.
2. Schedule the test and coordinate resources.
3. Conduct all subsystem reviews of the commands, telemetry monitors, procedures, scripts, contingency plans, etc., to be used during the test.
4. Conduct a final script review approximately one week prior to each test to cover the test plan, procedures, scripts, and test support and coordination activities.
5. Execute the planned command procedures and generate supporting data products during the test.
6. Obtain and process all supporting data into a post-test report.
7. Resolve anomalies and incorporate lessons learned for future tests.

When required, JPL will provide the instrument commanding to the contractor's observatory operations control center. The contractor shall provide the necessary ground network interface equipment to link to the control centers. The government will provide the necessary NASA ground network resources.

4.3.5.2.2 Flight Operations

The contractor shall perform two years of observatory operations for the QuikSCAT. JPL will provide Scatterometer operations. The contractor shall prepare a spacecraft operations description manual in accordance with CDRL 8 and a flight operations plan as described in CDRL 10.

4.3.5.2.2.1 Training

In coordination with the JPL Scatterometer operations team, the contractor shall train their own spacecraft operations team for on-orbit initialization, checkout, performance verification, and anomaly resolution. The contractor shall perform three training mission simulations for rehearsal of on-orbit mission phases. This includes one nominal operations simulation and two simulations with

contingencies. These simulations are in addition to the launch simulations referenced in section 4.3.5.1 paragraph 4. The communication links, interconnects, and ground network resources will be provided as specified in section 4.3.5.2.1.1.

4.3.5.3 On-Orbit Performance Verification

The contractor shall perform an on-orbit performance verification program which will confirm that the observatory performance is in accordance with the mission requirements, specifications, and interfaces. JPL will perform the necessary Scatterometer testing. As a minimum the contractor shall perform:

1. **Observatory 30 day On-Orbit Check-Out** - After the observatory has reached the operational orbit and deployed/released all appendages/mechanisms, the contractor shall perform a check-out to verify the post-launch performance and state-of-health of the observatory. All systems, including the attitude control system, shall be verified for proper function and performance. The check-out shall be completed prior to 30 days on-orbit. The contractor shall provide their on-orbit check-out plan to the Government in accordance with the mission performance verification plan CDRL #1. The contractor shall prepare a brief report (JPL will provide Scatterometer input) which summarizes the on-orbit performance of the observatory bus compared to its predicted performance for the mission after launch. Each subsystem is to be addressed and the performance of launch and flight operations crews are to be included. All pertinent issues affecting mission success shall be addressed. The extent of performance explanation required depends on the seriousness of the impacts that any problems identified may have on mission success. This report summarizes the observatory performance on-orbit after launch and check-out to determine initial mission success. Government acceptance of the observatory will occur after the 30 day on-orbit check-out.
2. **Observatory/Ground Control and Data Systems Interface Verification** - This effort shall be performed by the contractor after the observatory on-orbit performance and state-of-health have been confirmed. The purpose of this test is to verify proper operations of the observatory to ground system interfaces and to provide the necessary calibrations. The contractor shall calibrate the spacecraft clock to UTC time.

4.3.5.4 Support to On-Orbit Operations

4.3.5.4.1 Anomaly Resolution

The spacecraft contractor shall resolve out-of-specification on-orbit performance issues as assigned to the contractor by the Government QuikSCAT Project Office. This support shall remain effective until the specified mission end-of-life. This includes support of periodic conference calls on the status of anomalies under investigation.

For out-of-family but in-specification and non-specified performance, the spacecraft contractor shall perform on-orbit task assignments as authorized by the Government in accordance with contract clause B6. Each task will be initiated by written direction from the NASA contracting officer, and shall be coordinated with the contractor to define the details of the task, its manpower ceiling, and scheduling requirements.

4.3.5.4.2 Observatory Database Support

The contractor shall correct all discrepancies discovered in the databases until the specified mission end-of-life.

4.3.5.4.3 On-Orbit Trending

The contractor shall develop and implement an on-orbit observatory engineering trending program that shall remain in effect until the specified mission end-of-life. The program shall identify parameters to trend, and then monitor all parameters on a routine basis, analyzing the data with the intent to identify anomalous performance, out-of-family performance, degradation of components, characterize nominal aging effects, and predict EOL, etc. Comparisons shall be made between on-orbit performance and observatory-level pre-launch test data. The contractor shall make this data available to the Government for review.

4.2.6 Flight Software

The contractor shall treat the software component of firmware, which consists of computer programs and data loaded into a class of memory which cannot be dynamically modified by the computer during processing (e.g., programmable read-only memories, programmable logic arrays, digital signal processors, etc.), as software for the purposes of this SOW.

4.3.6.1 Software Requirements, Development, Verification, and Testing

The contractor shall perform all analyses and systems engineering required to allocate (from system and subsystem requirements) and identify software requirements, and to develop necessary design specifications for QuikSCAT. Software requirements traceability to system and subsystem requirements shall be provided in a traceability matrix. The contractor shall also describe the documentation system, source code generation and use, and the methods of maintaining equipment.

Requirements, design, and code walkthroughs or inspections shall be conducted at the spacecraft contractor's facility at the appropriate software developmental life-cycle phase to ensure the correctness of the requirements, design, and source code. These walkthroughs/inspections shall be open to Government participation. The coding, debugging, and developer testing efforts, the results of the walkthroughs, and programmer's notes shall be documented and available at the contractor's facility for Government review.

The contractor shall provide all the resources necessary to verify and validate all the software developed for the QuikSCAT spacecraft.

4.3.6.2 Software Maintenance

The contractor shall maintain the flight software along with the environments, emulators, and test software necessary to develop and verify these systems until the specified mission end-of-life.

4.3.6.3 Software Documentation

The contractor shall develop the necessary flight software documentation to ensure reliability, maintainability, and operability.

QSCDRL

CONTRACT DATA REQUIREMENTS

FOR

**THE NASA QUICK SCATTEROMETER (QuikSCAT)
MISSION**

NOVEMBER 3, 1997

**NASA/GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND 20771**

QuikSCAT
CONTRACT DATA REQUIREMENTS

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SECTION 1 - Introduction

1.1 Scope

- a) The Contract Data Requirements List (CDRL) is the basic contractual document which governs data required by and for the QuikSCAT delivery order.
- b) The contractor shall furnish data described by the Data Item Descriptions (DIDs) included herein and listed on the Data Requirements Lists (DRLs) for each item of data.
- c) All data shall be prepared, maintained, and delivered to NASA in accordance with the requirements of this CDRL.

1.2 Data Requirements List (DRL)

The DRLs provide a complete listing of the data requirements of the contract. Each DRL contains the following:

- a) The data item number, which corresponds to the data item description number.
- b) The data item title.
- c) The data item approval code defined as follows:
 - 1. Code A: The initial submission and all subsequent changes require approval of the NASA contracting officer prior to implementation.
 - 2. Code I: Deliverables are sent to NASA for information. NASA will request changes on deliverables where errors or omissions are noted.
- d) The data item submission dates are as follows:
 - 1. Mini-Proposal - Items needed to define the work and approaches to mission specific tasks (some items may be revised at date specific reviews).
 - 2. Date Specific - Management information needed on a monthly basis and for items to meet external interface milestones.

1.3 Data Items Description

- a) Each data requirement listed on the DRL is defined by a DID.
- b) The DID describes the purpose and required content of the data item, and provides specific format and preparation instructions as necessary.
- c) Much of the information requested in the DIDs may already exist in your documentation and format. We strongly encourage using your existing documents and formats whenever it will meet the requirements of the DID.

1.4 Distribution and Delivery

The contractor shall distribute and deliver data according to contract requirements and provisions. The data shall be delivered to the following address distribution codes as annotated on the DRL:

- A - Goddard Space Flight Center
Rapid Spacecraft Development Office Library
Code 401.5
Greenbelt, MD 20771
- B - Jet Propulsion Laboratory
California Institute of Technology
Mail Station 264/625
4800 OAK Grove Drive
Pasadena California 91101-8099
Attn J. Graf

In addition to the above, the original transmittal letter for all deliverables shall be addressed to:

Goddard Space Flight Center
Rapid Spacecraft Development Office, Contracting Officer
Code TBD
Greenbelt, MD 20771

The following shall be provided for each data item submission:

- a) Copy of Record - The Copy of Record is the official file copy submitted in the form in which it is intended to be distributed and marked "Copy of Record" and suitable for reproduction.
- b) Copies - Copies of each document specified in the DRL shall be delivered in a condition suitable for immediate distribution.
- c) Electronic Data Delivery - Formats for electronic media delivery are defined in paragraph 1.5 of this CDRL. Delivery of electronic media data items shall occur per the same delivery schedule as printed media.

1.5 Delivery Media

- a) There are two media in which data will be documented and are defined as:
 - 1. Hard Copy - Data typed, drawn or printed on paper by common, conventional practices. By these means, either the original, a reproducible copy or the record copy shall be reproduced for distribution as printed copies.
 - 2. Electronic - Data which is recorded in word processors, computerized data processing systems, or electronic storage devices such as magnetic tapes, disks and CD ROM.

- b) Documentation delivery (in hardcopy or electronic format) shall be as specified in the CDRL. Additionally, all CDRL data which has been generated electronically shall be delivered via electronic transfer or electronic transfer media such as disks.
- c) The instructions to facilitate the use of electronic media are to be supplied.

1.6 Documentation Change Procedures

- a) The contractor shall issue documentation change notices (DCNs) whenever minor changes or updates occur in data items that have been delivered to NASA.
- b) Change bars shall be used to indicate changes or updates.
- c) When major changes to a document are made a complete revision of the document shall be issued and delivered to NASA in accordance with the original instructions for the data item.
- d) No change bars are used when a document is updated by revision and the DCN numbers for that document shall be automatically recycled to 001.

QuikSCAT CONTRACT DATA REQUIREMENTS LIST									
DID #	Title	Submission			Media	Dist. Codes		Copies /code	
		A/I	Mini-Prop.	Date Specific		A	B		
1	Mission Performance Verification Plan	A		MDR	E/H	✓	✓	2	
2	External Interfaces Models and Analysis (Prelim @ MDR, Final @ MDR + 2 months)	I		MDR/MDR + 2 months	H	✓	✓	2	
3	Scatterometer Instrument Interface Control Document (ICD) (Prelim @ MDR, Final @ ARO + 3 months)	A		MDR/ARO + 3 months	E/H	✓	✓	2	
4	Launch Vehicle Documentation (LVD) (Prelim @ MDR, Final @ MDR + 2 months)	A		MDR/MDR + 2 months	E/H	✓	✓	2	
5	Ground Sys. Interface Control Doc. (GS-ICD) (Prelim @ MDR, Final @ ARO + 4 months)	A		MDR/ARO + 4 months	E/H	✓	✓	2	
6	Spacecraft and Observatory Integration and Test (I&T) Plan	A		MDR	E/H	✓	✓	2	
7	As-Built Bus Configured Item List	I		PSR	E/H	✓	✓	2	
8	Spacecraft Operations Description Manual	I		PSR	E/H	✓	✓	2	
9	Telemetry and Command Handbook (Prelim @ MDR, Final @ PER)	I		MDR/PER	E/H	✓	✓	2	
10	Flight Operations Plan (Prelim @ PER, Final @ PER + 1 month)	A		PER/PER + 1 month	E/H	✓	✓	2	
11	Observatory Launch Site Ops and Test Plan (Prelim @ PER, Final @ PER + 1 month)	A		PER/PER + 1 month	E/H	✓	✓	2	
12	Observatory Launch Site Operations and Test Procedures	I		PSR	H	✓	✓	2	
13	Missile System Prelaunch Data Pkg (MSPSP) (PER + 1 month)	A		PER + 1 month	E/H	✓	✓	2	
14	Transportation and Handling Plan (Prelim @ PER, Final @ PER + 1 months)	A		PER/PER + 2 months	E/H	✓	✓	2	
15	Engineering Change Proposals (ECPs), Deviations & Waivers	A		as needed	E/H	✓	✓		
16	Debris Generation Analysis Report (Prelim @ PER, Final @ PSR)	I		PER/PSR	E/H	✓	✓	2	

LEGEND: E = Electronic H = Hard copy ARO = After Receipt of Order

<p>Title: Mission Performance Verification Plan</p>	<p>CDRL No.: 1</p>
<p>Reference: Spacecraft and Observatory I&T Plan, DID #6</p>	
<p>Purpose: To identify clearly where, how, and when each spacecraft bus performance requirement is verified in the I&T program before launch and how these requirements are again going to be verified on-orbit.</p>	
<p>Related Documents:</p>	
<p>Preparation Information</p> <p>Each bus performance requirement is to be verified either by analysis or by test before and after launch.</p> <p>A. (I&T) Provide a matrix or outline narrative of where each performance requirement of the bus will be verified in the I&T flow. Identify the test procedure or analysis that accomplishes that item's requirement verification.</p> <p>B. (on-orbit) Provide a matrix or outline narrative of where/how each performance requirement of the bus is going to be verified after launch. Identify the test procedure or analysis that accomplishes that items requirement verification.</p>	

<p>Title: External Interfaces, Models and Analysis</p>	<p>CDRL No.: 2</p>
<p>Reference:</p>	
<p>Purpose: To provide the Scatterometer and ground system teams with spacecraft interface data, models, and analysis needed to assist them in their designs and preparations to support the observatory for launch and mission operations.</p>	
<p>Related Documents:</p>	
<p>Preparation Information</p> <p>The contractor shall provide to the Scatterometer and ground system team the required external interface information (data, models, and analysis) for the development of the Scatterometer or ground system. This shall include as a minimum:</p> <ul style="list-style-type: none"> A. Bus and observatory reduced finite element models. B. Structural interface analysis. C. Pointing and alignment budgets. D. Bus and observatory thermal models analysis. E. Ground system protocols and data rates compatibility analysis. F. Data contact scenarios and optimization (contacts versus data recorder size trade study). G. Flight dynamics and orbital maintenance analysis. H. Reliability analysis (worse case, parts stress, single event effects). I. Failure mode and effects analysis (FMEA) as described in section 4.3.1.3.1 of the SOW. 	

<p>Title: Scatterometer Instrument Interface Control Document (ICD)</p>	<p>CDRL No.: 3</p>
<p>Reference:</p>	
<p>Purpose: To coordinate and control all interface items between the spacecraft bus and the Scatterometer instrument to provide efficient electrical and mechanical integration.</p>	
<p>Related Documents:</p>	
<p>Preparation Information</p> <p>The contractor shall provide detailed information regarding the spacecraft bus interface to the Scatterometer instrument. The data provided by the Government, in the form of written words, drawings, and schematics, will be incorporated into this combined Scatterometer instrument and spacecraft bus ICD for applicable signatures.</p> <p>The spacecraft bus to Scatterometer interface is defined per the following topics as a minimum:</p> <ul style="list-style-type: none"> A. <u>Physical Requirements</u> - such as mass properties, dynamic propulsion (angular momentum, disturbance torques), footprint, clearance envelope, drill template, alignment, orientation, fields-of-view (optical, thermal, glint, RF), including tolerances. Electrical Connectors - regarding sex, type, orientation, pin assignments. Thermal control coatings, blankets, heat flow and operating limits. Red and green tag items for test and flight. B. <u>Electrical Power and Signals</u> - such as timing clock pulses, data busses, signal (name, type, function), voltage and current limits, frequencies, waveforms, rise and fall time, duration, periodicity, shielding, grounding, formats, line driver/receiver characteristics. Power fusing, voltage, currents, ripple, regulation. C. <u>Software</u> - such as codes, processors, memory storage, application description, uses. D. <u>Payload Environmental</u> - such as vibration, shock, acoustic, EMI/EMC, ESD, thermal, contamination, purges. E. <u>Safety</u> - such as pyrotechnics, energy storage, trip-over, hazardous materials. F. <u>Ground Support Equipment</u> - such as mechanical, electrical, test specific, targets, stimulators. G. <u>Operational Factors</u> - such as ground contracts needed per day, data storage capacity and compression, general flight rules and limitations. H. <u>Cabling and RF Waveguide</u> - such as routing and support brackets. <p>Show sufficient detail on both sides of each interface to provide a clear picture of the resultant mated interface. For example, electrical interfaces should be presented to schematic detail (logic elements and piece parts) to the point where impedance and transfer characteristics no longer affect the interface.</p>	

<p>Title: Launch Vehicle Documentation LVD</p>	<p>CDRL No.: 4</p>
<p>Reference:</p>	
<p>Purpose: To document and define requirements and control all aspects of the interface between the observatory and the launch vehicle to insure efficient integration and promote a successful launch to the mission orbit.</p>	
<p>Related Documents: Titan II User's Guide External Interfaces, Models and Analysis, CDRL #2</p>	
<p>Preparation Information</p> <p>This deliverable set of data defines the requirements of the observatory for the launch vehicle provider and is to include the following as a minimum:</p> <ul style="list-style-type: none"> A. Spacecraft questionnaire. B. Observatory mathematical model for dynamic analysis. C. Observatory environmental test documents. D. Observatory/launch system interface specification (electrical, mechanical, data) inputs. E. Mission operations and support Requirements. F. Payload (observatory) requirements document (PRD). G. Observatory drawings. H. Electrical wiring requirements. I. Fairing requirements. J. Observatory integrated test procedure inputs. K. Mission analysis requirements. L. Launch intervals (window). M. Radio frequency applications (provide by NASA with support from contractor). N. Post-launch orbit confirmation data. O. Launch hold criteria - observatory go/no go. 	

<p>Title: Ground System Interface Control Document (GS-ICD)</p>	<p>CDRL No.: 5</p>
<p>Reference:</p>	
<p>Purpose: Documents interfaces and agreements between the observatory and the ground data system.</p>	
<p>Related Documents:</p>	
<p><u>Preparation Information</u></p> <ul style="list-style-type: none"> A. Data formats, communications protocols, data rates. B. Compression algorithms, error detection and correction schemes. C. Antenna patterns, EIRP, G/T, beam width, uplink/downlink, frequencies, polarizations and modulations for each channel. D. Telemetry and command formats (see DID 9). E. Spacecraft contact scenarios for data transmission, operations, maintenance. F. Interface to the Government provided communication circuits/routers. G. Link analysis for available ground station antennas. H. Interface requirements for RF compatibility test. I. Interface requirements for End-to-End test. J. Approach for orbit determination for predicts and definitive ephemeris. K. Description of command and data time tagging. L. Description of spacecraft operating modes and command events. M. Approach for maneuver planning and execution. N. Description of products describing the operations sequence of events. 	

<p>Title: Spacecraft and Observatory Integration and Test (I&T) Plan</p>	<p>CDRL No.: 6</p>
<p>Reference:</p>	
<p>Purpose: To show the contractor's plans and approach to I&T for the observatory (integrated bus and Scatterometer and is to include final bus comprehensive performance testing.</p>	
<p>Related Documents:</p>	
<p>Preparation Information The contractor shall provide definitive test plans for the spacecraft bus and observatory integration and test which identify the scope, purpose, sequence (test flow), and success criteria for the activities below. The contractor shall identify where in the test flow repeat activities occur to re-baseline system performance (e.g. observatory full functional test). The minimum integration and test activities the contractor shall address in the plan at the spacecraft bus and observatory levels are:</p> <ul style="list-style-type: none"> I. Spacecraft bus level: <ul style="list-style-type: none"> A. Final spacecraft bus comprehensive performance tests. II. Observatory level: <ul style="list-style-type: none"> A. Scatterometer integration(*): <ul style="list-style-type: none"> 1. Mechanical integration. 2. Electrical integration. 3. Scatterometer comprehensive performance test. B. EMI/EMC/ESD test. C. Optical and mechanical alignments. D. Magnetic survey. E. Attitude control subsystem phasing. F. Solar array integration (required only if integrated at the observatory level). G. Flight payload attach fitting integration. H. Mass properties measurements. I. Vibration test. J. Acoustics test. K. Shock test. L. Solar array deployment. M. Thermal vacuum test. N. Thermal balance test. O. Cleanliness, control and monitoring. P. End-to-end functional test. <p>(*) The contractor shall coordinate plans and procedures for Scatterometer integration with the Government.</p>	

<p>Title: As Built Bus Configured Item List</p>	<p>CDRL No.: 7</p>
<p>Reference:</p>	
<p>Purpose: To document the “box level” component items that make up the delivered spacecraft bus. To be used to (1) determine if a latent problem is in the bus as discovered from elsewhere in the industry and (2) to help evaluate on-orbit performance problems issues should any arise.</p>	
<p>Related Documents:</p>	
<p>Preparation Information</p> <p>The subject list should include all of the box level components contained in the bus and provide the following information for each item as a minimum:</p> <ul style="list-style-type: none"> A. Name/nomenclature. B. Item number. C. Serial number. D. As built drawing number, including latest revision letter and change notice. E. Location in the bus (next level of assembly). F. Note any approved deviations, waivers, or problem failure reports affecting the installed configuration item. G. Applicable supporting remarks. H. Drawing tree of spacecraft. 	

<p>Title: Spacecraft Operations Description Manual</p>	<p>CDRL No.: 8</p>
<p>Reference:</p>	
<p>Purpose: To be used by the operations organization to develop detailed operations procedures and the observatory operations manual. Provides a description of the operation of the observatory.</p>	
<p>Related Documents: Flight Operations Support Plan DID #10, Ground System ICD DID #5, Telemetry and Command Handbook DID #9</p>	
<p>Preparation Information</p> <p>Operations description manual contents:</p> <ul style="list-style-type: none"> A. Overview and discussion of operations concept. B. Description of unique factors associated with the operation of the observatory. C. Overview of internal and external observatory interfaces. D. Unique ground system logistics, software, software maintenance, and sustaining engineering required for sustained observatory operations. E. Sample operational scenarios. F. Operation of the observatory and all spacecraft subsystems. G. Contingency scenarios and procedures. H. Redundancy management. I. State of health maintenance. J. Listing of operations limits (attitude, modes), cautions, and constraints. 	

<p>Title: Telemetry and Command Handbook</p>	<p>CDRL No.: 9</p>
<p>Reference:</p>	
<p>Purpose: To describe (in detail) the spacecraft bus, Scatterometer, and launch vehicle interfaces telemetry and command features for launch and flight operations application.</p>	
<p>Related Documents:</p>	
<p>Preparation Information</p> <p>I. Telemetry handbook contents:</p> <ul style="list-style-type: none"> A. Detailed listing of all telemetry assignments. B. Key parameters and information necessary for the description and interpretation of the telemetry requirements. C. Summary of number and type of telemetry assignments, including spares. D. Description of telemetry interfaces, format, requirements data, and limits. E. Listing of telemetry assignments that confirm commands. F. Transmission or sampling rates. G. Methods of in-flight or ground-test verification. H. Engineering units and calibration data, A to D for readout and calibration. <p>II. Command handbook contents:</p> <ul style="list-style-type: none"> A. Detailed listings of all commands that can be applied to the observatory that can effect a response or change in its configuration in anyway, either in test or in flight. B. Key parameters necessary for description of commands. C. Summary of number and type of commands used by each subsystem and the number of spares. D. Description of command input, verification, rates, and filler commands. E. Description of command requirements data and information necessary for interpretation. F. Listing of commands verified by telemetry and telemetry verifies. 	

<p>Title: Flight Operations Plan</p>	<p>CDRL No.: 10</p>
<p>Reference:</p>	
<p>Purpose: To describe the contractor's plan for performing the flight operations of the observatory starting at observatory/launch vehicle integration and test, through launch, and throughout the life of the mission. Included is how the contractor intends to perform <u>anomaly resolution</u> to the end of the mission.</p>	
<p>Related Documents:</p>	
<p>Preparation Information</p> <ul style="list-style-type: none"> A. Description of roles and responsibilities and plans of how the contractor will perform the operations of the spacecraft during launch vehicle integrated test, launch, and on-orbit operations for the life of the mission. B. Description and designation of any unique ground systems and responsibilities needed for spacecraft operations. C. Plan for anomaly identification, investigation, and resolution process. D. Plan for initial and periodic performance assessments to determine spacecraft viability and compliance with specifications. E. Description of complement of skills needed to perform this support and how the contractor will provide these resources. 	

<p>Title: Observatory Launch Site Operations and Test Plans</p>	<p>CDRL No.: 11</p>
<p>Reference: EWR 127-1, Titan II User's Guide as applicable</p>	
<p>Purpose: (1) To provide a detailed understanding of the launch site activities, operations and testing planned for a particular mission, (2) to support requirements of the MSPSP and (3) to obtain launch site procedure approvals.</p>	
<p>Related Documents:</p>	
<p>Preparation Information Describe all aspects of the activities at the launch site beginning with arrival of the observatory, including final testing and preparations, fueling, transportation between buildings and the launch vehicle, launch vehicle integration and testing, and removal of systems after launch. The data shall be originated to support launch site "test and inspection plans" requirements and the "ground operations plan" requirements as referenced in EWR 127-1.</p> <ul style="list-style-type: none"> A. Layout a schedule and timeline of proposed activities including spacecraft and Scatterometer testing. B. Specify what facilities and facility resources are needed. C. Show equipment placement and personnel area requirements. D. Fully explain staffing plan. E. Explain schedule and personnel contingency methods. F. Describe roles and responsibilities and the other equipment needed at each step of the plan. G. Describe fueling methods, crew training, SCAPE operations, fuel storage locations. H. Address cleanness methods, purge gasses and lines, garments. I. Identify special test equipment needed on the launch tower or in the blockhouse. <p>Identify specific communication links needed between locations at the launch site to perform observatory end-to-end testing and to support the observatory on the launch vehicle up to the point of launch.</p>	

<p>Title: Observatory Launch Site Operations and Test Procedures</p>	<p>CDRL No.: 12</p>
<p>Reference: EWR 127-1 Missile System Prelaunch Data Package (MSPSP), DID # 13 Launch Vehicle Payload Planner's Guides as applicable Observatory Launch Site Operations and Test Plan DID# 11</p>	
<p>Purpose: To document the complete understanding of how the planned activities are to be carried out at the launch site to meet requirements of (1) MSPSP, (2) launch site operations and test plan, (3) test and inspection plans and (4) procedure approval specified in EWR 127-1.</p>	
<p>Related Documents:</p>	
<p>Preparation Information</p> <p>For all of the activities at the launch site, most of which are identified in the referenced Observatory Launch Site Operations and Test Plan, DID# 11, detailed procedures are to be prepared, reviewed, and approved before use. Hazardous activities shall be identified and included in the referenced MSPSP, DID # 13. Specify in the procedures, the test objectives, personnel, and equipment requirements, environmental handling needs, Scatterometer and spacecraft bus electrical tests to be performed, battery conditioning, special calibrations, end-to-end type testing, red tags, green tags, load cells, optical alignment equipment, etc.</p> <p>Particular interest will be paid to the period of time that the observatory is mated to the launch vehicle to assure safety, smooth interaction between observatory and launch vehicle activities and a successful launch.</p>	

<p>Title: Missile System Prelaunch Data Package (MSPSP)</p>	<p>CDRL No.: 13</p>
<p>Reference: EWR 127-1, Appendix 3A Observatory Launch Site Operations and Test Plan DID #11 Titan II User 's Guide</p>	
<p>Purpose: Documents observatory and GSE design and test information to evaluate safety measures to be employed during observatory operations at the launch complex and to obtain approval to use the launch site facilities and resources when coupled with the launch site operations and test plan. Sections of this document will provide the information for approval for each safety issue identified in the launch site process.</p>	
<p>Related Documents:</p>	
<p>Preparation Information Describes all observatory systems, support hardware, and operations beginning with the arrival of the observatory and GSE through lift-off. A flow plan and a time line should be provided. The package should identify all hazards associated with the process at the launch site and show operations that require coordination either with the launch vehicle operations or other range activities.</p> <ul style="list-style-type: none"> A. Observatory test and build-up facility requirements, including floor space, electrical power, and cleanliness. B. Use of large scale GSE; e.g., test consoles and handling fixtures at each facility that is planned to be used. C. Scatterometer or spacecraft unique testing of high power RF lasers. D. Integrated vehicle or range activities for coordination and reviews. E. Personnel facilities. F. Staffing and training plans. G. Observatory transportation and servicing. H. Fueling process, location, safeguards, GSE, tankage, storage. <p>For each safety issue identified by the MSPSP, a payload hazard report (or equivalent) shall be generated. Each payload hazard report shall document the causes, controls, and precaution verification methods for each hazard.</p> <p>Payload hazard reports and the MSPSP shall be updated as the hardware progresses through the stages of design, fabrication, test, and flight readiness to support each safety milestone review for inclusion in the current SAR. The updates shall reflect current status of measures to eliminate or to minimize the effects of each hazard identified. Each iteration of the SAR shall be accompanied by copies of any waiver requests written for safety requirements that cannot be met.</p>	

<p>Title: Transportation and Handling Plan</p>	<p>CDRL No.: 14</p>
<p>Reference:</p>	
<p>Purpose: To understand the contractor's role, responsibility, and plans to ship the integrated spacecraft bus and Scatterometer along with the supporting equipment, from the integration and test facility to the launch site.</p>	
<p>Related Documents:</p>	
<p>Preparation Information The data provided in the plan should address the following as a minimum:</p> <ul style="list-style-type: none"> A. Description of shipping container. B. Methods of transporting observatory and ground support equipment. C. Bagging and purging requirements. D. Environmental controls and monitoring equipment. E. Expected roles and responsibilities of the contractor and the Government. F. Description of transportation/arrangements. G. Shipping crew support, convoy support. H. Off-loading of observatory at the launch site. I. Movement between facilities at the launch site. J. Fueling GSE. K. Lifting slings. L. Electrical and mechanical support equipment general description. <p>Identify specific procedures available or needed.</p>	

<p>Title: Engineering Change Proposals (ECPs), Deviations and Waivers</p>	<p>CDRL No.: 15</p>
<p>Reference:</p>	
<p>Purpose:</p>	
<p>Related Documents:</p>	
<p><u>Preparation Information</u></p> <p>The contractor shall prepare and submit class I engineering change proposals (ECPs) using MIL-STD-973, ECP forms DG 1692 and DD1692-1 as guidelines. In addition to the change description, the ECP shall contain sufficient information in the form of attachments, drawings, test results, etc., to allow the Government to evaluate the total impact of the proposed change. GSFC may direct the contractor to prepare ECPs under the “changes” clause of the contract. The contractor shall allow access to class II changes for Government review.</p> <p>For the purposes of this DID, a class I ECP is a change that:</p> <ul style="list-style-type: none"> A. Affects any NASA contract specification or interface requirement. B. affects schedules of end item deliverables to the Government. C. impacts Government furnished equipment/property. <p>Waivers and deviations shall be handled using MIL-STD-973 as a guide.</p>	

<p>Title: Debris Generation Analysis Report</p>	<p>CDRL No.: 16</p>
<p>Reference: NASA Directive NPD 8710.3, Dated May 29, 1997 (http://nodis.hq.nasa.gov/Library/Directives/NASA-WIDE/Policies/Program_Management/N_PD_8710_3.html) NSS 1740.14 Dated August 1995</p>	
<p>Purpose: Limit the generation of Orbital debris. This analysis is required to demonstrate compliance with the requirements of NPD 8710.3 and NSS 1740.14.</p>	
<p>Related Documents:</p>	
<p>Preparation Information</p> <p>An analysis shall be conducted and documented to assess orbital debris generation potential and debris-mitigation options. The analysis shall include the following:</p> <ul style="list-style-type: none"> A. The potential for orbital debris generation in both nominal operation and malfunction conditions, including malfunctions during launch. B. The potential for orbital debris generation due to on-orbit impact with existing space debris (natural or human generated) or other orbiting space systems. 	



Section 2
(Red-Line for QuikSCAT Mission)

Mission Implementation Specification
for
Rapid Spacecraft Acquisition

NASA Goddard Space Flight Center
Greenbelt, Maryland



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