Contract NAS1-97110

The following information is considered exempt from disclosure and has been deleted:

- From the Contract: Ceiling percentages, pg. 21.

OMB APPROVAL #: 2700-0042

AWARD/CONTRACT

1. THIS CONTRACT IS A RATED ORDER UNDER DPAS (15 CFR 350)	RATING	PAGE	OF	PAGE(S)
▷	DO-A1	1		71

2. CONTRACT NO. *(Proc. Inst. Ident.) NO.*	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQUEST/PROJECT NO.
NAS1-97110		LA.1021

5. ISSUED BY: CODE

National Aeronautics and Space Administration
Langley Research Center
Hampton, VA 23681-0001

6. ADMINISTERED BY *(If other than Item 5)* CODE

National Aeronautics and Space Administration
Dryden Flight Research Center
Edwards, CA 93523-0273

Delegation Being Made Via NASA Form 1430

Criticality Designator C

7. NAME AND ADDRESS OF CONTRACTOR (No., street, city, county, State and ZIP code)

Micro Craft, Inc.
P. O. Box 370
207 Big Springs Avenue
Tullahoma, TN 37388

8. DELIVERY

Destination

☐ FOB ORIGIN ☒ OTHER *(See below)*

9. DISCOUNT FOR PROMPT PAYMENT

N/A

10. SUBMIT INVOICES *(4 copies unless other-wise specified)* TO THE ADDRESS SHOWN IN: ▷ ITEM 12 Below

CODE FACILITY CODE

11. SHIP TO/MARK FOR CODE

See F.3.

12. PAYMENT WILL BE MADE BY: CODE

Financial Management Office
M/S D-1009, P. O. Box 273
Edwards, CA 93523-0273

13. AUTHORITY FOR USING OTHER THAN FULL AND OPEN COMPETITION

☐ 10 U.S.C. 2304(c) ( ) ☐ 41 U.S.C. 253(c) ( )

14. ACCOUNTING AND APPROPRIATION DATA

PR: LA.1021; R21855; $5,300,000 (Complete)

15A. ITEM NO.	15B. SUPPLIES/SERVICES	15C. QTY	15D. UNIT	15E. UNIT PRICE	15F. AMOUNT
	Hyper-X Research Vehicle Production			Target Cost	$29,900,000
				Maximum Incentive Fee	3,550,000

15G. TOTAL AMOUNT OF CONTRACT ▷ $33,450,000

16. TABLE OF CONTENTS

(X)	SEC.	DESCRIPTION	PAGE(S)	(X)	SEC.	DESCRIPTION	PAGE(S)
		PART I – THE SCHEDULE				PART II – CONTRACT CLAUSES	
X	A	SOLICITATION/CONTRACT FORM	1	X	I	CONTRACT CLAUSES	22
X	B	SUPPLIES OR SERVICES AND PRICES/COSTS	2			PART III – LIST OF DOCUMENTS, EXHIBITS AND OTHER ATTACHMENTS	
X	C	DESCRIPTIONS/SPECS./WORK STATEMENTS	2	X	J	LIST OF ATTACHMENTS	26
X	D	PACKAGING AND MARKING	13			PART IV – REPRESENTATIONS AND INSTRUCTIONS	
X	E	INSPECTION AND ACCEPTANCE	13		K	REPRESENTATIONS, CERTIFICATIONS AND OTHER STATEMENTS OF OFFERORS	
X	F	DELIVERIES OR PERFORMANCE	13				
X	G	CONTRACT ADMINISTRATION DATA	17		L	INSTRS, CONDS, AND NOTICES TO OFFERORS	
X	H	SPECIAL CONTRACT REQUIREMENTS	18		M	EVALUATION FACTORS FOR AWARD	

CONTRACTING OFFICER WILL COMPLETE ITEM 17 OR 18 AS APPLICABLE

17. ☒ CONTRACTOR'S NEGOTIATED AGREEMENT *(Contractor is required to sign this document and return 3 copies to issuing office.)* Contractor agrees to furnish and deliver all items or perform all the services set forth or otherwise identified above and on any continuation sheets for the consideration stated herein. The rights and obligations of the parties to this contract shall be subject to and governed by the following documents (s) this award/contract, (b) the solicitation, if any, and (c) such provisions, representations, certifications, and specifications, as are attached or incorporated by reference herein. *(Attachments are listed herein.)*

18. ☐ AWARD *(Contractor is not required to sign this document.)* Your offer on Solicitation Number _____, including the additions or changes made by you which additions or changes are set forth in full above, is hereby accepted as to the items listed above and on any continuation sheets. This award consummates the contract which consists of the following documents: (a) the Government's solicitation and your offer, and (b) this award/contract. No further contractual document is necessary.

19A. NAME AND TITLE OF SIGNER *(Type or print)*

LOWELL C. KEEL, AERODYNAMICS ENTERPRISE MANAGER

20A. NAME OF CONTRACTING OFFICER

MARY JANE YEAGER

19B. NAME OF CONTRACTOR	19C. DATE SIGNED	20B. UNITED STATES OF AMERICA	20C. DATE SIGNED
BY _____ *(Signature of person authorized to sign)*		BY _____ *(Signature of Contracting Officer)*	

NSN 7540-01-152-8070
PREVIOUS EDITION UNUSABLE

STANDARD FORM 26 (REV. 4-85)
Prescribed By GSA
FAR (48CFR) 53.214(a)

PART I - THE SCHEDULE

SECTION B - SUPPLIES OR SERVICES AND PRICES/COSTS

B.1 SUPPLIES AND/OR SERVICES TO BE FURNISHED

The Contractor shall provide all resources (except as may be expressly stated in this contract as furnished by the Government) necessary to furnish the required supplies and/or services in accordance with the Description/ Specifications/Work Statement in Section C.

B.2 TARGET COST AND INCENTIVE FEE

The target cost of this contract is $29,900,000. The maximum incentive fee of this contract is $3,550,000. The total target cost and incentive fee of this contract is $33,450,000.

B.3 CONTRACT FUNDING (NASA 18-52.232-81) (JUN 1990)

(a) For purposes of payment of cost, exclusive of fee, in accordance with the Limitation of Funds clause, the total amount allotted by the Government to this contract is $5,220,000. This allotment covers the following estimated period of performance: Contract award through July 1997.

(b) An additional amount of $80,000 is obligated under this contract for payment of fee.

SECTION C - DESCRIPTION/SPECIFICATIONS/WORK STATEMENT

C.1 STATEMENT OF WORK - HYPER-X RESEARCH VEHICLE PRODUCTION

1.0 INTRODUCTION: The goal of the Hyper-X Program is to demonstrate and validate the technology, the experimental techniques, and computational methods and tools for design and performance predictions of a hypersonic aircraft with an airframe-integrated dual-mode scramjet propulsion system. Accomplishing this goal requires three essential elements: (1) demonstration of hypersonic-aircraft powered and unpowered flight in an airframe-integrated, hydrogen-fueled dual-mode scramjet propelled research vehicle at Mach 5, 7 and 10; (2) verification of computational predictions, analysis, and ground test methodologies; and (3) scaling of 1 and 2 above to concepts for future operational air-breathing hypersonic cruise and space access vehicles. This statement of work is to provide the research vehicles for the first two essential elements.

2.0 OBJECTIVE: The objective of this contract is to produce four complete Hyper-X research vehicles and one Hyper-X research vehicle-to-booster adapter and to provide associated hardware, software and documentation. The contractor shall be responsible for system/subsystem integration, certain aspects of verification and validation as defined in "Technical Requirements," and systems acceptance testing of the flight vehicles. As a technical goal, the Hyper-X research vehicle production is to be accomplished through the use of a series of design, fabrication, manufacturing, assembly and testing activities organized to minimize the costs and time required for the production of the flight research vehicles (e.g., "Rapid Prototyping").

3.0 CONTRACTOR'S TASKS: The contractor shall perform the following tasks in accordance with the Technical Requirements of section 4.0.

3.1 Manufacture the four research vehicle airframes and engine components based on the Government furnished external configuration and internal engine flow path mold lines and one research vehicle-to-booster adapter based on the Government furnished external configuration and ejection/separation system.

3.2 Design and fabricate and/or procure and integrate all systems/subsystems (including software) required for production of four complete Hyper-X research vehicles and one research vehicle-to-booster adapter.

3.3 Perform system verification, analysis and testing (including functional, environmental, and performance) of all four research vehicles and the research vehicle-to-booster adapter.

3.4 Provide programmatic and technical documentation as defined in Exhibit A.

3.5 Provide engineering and technical services required for the support of Hyper-X research vehicle-to-booster integration, testing, mission operations, technical and programmatic reviews, etc. (see Exhibit B for additional details on significant areas requiring support). These services shall include engineering and technical support at the contractor's facility as well as Dryden Flight Research Center (DFRC) and Langley Research Center (LaRC).

4.0 TECHNICAL REQUIREMENTS: The contractor shall perform the Contractor's Tasks in accordance with the following Technical Requirements and applicable Government supplied data as set forth in section H.7.

4.1 Mission Objectives: Each research vehicle will demonstrate the performance of an airframe-integrated, dual mode scramjet powered vehicle at selected test conditions. Data shall be acquired to verify scramjet, aerodynamics and stability and control performance predictions and the flight correlation of the ground based experimental data. In addition, data will be acquired to verify the hypersonic vehicle structural and system design methods. The vehicle shall be designed such that the probability of causing injury or damage to the support aircraft or personnel or any personnel or structures in the flight test area will be reasonably judged to be extremely improbable by DFRC using DFRC Basic Operating Manual safety criteria.

4.2 Mission Scenario: The Hyper-X research vehicle will be rocket boosted to the required flight condition as discussed in sections 4.3 and 4.10.2, separate from the booster as described in section 4.10.4, establish unpowered controlled flight, open the engine inlet, achieve inlet start and approximately 2 seconds of tare, no fuel engine operation; establish fuel injection and achieve at least 5 seconds of stable combustor operation maintaining vehicle stability and control within the flight angle-of-attack and side slip limits. Following engine operation, the Hyper-X research vehicle shall obtain approximately 5 seconds of fuel-off (inlet open) performance, close the inlet cowl door, fly a controlled deceleration trajectory to low subsonic speed and conclude the flight at a specified point (see section 4.12.2) within the test range.

4.3 Test Conditions: Test conditions, for the primary powered portion of the experiment, are specified by flight Mach number, Qbar (dynamic pressure), α(angle-of-attack), β(angle of side slip), and φ(scramjet fuel equivalence ratios). The desired test conditions and acceptable "aim" envelope subject to launch system performance uncertainty for the four flight tests (two at Mach 10) shall be:

Mach	Qbar, PSF	α, deg.	β, deg.	φ
5 +.2/-0	1000 +/- 50	2 +/-.5	0 +/-.5	1.0 +/-.1
7 +.1/-.1	1000 +/- 50	2 +/-.5	0 +/-.5	1.2 +/-.1
10 +.1/-.1	1000 +/- 50	2 +/-.5	0 +/-.5	1.2 +/-.1

Powered operation shall be performed within these constraints but the determination of actual conditions will be derived from post-flight data analysis. During the powered operating condition (i.e., after delivery to the nominal condition) the primary test condition will be α, β, and

φ. Mach numbers and dynamic pressure shall be calculated from altitude and velocity using a day-of-launch atmospheric model provided by the Government.

4.4 Vehicle Operation Scenario: Vehicle operation shall be fully autonomous. The Government will monitor (Section 4.10.7) and terminate (section 4.10.6) vehicle operation if any potential exists for exceeding the limits of the flight test range or in the event of any other unsafe operation.

4.5 Geometry

4.5.1 Hyper-X Research Vehicle

4.5.1.1 System Design: The Government supplied Unigraphics and/or IGES files provide a candidate Hyper-X research vehicle system design. It is the Government's intent to permit flexibility for alternative approaches in the areas of structural design, system/subsystems design, and materials consistent with the maintenance of mission critical design parameters as discussed below:

4.5.1.2 Outer Mold Line: The prescribed Hyper-X research vehicle mold-lines shall be maintained. The mold-lines are provided in the Government furnished Unigraphics and/or IGES design file and shall be maintained within the following manufacturing tolerances (unloaded):

4.5.1.2.1 Butt Gap and Surface Mismatch: The maximum gap shall not exceed 0.030 inches.

4.5.1.2.2 Contour: Maximum exterior contour deviations shall not exceed 0.040 inches.

4.5.1.2.3 Surface Waviness: Surface waviness shall not exceed 0.015 inches from peak-to-valley in a 6-inch span.

4.5.1.2.4 Surface Roughness: The exterior surface roughness shall not exceed 64 microinches rms (root mean square) for metal surfaces and 128 microinches rms for the TPS (Thermal Protection System).

4.5.1.3. Airframe Deflection: Airframe deflection when loaded at the designed powered flight condition (section 4.3) shall not compromise scramjet performance or induce forebody or ramp shock impingement on the cowl leading edge. Forward and aft facing steps shall not exceed 0.040" and 0.060" respectively at any location on the external mold line due to the predicted aero-thermal loading at the powered test condition.

4.5.1.4 Engine Flowpath: The Hyper-X flight vehicle shall maintain the prescribed flow path-lines, as per the candidate design. These lines include but are not limited to forebody, cowl and side wall leading edge radii, forebody initial wedge as well as ramp compression angles, inlet internal side wall compression and sweep angles, cowl internal geometry, isolator length, fuel injector geometry including injector orifice sizing to control fuel distribution, combustor area ratio and expansion angles, nozzle expansion angles, including side wall expansion and trailing edge sweep. At the predicted aero-thermal loading for the powered condition, the engine to vehicle interface, and the entire internal flowpath shall have no forward facing steps and aft facing steps shall be limited to 0.010 inches. In addition, the internal flow path inlet throat and combuster flow path area shall not vary by more than 1% of the design mold line values.

4.5.2 Hyper-X Research Vehicle-to-Booster Adapter: The prescribed Hyper-X research vehicle-to-booster adapter mold-line as provided in the Government furnished Unigraphics

and/or IGES design files shall be maintained. Manufacturing tolerances shall be consistent with Pegasus' requirements.

4.6 Boundary Layer Trips: The Hyper-X research vehicle shall incorporate boundary layer trips for the flowpath only. These trip sizes and locations will be specified by the Government.

4.7 Weight and CG: The Hyper-X research vehicle shall maintain the prescribed size, length, and shape of the candidate design. The three axis C.G. shall be at 66.24"+/-2.9" in X, 0+/-0.3" in Y and -0.76"+/-0.2" in Z in order to maintain control surface effectiveness. Ballast may be required to maintain the CG location to achieve neutral to positive stability. For alternative fabrication methods, materials, or subsystem components, changes to the baseline ballast are acceptable to meet the flight test condition requirements.

4.8 8' High Temperature Tunnel (HTT) Restrictions: The Hyper-X flight vehicle design shall permit testing in the 8' HTT at LaRC. The Hyper-X design shall be able to withstand up to 10 thermal cycles in the 8'HTT test environment, with exposure up to 15 second duration, and with the loads specified in Section 4.9.5.1 and .2. The vehicle shall contain as many active subsystems as possible, while meeting safety constraints for hydrogen/fuel and pyrotechnics. Since Hyper-X research vehicle on-board hydrogen will not be permitted in the test facility, the facility's 1200 PSIG hydrogen and silane external fuel supply will be utilized as the research vehicle fuel source during the tests. Modifications to the Hyper-X vehicle which increase the planform area including 8' HTT mounting provisions are not permitted due to the tunnel test section size constraints. All systems/subsystems shall have interfaces which can be accessed for vehicle checkout and control during the 8' HTT test program. This interface shall be identified in the Interface Control Document.

4.9 Structures

4.9.1 Loads: External airframe, engine flow path and vehicle-to-booster adapter structural and thermal loads will be provided by the Government. The research vehicle and vehicle-to-booster adapter shall have sufficient design margin to accomplish the mission objectives. The safety factors of section 4.9.3 shall be applicable for all designs.

4.9.2 Materials: The research vehicle and research vehicle-to-booster adapter shall be constructed from the materials stipulated in the candidate design or equivalent. Alternate materials suitability shall be assessed using the loads specified in section 4.9.1. All vehicle flowpath materials (including the forebody) and TPS shall be non-ablative. The TPS shall be as suggested in the candidate design or equivalent to assure 1) the control of the maximum internal temperatures to component "survivability" and/or "operational" temperature limits and 2) the control of the maximum airframe structure temperatures to limit thermal distortions and the external configuration to conditions specified in section 4.5.1.

4.9.3 Safety Factors/Verification

4.9.3.1 Design Loads and Thermal Conditions for Captive Carry on B-52B: All primary structures shall be designed to ensure positive margins of safety based on the conditions shown in Exhibit E with a 2.25 (3.0 for non-metallic structures) factor of safety applied to the loads derived from these conditions. The research vehicle and research vehicle-to-booster adapter shall be designed for sustained outer surface temperatures from -50°F to 180°F, due to altitude and solar radiation on the ground respectively. Active supplemental cooling shall be provided to keep the subsystems within operational limits during ground operations, including ground holds, with systems powered.

4.9.3.2 Design Loads and Thermal Conditions for Boost and Free Flight: All primary structure and structure critical to the success of the primary mission shall be

designed to ensure positive margins of safety for a 1.5 ultimate F.S.(factor of safety) for all loads including thermal induced loads. The 1.5 F.S. is a general minimum factor of safety. Additional factors of safety which are normally applied to specific applications including but not limited to fittings, castings, fasteners, fluid and gaseous plumbing, and billet-size shall be applied per aerospace industry practice. Conservative designs shall be applied at complex structural areas, especially if composite structures are utilized, so that structural proof testing is not required. Total structural weight is of secondary importance to reliability and maintainability, cost, safety, and schedule. The design trajectory and flight design envelope will be furnished by the Government.

4.9.4 Structural Dynamics: The fundamental structural first bending mode frequency of the Hyper-X research vehicle and booster combination when configured for flight shall be 10 Hertz or greater in order to preclude structural dynamic coupling to the B-52B structural modes.

4.9.5 8'HTT: The vehicle and support hardware for mounting the vehicle in the 8'HTT shall withstand Mach 7 flight conditions at a dynamic pressure of 1000 psf. The Contractor shall be responsible for providing a mounting interface adapter on the vehicle for use in the 8'HTT test that will permit correct positioning of the vehicle in the 8'HTT. The Government will provide the mounting strut to interface the flight vehicle mounting interface adapter to the wind tunnel balance. The factor of safety for this interface adapter will be provided by the Government and the design will be approved by the Government. The Contractor shall evaluate the following 8'HTT load cases and provide the Government with documentation of the analyses used and the results.

4.9.5.1 At 8' HTT start, the test section pressure changes from atmospheric pressure to approximately 2.0 psia in two seconds. Therefore, internal airframe and engine cavities shall be vented such that component and material loads do not exceed design limit conditions. Previous testing experience has shown that a vent area of 7 square inches per 20,000 cubic inches of enclosed volume is adequate for 8' HTT test operations.

4.9.5.2 The vehicle will be injected and retracted from the flow after 8' HTT startup and prior to shutdown. The vehicle and mount system must withstand + or - 2g's of vertical acceleration during the injection and retraction process and the aerodynamic loads imposed by injection through the tunnel shear layer.

4.10 System/Subsystems Requirements: The research vehicle and vehicle-to-booster adapter shall have sufficient margin and redundancy to accomplish the mission objectives. A duplicate integrated hardware/software suite shall be provided to DFRC for independent validation testing. It is the intent of the Government that this system suite be utilized on vehicle number 3 or 4.

4.10.1 General System/Subsystem Environment: All systems/ subsystems on the Hyper-X research vehicle and research vehicle-to-booster adapter shall be capable of surviving the ground and flight operations and operating reliably throughout the mission. The research vehicle will be air launched to an altitude of approximately 100,000 feet. The systems/subsystems and components shall be capable of operation during and after the acceleration, vibration, shock, temperature, and pressures imposed by the flight environment and the Pegasus booster. Independent inert gas purge systems shall be provided for both the internal cavities (airframe, engine, adapter and vehicle-adapter interface) and for the engine pressurized fuel system. All internal cavities subject to fuel contamination shall be purged, vented and monitored for leakage, and the fuel controls designed to dump/evacuate the fuel and silane/hydrogen tanks if a combustable mixture is detected while attached to the B-52B. When detached from the B-52B, cavity purge shall be maintained, but detection of a combustable mixture shall not interfere with normal flight operations (i.e., do not dump fuel or activate the FTS). The B-52B will have GN_2 which may be utilized for any purge requirements while the booster is attached to the B-52B. Testing and/or analyses shall be performed to demonstrate the functional verification of the subsystems when subjected to the expected flight environment. The environment definition shall be based on analyses or tests. Verification of airworthiness shall be accomplished by tests or similarity. Parts and components

selection shall be based on appropriate aerospace standards or specifications. As a goal, the Government encourages the use of the "Fail-Op" design philosophy with regard to systems/subsystems design and selection.

4.10.2 Guidance, Navigation, and Control: The Hyper-X vehicle shall be fully autonomous. After boost to the desired test condition (booster guidance is not a part of this SOW), separation from the booster shall be initiated by the Hyper-X vehicle. After separation, the vehicle control system shall stabilize and maintain the required vehicle angle of attack and side slip during the engine ignition and burn. To achieve the required control accuracy and to verify flight conditions with respect to airdata, a direct measurement of airdata shall be required. The flight test condition shall be maintained for 5 seconds in the presence of induced pitching moments due to engine cowl movement, engine ignition, and engine operation. Upon completion of the test sequence, the test conditions are to be maintained for up to an additional 5 seconds. As a secondary objective, the vehicle shall be controlled to mission completion. During the descent, the control system shall initiate maneuvers to control and dissipate vehicle energy. Additionally, the capability to superimpose short duration programmed test inputs on the control surface motions for the purposes of aerodynamic parameter identification is required. For all phases, the control system shall have a minimum of 6 db gain margin and 45 degrees phase margin for all control feedback loops. All structural modes shall be suppressed with at least 9 db of gain attenuation. All closed loop eigenvalues shall have greater than 0.2 damping ratio. The Government will furnish a preliminary set of research vehicle control laws for the descent portion of flight. The final flight software design which includes control laws, guidance algorithms, navigation systems as well as control of the engine shall be the responsibility of the Contractor.

4.10.3 Engine Control Subsystems: The engine control system shall control the inlet cowl flap position, the engine fuel system (both hydrogen and silane), and the water cooling system. The control logic equations will be supplied by the Government.

4.10.3.1 The inlet cowl flap shall be controlled on signal from the engine control system to one of two positions, fully opened (prior to the power test condition) or fully closed (after test). The inlet cowl flap shall be opened once and closed once during the flight. The flap shall be fully opened and closed within 0.5 second.

4.10.3.2 The engine fuel system and fuel controls shall actively control the flow rate of separate supplies of gaseous hydrogen and a gaseous mixture of 20% silane (SiH4) and 80% hydrogen (by volume) to the engine. The hydrogen system shall have a nominal flow rate of 0.28 lbm/sec at a minimum temperature of 459 Rankine. This flow must be maintained for 5 seconds. The silane-hydrogen mixture shall have a total capacity of 0.24 lbm, a maximum flow rate of 0.09 lbm/sec at a minimum temperature of 459 Rankine, and be controllable for the duration of the powered tests. These systems shall be designed for operation up to 24 hours from fill, with up to 21 hours at up to 180°F, followed by up to 3 hours at -50°F external ambient temperatures. The fuel storage tanks shall have a minimum factor of safety of 2.5. The lines and fittings in the fuel system shall have a minimum factor of safety of 4. During ground operations until immediately prior to B-52B engine start, no single point failure may cause an inadvertent release of propellant. Any shutoff mechanism shall be independent of the other systems/subsystems and shall provide a physical interrupt. Manual shutoff valves in the high pressure propellant feed systems which can be opened just prior to flight are currently used in flight test operations. There shall be an inert gas purge system for the pressurized fuel system.

4.10.3.3 Water Cooling System: The cooling water system, when utilized, shall actively control the flow rate of water to the cooled portions of the engine and airframe. Control laws for flow rates for the candidate configuration will be provided by the Government. Storage tanks shall have a minimum factor of safety of 2.5. The lines and fittings in the water system shall have a minimum safety factor of 4. The maximum water flow rate, and the total water storage requirements for the candidate configuration will be provided by the Government. This system shall operate at sustained ambient conditions from -50° F to +180°F.

4.10.4 Ejection System: The research vehicle-to-booster adapter/separation system shall be maintained as defined, including the mechanical design, separation sequence and the minimum Hyper-X research vehicle relative velocity of 9 ft/sec away from the adapter at the end of the adapter rails. Axial acceleration of the Hyper-X research vehicle throughout the separation sequence shall not exceed 5 g's. Analysis and ground tests utilizing simulated flight masses and loads shall be designed and conducted to verify that the Hyper-X research vehicle will successfully separate from the adapter. Separation flight conditions and trajectories will be furnished by the Government.

4.10.5 Power: The Hyper-X research vehicle shall provide on board power for all systems/subsystems. This includes the time period from Hyper-X research vehicle/booster separation to the time at which the flight is completed. Power during the captive carry will be provided by the B-52B aircraft. Power during boost will be provided by the Pegasus/adapter system. The adequacy of the Hyper-X research vehicle power subsystem shall be demonstrated by testing and analyses. Appropriate switching, fusing, and interfaces shall be designed for research vehicle flight operation and to interface with ground test equipment and ground power. The power subsystem shall be designed and tested to assure that unacceptable transients are not produced at the time of stack separation from the B-52B and Hyper-X research vehicle separation from the booster.

4.10.6 Flight Termination System (FTS): The purpose of the flight termination system is to provide safe, deterministic termination of an abnormal flight condition. While the research vehicle will fly over water, the flight termination system shall preclude encroachment on the coast where personal injury and property damage might ensue.

4.10.6.1 Hyper-X Research Vehicle FTS: The vehicle flight termination system shall be dual redundant with dedicated power subsystems and capable of the execution of a termination command at any point after separation from the booster until flight completion. It shall be totally isolated from the rocket booster FTS and shall operate on different tones such that independent operation is assured. Tests and analyses shall be performed to verify the adequacy of the FTS. All FTS components shall be selected to meet the required environmental conditions. Methods to terminate the vehicle can include removal of a horizontal or vertical tail or any method that does not require carrying large amounts of pyrotechnics. Reliability of the FTS shall be 99.999%. The FTS system must be capable of remote "safing" for ground tests and processing. The Hyper-X research vehicle FTS shall be "armed" at separation from the Pegasus.

4.10.6.2 Booster FTS: The dual redundant booster FTS is not a part of this contract. The booster FTS will be separate and isolated from the Hyper-X vehicle FTS.

4.10.7 Instrumentation

4.10.7.1 Instrumentation/measurement parameters (type and location) and requirements (sample rates, presample filter cut off frequency, range, resolution and accuracy) will be provided by the Government and updated to reflect specific installation problems (e.g., section 4.10.7.6). These measurements shall be acquired and telemetered. Internal measurements for alternative system/subsystem designs may require modifications subject to Government approval. The sample rate of each parameter shall be five times the expected maximum frequency of that parameter. Presample (or anti-aliasing) filter cutoff frequency shall be considered as the frequency at which the signal is attenuated 3 dB; at higher frequencies the signal is attenuated 6 dB per pole per octave. Approximately 24 channels of mission critical performance data as defined by the Government shall be stored and repeatedly transmitted following the test event until mission completion to assure that critical performance data is acquired.

4.10.7.2 All sensors and transducers selected to obtain the required measurements shall meet the specified data frequency, range, resolution, and accuracy

requirements as specified by the Government. They shall be aerospace qualified or shall be environmentally qualified by the contractor to aerospace standards suitable for the mission as specified in Section 4.10.1.

4.10.7.3 All wiring and connectors shall be aerospace qualified or shall be environmentally qualified by the contractor to aerospace standards suitable for this mission. Aerospace standards or specifications for wiring, crimping, soldering practices shall be used throughout.

4.10.7.4 Signal conditioning equipment qualified to aerospace standards and to the levels required in Section 4.10.1 shall be provided as necessary to interface with the sensors, transducers and any other required input signals to the PCM data acquisition system. Provision shall be made to allow for 40 percent growth in the number of signal conditioning channels above those identified in Section 4.10.7.1.

4.10.7.5 A Pulse Code Modulation (PCM) data acquisition system qualified to aerospace standards to the conditions specified in Section 4.10.1 shall be utilized. The PCM shall be of miniature form factor with sufficient capability to implement the required measurements list (see section 4.10.7.1). The PCM format shall be under configuration control, conform to IRIG standards and shall be provided by the contractor in both hard copy and electronic file forms. The calibration file for each parameter in the PCM format containing the coefficients (C0, C1,C2, ...C5) derived from the general form [EU equals (C0) + (C1)(cts) + (C2)$(CTs)^2$...+ (C5)$(CTs)^5$] where EU equals Engineering Units and cts equals PCM counts, shall be provided in electronic file format readable by Microsoft Excel and shall be under configuration control. Provision shall be made to allow for 40 percent growth in PCM format capacity. In no case shall the PCM bit rate exceed two megabits per sec. Data latency shall be quantified for analog, bilevel digital and avionics bus inputs; lags in no case shall exceed 20 milliseconds. One output stream shall provide modulation for the instrumentation transmitter and shall be premodulation filtered to IRIG standards for PCM/FM telemetry. At least one other unfiltered output stream shall be provided for ground-based decommutation.

4.10.7.6 Instrumentation Integration: Strain gauge, thermocouple, and pressure instrumentation shall be located in areas to provide the measurements specified by the Government. If measurement locations are moved due to construction interactions, such as thermal protection system (TPS) tile joints, the alternate measurements and locations will be approved by the Government. The installation of strain gauges, associated interbridge wiring, and thermocouples for attachment to the internal airframe structure will be performed by Government personnel at the contractor's facility. This work will be performed with minimal impact on ongoing Contractor activities. Design and construction of thermocouple and pressure instrumentation plugs for the AETB TPS of the candidate design will be provided by the Government.

4.10.7.7 In accordance with the documentation requirements of Exhibit A , two complete sets of hardcopy as built instrumentation system drawings shall be provided by the contractor to allow for verification and troubleshooting. An electronic file of these drawings readable by AutoCad shall be provided.

4.10.8 Antennas/RF/Tracking

4.10.8.1 The following antenna systems shall be installed: S band telemetry, C band radar transponder, Flight Termination System (FTS) receiver, and GPS (Global Positioning System) receiver. Antenna systems shall be aerospace qualified or shall be environmentally qualified by the contractor to the conditions of section 4.10.1 consistent with their mounting locations. Each antenna shall be placed on the surface under the TPS. Each antenna system shall provide

adequate pattern coverage and gain such that link is maintained throughout captive carry, release, rocket boosted flight and free flight to impact, including the case where control of vehicle attitude is lost. The B-52B and research vehicles will be based out of NASA DFRC at Edwards Air Force Base (EAFB). Vehicle launches, rocket boosted flights and free flights will be conducted in the Western Test Range (WTR) over the Pacific Ocean employing a flight path consistent with the utilization of the range flight support capabilities including telemetry reception and relay, radar tracking, flight termination system services and data acquisition and communications equipment. All Hyper-X research vehicle RF (Radio Frequency) equipment shall be compatible with WTR (Western Test Range) RF equipment.

4.10.8.1.1 The S band telemetry link shall be such that a bit error rate of 10^{-5} or less is maintained. The S band telemetry transmitter shall be frequency selectable in 1 Mhz (megahertz) steps within the 2200.5 to 2399.5 Mhz range.

4.10.8.1.2 Tracking shall be accomplished by C band radar transponder in the vehicle and corresponding ground-based range equipment.

4.10.8.1.3 The FTS receivers shall provide received carrier signal strength as analog outputs to the PCM as well as discrete outputs to the PCM to indicate "monitor," "arm" and "terminate" status. The FTS RF link shall be continuously monitored through signal strength measurement parameters in the telemetry stream to assure that minimum or greater signal strength necessary to terminate the vehicle is maintained.

4.10.8.2 In accordance with the documentation requirements of Exhibit A , two complete sets of hardcopy as built RF system drawings shall be provided by the contractor to allow for verification and troubleshooting. An electronic file of these drawings readable by AutoCad shall be provided.

4.10.8.3 No RF source shall interfere with any other RF source or receiver on the vehicle, launch stack or B-52B.

4.10.9 Operability: As a goal, the vehicle and its subsystems shall be constructed such that normal maintenance, service, and adjustment operations can be completed within an 8 hour work shift. Extraordinary measures should not be required for servicing and operations.

4.10.9.1 Accessibility: There shall be access for servicing of the hydrogen, silane, water, and inert gas tanks prior to flight. Pre-flight servicing and check out of instrumentation and avionics shall be accomplished through external connectors. Additional hatches/access, shall be provided to permit normal maintenance of instrumentation, avionics and the propellant system in the vehicle.

4.10.10 Test/Testability: Vehicle/system "testability" is critical to maintaining the schedule and program costs. The tests listed below shall be conducted on the research vehicle and research vehicle-to-booster adapter and their results analyzed to ensure adequate operation of the vehicle and its systems. Access to the systems by ground test facilities both with and without the research vehicle-to-booster adapter installed is a requirement, as is the ability to input simulated sensor inputs (nominal and off-nominal flight trajectories and failure mode) and actuation of all vehicle systems. The fuel system shall be designed to permit functional ground testing prior to flight. Test plans shall be written for all testing conducted by the Contractor at his facility and approved by the Government. Test results shall be documented at the completion of all tests. The Government reserves the right to observe or participate in testing performed by the Contractor.

4.10.10.1 Component level testing: All components shall be qualified to the conditions of section 4.10.1 and shall meet the more severe of the altitude, temperature, and vibration definitions described in the "Pegasus Payload Users Guide" and the category I

environmental acceptance criteria set forth in the NASA DFRC "Environmental Process Specification 21-2." Requalification will not be required. Additionally, each flight component shall undergo environmental testing including, but not limited to, vibrations and altitude tests, to reduce the probability of 'infant mortality' causing mission failure.

The environmental tests shall demonstrate that components can survive the environments defined in 4.10.1 of this SOW. The functional tests shall demonstrate that the components shall perform to the specified levels.

4.10.10.2 Integration testing: Integration testing is composed of bench integration tests and software/hardware tests. Integration tests with component level tests make up the bulk of the verification tests. All subsystems, including, but not limited to, power, avionics, actuation, fuel, thermal control, instrumentation, purge and antenna/radiation subsystems shall be integrated at the bench level to the maximum extent possible prior to installation on the vehicle. Software shall be tested at the unit level and at the hardware/software (H/W-S/W) integration level. Verification of the software and the integrated hardware/software system shall be completed before delivery of the vehicle by the Contractor. Sufficient testing shall be done to demonstrate the system meets the specifications and requirements. A duplicate integrated H/W-S/W system suite and test H/W-S/W including documentation used for integrated systems testing shall be provided to DFRC. The Contractor shall provide documentation and models representative of the flight hardware as required to support simulation activities (see Exhibit B). This documentation shall include but not be limited to performance characteristics and/or software models for actuators, guidance and navigation controls, sensors, vehicle mass properties, hinge moments and vehicle stage separation. Complete software and documentation requirements are included in Exhibit A.

4.10.10.3 Research Vehicle-to-Booster Ejector/Separation System Testing: The contractor shall demonstrate the functionality of the research vehicle-to-booster adapter and ejector/separation mechanisms by conducting ground tests such as forced ejection tests. Ground tests and analyses shall be performed to verify that the system functions properly, including any quick disconnects. The power subsystem shall also be functionally tested to assure that unacceptable power transients are not produced during Hyper-X flight vehicle stage separation.

4.10.10.4 FTS Testing: The FTS for the Hyper-X research vehicle shall be tested to demonstrate operability in normal and extreme conditions as defined by the Contractor and approved by the Government. Extreme conditions may include but are not limited to: research vehicle attitudes/rates that will create adverse FTS antenna exposure and extended operational temperature limits. Failures will be induced to indicate proper operation in case of loss of elements to demonstrate the dual redundant nature of the system.

4.10.10.5 Vehicle/system level tests: Installed systems functional tests shall be performed on the vehicle at critical times in the processing of the Hyper-X research vehicle at the contractor's facility, LaRC, and DFRC. These times shall include: prior to, during, and after significant events such as transportation; the LaRC 8' HTT tests; and Hyper-X research vehicle/rocket booster/aircraft integration activities. These tests shall be designed to test the functionality of all Hyper-X research vehicle systems. They may simply be abbreviated "health checks" or they may be more complex and designed for full performance testing and diagnostic testing. The systems to be tested include, but are not restricted to, fuel system, power, avionics, actuation, thermal control, instrumentation, and purge. Testing to demonstrate systems performance with induced failure conditions shall also be performed. Radiation testing of the installed antennas shall also be conducted.

4.10.10.6 GVT Tests: A Ground Vibration Test (GVT) of the Hyper-X research vehicle with vehicle-to-booster adapter shall be completed by the Contractor. Results of the GVT will be utilized to verify structural and modal analyses. If Hyper-X research vehicle

modifications are required after the GVT, they shall be completed prior to delivery of the vehicle to LaRC for the 8' HTT test (mach 5 and 7 vehicles) or DFRC (mach 10 vehicles).

4.10.10.7 Electromagnetic Interference (EMI) and Electromagnetic Compatibility (EMC) Tests: EMI testing of the Hyper-X research vehicle and systems shall be conducted by the Contractor at the installed system level. Both analysis and testing are required to demonstrate that EMI/EMC problems will not adversely affect any system/subsystems performance during the missions.

4.10.10.8 Ground Support Equipment: In accordance with Exhibit A, the Contractor shall define all ground support equipment to be utilized by the Contractor to support ground operations and testing at the Contractor's facility, at DFRC and at the LaRC 8' HTT test. In addition, the Contractor shall provide all unique ground support equipment. Support equipment for software loading shall also be identified by the Contractor.

4.11 Launch/Booster: The Pegasus air launched booster system has been selected by the Government for this mission. The Contractor is not responsible for engineering analysis, design, vehicle modification and flight certification of the Pegasus booster. This includes coverage for all events from B-52B captive carry through the initiation of research vehicle separation. Time histories of the design boost trajectories for the four test conditions will be provided by the Government. The NASA/DFRC B-52B will be the launch aircraft. The cost of this aircraft use and its associated pylon, the booster system, and launch services will be the responsibility of the Government.

4.12 Range: The Government intends to conduct the entire launch and free flight operation within the Western Test Range, typically associated with Vandenberg AFB and Point Mugu NAS. The Government intends to utilize ground facilities of these sites including airborne or mobile ground based telemetry, radar, FTS, and data acquisition stations.

4.12.1 Stack Integration/Staging: Final booster/ vehicle-to-booster adapter/vehicle stack integration and launch activities prior to take off are planned to occur at Vandenberg Air Force Base or DFRC. The contractor shall provide technical support for this activity.

4.12.2 Launch/Flight Locations: Planned flight profiles for the Mach 5, Mach 7, and Mach 10 test missions will be provided by the Government. These show launch positions off the California coast with expended rocket booster splashdown slightly downrange, and Hyper-X research vehicle flight recovery on San Nicolas island.

4.13 Hyper-X research vehicle recovery: Post-mission recovery of the Hyper-X research vehicles is required.

4.14 Transportation , Storage, and Handling: Two cradle support stands and one vehicle-to-booster adapter support stand shall be provided by the contractor and utilized at the contractor's facility, LaRC, and DFRC to facilitate systems testing and check out.

4.14.1 Research Vehicle Cradle Support Stands: The cradle support stands shall be transportable by standard Government aerospace tug equipment. Access to hatches and connectors shall not require the vehicle to be moved from the cradle support stand. The cradle shall permit integrated system testing and validation testing to be performed allowing full motion of the inlet cowl, the horizontal tails and the rudders. The cradle shall not impede access to test or servicing connections. The cradle shall secure the vehicle and prevent damage during transportation and movement. A cradle support stand enclosure shall be supplied to protect the vehicle during transportation and storage. The enclosure shall protect the vehicle from damaging environmental conditions during transportation and storage. Appropriate lifting hardware shall be integrated with the enclosure to facilitate movement of the vehicle, cradle support, and enclosure. The method of transportation shall be approved

by the Government. The vehicle, cradle support, and enclosure shall provide environmental protection from vibration, shock, temperature, and humidity such that the Hyper-X research vehicle transportation and storage conditions do not exceed flight design conditions. These environments shall be monitored and recorded during transportation and storage. In addition, the contractor shall provide two sets of handling equipment to be used for installation of the Hyper-X research vehicle into the LaRC 8'HTT and integration of the Hyper-X research vehicle with the launch vehicle booster. This equipment shall permit safe handling of the Hyper-X research vehicle and shall be designed and certified to aerospace standards.

4.14.2 Vehicle-to-Booster Adapter Cradle Support Stand: One adapter cradle support stand shall be provided by the Contractor and utilized at the Contractor's facility and DFRC to facilitate systems testing and check out. The cradle support stand shall be transportable by standard Government aerospace tug equipment. Access to hatches and connectors shall not require the adapter to be moved from the cradle support stand. The cradle shall secure the adapter and prevent damage during transportation and movement. A cradle support stand enclosure shall be supplied to protect the adapter from damaging environmental conditions during transportation and storage. Appropriate lifting hardware shall be integrated with the enclosure to facilitate movement of the adapter, cradle support, and enclosure. The method of transportation shall be approved by the Government. The adapter, cradle support, and enclosure shall provide environmental protection from vibration, shock, temperature, and humidity such that the adapter transportation and storage conditions do not exceed flight design conditions. These environments shall be monitored and recorded during transportation and storage. In addition, the contractor shall provide one set of handling equipment to be used for integration of the adapter with the booster. This equipment shall permit safe handling of the adapter and shall be designed and certified to aerospace standards.

SECTION D - PACKAGING AND MARKING

D.1 PACKAGING AND MARKING

The Contractor shall pack and mark all items delivered under this contract in accordance with standard commercial practices.

SECTION E - INSPECTION AND ACCEPTANCE

E.1 FINAL INSPECTION AND ACCEPTANCE (LaRC 52.246-94) (OCT 1992)

Final inspection and acceptance of all items specified for delivery under this contract shall be accomplished by the Contracting Officer or his duly authorized representative at destination.

SECTION F - DELIVERIES OR PERFORMANCE

F.1 DELIVERY SCHEDULE

The Contractor shall deliver the items required to be furnished by this contract as follows:

Item No.	Description	Quantity	Delivery From Effective Date of Contract
1	Simulation Models	One (1)	2 months
2	Spare Vehicle System Suite, Flight Software and Test Hardware/Software	One (1)	5 months

3	Mach 7 Research Vehicle	One (1)	10 months
4	Cradle support stand	One(1)	10 months
5	Handling equipment	One(1)	10 months
6	8'HTT sting adapter	One(1)	10 months
7	Vehicle-to-Booster adapter, support stand and handling equipment	One (1)	13 months
8	Mach 7 Research Vehicle (Refurbished post 8'HTT)	One (1)	14 months
9	Mach 5 Research Vehicle	One (1)	21 months
10	Cradle support stand	One(1)	21 months
11	Handling equipment	One(1)	21 months
12	Mach 5 Research Vehicle (Refurbished post 8'HTT)	One(1)	25 months
13	Mach 10 Research Vehicle	One (1)	34 months
14	Mach 10 Research Vehicle	One (1)	46 months
15	Contract technical and programmatic documentation as specified in Exhibit A		

F.2 PERIOD OF PERFORMANCE (NASA 18-52.211-72) (DEC 1988)

The period of performance of this contract shall be 55 months from the effective date of the contract.

F.3 PLACE OF DELIVERY (LaRC 52.211-92) (OCT 1992)

Delivery shall be f.o.b. destination:

Deliverable No. 3,4,5,6,9,10&11

National Aeronautics and Space Administration
Langley Research Center
4 South Marvin Street (Bldg. 1206)
Hampton, VA 23681-0001

Deliverable No. 1,2,7,8,12,13&14

National Aeronautics and Space Administration
Dryden Flight Research Center
Warehouse #7
Edwards, CA 93523-1000

F.4 PLACE(S) OF PERFORMANCE (LaRC 52.211-98) (OCT 1992)

The place(s) of performance shall be:

The Contractor's facilities located in Tullahoma, Tennessee; Ontario, California; Hampton, Virginia; and San Diego, California.

F.5 ORAL PRESENTATIONS (LaRC 52.211-100) (AUG 1991)

The Contractor shall make oral presentations under this contract at the approximate times and locations identified below:

		Research Vehicle Months from the Effective Date of Contract			
	Meeting /Location	#1	#2	#3	#4
1.	Contract Kick-off Meeting (Contractor's Facility)	.5	N/A	N/A	N/A
2.	Manufacturing Readiness Review (Contractor's Facility)	.5	11	22	35
3.	Critical Design Review (Contractor's Facility)	3	14	25	38
4.	Pre-Ship Review (Contractor's Facility)	10	21	34	46
5.	Test Readiness Review (LaRC)	11	22	N/A	N/A
6.	Pre-Ship Refurbishment (Contractor's Facility)	14	25	N/A	N/A
7.	Flight Readiness Review (DFRC)	20	32	43	54

Manufacturing Readiness Reviews: The MRR shall meet the design readiness intent of a PDR as appropriate for a "Rapid Prototyping" manufacturing process. Government decisions to proceed with extended manufacturing operations or long lead acquisition activities will be addressed at this time. The Contractor shall establish/identify the detailed design approach, all major subsystem components and their availability, long lead components and all required ground support and testing equipment. In addition, the initial thermal, structural and safety analyses shall have been completed as well as the Hyper-X research vehicle manufacturing, integration, testing and Quality Assurance plans. Programmatically the WBS, cost reporting, and schedule reporting plans shall be complete. This Review shall serve as the manufacturing release each Hyper-X research vehicle and the vehicle-to-booster adapter.

Subsequent reviews for follow-on vehicles shall be conducted to evaluate technical and programmatic changes to the designs or processes prior to the initiation of manufacturing operations. These reviews shall include the same type of review material with emphasis placed on updates, refinements, current data and "lessons learned" from the previous Hyper-X vehicle production.

Critical Design Review: The CDR shall be conducted to signify that the detail design of the Hyper-X research vehicle, the vehicle-to-booster adapter, ground support and test equipment, handling equipment and systems software is essentially complete (i.e., no significant developmental risks can be identified). While significant fabrication, manufacturing and acquisition activities may be complete or are in progress (see MRR above), the mature design shall be shown to meet the established program requirements. Additionally, detailed analyses (stress thermal, structural, etc.), systems (controls, termination, power, fuel, instrumentation, etc.) and a safety analysis shall be complete. Programmatically, the WBS, cost reporting and schedule reporting plans shall be updated, as necessary, to reflect the current program status and compared to the baseline plans established at the MRR. This review shall initiate the configuration control process and formal Quality Assurance system/subsystem tracking as specified in the Quality Assurance plan presented at the MRR.

Subsequent reviews for follow-on vehicles shall be conducted to evaluate technical and programmatic changes. These reviews shall include the same type of review material with emphasis placed on updates, refinements, current data and "lessons learned" from the previous Hyper-X vehicle production.

Pre-Ship Reviews/Refurbishment: Prior to the shipment of major hardware end item deliverables, the Contractor shall conduct a Pre-Ship Review. The objective of these reviews shall be to assess the readiness and completeness of the hardware end items for shipment. The review shall verify that the Contractor performed system/subsystem integration and testing activities are complete without significant unresolved problems or open issues. The final documentation, as it applies to the particular end-item shall be complete. Requirements and plans for shipping and handling, including servicing, inspections and functional testing and operations shall be complete. Programmatically, the WBS, cost reporting and schedule reporting plans shall be updated, as necessary, to reflect the current program status. These reviews shall address all significant hardware processing activities in detail, subsequent to any previous deign or Pre-Ship Review. Agenda items that shall be addressed include but are not limited to the following:

-Results of research vehicle/vehicle-to-booster adapter separation tests
-Results of fabrication/manufacturing operations
-Results of systems/subsystems testing and integration
-Results of Systems environmental and functional testing
-Details of failures and non-conformances and their impact on the Hyper-X research vehicle
-Details of any modifications, repair or rework activities

Test Readiness Review: The objective of this review will be to assure the adequacy and readiness of all test facility and test article systems and subsystems for test operations. LaRC will be responsible for all facility test readiness assessments and the Contractor shall be responsible for all Hyper-X research vehicle test readiness assessments. The tests will be directed and conducted by LaRC. Test readiness assessments shall include but not be limited to the following:

-Test Plans including facility operations, test article operations and contingencies
-Facility and GSE readiness
-Carriage and strut loads assessment
-Pre-Test facility and test article preparations and checkout
-Hyper-X research vehicle structural and thermal loads assessment
-Quality assurance participation
-Test operations safety assessment

Flight Readiness Review: The FRR shall assess the overall readiness of the vehicle and flight, including readiness to achieve the flight objectives. Specifically, the FRR will establish the status of the vehicle and launch support facilities, systems, equipment and range support with respect to proceeding with the flight test. Additionally, verification of documentation completeness and an assessment of

operational, safety, reliability, quality assurance and contingency plans and procedures will be accomplished. This joint review will be presented by the Government and contractor. This review will serve as the vehicle and associated systems release to flight status.

The specific dates of the presentations shall be mutually selected by the Contracting Officer and the Contractor. All presentations shall include a technical interchange regarding the work accomplished to date. In addition to the above required reviews/meetings, Technical Status Meetings shall be held on a quarterly basis excepting quarters when another review/meeting is held. The presentations, shall also include a brief summary of reportable items under the Section I clause entitled "New Technology."

SECTION G - CONTRACT ADMINISTRATION DATA

G.1 DESIGNATION OF NEW TECHNOLOGY REPRESENTATIVE AND PATENT REPRESENTATIVE (NASA 18-52.227-72) (APR 1984)

(a) For purposes of administration of the clause of this contract entitled "New Technology" or "Patent Rights - Retention by the Contractor (Short Form)", whichever is included, the following named representatives are hereby designated by the Contracting Officer to administer such clause:

Title	Office Code	Address (including zip code)
New Technology Representative	T	NASA Dryden Flight Research Center P.O. Box 273 Edwards, CA 93523-0278
Patent Representative	XL	NASA Dryden Flight Research Center P.O. Box 273 Edwards, CA 93523-0278

(b) Reports of reportable items, and disclosure of subject inventions, interim reports, final reports, utilization reports, and other reports required by the clause, as well as any correspondence with respect to such matters, should be directed to the New Technology Representative unless transmitted in response to correspondence or request from the Patent Representative. Inquiries or requests regarding disposition of rights, election of rights, or related matters should be directed to the Patent Representative. This clause shall be included in any subcontract hereunder requiring a "New Technology" clause or "Patent Rights - Retention by the Contractor (Short Form)" clause, unless otherwise authorized or directed by the Contracting Officer. The respective responsibilities and authorities of the above-named representatives are set forth in 18-27.375-3 of the NASA FAR Supplement.

G.2 SUBMISSION OF VOUCHERS FOR PAYMENT (NASA 18-52.216-87) (DEC 1988)

Public vouchers for payment of costs and fee shall include a reference to this contract, NAS1-97110, and your Taxpayer Identification Number and be forwarded to:

NASA Dryden Flight Research Center
Attn: Financial Management Office
M/S D 1009
P.O. Box 273
Edwards, CA 93523-0273

This is the designated paying office for vouchers for purposes of the Prompt Payment clause of this contract.

Vouchers shall be submitted through DCAA.

G.3 COST AND INCENTIVE FEE PAYMENTS

Payments of cost shall be made in monthly installments. Incentive fee payments will be made in accordance with the approved Incentive Fee Plan (see H.5).

SECTION H - SPECIAL CONTRACT REQUIREMENTS

H.1 RIGHTS TO PROPOSAL DATA (TECHNICAL) (FAR 52.227-23) (JUN 1987)

Except for data contained on pages NONE, it is agreed that as a condition of award of this contract, and notwithstanding the conditions of any notice appearing thereon, the Government shall have unlimited rights (as defined in the "Rights in Data - General" clause contained in this contract) in and to the technical data contained in the proposal dated December 17, 1996, upon which this contract is based.

H.2 CONTRACTOR EMPLOYEE'S SECURITY CLEARANCE (LaRC 52.204-90) (OCT 1996)

By virtue of their particular work assignment, certain Contractor employees, may be required to have a security clearance granted in accordance with the National Industry Security Program Operating Manual (NISPOM) dated March 14, 1996. Clearances will be issued by the Department of Defense (DOD). Within 10 working days after an employee is identified by the Government and/or the Contractor as requiring a SECRET or higher clearance, the Contractor shall submit to the Contracting Officer evidence of the submittal of a request for clearance to DOD for such employee. If the clearance for an employee has not been issued by DOD within 120 calendar days of the submittal of the request for clearance to DOD, the Contractor may be required to remove the employee from the contract.

H.3 SECURITY PROGRAM/FOREIGN NATIONAL EMPLOYEE INVESTIGATIVE REQUIREMENTS

Prior to reporting to Dryden Flight Research Center (DFRC) or Langley Research Center (LaRC) to perform under a contract or grant, each Foreign National shall have approval for access to DFRC or LaRC facilities from NASA Headquarters, International Relations Division (Code XID). A copy of the access authorization request shall be provided to the DFRC or LaRC Chief of Security. Additionally, an investigation by the Government shall be completed on each Foreign National contractor prior to reporting to DFRC or LaRC to perform under a contract or grant. A properly executed "Name Check Request" (NASA Form 531) and a completed "applicant" fingerprint card shall be submitted to the DFRC or LaRC Security Office for each Foreign National contractor at least 75 days prior to the estimated entry on duty date. The NF 531 and fingerprint card may be obtained from the DFRC or LaRC Security Office. If the access approval is obtained from NASA Headquarters prior to completion of the investigation, and the Contracting Officer requires a Foreign National to work on DFRC or LaRC, an escort request may be considered by the DFRC or LaRC Chief of Security.

H.4 INCORPORATION OF SECTION K OF THE PROPOSAL BY REFERENCE (LaRC 52.215-107) (MAR 1989)

Pursuant to FAR 15.406-1(b), the completed Section K of the proposal dated February 26, 1997 is hereby incorporated herein by reference.

H.5 INCENTIVE FEE PLAN

The incentive fee dollars identified in Section B shall be disbursed in accordance with the established Incentive Fee Plan (see Exhibit E).

H.6 ADVANCE APPROVAL FOR RELEASE OF TECHNICAL INFORMATION

The Contractor shall not release technical information based on or containing data first produced in the performance of this contract and describing the work performed under this contract unless prior written approval is given by NASA. The Contractor shall submit technical information regarding the contract effort, such as journal articles, meeting papers, and technical documents, to the Contracting Officer Technical Representative (COTR) for review and concurrence prior to establishing claim to copyright, publication, presentation, or release to others.

H.7 GOVERNMENT FURNISHED ITEMS

DESIGN DATA AND TEST PLANS

At contract award
-required Mach 7 engine mold line (anticipate addition of leading edge water cooling using the candidate Mach 10 cooling design)
-updated research vehicle aero data base, wind tunnel data, and CFD results
-preliminary (inner loop) control laws for candidate design
-booster stack aero data base, wind tunnel data and CFD results
-loads model for Mach 7 booster stack and free flyer
-preliminary aero data base for research vehicle-booster stage separation
-updated candidate engine structural design
-updated instrumentation/measurement list
-updated airframe thermal loads(heat transfer at wall temperatures at multiple conditions over the reference flight trajectory)
-startup and shutdown loads for the 8' HTT including factors of safety
-research vehicle adapter/Pegasus Interface Document

At 2 months after contract award
-preliminary research vehicle/booster adapter separation trajectory for Mach 7
-preliminary (version 1) research vehicle/booster adapter separation control laws for Mach 7
-preliminary research vehicle/booster adapter separation loads for Mach 7

At 3 months after contract award
-updated engine control laws
-updated vehicle inner loop control laws
-Mach 7 boundary layer trip location and concept

At 7 months after contract award
-updated stage separation aero data base and loads for Mach 7
-updated stage separation sequence for Mach 7
-Mach 7 8' HTT test plan

At 9 months after contract award
-preliminary (version 2) research vehicle/booster stage separation (inner loop) control laws for Mach 7

At 10 months after contract award
-updated research vehicle/booster separation trajectory for Mach 7
-Mach 7 vehicle trip design

At 13 months after contract award
-updated internal mold line and updated engine candidate structural design for Mach 5

-updated Mach 5 boundary layer trip design
-Mach 7 flight test plan

At 16 months after contract award
-Mach 5 8' HTT test plan
-updated stage separation Mach 5 aero database, loads, trajectory and sequence

At 25 months after contract award
-updated internal mold line and updated engine candidate structural design for Mach 10
-updated Mach 10 boundary layer trip design
-updated stage separation aero data base, loads and trajectory and sequence for Mach 10
-Mach 5 flight test plan

At 37 months after contract award
-Mach 10 flight test plan

At 49 months after contract award
-2nd Mach 10 flight test plan

OTHER/SUPPORT

-mounting strut to interface the flight vehicle to
8' HTT wind tunnel (10/1/97)
-DFRC personnel will purchase and install all strain gauges and
thermocouples on the Hyper-X research vehicle (as required)
-LaRC will provide pressure and thermocouple instrumentation plugs for the AETB

H.8 PROVIDING FACILITIES TO CONTRACTORS

In accordance with FAR 45.302-1, it is the policy of the Government that Contractors shall furnish all facilities required for performing Government contracts. "Facilities" include real property and plant equipment. Plant equipment includes personal property such as general off-the-shelf equipment, machine tools, test equipment, furniture and vehicles. "Facilities" do not include material, special test equipment, special tooling or agency-peculiar property.

In keeping with the policy set forth in FAR 45.302-1, the Government will not provide "facilities" under this contract for on or off-site performance.

H.9 LIMITATION OF LIABILITY - HIGH VALUE ITEMS

As prescribed in FAR 46.805(a), the following deliverable items under the contract are designated as high value items:

Flight Research Vehicles
Vehicle-to-booster adapter

H.10 NASA QUALITY MANAGEMENT SYSTEM POLICY

The Contractor shall establish and maintain a Quality Management System (QMS) that, as a minimum complies with the requirements of the International Organization for Standardization's 'ISO 9000' Standard Series or the American National Standards Institute/American Society for Quality Control's 'Q9000 Series' and associated documentation. The QMS shall be capable of providing adequate assurance that the technical system specifications can be consistently met and compliance demonstrated.

H.11 ADVANCE AGREEMENT ON INDIRECT RATE(S)

A. Notwithstanding the provisions of the Section I clause entitled "Allowable Cost and Payment," the Contractor will be reimbursed at the indirect ceiling rates specified below or the actual rates, whichever are less, for each of the Contractor's fiscal years applicable to this contract. The Contractor's fiscal year is a calendar year. Any costs that are not reimbursed due to the ceilings shall be deemed unallowable costs. These unallowable costs shall not be recovered under this or any other Government contract.

Indirect Cost Pool	Fiscal Year	Ceiling Percentage	Allocation Base
General & Administrative Expenses (G&A)	1997		Total Cost Input
General & Administrative Expenses (G&A)	1998		Total Cost Input
General & Administrative Expenses (G&A)	1999	Deleted 14 CFR 1206.309 (b) (4)	Total Cost Input
General & Administrative Expenses (G&A)	2000		Total Cost Input
General & Administrative Expenses (G&A)	2001		Total Cost Input
General & Administrative Expenses (G&A)	2002		Total Cost Input

B. The above rate ceilings are predicated upon the bases listed above and the accounting practices and accounting system in effect on February 28, 1997. If the Contractor changes its accounting practices or accounting system in any way, the Contractor will immediately notify the Government. Within 30 days of such change the Contractor shall present to the Contracting Officer information that demonstrates that the change will not impact the allowable cost computed using the above rates or shall submit a proposal for adjustment of the ceilings so that the total costs allowable will not exceed the total costs that would have been allowable had the Contractor not changed its accounting practices or accounting system. In the event that the parties cannot agree on new ceilings using the Contractor's new accounting practices or system and the Contractor does not agree to return to the previous accounting practices and system, the Contracting Officer may equitably adjust the ceilings.

H.12 LIMITATION OF COSTS FOR THE PRODUCTION OF THE FOURTH VEHICLE

A. The Contractor has offered, and the Government has accepted, that the fourth (4^{th}) vehicle to be produced under this contract may be either the first (1^{st}) or second (2^{nd}) vehicle refurbished after flight to meet the performance requirements set out in the contract. The Government agrees to pay the costs of refurbishment and items unique to the fourth vehicle up to a ceiling of $1.7 million (the ceiling). Modifications of this contract adding or deleting items unique to the fourth (4^{th}) vehicle will serve as a basis for an equitable adjustment of the ceiling, upwards or downwards, to be negotiated with the addition or deletion of the items. Any modification adjusting the ceiling will specifically modify the amount specified in this clause.

B. In the event the Contractor is unable to successfully refurbish either the first (1^{st}) or second (2^{nd}) vehicle for use as the fourth (4^{th}) vehicle, or to the extent the actual cost of refurbishment exceeds the ceiling, the Contractor agrees, notwithstanding any other clause of this contract or any other generally accepted accounting standard, that all costs for the production of the fourth (4^{th}) vehicle, in excess of the ceiling, will be neither allocable or allowable to this contract or to any other Government contract, grant, or subcontract (including allocation to other grants, contracts, or agreements as part of an independent

research and development program.) All costs for the refurbishment or production of the fourth (4th) vehicle in excess of the ceiling shall be the sole responsibility of the Contractor.

C. The Contractor agrees to segregate all costs attributable to the production of the fourth (4th) vehicle (whether through refurbishment or new production) in order to assist in the administration of this clause.

D. The Contractor agrees that regardless of its bearing of any costs that exceed the ceiling it will not dispute the Government's data rights to any and all data arising out of the fabrication and use of the fourth (4th) vehicle just as if the Government had fully funded the cost of that vehicle. The extent of such data rights are as specified elsewhere in this contract.

PART II - CONTRACT CLAUSES

SECTION I - CONTRACT CLAUSES

I.1 LISTING OF CLAUSES INCORPORATED BY REFERENCE:

NOTICE: The following solicitation provisions and/or contract clauses pertinent to this section are hereby incorporated by reference.

FEDERAL ACQUISITION REGULATION (48 CFR CHAPTER 1) CLAUSES

CLAUSE NUMBER	TITLE AND DATE
52.202-1	Definitions (OCT 1995)
52.203-3	Gratuities (APR 1984)
52.203-5	Covenant Against Contingent Fees (APR 1984)
52.203-6	Restrictions on Subcontractor Sales to the Government (JUL 1995)
52.203-7	Anti-Kickback Procedures (JUL 1995)
52.203-8	Cancellation, Rescission, and Recovery of Funds for Illegal or Improper Activity (JAN 1997)
52.203-10	Price or Fee Adjustment for Illegal or Improper Activity (JAN 1997)
52.203-12	Limitation on Payments to Influence Certain Federal Transactions (JAN 1990)
52.204-2	Security Requirements (AUG 1996)
52.204-4	Printing/Copying Double-Sided on Recycled Paper (JUN 1996)
52.209-6	Protecting the Government's Interest when Subcontracting with Contractors Debarred, Suspended, or Proposed for Debarment (JUL 1995)
52.211-5	New Material (MAY 1995)
52.211-7	Other Than New Material, Residual Inventory and Former Government Surplus Property (MAY 1995)
52.211-15	Defense Priority and Allocation Requirements (SEP 1990)
52.215-2	Audit and Records--Negotiation (AUG 1996)
52.215-26	Integrity of Unit Prices (FEB 1997)
52.215-27	Termination of Defined Benefit Pension Plans (MAR 1996)
52.215-33	Order of Precedence (JAN 1986)
52.215-39	Reversion or Adjustment of Plans for Postretirement Benefits Other Than Pensions (PRB) (MAR 1996)
52.215-42	Requirements for Cost or Pricing Data or Information Other Than Cost or Pricing Data - Modifications (JAN 1997)
52.216-7	Allowable Cost and Payment (FEB 1997)
52.219-8	Utilization of Small, Small Disadvantaged and Women-Owned Small Business Concerns (OCT 1995)
52.222-1	Notice to the Government of Labor Disputes (FEB 1997)

52.222-2	Payment for Overtime Premiums (JUL 1990) [Insert "0"]
52.222-3	Convict Labor (AUG 1996)
52.222-26	Equal Opportunity (APR 1984)
52.222-28	Equal Opportunity Preaward Clearance of Subcontracts (APR 1984)
52.222-35	Affirmative Action for Special Disabled and Vietnam Era Veterans (APR 1984)
52.222-36	Affirmative Action for Handicapped Workers (APR 1984)
52.222-37	Employment Reports on Special Disabled Veterans and Veterans of the Vietnam Era (JAN 1988)
52.223-2	Clean Air and Water (APR 1984)
52.223-3	Hazardous Material Identification and Material Safety Data (JAN 1997)--Alternate I (JUL 1995)
52.223-6	Drug-Free Workplace (JAN 1997)
52.223-14	Toxic Chemical Release Reporting (OCT 1996)
52.225-11	Restrictions on Certain Foreign Purchases (OCT 1996)
52.227-1	Authorization and Consent (JUL 1995)--Alternate I (APR 1984)
52.227-2	Notice and Assistance Regarding Patent and Copyright Infringement (AUG 1996)
52.227-14	Rights in Data - General (JUN 1987) -- as modified by NASA FAR Supplement 18-52.227-14
52.227-16	Additional Data Requirements (JUN 1987)
52.228-7	Insurance - Liability to Third Persons (MAR 1996)
52.227-11	Patent Rights - Retention by the Contractor (Short Form) (JUN 1989) - as modified by NASA FAR Supplement 18-52.227-11
52.232-9	Limitation on Withholding of Payments (APR 1984)
52.232-17	Interest (JUN 1996)
52.232-22	Limitation of Funds (APR 1984)
52.232-23	Assignment of Claims (JAN 1986)
52.232-25	Prompt Payment (MAR 1994)
52.232-33	Mandatory Information for Electronic Funds Transfer Payment (AUG 1996)
52.233-1	Disputes (OCT 1995) Alternate I (DEC 1991)
52.233-3	Protest After Award (AUG 1996) Alternate I (JUN 1985)
52.242-1	Notice of Intent to Disallow Costs (APR 1984)
52.242-2	Production Progress Reports (APR 1991)
52.242-3	Penalties for Unallowable Costs (OCT 1995)
52.242-4	Certification of Final Indirect Costs (JAN 1997)
52.242-13	Bankruptcy (JUL 1995)
52.242-15	Stop-Work Order (AUG 1989) --Alternate I (APR 1984)
52.243-2	Changes--Cost-Reimbursement (AUG 1987) --Alternate V (APR 1984)
52.244-2	Subcontracts (Cost-Reimbursement and Letter Contracts) (FEB 1997) Alternate I (AUG 1996)
52.244-5	Competition in Subcontracting (DEC 1996)
52.244-6	Subcontracts for Commercial Items and Commercial Components (OCT 1995)
52.245-5	Government Property (Cost-Reimbursement, Time-and-Material, or Labor-Hour Contracts) (JAN 1986)
52.246-8	Inspection of Research and Development - Cost-Reimbursement (APR 1984)
52.246-23	Limitation of Liability (FEB 1997)
52.246-24	Limitation of Liability - High-Value Items (FEB 1997) Alternate I (APR 1984)
52.247-34	F.O.B. Destination (NOV 1991)
52.247-67	Submission of Commercial Transportation Bills to the General Services Administration for Audit (FEB 1995)
52.249-6	Termination (Cost-Reimbursement) (SEP 1996)
52.249-14	Excusable Delays (APR 1984)
52.252-6	Authorized Deviations in Clauses (APR 1984)

NASA FAR SUPPLEMENT (48 CFR CHAPTER 18) CLAUSES

CLAUSE NUMBER	TITLE AND DATE
1852.204-75	Security Classification Requirements (SEP 1989)
1852.211-74	Notice of Delay (DEC 1988)
1852.215-84	Ombudsman (OCT 1996) [NASA HQ, Tom Luedtke and LaRC, Belinda Adams (NOTE: Calls for B. Adams shall be directed to Sandra Ray)]
1852.216-89	Assignment and Release Forms (OCT 1996)
1852.219-74	Use of Rural Area Small Businesses (SEP 1990)
1852.219-76	NASA Small Disadvantaged Business Goal (JUL 1991)
1852.223-70	Safety and Health (FEB 1996)
1852.228-75	Minimum Insurance Coverage (OCT 1988)
1852.235-70	Center for AeroSpace Information (NOV 1992)
1852.242-70	Technical Direction (SEP 1993)
1852.242-73	NASA Contractor Financial Management Reporting (APR 1994)
1852.243-71	Shared Savings (DEC 1996)
1852.244-70	Geographic Participation in the Aerospace Program (APR 1985)
1852.245-70	Acquisition of Centrally Reportable Equipment (MAR 1989)
1852.245-73	Financial Reporting of Government-Owned/Contractor-Held Property (JUL 1994)
18-52.246-72	Material Inspection and Receiving Report (JUN 1995) [Insert 5 and 4]

I.2 CLAUSES IN FULL TEXT

The clauses listed below follow in full text:

52.252-2	Clauses Incorporated by Reference (JUN 1988)
52.216-10	Incentive Fee (FEB 1997)

I.3 CLAUSES INCORPORATED BY REFERENCE (FAR 52.252-2) (JUN 1988)

This contract incorporates one or more clauses by reference, with the same force and effect as if they were given in full text. Upon request, the Contracting Officer will make their full text available.

I.4 INCENTIVE FEE (FAR 52.216-10) (FEB 1997)

(a) General. The Government shall pay the Contractor for performing this contract a fee determined as provided in this contract.
(b) Target cost and target fee. The target cost and target fee specified in the Schedule are subject to adjustment if the contract is modified in accordance with paragraph (d) below.

(1) "Target cost," as used in this contract, means the estimated cost of this contract as initially negotiated, adjusted in accordance with paragraph (d) below.

(2) "Target fee," as used in this contract, means the fee initially negotiated on the assumption that this contract would be performed for a cost equal to the estimated cost initially negotiated, adjusted in accordance with paragraph (d) below.
(c) Withholding of payment. Normally, the Government shall pay the fee to the Contractor as specified in the Schedule. However, when the Contracting Officer considers that performance or cost indicates that the Contractor will not achieve target, the Government shall pay on the basis of an appropriate lesser fee. When the Contractor demonstrates that performance or cost clearly indicates that the Contractor will earn a fee significantly above the target fee, the Government may, at the sole discretion of the Contracting Officer, pay on the basis of an appropriate higher fee. After payment of 85 percent of the applicable fee,

the Contracting Officer may withhold further payment of fee until a reserve is set aside in an amount that the Contracting Officer considers necessary to protect the Government's interest. This reserve shall not exceed 15 percent of the applicable fee or $100,000, whichever is less. The Contracting Officer shall release 75 percent of all fee withholds under this contract after receipt of the certified final indirect cost rate proposal covering the year of physical completion of this contract, provided the Contractor has satisfied all other contract terms and conditions, including the submission of the final patent and royalty reports, and is not delinquent in submitting final vouchers on prior years' settlements. The Contracting Officer may release up to 90 percent of the fee withholds under this contract based on the Contractor's past performance related to the submission and settlement of final indirect cost rate proposals.

(d) Equitable adjustments. When the work under this contract is increased or decreased by a modification to this contract or when any equitable adjustment in the target cost is authorized under any other clause, equitable adjustments in the target cost, target fee, minimum fee, and maximum fee, as appropriate, shall be stated in a supplemental agreement to this contract.

(e) Fee payable. (1) The fee payable under this contract shall be the target fee increased by 30 cents for every dollar that the total allowable cost is less than the target cost or decreased by 30 cents for every dollar that the total allowable cost exceeds the target cost. In no event shall the fee be greater than $887,500 percent or less than 0 percent of the target cost.

(2) The fee shall be subject to adjustment, to the extent provided in paragraph (d) above, and within the minimum and maximum fee limitations in subparagraph (1) above, when the total allowable cost is increased or decreased as a consequence of (i) payments made under assignments or (ii) claims excepted from the release as required by paragraph (h)(2) of the Allowable Cost and Payment clause.

(3) If this contract is terminated in its entirety, the portion of the target fee payable shall not be subject to an increase or decrease as provided in this paragraph. The termination shall be accomplished in accordance with other applicable clauses of this contract.

(4) For the purposes of fee adjustment, "total allowable cost" shall not include allowable costs arising out of -

(i) Any of the causes covered by the Excusable Delays clause to the extent that they are beyond the control and without the fault or negligence of the Contractor or any subcontractor;

(ii) The taking effect, after negotiating the target cost, of a statute, court decision, written ruling, or regulation that results in the Contractor's being required to pay or bear the burden of any tax or duty or rate increase in a tax or duty;

(iii) Any direct cost attributed to the Contractor's involvement in litigation as required by the Contracting Officer pursuant to a clause of this contract, including furnishing evidence and information requested pursuant to the Notice and Assistance Regarding Patent and Copyright Infringement clause;

(iv) The purchase and maintenance of additional insurance not in the target cost and required by the Contracting Officer, or claims for reimbursement for liabilities to third persons pursuant to the Insurance - Liability to Third Persons clause;

(v) Any claim, loss, or damage resulting from a risk for which the Contractor has been relieved of liability by the Government Property clause; or

(vi) Any claim, loss, or damage resulting from a risk defined in the contract as unusually hazardous or a nuclear risk and against which the Government has expressly agreed to indemnify the Contractor.

(5) All other allowable costs are included in "total allowable cost" for fee adjustment in accordance with this paragraph (e), unless otherwise specifically provided in this contact.

(f) Contract modification. The total allowable cost and the adjusted fee determined as provided in this clause shall be evidenced by a modification to this contract signed by the Contractor and Contracting Officer.

(g) Inconsistencies. In the event of any language inconsistencies between this clause and provisioning documents or Government options under this contract, compensation for spare parts or other supplies and services ordered under such documents shall be determined in accordance with this clause.

PART III - LIST OF DOCUMENTS, EXHIBITS AND OTHER ATTACHMENTS

SECTION J - LIST OF ATTACHMENTS

Exhibit A	Hyper-X Contract Documents Requirements List (DRL) and Data Requirements Description (DRD), 43 pages
Exhibit B	Related Government Activities, 1 page
Exhibit C	Contract Security Classification Specification, DD Form 254, 2 pages
Exhibit D	B-52B Captive Carry Loads Conditions, 2 pages
Exhibit E	Incentive Fee Plan, 4 pages

EXHIBIT A

HYPER-X DOCUMENTS REQUIREMENTS LIST (DRL)

AND

DATA REQUIREMENTS DESCRIPTION (DRD)

DOCUMENTS REQUIREMENTS LIST INSTRUCTIONS

(1) **DRL/DRD ITEM NO.** - Items numbered sequentially, one (1) and up, for each documentation item or category of items required to be submitted to NASA. The DRD bears the same number as the DRL item and provides the general description of the contents required in the documentation to be prepared and submitted by the Contractor to satisfy the DRL item.

(2) **REFERENCE PARAGRAPH**

Work Statement - Specify "Statement of Work" paragraph number where the DRL item is referenced.

Other - Paragraph number of other documents, required by the specific contract, where the DRL item is referenced.

(3) **Document** - Title of the documentation item to be submitted.

(4) **Submit to NASA** - Number of days preceding or subsequent to an identifiable milestone event that submittal(s) of the documentation must arrive (e.g., 30 days prior to preliminary design review).

(5) Updating by Contractor - Frequency of submittals subsequent to initial submittal (i.e., monthly, quarterly, as required, etc.).

(6) **Distribution**

Type - One or more of the designations noted below:

P - Documentation to be typed and reproduced by office copying machines, diazo equipment, or offset printing if required.

E - If possible with no additional effort, documentation to be provided in printable electronic file copy on 3.5-inch floppy diskette or transmittal via the Internet. Any pages containing original signatures, however, must be provided paper. Files should be in their original created form, in print files, or as images.

R - The reproducible copy of a Contractor document shall consist of the master copy of the text, cleanly typed on opaque white paper from which negatives and printing plates can be made, unscreened glossy prints of photographs, and original artwork of a quality suitable for reproduction by offset printing. The reproducible copy should be unbound, but should have page numbers added in proper sequence. To avoid damage in handling and shipping, the reproducible copy should be carefully packaged.

D - Drawings, wiring diagrams, schematics, and subsequent changes shall be high quality reproducibles, full size ozalid process or equivalent.

Quantity - Recipient codes noted below, and the number of copies to be submitted for each code.

A - NASA/DFRC Hypre-X Project Office
B - NASA/DFRC Contract Administrator
C - NASA/LaRC Hyper-X Project Office
D - In accordance with instructions on form

(7) **NASA ACTION REQUIRED** - One or more of the designations noted below:

A Information - Submitted to NASA - no action required.

B Review - Document may be implemented by the Contractor if he has not been notified of corrective actions within two (2) weeks after receipt by NASA.

C* Approval - The Contractor shall not implement documents in this category until NASA approval, in writing, is granted.

D* Concurrence - Used only for those existing Contractor standard plans, procedures, instructions being submitted to satisfy project requirements. The Contractor shall not implement documents in this category until NASA concurrence is granted.

* Approval or concurrence shall be determined within 30 days of submittal of the DRL. If approval or concurrence has not been granted prior to the planned implementation of the documents, the COTR shall be notified by the Contractor.

(8) Per Item (6) Distribution, when the Contract Administrator (B) is not designated to receive a copy of the report/document, the Contractor shall furnish a copy of the report/document transmittal letter to the Contract Administrator. The Contractor shall also furnish a copy of the transmittal letter and a copy of each Financial Management Report to the delegated Administrative Contracting Officer of the cognizant DoD (or other agency) contract administrative services component.

(9) Per Items appearing in column 3, the basic categories of document submittals which appear in this DRL are listed and defined below.

a. Preliminary - Document shall be as complete and fully detailed as possible at the time of submittal.

b. Initial - Document shall be complete and fully detailed.

c. Designated by Formal Review Acronym - Document shall be complete, fully detailed, and thoroughly up-to-date, whether the document is an initial, repeat, or revised edition submittal.

d. Final - Document shall be complete, fully detailed, and include incorporation of revisions resulting from NASA approval/review cycle and/or utilization of document by the Contractor.

(10) For DRL Items in column 7 with updating specified as "As Required," the "As Required" is defined as, "the document shall be updated (by change pages) to represent the Contractor's latest organization, planning, hardware design, test results, etc."

DOCUMENTS REQUIREMENTS LIST

(1) DR/DRD ITEM NO.	2 REF. PARAGRAPH WORK STATEMENT	OTHER	(3) DOCUMENT	(4) SUBMIT TO NASA	(5) UPDATING BY CONTRACTOR	(6) DISTRIBUTION TYPE	QUANTITY	(7) NASA/LaRC ACTION REQUIRED
1			Manufacturing Plan Prelim: Final:	 7 days prior to MRR 30 days prior to CDR		P E	A-2 B-1 C-1	 Review Approval
2			Program Assurance Plan Prelim: Final:	7 days prior to MRR 1 mo. after MRR	As req'd	P E	A-2 B-1 C-1	Review Approval
3			Safety and Health Plan	30 days after contract award		P	A-2 B-1 C-1	Approval
4			Monthly Progress Report	Monthly: 10th working day after close of contractor's accounting month being reported	Monthly	P E	A-2 B-1 C-1	Info
5		NPG 9501.2C	Financial Management Reports:					
			Baseline Report Initial: Update:	7 days prior to MRR	 April/Sep	P E	A-2 B-2 C-1	Review
			Baseline Budget Revisions	As required	As req'd for frml replans	P E	A-2 B-2 C-1	Concur
			Monthly Report (533M)	10 working days after close of Contractor's accounting month	Monthly	P E	A-2 B-1 C-1	Review

DOCUMENTS REQUIREMENTS LIST

(1) DR/DRD ITEM NO.	2 EF. PARAGRAPH WORK STATEMENT	2 EF. PARAGRAPH OTHER	(3) DOCUMENT	(4) SUBMIT TO NASA	(5) UPDATING BY CONTRACTOR	(6) STRIBUTION TYPE	(6) STRIBUTION QUANTITY	(7) NASA/LaRC ACTION REQUIRED
5 cont.			Monthly Earned Value/Performance Measurement Report	Monthly	Monthly	P E	A-2 B-1 C-1	Review
			Quarterly Report (533-Q)	Per NPG 9501.2C	Per NPG 9501.2C	P E	A-2 B-1 C-1	Review
6			Progress Schedules and Reports: NASA-selected major milestones shall be under configuration control					
			A. Master Schedule Initial:	7 days prior to MRR	Monthly	P E	A-2 B-1 C-1	Concur
			Final:	30 days after MRR				
			Update:	10 working days after close of Contr's acct. schedule update cycle				
			B. Logic Flow Network Schedules Initial:	7 days prior to MRR	Monthly	P E	A-2 B-1 C-1	Info
			Final:	30 days after MRR				
			Update:	10 working days after close of contractor's schedule update cycle				
			C. Schedule Reporting	Bi-weekly	Bi-weekly	P E	A-2 B-1 C-1	Info

DOCUMENTS REQUIREMENTS LIST

(1) DR/DRD ITEM NO.	2 REF. PARAGRAPH WORK STATEMENT	2 REF. PARAGRAPH OTHER	(3) DOCUMENT		(4) SUBMIT TO NASA	(5) UPDATING BY CONTRACTOR	(6) STRIBUTION TYPE	(6) STRIBUTION QUANTITY	(7) NASA/LaRC ACTION REQUIRED
7			WBS and WBS Dictionary		7 days prior to MRR	As req'd	P E	A-2 B-1 C-1	Concur
8			Drawings and Design Files	Initial:	7 days prior to MRR, or 14 days prior to Fab or procurement, whichever comes first	As req'd	P E D	A-2	Review
				Update:	7 days prior to Fab operations		P E D	A-2	Approval
				Final:	Final drawings (hard cy) submitted 30 days after vehicle delivery Auto Cad files Excel files				Info
9	4.8 4.9.5 4.10.10		Interface Control Document	Prelim: Final:	7 days prior to MRR 30 days prior to CDR		P E	A-2 C-1	Review Approval
10			Hardware-in-the-Loop Simulation Software Models and Documentation		30 days prior to CDR	As Req'd	P E	A-2 C-1	Approval
11	4.9		Structural/Thermal/ Dynamic Analysis	Prelim: Interim: Final:	7 days prior to MRR 15 days prior to the CDR 15 days prior to PSR	Prior to Pre-Ship Review	P E	A-2 C-1	Review

DOCUMENTS REQUIREMENTS LIST

(1) DR/DRD ITEM NO.	2 REF. PARAGRAPH WORK STATEMENT	2 REF. PARAGRAPH OTHER	(3) DOCUMENT		(4) SUBMIT TO NASA	(5) UPDATING BY CONTRACTOR	(6) STRIBUTION TYPE	(6) STRIBUTION QUANTITY	(7) NASA/LaRC ACTION REQUIRED
12			Flight System Hazard Analysis	Prelim: Subsyst: Optnl:	7 days prior to MRR 30 days prior to CDR 7 days prior to integrated systems tests		P E	A-2 C-1	Review Approval Approval
13			Spares Plan and List		7 days prior to reviews	As req'd	P E	A-2* C-1	Approval
14	9.10.10.8		GSE List	Prelim: Final:	7 days prior to MRR 30 days after MRR	As req'd	P E	A-2 B-1 C-1	Review Info
15	4.9.2 4.10		Parts and Materials List	Prelim: Final:	7 days prior to MRR 15 days prior to Sys. Ass'y	As req'd	P E	A-2 C-1	Review Approval
16	3.5 3.7.8 4.10		Test and Verification Documentation	Initial: Final:	7 days prior to MRR 15 days prior to Sys Test	As req'd	P E	A-2 C-1	Approval
17	4.10		Safety Data Package	Initial: Final:	7 days prior to MRR 30 days prior to delivery of research vehicle	As req'd	P E	A-2 C-1	Approval
18	4.10		Failure Mode and Effects Analysis (FMEA) and Critical Items List (CIL)	Prelim: Update: Final:	7 days prior to MRR 30 days after MRR 2mo prior to pre-ship rev	As req'd	P E	A-2 C-1	Review Approval

DOCUMENTS REQUIREMENTS LIST

(1) DR/DRD ITEM NO.	2 REF. PARAGRAPH WORK STATEMENT	OTHER	(3) DOCUMENT	(4) SUBMIT TO NASA	(5) UPDATING BY CONTRACTOR	(6) DISTRIBUTION TYPE	QUANTITY	(7) NASA/LaRC ACTION REQUIRED
19			Failure Reports	Within 24 hrs. after occurrence by FAX with follow-up by mail	When modified	P E	A-2 C-1	Info
20			Failure Analysis and Corrective Action Report/Closure	Within 14 days of closure	When modified	P E	A-2 C-1	Approval
21		LMI 7120.1 Section F.5	Pre-Ship Review Data	15 days prior to PSR	N/A	P E	A-10 C-10	Review
22			RESERVED					
23			Final Report: Outline: Final:	 Pre-ship review 30 days after draft aprvl. each vehicle delivery		P E	A-5 B-1 C-5	Review Info
24		Section I NASA FAR Supp. clause 18-52, 245-73	Report of Government Owned/Contractor Held Property	Annually	N/A	P	B-2 D-1	Info

DATA REQUIREMENTS DESCRIPTION

1. TITLE	2. NUMBER
Manufacturing Plan	DRD-1
3. USE	4. DATE
	10/21/96
	5. PREPARED BY:
To establish and control Hyper-X research vehicle manufacturing operations and processes.	RTS
	6. APPROVED BY:
7. INTERRELATIONSHIP	8. REFERENCES

9. PREPARATION INFORMATION

The detailed manufacturing plan shall address all major functions required for the fabrication, manufacturing, acquisition, and integration of the Hyper-X research vehicles, the research vehicle-to-booster adapter, and specified ground handling and special test equipment. The Manufacturing Plan shall include interface definitions of all vehicle components and system integration hardware. It shall include narrative and block diagrams showing the manufacturing organization and its relationship to the engineering, Quality Assurance, and project management organizations. The "Rapid Prototyping" and "Concurrent Engineering" aspects of the manufacturing process shall be clearly defined.

DATA REQUIREMENTS DESCRIPTION

1. TITLE	2. NUMBER
Program Assurance Plan	DRD-2

3. USE	4. DATE
To provide requirements for the management and implementation of Systems Safety, Configuration Control, Reliability, Quality Assurance, Parts, Materials and Processes, and Software Quality Programs for the Hyper-X Research Vehicle.	10/21/96
	5. PREPARED BY: RTS
	6. APPROVED BY:

7. INTERRELATIONSHIP	8. REFERENCES
MIL-STD-1575 MIL-STD-975 ISO 9000 ANSI/ASQC 9000 DFRC: * Basic Operations Manual * Progress Specifications Manual * Aircraft Maintenance and Safety Manual	

9. PREPARATION INFORMATION

The Program Assurance (PA) Plan shall describe the implementation of the PA requirements. This Plan shall be submitted to NASA, and after approval shall be the document which controls the PA tasks. The System Safety Section shall be prepared so tht it can be utilized as a "Stand Alone" documents.

As per the policy section of NMI 1270.3, the NASA supplier/contractor shall have a quality management system that, as a minimum, shall comply with the appropriate standard contained in the current version of the International organization for standardization's "ISO 9000" standard series or The American National Standards Institute/American Society for Quality Control's "Q9000" Series and associated documentation.

DATA REQUIREMENTS DESCRIPTION

1. TITLE	2. NUMBER
Safety and Health Plan	DRD-3a
3. USE	4. DATE
	10/21/96
	5. PREPARED BY:
Provide a comprehensive plan setting forth the contractor's approach to industrial safety provisions of this contract.	RTS
	6. APPROVED BY:
7. INTERRELATIONSHIP	8. REFERENCES

9. PREPARATION INFORMATION

Safety and Health Plan--Within 30 calendar days after the effective date of the contract, the Contractor shall submit a detailed safety and health plan showing how the Contractor intends to protect the life, health, and well being of NASA and Contractor employees as well as property and equipment. This plan, as approved by the Contracting Officer, should contain, as a minimum the following:

1. Points of Contact and Responsibility--Organizational flow chart and description of responsibilities of each employee in your organization for safety.

2. Employee Safety Training, Certification and Programs--Detailed information on type of training required, parties responsible for certification, and outline of applicable regulations. Detail company programs which emphasize personal safety and motivate employees to be safety conscious.

3. Safety Policies/Procedures--Recognition of applicable LaRC/DFRC safety policies and procedures such as Langley Handbook 1710.10, LaRC Red Tag System.

4. Accident Investigaton and Reporting--Procedures for investigating and reporting accidents/incidents including immediate notification to the NASA Safety Manager of all injuries and damage to equipment or facilities.

5. Hazardoous Operations--

(a) Description of hazardous operations involved in contract performance.
(b) Plans for apprising employees of all hazards to which they may be exposed.
(c) Proper conditions and precautions for safety use and exposure to hazardous operations. Include recognition of LHB 1710.12, Potentially Hazardous Materials.

DATA REQUIREMENTS DESCRIPTION

37

1. TITLE	2. NUMBER
Safety and Health Plan	DRD-3b
3. USE	4. DATE
Provide a comprehensive plan setting forth the contractor's approach to industrial safety provisions of this contract.	10/21/96
	5. PREPARED BY: RTS
	6. APPROVED BY:
7. INTERRELATIONSHIP	8. REFERENCES

9. PREPARATION INFORMATION

6. People with Disabilities--In accordance with the Americans with Disabilities Act, the plans should specify that prior to assigning a person with disabilities to this contract, the Contractor shall contact the NASA Disability Program Manager.

7. Other Safety/Environmental Considerations--Any other safety and environmental considerations unique to your operation.

DATA REQUIREMENTS DESCRIPTION

1. TITLE	2. NUMBER
Monthly Progress Reports	DRD-4a 38

3. USE	4. DATE
To provide an overview of management and technical effort and progress toward contract objectives.	10/21/96
	5. PREPARED BY: RTS
	6. APPROVED BY:

7. INTERRELATIONSHIP	8. REFERENCES
Progress Schedules and Reports Financial Management Reports	

9. PREPARATION INFORMATION

The Contractor shall prepare and submit Monthly Progress Reports. The first part shall consist of the Management Summary Outlook, and the Technical Progress Narratives. The second part shall consist of the Program Assurance and Documentation Status Narratives. Supporting data, graphs, photographs, and sketches shall be used as needed for clarification for all requirements of this DRD. The format of the report shall be:

1. A cover page containing:
   a. Contract number and title
   b. "Monthly Progress Report," sequence number of report, and period of performance being reported
   c. Contractor's names, address, and organization
   d. Author(s) signature and approval signature of Contractor's project manager
   e. Date of publication

2. Management Summary Outlook
   (a) Narrative - This narrative in bullet form shall include the contract status in relation to plan as well as the outlook for achieving major goals. Specific discussions shall include: Planned versus actual accomplishments as identified by Paragraph (b); and status (i.e., changes, additions, deletions) of the major concerns.

   (b) Planned vs. Actual Accomplishments - The Contractor shall provide the major/critical milestones status for the following categories: carryover milestones (previously scheduled but not completed), milestones due this period, and major/critical milestones scheduled for the next period. Milestone selection should be based on significance and criticality for achieving major goals.

TITLE	DATE	NUMBER
Monthly Progress Report	10/21/96	DRD-4b

PREPARATION INFORMATION

3. Technical Progress Narrative

Monthly Technical Progress Narrative shall be brief and factual and shall be prepared in accordance with the following format:

Significant Progress

(a) Status vs. Plans - A description of overall progress compared to the plan plus a separate description of reportable Work Breakdown Structure (WBS) subdivisions or work on which effort was expended during the reporting period. Supplementary (informal) information regarding technical, cost and/or schedule status shall be provided upon request as required.

(b) Status of Technical Changes (Impending or Potential) - This section shall briefly overview the status of important technical items which are in a state of significant change or may be subject to such change in the future.

(c) Test/Calibration Program Status - This section shall identify any tests/calibrations performed during the reporting period and summarize the results.

(d) Recommendations - Contractor's recommendations to NASA regarding significant changes in plans or schedules which may require NASA approval or action.

4. Program Assurance Narrative

(a) Reliability Program Status - This section shall include those reporting items defined in NHB 5300.4(1A-1), Paragraph 1A203.

(b) Quality Program Status - This section shall include those reporting items defined in ISO 9000.

(c) Safety Program Status - Any unresolved safety items or operation constraints which are the result of safety considerations shall be identified.

(d) Parts, Materials and Processes Status

(e) Configuration Management Status

5. Documentation Status Narrative

(a) Document Status List - The Contractor shall present a status list of all changes to required documentation.

(b) Failure Summary List - These lists shall identify open failures that occurred during the reporting period which have remained open; and those which have remained open from previous reporting periods.

(c) Configuration Changes Summary - The list shall identify Class I changes which have occurred during the reporting period.

DATA REQUIREMENTS DESCRIPTION

1. TITLE	2. NUMBER
Financial Management Reports	DRD-5a
3. USE	4. DATE
	10/21/96
	5. PREPARED BY:
Provides the NASA with financial management status of the contract.	RTS
	6. APPROVED BY:
7. INTERRELATIONSHIP	8. REFERENCES
Progress Schedules and Reports Monthly Progress Report Contract Management Plan Work Breakdown Structure	NPG 9501.2C

9. PREPARATION INFORMATION

The Contractor's financial management reporting shall be prepared in accordance with NPG 9501.2C and the paragraphs herein.

1. Baseline Budget - The Contractor shall establish and maintain a time-phased baseline budget for each reporting level WBS subdivision of work, and integrated with the schedule system. Changes to baseline budgets shall be fully explained in the Contractor baseline budgets and management Narrative Remarks accompanying the first report depicting the changes. Changes to baseline budgets should be held to a minimum and not be made more frequently than twice during any twelve-month period, unless extraordinary conditions necessitate such action. The Contractor shall coordinate his plans regarding revisions to his baseline budget with the NASA COTR prior to effecting such changes. NASA approval of budget revisions is required before the Contractor implement same.

2. Management Reserve/Cost Control - The Contractor will establish a management reserve within the negotiated contract value as operating budgets are agreed to among his performing organizations/WBS managers.

"As cost concerns arise, they shall be identified and quantified. They shall be carried as liens against management reserve until resolution is reached.

As potential reductions in cost are identified, they shall be quantified and carried as potential additions to management reserve until resolution is reached.

DATA REQUIREMENTS DESCRIPTION CONTINUED

TITLE	DATE	NUMBER
Financial Management Reports	10/21/96	DRD-5b

PREPARATION INFORMATION

The Contractor shall use his own form or adopt another to report the cost concerns/offsets.

Changes to the baseline budget of a WBS reporting level of work, or transfer of funds between reporting levels of work, except those resulting from contract modifications, shall be processed in accordance with the cost control discipline required above. Budget respreads, including those incorporating changes to management reserve, shall be reported to NASA for concurrence.

3. Reports

A. The Contractor shall submit the following reports (or Contractor's equivalent) in accordance with NPG 9501.2C using the elements of cost listed in Paragraph 4. Also, the Contractor shall use the NASA Form 533 series of reports to obtain cost data from major cost-type subcontractors (or inter-divisional transfers) which meet the reporting criteria in NPG 9501.2C, following the same reporting procedures specified herein. The subcontractor reports shall be included as attachments to the Contractor's required 533 reporting, as applicable.

a. Initial Baseline Report (reflecting the Contractor's baseline budget, time-phased by accounting month).
b. Monthly Report (NASA Form 533M or Contractor Equivalent).
c. Quarterly Report (NASA Form 533Q or Contractor Equivalent).
d. Baseline Budget Revisions (reflecting Contractor's revised budget, time-phased by accounting month.
e. Earned Value/Performance Measurement Report.

Reports (b) and (c) shall be reported to the third level of the program by Element of Cost. This level shall be negotiated between DFRC and the Contractor. Reports (a), (d) and (e) shall be reported at either the second, third, or fourth level of the hardware end-item WBS. Reports (a) and (d) shall be reported by Element of Cost. Report (e) shall report total contract cost by the second, third, or fourth level of the WBS (to be negotiated between DFRC and Contractor) with overhead, CMF and G&A provided at the top level.

4. Elements of Cost
   a Direct labor hours (by discipline/function, e.g., engineering, manufacturing, etc.)
   b. Direct labor dollars (by discipline/function, e.g., engineering, manufacturing, etc.)
   c. Overhead or burden (by discipline/function, e.g., engineering, manufacturing, etc.)
   d. Materials
   e. Subcontracts and major procurements (over $100K; list each separately)*
   f. Interdivisional
   g. Other Direct Costs (ODC)
   h. Subtotal
   i. General and Administrative (G&A)
   j. Cost of facilities capital** (CMF)
   K. Total contract cost**
   l. Fee**
   m. Total cost plus fee**

TITLE	DATE	NUMBER
Financial Management Reports	10/21/96	DRD-5c

PREPARATION INFORMATION

* To be reported at lowest applicable WBS Level
** To be reported at WBS Level 1 only

5. Special Instructions

a. Contractor Narrative Remarks shall cover the status of the changes to the 533M and Earned Value (as a single report), and Contractor Baseline Budget revisions shall include the status of the cost concern/cost offset(s) and management reserve including the outlook for resolution of any cost concerns or cost offsets. It shall also identify the pricing bases or changes thereto for direct and indirect costs in the initial report and any change thereto in the first report reflecting the change, as well as the impact of such change.

(1) The planned (budgeted) cost for the month being reported and cumulative to date respectively, shall be consistent with the baseline budget.

(2) Any material status will be available for review at the Contractor's location.

(3) The detailed plans for the next 2 months shall reflect the current operations plan.

6. Quick-Look Reports - Generally, the reports specified above will be the maximum required; however, supplementary information shall be provided, upon request, on an exception basis. For example, if specific WBS subdivisions of work are determined by NASA to be critical from a technical, schedule and/or cost standpoint, the Contractor may be required to provide monthly quick-look status reports showing actual man-hours expended versus budget or status of major/critical material procurements. These quick-look reports need not agree precisely with the formal monthly financial reports. Likewise, under certain conditions, the Contractor may be required to provide cost and manpower data for WBS subdivisions of work which are not normally reported on.

DATA REQUIREMENTS DESCRIPTION

4 3

1. TITLE	2. NUMBER
Progress Schedules and Reports	DRD-6
3. USE	4. DATE
	10/21/96
	5. PREPARED BY:
Identifies contract schedule development, implementation, update, maintenance, analysis, and reporting requirements.	RTS
	6. APPROVED BY:
7. INTERRELATIONSHIP	8. REFERENCES
Financial Management Reports Monthly Progress Report Work Breakdown Structure	

9. PREPARATION INFORMATION

A. Master Schedule

The Contractor shall establish and maintain a master schedule of the total contractual effort, in a Microsoft Project computer file. The Contractor shall utilize the Critical Path Method (CPM) Analysis for the project.

B. Logic-Flow Network Schedules

C. Schedule Reporting

The Contractor shall submit bi-weekly, the updated schedule in a Microsoft Project Computer file. The contractor shall also provide two tabular narrative reports, the Behind Schedule Report, and the 45-day Look Ahead Report. The Behind Schedule Report includes the WBS number, description, baseline scheduled date, estimated completion date, the issue, the corrective action being taken, and the responsible party/organization. The 45-day Look Ahead Report includes the R, Y, and G status, the WBS number, description, baseline schedule date, estimated completion date, the issue, any action being taken on the activity, and the responsible party/organization. Red, yellow or green status is assigned for each activity; where R=Milestone is expected to complete beyond the schedule date. (An Estimated Completion Date"ECD" is provided); Y= Activity leading up to milestone is currently behind schedule, or there is evidence to substantiate that the milestone may not complete on schedule; G= On schedule condition and expected to be completed on or before the schedule date.

Critical Path and Network Analysis

The preliminary network shall be submitted within 10 calendar days of Notice to Proceed. The initial Microsoft Project network shall be submitted within 30 calendar days of contract go-ahead. Thereafter, the Contractor shall submit an updated Microsoft Project network on a bi-weekly basis. Activities with durations in excess of 30 days shall be allowed only if such an activity is not logically capable of further subdivision.

DATA REQUIREMENTS DESCRIPTION

44

1. TITLE	2. NUMBER
Work Breakdown Structure (WBS) and WBS Dictionary	DRD-7
3. USE The WBS establishes the fundamental framework wherein all effort is identified to meet the contract objective and fulfill the Statement of Work. It provides the logical structure for planning and controlling technical schedule, costs, manpower, and performance; and for status assessment and reporting.	4. DATE 10/21/96 5. PREPARED BY: RTS 6. APPROVED BY:
7. INTERRELATIONSHIP Progress Schedules and Reports Financial Management Reports	8. REFERENCES NHB 5600.2

9. PREPARATION INFORMATION

A. WBS shall:

(1) Define all the work necessary to complete the project:

(2) Be an end-item product-oriented, hierarchical division (tree) of deliverable items (hardware, software, information) and associated services; and

(3) Relate the elements of work to each other and to the end-item system or product.

(4) Includes all subcontract and major procurement efforts at the proper end-item.

(5) Be presented in both tabular and graphic form

The lowest level of the WBS shall correspond to at least the lowest level at which work scheduled, work accomplished, and actual costs can be correlated. The coding structure will be used to uniquely identify particular WBS end-item on all performance, budget, schedule, and financial reports.

B. WBS Dictionary shall define the scope of each WBS end-item and describe the tasks included in each end-item as follows:

(1) objective
(2) work to be performed
(3) product and quantity of hardware or services to be developed and delivered
(4) software or services to be furnished
(5) other significant data which describes the "end-item products" of each WBS
(6) the criteria for determining completion of the work

DATA REQUIREMENTS DESCRIPTION

45

1. TITLE	2. NUMBER
Drawings and Design Files	DRD-8
3. USE	4. DATE
	10/21/96
	5. PREPARED BY:
Documentation of design.	RTS
	6. APPROVED BY:
7. INTERRELATIONSHIP	8. REFERENCES
SOW Para 4.10.7.7 Para 4.10.8.2	SOW Para 4.10.7.5 Para 4.10.7.7 Para 4.10.8.2

9. PREPARATION INFORMATION

Structural components shall be provided in IGES electronic form. "As built" RF system, telemetry, instrumentation, power, FTS, pneumatic, fluid, and fuel system drawings shall be provided in hardcopy and AutoCad Version 13 electronic form. Instrumentation Calibration Files shall be submitted in electronic form (Microsoft Excel) in accordance with SOW Section 4.10.7.5. Drawings and schematics of the systems/subsystem shall not be larger than "E" size (34 inches by 44 inches). Each drawing shall be identified by a NASA drawing number located inside the Drawing "Title" Block under the title of the drawing. The final engineering drawings shall be up-to-date, shall incorporate all drawing changes on the original drawing sheet, and shall reflect the "as-built" hardware.

The design documentation shall include software description, hardware description, and wire lists.

Drawings and design files shall include configuration and interface definitions of all research vehicle components and system integration test hardware.

DATA REQUIREMENTS DESCRIPTION

1. TITLE	2. NUMBER
Interface Control Document	DRD-9
3. USE	**4. DATE**
To establish and control Hyper-X research vehicle interfaces for 8-Ft HTT test and installation and integration operations for flight missions.	10/21/96
	5. PREPARED BY: RTS
	6. APPROVED BY:
7. INTERRELATIONSHIP	**8. REFERENCES**
Paragraphs 4.5.2, 4.10.5, & 4.17	

9. PREPARATION INFORMATION

The Interface Control Document shall include Hyper-X research vehicle interface definitions for the LaRC 8-Ft HTT and the Hyper-X research vehicle-to booster adapter. The interfaces to be defined include mechanical, electrical, and plumbing. Both flight interfaces and processing/ testing interfaces shall be clearly defined. Drawings, schematics, and wiring lists as appropriate shall be included.

DATA REQUIREMENTS DESCRIPTION

1. TITLE	2. NUMBER
Real-Time Hardware-in-the-Loop Simulation Software Models and Documentation	DRD-10
3. USE	4. DATE
To support development of a hardware-in-the-loop simulation of the Hyper-X Research Vehicle for system/subsystem validation testing at DFRC.	10/21/96
	5. PREPARED BY: RTS
	6. APPROVED BY:
7. INTERRELATIONSHIP	8. REFERENCES SOW Section 3.5

9. PREPARATION INFORMATION

The Contractor shall provide as a minimum the following software models and documentation for use in a real-time, hardware-in-the-loop simulation:

1. Actuator
2. Controls, guidance, and navigation
3. Engine Performance
4. Sensors
5. Mass properties
6. Hinge moments
7. Vehicle separation
8. Loads
9. Thermodynamics
10. Structural
11. Aerodynamics

Other models may be required as subsystems are better defined.

These models shall be of sufficient detail and fidelity to accurately characterize the systems of the vehicle. All software models shall be designed to run in real-time. Verification of the software shall be completed by the Contractor before delivery of the models.

The Contractor shall also provide documentation with each software model. This shall include, but is not limited to, descriptions of the models and block diagrams of the systems where appropriate.

These models shall be delivered for government use and maintained current with the maturity of the design.

DATA REQUIREMENTS DESCRIPTION

1. TITLE	2. NUMBER
Structural/Thermal/Dynamic Analyses	DRD-11
3. USE	4. DATE
To support the development of a safe design consistent with all misison structural and thermal constraints.	10/21/96
	5. PREPARED BY: RTS
	6. APPROVED BY:
7. INTERRELATIONSHIP	8. REFERENCES

9. PREPARATION INFORMATION

1. Stress Analysis Report: This report shall contain the results and descriptions of loads, analysis, strength analysis, engineering computations, and other related data. This report shall indicate how the structural requirements, including thermal stresses, were applied in the design effort. The most critical margins of safety shall be summarized in the report with reference to location of related analysis. This report need not be typed but shall include a compilation of the stress analysts working calculations with sufficient clarity and along with sufficient notations to be readily understood by an independent stress analyst without consultation. The stress analysis shall address loads conditions expected for the LaRC 8'HTT tests. This subset of load cases is described in Section 4.9.5 of the SOW.

2. Thermal Analysis Report: This report shall contain the results and description of all thermal analysis done to support the requirements of the statement of work. The report need not be typed but shall include a compilation of the thermal analysts methods, assumptions, and calculations with sufficient clarity and along with sufficient notations to be readily understood by an independent thermal analyst without consultation. The primary structural model shall be delivered in MSC - NASTRAN.

3. Analytical Models: All analytical models developed under this contract to analyze the structure for static and dynamic loads, flutter, aerservoelastic stability, and thermal predictions shall be delivered to NASA.

4. Flutter Evaluation Report: This report shall contain the results of flutter evaluation to ensure that no aerodynamic surface flutter will be encountered within the specified flight envelope. Three copies of the report shall be delivered to NASA.

DATA REQUIREMENTS DESCRIPTION

1. TITLE	2. NUMBER
Flight System Hazard Analysis	DRD-12
3. USE	4. DATE
	10/21/96
	5. PREPARED BY:
Provide a comprehensive report that identifies and assesses Hyper-X mission hazardous operations.	RTS
	6. APPROVED BY:
7. INTERRELATIONSHIP	8. REFERENCES
NHB 1700.1 (V7) NHB 5300.9 July 1991	

9. PREPARATION INFORMATION

Hazard Analyses: Safety analyses of the design, hardware, and operation of the Hyper-X research vehicle, ejection system, and adapter shall be performed by the contractor. The results of these analyses shall be documented in the following:

Preliminary Hazard Analysis - This analysis shall be completed prior to the Manufacturing Readiness Review. It is necessary that the results of this study be incorporated, as far as possible, into the final design.

Subsystem Hazard Analysis - This analysis shall be completed prior to the critical design review.

Operational Hazard Analysis - This analysis shall commence after design is complete and be deliver prior to the start of the Integrated System Tests.

The general philosophy and methodology of safety analyses, the descriptions of each of these reports, and the desired format may be found in NASA System Safety Handbook, NHB 1700.1 (V7) or Safety, Reliability, and Quality Assurance Provisions for the Office of Aeronautics, Exploration, and Technology Centers, NHB 5300.9, July 1991. Government personnel will write the System Safety Plan discussed in these documents, and the plan will specify methods of tracking the hazards uncovered by the various safety analyses.

DATA REQUIREMENTS DESCRIPTION

50

1. TITLE	2. NUMBER
Spares Plan and List	DRD-13
3. USE	4. DATE
	10/21/96
	5. PREPARED BY:
Identify spare parts, devices, materials, assemblies and components.	RTS
	6. APPROVED BY:
7. INTERRELATIONSHIP	8. REFERENCES
Program Assurance Plan	

9. PREPARATION INFORMATION

The Spares Plan and list shall address the following:

1. List the spare parts, devices, materials, assemblies and components to be provided.
2. Identify the "critical spares," those with limited life/cycle, the long lead items and those which may have other special considerations.
3. List assembly part number, serial number, and next assembly.
4. Identify serial numbers, lot numbers, purchase order numbers, or any other means which will assure traceability of each listed item.
5. Include quality assurance verification to substantiate that each item is built to the as-planned configuration.
6. Include all failure and non-conformance reports and analyses related to each listed item.
7. Include calibration data as approrpiate.
8. Identify order of priority of each item.
9. Provide full cost information on each item.

DATA REQUIREMENTS DESCRIPTION

51

1. TITLE	2. NUMBER
Ground Support Equipment List	DRD-14
3. USE	4. DATE
	10/21/96
	5. PREPARED BY:
To identify and define all non-unique assembly, integration, test, and handling equipment required to meet the Contractors tasks of this SOW.	RTS
	6. APPROVED BY:
7. INTERRELATIONSHIP	8. REFERENCES

9. PREPARATION INFORMATION

The list shall identify GSE required at the Contractor's facility, NASA LaRC, and DFRC. The objective of this effort is to permit existing Government owned property to be made available for use on this contract.

DATA REQUIREMENTS DESCRIPTION

1. TITLE	2. NUMBER
Parts and Materials List	DRD-15
3. USE	4. DATE
Provide a method for the NASA to approve all parts and materials used in the Flight Systems.	10/21/96
	5. PREPARED BY: RTS
	6. APPROVED BY:
7. INTERRELATIONSHIP	8. REFERENCES
Program Assurance Plan NHB 1700.7 MSFC-HDBK-527/JSC 09604 MIL-HNDBK-5	

9. PREPARATION INFORMATION

The Contractor shall prepare in tabular format lists of all materials, the significant characteristics (cross referenced to the parts list showing where used), and reference documentation justifying acceptability for use. This list shall be updated throughout the program per the DRL. Materials shall be grouped as non-metallic, metallic and lubricants.

DATA REQUIREMENTS DESCRIPTION

1. TITLE	2. NUMBER
Test and Verification Documentation	DRD-16a
3. USE	4. DATE
	10/21/96
	5. PREPARED BY:
Provide all documentation relative to testing requirements, verification, procedures, notification and reports.	RTS
	6. APPROVED BY:
7. INTERRELATIONSHIP	8. REFERENCES

9. PREPARATION INFORMATION

The Contractor shall provide complete documentation of all testing necessary to meet the program's objectives. This documentation shall, as a minimum, include:

1. Verification Plan:

   a. Testing--The contractor shall establish at each level a comprehensive test program for all system hardware, GSE, and software consistent with the performance requirements of the SOW. This documentation shall include an integrated test plan (including hardware/software and GSE/software integration testing). That discusses all contractor conducted subsystem/system planned testing.

      For each test, the plan shall include identification of: test article(s); level of assembly and configuration; objective; environments, duration, cycles, and methods; performance test and instrumentation needs; equipment and instrumentation certification and calibration policies; personnel responsibilities; flow chart of the integrated test sequence; interrelationships between the Test and Calibration plans; quality and safety activities; test methods and controls to be used; photographic coverage required; etc.

   b. Verification--As part of the comprehensive test program, the Contractor shall include a complete verification approach for all hardware, software and GSE providing a comprehensive description of all test and analytical activities. The approach shall include, but not be limited to, all design, analysis, development, performance, interface, integration, and safety requirements, and shall specify the method and specific mechanism of verification (whether by test, analysis, or a combination of both). The plan shall give a rationale for retest determination. For each analysis, criteria for assessing acceptablity of results, etc. The plan shall include, but not be limited to, the following areas:

TITLE	DATE	NUMBER
Test and Verification Documentation	10/21/96	DRD-16b

PREPARATION INFORMATION

(1) Structural and Mechanical - This activity includes the verification of: (1) design and specifiied factors of safety, (2) interace compatibility, (3) "workmanship" test standards, and (4) compliance with safety requirements. This verification shall be accomplished with a series of interdependent test and analysis activities including the ground vibration test and ejection system separation test. A demonstration of mechanical function adequacy, the ability to withstand the anticipated ascent and descent environments, and compliance with mass property requirements.

(2) Electromagnetic compatibility - The Contractor shall ensure that the instrument does not generate electromagnetic interference that could adversely affect the safey and operation of the launch vehicle, the platform, other instruments or itself.

(3) Vacuum and Thermal - The Hyper-X research vehicle shall be capable of functioning satisfactorily under mission environments. The Thermal/vacuum tests shall demonstrate the ability of the instrument to function satisfactorily in vacuum at the normal mission operating temperatures, at temperature 10C beyond predicted mission extremes, during transition between extremes, and in functional modes of thermal designs and the ability of the thermal control systems to maintain the equipment within the established thermal limits for the mission.

(4) Functional - The contractor shall ensure that each component's functions are verified per design. The contractor shall also verify that the integrated system performs as specified in the design.

(5) Ground Vibration Test -

2. Test Procedures - Consistent with the Test and Verification plans, the Contractor shall prepare and utilize test procedures for all tests conducted on the hardware, software, and GSE. These test procedures shall:

a. Meet the requirements of Chapter 7, NHB 5300.4(1B).

b. To the extend feasible, be prepared in a format containing maximum and minimum acceptance values, provide blank spaces for entering actual performance values and space for the test coordinator and quality assurance verification stamps or initials opposite the recorded data.

c. At the conclusion of each test, become the data portion of the test report.

d. Describe test support equipment and test facility configurations.

3. Test Notification - The Contractor shall advise NASA via telecon and datafax transmission prior to the planned start of each formal test or portion thereof. The Contractor shall update and include the overall test schedule in the Monthly Progress Report.

TITLE	DATE	NUMBER
Test and Verification Documentation	10/21/96	DRD-16c

PREPARATION INFORMATION

4. Test Reports - The Contractor shall maintain a notebook or folder for each test performed in accordance with the Test Plan. This folder shall be maintained so that it indicates current status of the test at any given time and be kept in the Contractor's test facility for inspection and reproduction by the Government as appropriate. The following items shall be placed in the notebook or folder:

a. Filled-in test procedure(s).

b. Data analysis summary which indicates pass/fail status.

c. If retesting is performed, a log shall be provided that traces each additional test or partial test that was performed. The log shall indicate partial/complete pass/fail results for each additional test performed and the log shall indicate overall test pass/fail status.

d. Summary of all non-conformances and failures that occurred.

e. Trend analysis(s) performed.

f. List of test results to be included in the End-Item-Data-Package.

g. List of test results to be included in the Final Report.

DATA REQUIREMENTS DESCRIPTION

5 6

1. TITLE	2. NUMBER
Safety Data Package	DRD-17
3. USE	4. DATE
The Safety data packages will provide the required safety documentation for accomplishing the flight and ground safety Hyper-X research vehicle operations.	10/21/96
	5. PREPARED BY: RTS
	6. APPROVED BY:
7. INTERRELATIONSHIP	8. REFERENCES
Program Assurance Plan NSTS 18789A MIL-STD-1574	

9. PREPARATION INFORMATION

The Safety Data Package (SDP) shall contain descriptions of the Hyper-X Research Vehicle, its subsystems, mission description, identified hazards and controls.

The SDPs shall be developed and submitted to the government, and shall be commensurate with the design development maturity of the hardware at each of the following reviews:

Manufacturing Readiness Review
Critical Design Review
Pre-Ship Review

DATA REQUIREMENTS DESCRIPTION

1. TITLE	2. NUMBER
Failure Mode and Effects Analysis (FEMA) and Critical Items List (CIL)	DRD-18
3. USE	4. DATE
Determine possible failure modes and the effects for the Hyper-X Research Vehicle mission critical functions.	10/21/96
	5. PREPARED BY: RTS
	6. APPROVED BY:
7. INTERRELATIONSHIP	8. REFERENCES
Program Assurance Plan NHB 5300.4 (1A-1)	

9. PREPARATION INFORMATION

- The FEMA shall be under the change control system.
- The CIL shall be under the change control system and contain:
  - Scope and Objective
  - Applicable Documents
  - Criticality Definitions
    - Reliability
    - Safety
    - Fracture
  - Supporting Analysis
  - Critical Items/Retention Rationale
  - Critical Item Control Summaries

DATA REQUIREMENTS DESCRIPTION

1. TITLE	2. NUMBER
Failure Reports	DRD-19
3. USE	4. DATE
Identify failure during testing.	10/21/96
	5. PREPARED BY: RTS
	6. APPROVED BY:
7. INTERRELATIONSHIP	8. REFERENCES
Program Assurance Plan	

9. PREPARATION INFORMATION

The Failure Report shall contain as a minimum the following information:

1. Failure Report Number (sequential)
2. Date of failure
3. Item identification number, serial number, and manufacturer of the component, assembly, subassembly, and/or part involved
4. Site of failure
5. Type of test or operation during which failure occurred
6. Non-Conformance Report Number if applicable
7. Description of failure
8. Originator of failure notification: name, signature, telephone, organization, and department

DATA REQUIREMENTS DESCRIPTION

1. TITLE	2. NUMBER
Failure Analysis and Corrective Action Report/Closure	DRD-20
3. USE	4. DATE
	10/21/96
	5. PREPARED BY:
Provide cognizance of the cause and suitability of corrective action for each failure during testing and ensure proper closure of all report failures.	RTS
	6. APPROVED BY:
7. INTERRELATIONSHIP	8. REFERENCES
Program Assurance Plan	

9. PREPARATION INFORMATION

1. A Failure analysis and Corrective Action Report is required for each failure documented on a Failure Report.

2. The Failure Analysis and Corrective Action Report shall provide the calculations, test data, diagrams, photographs, and analysis supporting the determination of cause and corrective action. The Failure Analysis and Corrective Action Report shall also provide an updated brief synopsis of (a) the failure, the failed article, the failure analysis findings, and the corrective action; (b) disposition affectivity and corrective action documentation (e.g., engineering orders and shop orders) shall be defined; (c) the failure shall also be classified as to criticality, related previous occurrence(s) in this project, verified or unverified failure, and the failure shall be categorized as to one of the following types of failure:
   - Design (design deficiency or drawing error)
   - Parts, Devices, and Materials
   - Manufacturing process (fabrication/assembly procedures, or equipment)
   - Workmanship (skill, judgment)
   - Test Error (test procedures, equipment, personnel)
   - Other (specify)

3. The Contractor shall submit a written recommendation that the government approve the closure of the failure when the criteria for closure have been satisfied for a given Failure Report.
   (a) The cause of the failure is identified,
   (b) Remedial and preventive actions/changes have been accomplishd on existing items and verified by test ,
   (c) Affectivity of preventive action has been established to include failure items and verified by test.
   (d) The closure statement has been signed off by appropriate Contactor management authority to indicate technical review and by reliability and/or control to certify completion of closure actions.

DATA REQUIREMENTS DESCRIPTION 60

1. TITLE	2. NUMBER
Pre-Ship Review (PSR) Data Package	DRD-21

3. USE	4. DATE
Provide data/documentation necessary to assess final hardware/software/GSE status, perform final review of project/mission plans, review results of acceptance testing and support acceptance/delivery decisions prior to instrument delivery.	10/21/96
	5. PREPARED BY: RTS
	6. APPROVED BY:

7. INTERRELATIONSHIP	8. REFERENCES
Failure Analysis and Corrective Action Report/Closure Material Inspection and Receiving Report Form DD250	

9. PREPARATION INFORMATION

A. Data Package

The Pre-Ship Review (PSR) data package shall include a copy of all pertinent technical reports and drawings identified in the DRL, as required for submittal to NASA prior to the PSR. The PSR will also ensure that all Failure Analysis and Corrective Action Reports have been closed. The package shall include additional information which the Contractor deems necessary to validate hardware quality, conform flight worthiness and interface compatibility, and verify documentation compliance to the readiness review participants. This additional information shall include, as a minimum, the following:

1. A brief narrative, on each agenda subject, discussing the Contractor's planned PSR presentation.
2. Test reports.
3. A listing of failures and design modifications.
4. "As'Built" drawings.

DATA REQUIREMENTS DESCRIPTION

61

1. TITLE	2. NUMBER
Final Report	DRD-23
3. USE	4. DATE
	10/21/96
	5. PREPARED BY:
Provide a comprehensive report setting forth the results of the contract.	RTS
	6. APPROVED BY:
7. INTERRELATIONSHIP	8. REFERENCES

9. PREPARATION INFORMATION

The contractor shall provide a final report describing all major contractor activities associated with the production of Hyper-X research vehicles. This report shall include in chronological form all major technical activities including the design phase, the fabrication phase, the systems integration phase and the testing phase. It shall include summaries of major reviews as wall as discussions of unique engineering/manufacturing/integration activities such as "Rapid Prototype" and "Concurrent Engineering" manufacturing operations.

DATA REQUIREMENTS DESCRIPTION

1. TITLE	2. NUMBER
Report of Government Owned/Contractor Held Property	DRD-24
3. USE	4. DATE
To report annually any Government owned/Contractor furnished property that has been furnished or that has been acquired by the Contractor under the terms of this contract.	10/21/96
	5. PREPARED BY: RTS
	6. APPROVED BY:
7. INTERRELATIONSHIP	8. REFERENCES Section I, NASA FAR Clause 18-52.245-73

9. PREPARATION INFORMATION

1. Applicable Documents

   NASA FAR Supplement Clause 18-52.245-73, Financial Reporting of Government Owned/Contractor Held Property (Sep. 1987).

   NASA FAR Supplement Subpart 18-45.71.

2. The report shall be submitted on NASA Form 1018 no later than October 31 of each year. Specific instructions for the preparation of NASA Form 1018 are contained in NASA FAR Supplement Subpart 18-45.71.

EXHIBIT B

RELATED GOVERNMENT ACTIVITIES

1.0 Validation testing will be completed at DFRC. As many subsystems as reasonable will be integrated to provide a simulation of the vehicle dynamics. Failure modes and effects testing, as well as normal operations testing will be performed. Abnormal and off nominal conditions testing will be completed.

2.0 The LaRC 8' HTT will include a vehicle dynamics simulation. The vehicle shall operate with as many flight subsystems installed as possible in order to produce a simulated flight test. These subsystems will be exercised during the 8' HTT tests.

3.0 A vehicle-in-the-loop test will be performed at DFRC after any post LaRC 8' HTT refurbishment or modifications are completed. The vehicle-in-the-loop test will consist of a subset of the validation and installed systems tests as required

4.0 B-52B Integration Testing - After adapter/ejector/separation testing is completed by the contractor, the adapter will be shipped to DFRC for integration to the booster. Integration of the adapter to the booster will begin when both the adapter and the booster are available. All subsystems will be functionally tested to assure proper operations in both nominal and off-nominal conditions. The adapter will also be integrated with the booster stack to assure all systems work together. EMI testing of the adapter and booster with the B-52B will then occur.

5.0 Once the Hyper-X research vehicle has completed all the validation and integration tests it will be integrated with the adapter and rocket booster. The system will then be mated to the B-52B and testing will be done to assure correct subsystems operations.

6.0 Flight Systems Tests: Prior to flight, a Combined Systems test will be completed to assure all systems, both ground and flight, work together and the total system, B-52B, rocket booster stack and Hyper-X research vehicle systems are ready to fly. One or more taxi tests will be completed. One or more captive carry tests of the stack and B-52B will be done for envelope expansion. A flight test plan will be developed by the Government with inputs from the contractor. The flight test plan will define the taxi tests, captive carry tests and the vehicle release test.

7.0 Flight System Simulations Prior to the initial Hyper-X research vehicle flight test, ground flight simulations will be performed by the Government to assure the adequacy of the total Hyper-X research vehicle hardware/software system design.

8.0 Hyper-X research vehicle-to-booster adapter: The Government provided design baseline includes a research vehicle to Pegasus booster adapter with research vehicle separation system. The aerodynamic performance of the booster stack including the baseline adapter configuration is being evaluated by the Government through a series of analyses and wind tunnel tests. As such the external configuration of this adapter is subject to refinement. The test and analyses data will be provided by the Government.

9.0 Guidance, Navigation and Control Law Development: After contract award, the Government will be available to support the Contractor in the design/development/refinement of inner-loop control laws.

10.0 The Government will provide CFD mutually agreed upon that is required to support design, ground (8'HTT) and flight experimental testing, to include but not limited to external aero/thermal analysis and engine flow path internal loads and performance. In addition, the Government plans to provide limited support for thermal and structural analysis.

11.0 The Government will provide the experimental aerodynamic, aerothermal and engine testing mutually agreed upon to support the technical objectives of the Hyper-X program.

EXHIBIT C

DD-254

EXHIBIT " C "

DEPARTMENT OF DEFENSE
CONTRACT SECURITY CLASSIFICATION SPECIFICATION

(The requirements of the DoD Industrial Security Manual apply to all security aspects of this effort.)

1. CLEARANCE AND SAFEGUARDING
a. FACILITY CLEARANCE REQUIRED: SECRET
b. LEVEL OF SAFEGUARDING REQUIRED: SECRET

2. THIS SPECIFICATION IS FOR: *(X and complete as applicable)*

X	a. PRIME CONTRACT NUMBER: NAS1-97110	
	b. SUBCONTRACT NUMBER	
	c. SOLICITATION OR OTHER NUMBER	Due Date (YYMMDD)

3. THIS SPECIFICATION IS: *(X and complete as applicable)*

X	a. ORIGINAL *(Complete date in all cases)*		Date (YYMMDD): 97-03-01
	b. REVISED *(Supersedes all previous specs)*	Revision No.	Date (YYMMDD)
	c. FINAL *(Complete item 5 in all cases)*		Date (YYMMDD)

4. IS THIS A FOLLOW-ON CONTRACT? [ ] YES [ ] NO If Yes, complete the following:

Classified material received or generated under _____ *(Preceding Contract Number)* is transferred to the follow-on contract.

5. IS THIS A FINAL DD FORM 254? [ ] YES [ ] NO If Yes, complete the following:

In response to the contractor's request dated _____, retention of the identified classified material is authorized for the period of _____

6. CONTRACTOR *(Include Commercial and Government Entity (CAGE) Code)*

a. NAME, ADDRESS, AND ZIP CODE	b. CAGE CODE	c. COGNIZANT SECURITY OFFICE *(Name, Address, and Zip Code)*
MICRO CRAFT, Inc. 207 BIG SPRINGS AVENUE TULLAHOMA, TN 37388	5A517	DEFENSE INVESTIGATIVE SERVICES DIRECTOR OF INDUSTRIAL SECURITY 2461 EISENHOWER AVENUE ALEXANDRIA VA 22331-1211

7. SUBCONTRACTOR

a. NAME, ADDRESS, AND ZIP CODE	b. CAGE CODE	c. COGNIZANT SECURITY OFFICE *(Name, Address, and Zip Code)*
N/A	N/A	N/A

8. ACTUAL PERFORMANCE

a. LOCATION	b. CAGE CODE	c. COGNIZANT SECURITY OFFICE *(Name, Address, and Zip Code)*
N/A	N/A	N/A

9. GENERAL IDENTIFICATION OF THIS PROCUREMENT
HYPER - X RESEARCH VEHICLE PRODUCTION

10. THIS CONTRACT WILL REQUIRE ACCESS TO:	YES	NO	11. IN PERFORMING THIS CONTRACT, THE CONTRACTOR WILL:	YES	NO
a. COMMUNICATIONS SECURITY (COMSEC) INFORMATION		X	a. HAVE ACCESS TO CLASSIFIED INFORMATION ONLY AT ANOTHER CONTRACTOR'S FACILITY OR A GOVERNMENT ACTIVITY		X
b. RESTRICTED DATA		X	b. RECEIVE CLASSIFIED DOCUMENTS ONLY		X
c. CRITICAL NUCLEAR WEAPON DESIGN INFORMATION		X	c. RECEIVE AND GENERATE CLASSIFIED MATERIAL	X	
d. FORMERLY RESTRICTED DATA		X	d. FABRICATE, MODIFY, OR STORE CLASSIFIED HARDWARE	X	
e. INTELLIGENCE INFORMATION:			e. PERFORM SERVICES ONLY		X
(1) Sensitive Compartmented Information (SCI)		X	f. HAVE ACCESS TO U.S. CLASSIFIED INFORMATION OUTSIDE THE U.S., PUERTO RICO, U.S. POSSESSIONS AND TRUST TERRITORIES		X
(2) Non-SCI		X	g. BE AUTHORIZED TO USE THE SERVICES OF DEFENSE TECHNICAL INFORMATION CENTER (DTIC) OR OTHER SECONDARY DISTRIBUTION CENTER		X
f. SPECIAL ACCESS INFORMATION		X	h. REQUIRE A COMSEC ACCOUNT	X	
g. NATO INFORMATION		X	i. HAVE TEMPEST REQUIREMENTS		X
h. FOREIGN GOVERNMENT INFORMATION		X	j. HAVE OPERATIONS SECURITY (OPSEC) REQUIREMENTS		X
i. LIMITED DISSEMINATION INFORMATION		X	k. BE AUTHORIZED TO USE THE DEFENSE COURIER SERVICE		X
j. FOR OFFICIAL USE ONLY INFORMATION		X	l. OTHER *(Specify)* SEE ATTACHMENT		
k. OTHER *(Specify)* N/A					

DD Form 254, DEC 90 *Previous editions are obsolete.* 805/340

EXHIBIT " C "

Table 1a. Conditions for defining the Static and Aerodynamic Loads for the B-52 Mated Configuration.

Condition Number	Design Limit Static Loads			Flight Conditions					
	n_x +Fwd (g's)	n_y +Left (g's)	n_z +Down (g's)	B-52 Velocity (KEAS*)	Altitude (feet)	$\alpha_{fuselage}$ (degrees)	Beta** (degrees)		
101	1.0	0	2.2	203.	0	14.0	-9.18	0	+9.18
102	1.0	0	2.2	300.	0	2.0	-6.22	0	+6.22
103	1.0	0	2.2	286.	27500	1.9	-6.52	0	+6.52
104	−1.0	0	2.2	203.	0	14.0	-9.18	0	+9.18
105	−1.0	0	2.2	300.	0	2.0	-6.22	0	+6.22
106	−1.0	0	2.2	286.	27500	1.9	-6.52	0	+6.52
107	0	0.4	1.0	144.	0	14.0	-12.98	0	+12.98
108	0	0.4	1.0	300.	0	−1.7	-6.22	0	+6.22
109	0	0.4	1.0	286.	27500	−2.3	-6.52	0	+6.52
110	0	−0.4	1.0	144.	0	14.0	-12.98	0	+12.98
111	0	−0.4	1.0	300.	0	−1.7	-6.22	0	+6.22
112	0	−0.4	1.0	286.	27500	−2.3	-6.52	0	+6.52
113	1.0	0	−1.0	154.	0	−15.1	-12.11	0	+12.11
114	1.0	0	−1.0	300.	0	−8.0	-6.22	0	+6.22
115	1.0	0	−1.0	286.	27500	−9.2	-6.52	0	+6.52
116	−1.0	0	−1.0	154.	0	−15.1	-12.11	0	+12.11
117	−1.0	0	−1.0	300.	0	−8.0	-6.22	0	+6.22
118	−1.0	0	−1.0	286.	27500	−9.2	-6.52	0	+6.52

* KEAS = knots Equivalent Air Speed

** Beta angles are based on the angle of the resultant vector formed by the B-52 velocity and a lateral gust of 55 ft/sec.

$$\text{Beta} = (55/(6080.20/3600))\ (57.3)/V_{KEAS} = (32.565/V_{KEAS}) * 57.3$$

Table 1b. Conditions for defining the Static Ground Loads for the B-52 Mated Configuration.

Condition Number	Design Limit Static Loads		
	n_x +Fwd (g's)	n_y +Left (g's)	n_z +Down (g's)
119	0.5	0	2.2
120	–0.5	0	2.2
121	0	0.28	2.2
122	0	–0.28	2.2

EXHIBIT E

HYPER-X FEE SUMMARY

The fee structure for Contract NAS1-97110 shall involve **multiple incentives.** Three elements shall be incentivized under this fee structure as follows:

1. ***Schedule* (30% of fee pool negotiated)**
2. ***Cost Performance* (25% of the fee pool negotiated)**
3. ***Technical Performance* (45% of the fee pool negotiated)**

Schedule and ***Technical*** performance incentives shall be earned on the basis of schedule and technical performance of specific contract deliverables or events as noted below. ***Cost*** incentive fee shall be based on the cumulative cost of all contractually required items. The maximum sum of all incentive fees for schedule, cost performance and technical performance is $3,550,000 (11.87% of target cost). There will be no rollover of unearned fee between elements. The incentive plan for each element is described below.

I. SCHEDULE

The contractor is required to deliver all items in accordance with the contract terms and conditions and the Statement of Work. [Note: The scheduled delivery date (SDD) is defined as the date of receipt at destination.]

An incentive fee of $1,065,000 is offered as follows:

A. Vehicle 1 for 8'HTT Test (Deliverable Nos. 3 through 6)

For delivery of the vehicle 1 and support hardware at destination subject to Government inspection and acceptance, the contractor may earn the incentive fee of $319,500 as follows:

30 days or more prior to the SDD	$319,500
29 days prior to and including the SDD	213,000
1 to 30 days after the SDD	71,000
31 or more days after the SDD	0

B. Vehicle 1 Refurbished (Deliverable No. 8)

For delivery of the refurbished vehicle 1 at destination subject to Government inspection and acceptance, the contractor may earn the incentive fee of $106,500 as follows:

Prior to and including the SDD	106,500
1 to 21 days after the SDD	71,000
22 to 34 days after the SDD	35,500
35 or more days after the SDD	0

C. Adapter (Deliverable No. 7)

For delivery of the adapter at destination subject to Government inspection and acceptance, the contractor may earn the incentive fee of $159,750 as follows:

30 or more days prior to the SDD	159,750
29 days prior to SDD and through 7 days after the SDD	142,000
8 to 30 days after the SDD	106,500

31 to 45 days after the SDD	35,500
46 or more days after the SDD	0

D. Vehicle 2 Refurbished (Deliverable No. 12)

For delivery of the refurbished vehicle 2 at destination subject to Government inspection and acceptance, the contractor may earn the incentive fee of $213,000 as follows:

45 or more days prior to the SDD	213,000
44 to 15 days prior to the SDD	195,250
14 days prior to SDD and through 7 days after the SDD	177,500
8 to 30 days after the SDD	106,500
31 to 45 days after the SDD	35,500
46 or more days after the SDD	0

E. Vehicle 3 (Deliverable No. 13)

For delivery of the vehicle 3 at destination subject to Government inspection and acceptance, the contractor may earn the incentive fee of $159,750 as follows:

45 or more days prior to the SDD	159,750
44 to 15 days prior to the SDD	142,000
14 days prior to SDD and through 7 days after the SDD	124,250
8 to 30 days after the SDD	71,000
31 to 45 days after the SDD	35,500
46 or more days after the SDD	0

F. Vehicle 4 (Deliverable No. 14)

For delivery of the vehicle 4 at destination subject to Government inspection and acceptance, the contractor may earn the incentive fee of $106,500 as follows:

45 or more days prior to the SDD	106,500
44 to 15 days prior to the SDD	88,750
14 days prior to SDD and through 7 days after the SDD	71,000
8 to 30 days after the SDD	53,250
31 to 45 days after the SDD	35,500
46 or more days after the SDD	0

Schedule incentive fees will be paid as soon as possible after delivery and acceptance of each item noted above.

II. COST PERFORMANCE

A. The share ratio for cost is set forth in Federal Acquisition Regulation (FAR) 52.216-10, Incentive Fee (FEB 1997). Fees offered as incentives on cost performance are described as follows:

1. Target Fee: The target fee that may be achieved by the contractor for maintaining actual costs at target cost of $29,900,000 is $532,500.

2. Maximum Fee: The maximum fee that may be achieved by the contractor for cost underruns is $887,500.

3. Minimum Fee: The minimum fee is 0.

B. Audit Adjustment. Cost incentive fee will be provisionally paid as soon as possible after delivery and acceptance of each vehicle. Payment is subject to the provisions of FAR 52.216-10. Payment is subject to later adjustment based upon final audit determination of actual costs.

III. TECHNICAL PERFORMANCE

An incentive fee of $1,597,500 is offered for Technical Performance Incentive as follows:

A. Research Vehicle 1 Flight Test (Maximum fee - $497,000)

Incentive Description 1	319,500
Incentive Description 1 and 2	426,000
Incentive Description 1, 2 and 3	497,000
Incentive Description 4	0
Incentive Description 5	319,500

B. Research Vehicle 2 Flight Test (Maximum fee - $390,500)

Incentive Description 1	248,500
Incentive Description 1 and 2	319,500
Incentive Description 1, 2 and 3	390,500
Incentive Description 4	0
Incentive Description 5	248,500

C. Research Vehicle 3 Flight Test (Maximum fee - $355,000)

Incentive Description 1	248,500
Incentive Description 1 and 2	319,500
Incentive Description 1, 2 and 3	355,000
Incentive Description 4	0
Incentive Description 5	248,500

D. Research Vehicle 4 Flight Test (Maximum fee - $355,000)

Incentive Description 1	248,500
Incentive Description 1 and 2	319,500
Incentive Description 1, 2 and 3	355,000
Incentive Description 4	0
Incentive Description 5	248,500

INCENTIVE DESCRIPTIONS

The following technical performance incentive descriptions apply to all research vehicle flight tests as listed above.

1. Research objectives for the dual mode scramjet powered phase of the flight test are successfully accomplished. Successful accomplishment of the research objectives is defined as correct inlet cowl operation, correct system/subsystem operation, data transmission and research vehicle controlled at the required angle-of-attack and side slip during the test period (cowl open to cowl closed), as defined in the Statement of Work.

2. The research vehicle control systems (flight, engine and propellant systems) demonstrate performance and stability margins (phase and gain) to fully control the research vehicle through booster ejection, the dual mode scramjet experiment phase and descent to mission completion, including maneuvers to control and dissipate vehicle energy and short duration programmed test inputs on the control surface motions.

3. Research vehicle design innovations increase vehicle/system/subsystem performance and/or probability of mission success and/or quantity/quality of research objectives.

4. Number 1 above is not successfully accomplished.

5. Research vehicle flight test is not successfully accomplished due to no fault of the contractor, after the delivery of a vehicle conforming to the Statement of Work.