

SOLICITATION, OFFER AND AWARD		1. THIS CONTRACT IS A RATED ORDER UNDER DPAS (15 CFR 350)		RATING DO-C9	PAGE OF 1 18 PAGES	
2. CONTRACT NO.	3. SOLICITATION NO. N00173-00-R-DL01	4. TYPE OF SOLICITATION <input type="checkbox"/> SEALED BID (IFB) <input checked="" type="checkbox"/> NEGOTIATED (RFP)		5. DATE ISSUED May 2, 2000	6. REQUISITION/PURCHASE NO.	
7. ISSUED BY CONTRACTING OFFICER NAVAL RESEARCH LABORATORY ATTN: CODE: 3220.dl WASHINGTON DC 20375-5300		CODE N000173	8. ADDRESS OFFER TO (If other than Item 7)			

NOTE: In sealed bid solicitations "offer" and "offeror" mean "bid" and "bidder".

SOLICITATION

9. Sealed offers in original and 5 copies for furnishing the supplies or services in the Schedule will be received at the place specified in Item 8, or if handcarried, in the depository located in Bldg. 222, Room 115A until 4 PM local time June 5, 2000
(Hour) (Date)

CAUTION - LATE Submissions, Modifications, and Withdrawals: See Section L, Provision No. 52.214-7 or 52.215-10. All offers are subject to all terms and conditions contained in this solicitation.

10. FOR INFORMATION CALL:	A. NAME Dian Lockamy	B. TELEPHONE NO. (Include area code) (NO COLLECT CALLS) (202) 767-3782
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OFFER (Must be fully completed by offeror)

NOTE: Item 12 does not apply if the solicitation includes the provisions at 52.214-16, Minimum Bid Acceptance Period.

12. In compliance with the above, the undersigned agrees, if this offer is accepted within _____ calendar days (60 calendar days unless a different period is inserted by the offeror) from the date for receipt of offers specified above, to furnish any or all items upon which prices are offered at the price set opposite each item, delivered at the designated point(s), within the time specified in the schedule.

13. DISCOUNT FOR PROMPT PAYMENT (See Section I, Clause No. 52-232-8)	10 CALENDAR DAYS	20 CALENDAR DAYS	30 CALENDAR DAYS	CALENDAR DAYS
	%	%	%	%
14. ACKNOWLEDGMENT OF AMENDMENTS (The offeror acknowledges receipt of amendments to the SOLICITATION for offerors and related documents numbered and dated:	AMENDMENT NO.	DATE	AMENDMENT NO.	DATE
15A. NAME AND ADDRESS OF OFFEROR	CODE	FACILITY	16. NAME AND TITLE OF PERSON AUTHORIZED TO SIGN OFFER (Type or print)	
15B. TELEPHONE NO. (Include area code)	15C. CHECK IF REMITTANCE ADDRESS IS DIFFERENT FROM ABOVE - ENTER SUCH ADDRESS IN SCHEDULE.		17. SIGNATURE	18. OFFER DATE

AWARD (To be completed by Government)

19. ACCEPTED AS TO ITEMS NUMBERED	20. AMOUNT	21. ACCOUNTING AND APPROPRIATION		
22. AUTHORITY FOR USING OTHER THAN FULL AND OPEN COMPETITION:		23. SUBMIT INVOICES TO ADDRESS SHOWN IN (4 copies unless otherwise specified)		
<input type="checkbox"/> 10 U.S.C. 2304(c) ()	<input type="checkbox"/> 41 U.S.C. 253(c) ()			
24. ADMINISTERED BY (If other than Item 7)	CODE	25. PAYMENT WILL BE MADE BY	CODE	ITEM
26. NAME OF CONTRACTING OFFICER (Type or print)		27. UNITED STATES OF AMERICA		28. AWARD DATE
		(Signature of Contracting Officer)		

IMPORTANT - Award will be made on this Form, or on Standard Form 26, or by other authorized official written notice.

**PART I - THE SCHEDULE
SECTION B
SUPPLIES OR SERVICES AND PRICES/COSTS**

B-1 SUPPLIES OR SERVICES AND PRICES/COSTS

ITEM NUMBER	SUPPLIES OR SERVICES	QTY	UNIT	UNIT PRICE	AMOUNT
0001	The Contractor shall provide services and material to perform in accordance with Attachment (1), Statement of Work, except Section 5.				
0002	Contract Data Requirements List (DD Form 1423) Exhibit "C"			**NSP	**NSP
OPTION 1					
0003	The Contractor shall provide the necessary labor and materials to refurbish the existing TAFS system in accordance with Section 5.1 of Attachment (1), Statement of Work.				
OPTION 2					
0004	The Contractor shall provide selected system spare components in accordance with Section 5.2 of Attachment (1), Statement of Work.				

TOTAL DOLLAR AMOUNT FOR CLINs*: \$

*CONTRACT LINE ITEM NUMBER

** Not Separately Priced

**SECTION C
DESCRIPTION/SPECIFICATIONS/STATEMENT OF WORK**

C-1 Items furnished under this contract shall comply with Attachment (1), Statement of Work with Exhibit A, Performance Specification/Description for the Central Target Simulator Facility, Exhibit B, SCRAMNet Interface Control for the Central Target Simulator Facility and Exhibit C, DD Form 1423, Contracts Data Requirements List, and all other Attachments cited in Section J, which are incorporated by reference into Section C.

F-2 FAR 52.211-8 - TIME OF DELIVERY (JUN 1997)

(a) The Government requires delivery to be made according to the following schedule:

REQUIRED DELIVERY SCHEDULE		
<i>[Contracting Officer insert specific details]</i>		
Item No.	Quantity	Within Months After Date Of Contract
0001	1 LOT	12 MAC
0002	1 LOT	12 MAC
OPTION		
0003	1 LOT	12 MAC*
0004	1 LOT	12 MAC*

*Twelve Months after exercise of Option, if exercised.

The Government will evaluate equally, as regards time of delivery, offers that propose delivery of each quantity within the applicable delivery period specified above. Offers that propose delivery that will not clearly fall within the applicable required delivery period specified above, will be considered nonresponsive and rejected. The Government reserves the right to award under either the required delivery schedule or the proposed delivery schedule, when an offeror offers an earlier delivery schedule than required above. If the offeror proposes no other delivery schedule, the required delivery schedule above will apply.

OFFEROR'S PROPOSED DELIVERY SCHEDULE		
Item No.	Quantity	Within Months After Date Of Contract

(b) Attention is directed to the Contract Award provision of the solicitation that provides that a written award or acceptance of offer mailed, or otherwise furnished to the successful offeror, results in a binding contract. The Government will mail or otherwise furnish to the offeror an award or notice of award not later than the day award is dated. Therefore, the offeror should compute the time available for performance beginning with the actual date of award, rather

than the date the written notice of award is received from the Contracting Officer through the ordinary mails. However, the Government will evaluate an offer that proposes delivery based on the Contractor's date of receipt of the contract or notice of award by adding (i) five calendar days for delivery of the award through the ordinary mails or (ii) one working day if the solicitation states that the contract or notice of award will be transmitted electronically. (The term "working day" excludes weekends and U.S. Federal holidays.) If, as so computed, the offered delivery date is later than the required delivery date, the offer will be considered nonresponsive and rejected.

F-3 PLACE OF DELIVERY - FOB DESTINATION

The contractor shall deliver supplies, all transportation charges paid, to destination in accordance with the clause in Section F of the Schedule titled FAR 52.247-34 FOB Destination (NOV 1991).

Receiving Officer

Naval Research Laboratory

Contract Number

ATTN: *

CODE: *

LOCATION: *

Bldg. 49

4555 Overlook Avenue, SW

Washington DC 20375-5320

(* To be filled in at time of award.)

SECTION G

CONTRACT ADMINISTRATION DATA

G-1 PROCURING OFFICE REPRESENTATIVE

In order to expedite administration of the contract, the Administrative Contracting Officer (ACO) will direct inquiries to the appropriate office listed below. Please do not direct routine inquiries to the person listed in Item 20A on Standard Form 26.

Contract Matters- *

Security Matters- *

Safety Matters- *

Patent Matters- *

Release of Data- *

The ACO will forward invention disclosures and reports directly to the Associate Counsel for Patents, Code 1008.2, Naval Research Laboratory, Washington DC 20375-5320. The Associate

Counsel for Patents will return the reports along with a recommendation to the Administrative Contracting Officer. The Associate Counsel for Patents will represent the Contracting Officer with regard to invention reporting matters arising under this contract.

(* To be filled in at time of award)

G-2 TECHNICAL MANAGER - FUNCTIONS AND LIMITATIONS

* is hereby designated the cognizant Technical Manager who will represent the Contracting Officer in the administration of technical details within the scope of this contract and inspection and acceptance. The Technical Manager is not otherwise authorized to make any representations or commitments of any kind on behalf of the Contracting Officer or the Government. The Technical Manager does not have the authority to alter the Contractor's obligations or change the specifications in the contract. If, as a result of technical discussions, it is desirable to alter contract obligations or statements of work, a modification must be issued in writing and signed by the Contracting Officer. The Technical Manager, after review and signature of the "Material Inspection and Receiving Report, DD Form 250, If applicable, will forward a copy to the Administrative Contracting Officer.

(* To be filled in at time of award)

G-3 NAPS 5252.232-9000 - SUBMISSION OF INVOICES (FIXED PRICE) (JUL 1992)

(a) "Invoices" as used in this clause does not include contractor's requests for progress payments.

(b) The contractor shall submit original invoices with 4 copies to the address identified in the solicitation/contract award form (SF 26-Block 10; SF 33-Block 23; SF 1447-Block 14), unless delivery orders are applicable, in which case invoices will be segregated by individual order and submitted to the address specified in the order (DD 1155-Block 13 or SF 26-Block 10).

(c) The use of copies of the Material Inspection and Receiving Report (MIRR), DD Form 250, as an invoice is encouraged. DFARS Appendix F-306 provides instructions for such use. Copies of the MIRR used as an invoice are in addition to the standard distribution stated in DFARS F-401.

(d) In addition to the requirements of the Prompt Payment clause of this contract, the contractor shall cite on each invoice the contract line item number (CLIN); the contract subline item number (SLIN), if applicable; the accounting classification reference number (ACRN) as identified on the financial accounting data sheets, and the payment terms.

(e) The contractor shall prepare:

X a separate invoice for each activity designated to receive the supplies or services.

* a consolidated invoice covering all shipments delivered under an individual order.

* either of the above.

(f) If acceptance is at origin, the contractor shall submit the MIRR or other acceptance verification directly to the designated payment office. If acceptance is at destination, the consignee will forward acceptance verification to the designated payment office.

G-4 INVOICING ADDRESS

With reference to paragraph (b) of the above provision, "Submission of Invoices(Fixed Price)", the contractor shall submit invoices to the address in Block 12 of the contract award form (SF26).

**SECTION H
SPECIAL CONTRACT REQUIREMENTS**

H-1 TYPE OF CONTRACT

(To be filled in at time of award)

H-2 YEAR 2000 COMPLIANT INFORMATION TECHNOLOGY

This requirement applies to information technology (IT) that processes date-related information. All such IT delivered under this contract shall be Year 2000 compliant as defined at FAR 39.002.

H-3 REPRESENTATIONS AND CERTIFICATIONS

The Contractor's completed Representations, Certifications, and Other Statements of Offerors or Respondents is incorporated herein by reference in any resultant award.

(To be filled in at time of award)

H-4 OPTION(S)

The Government may require delivery of the optional items under this contract by the Contracting Officer's giving written notice anytime from date of contract award through the twelve month delivery schedule.

PART II - CONTRACT CLAUSES
SECTION I
CONTRACT CLAUSES

I-1 52.252-2 - CLAUSES INCORPORATED BY REFERENCE (FEB 1998)

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

Also, the full text of a clause may be accessed electronically at this/these address(es):

<http://www.arnet.gov/far>

<http://heron.nrl.navy.mil/contracts/home.htm>

a. FEDERAL ACQUISITION REGULATION CLAUSES

FAR CLAUSE TITLE

- 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 (JUN 1997)
- 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 - Material Requirements (OCT 1997)
- 52.211-15 - Defense Priority and Allocation Requirements (SEP 1990)
- 52.215-2 - Audit And Records-Negotiation (JUNE 1999)
- 52.215-8 - Order of Precedence - Uniform Contract Format (OCT 1997)
- 52.215-11 - Price Reduction for Defective Cost or Pricing Data - Modifications (OCT 1997)
- 52.215-13 - Subcontractor Cost or Pricing Data Modifications (OCT 1997)
- 52.215-14 - Integrity of Unit Prices (OCT 1997)
- 52.215-17 - Waiver of Facilities Capital Cost of Money (OCT 1997) (*will be included if the successful offeror does not propose facilities capital cost of money*)
- 52.215-21 - Requirements for Cost or Pricing Data or Information Other Than Cost or Pricing Data-Modifications (OCT 1997) - Alternate I (OCT 1997)
- 52.217-8 - Option To Extend Services (NOV 1999)
- 52.219-4 - Notice of Price Evaluation Preference For HUBZone Small Business Concerns (JAN 1999) Offeror elects to waive the evaluation preference.
- 52.219-6 - Notice Of Total Small Business Set-Aside (JUL 1996)
- 52.219-8 - Utilization Of Small Business Concerns (OCT 1999)
- 52.219-14 - Limitations On Subcontracting (DEC 1996)

- 52.222-1 - Notice To The Government Of Labor Disputes (FEB 1997)
- 52.222-3 - Convict Labor (AUG 1996)
- 52.222-21 - Prohibition of Segregated Facilities (FEB 1999)
- 52.222-26 - Equal Opportunity (FEB 1999)
- 52.222-35 - Affirmative Action For Disabled Veterans And Veterans Of The Vietnam Era (APR 1998)
- 52.222-36 - Affirmative Action For Workers With Disabilities (JUN 1998)
- 52.222-37 - Employment Reports On Disabled Veterans And Veterans Of The Vietnam Era (APR 1998)
- 52.223-3 - Hazardous Material Identification And Material Safety Data (JAN 1997)
- 52.223-5 - Pollution Prevention and Right-To-Know Information (APR 1998)
- 52.223-6 - Drug-Free Workplace (JAN 1997)
- 52.223-14 - Toxic Chemical Release Reporting (OCT 1996)
- 52.225-13 - Restrictions On Certain Foreign Purchases (FEB 2000)
- 52.227-1 - Authorization And Consent (JUL 1995)
- 52.227-2 - Notice And Assistance Regarding Patent And Copyright Infringement (AUG 1996)
- 52.227-3 - Patent Indemnity (APR 1984)
- 52.227-11 - Patent Rights - Retention By The Contractor (Short Form) (JUN 1997) *(will be included if the successful offeror is a small business or a non-profit organization)*
- 52.228-5 - Insurance - Work on a Government Installation (JAN 1997)
- 52.229-3 - Federal, State, And Local Taxes (JAN 1991)
- 52.229-5 - Taxes - Contracts Performed In U.S. Possessions Or Puerto Rico (APR 1984)
- 52.232-1 - Payments (APR 1984)
- 52.232-8 - Discounts For Prompt Payment (MAY 1997)
- 52.232-9 - Limitation On Withholding Of Payments (APR 1984)
- 52.232-11 - Extras (APR 1984)
- 52.232-17 - Interest (JUN 1996)
- 52.232-23 - Assignment Of Claims (JAN 1986)
- 52.232-25 - Prompt Payment (JUN 1997)
- 52.232-33 - Payment By Electronic Funds Transfer-Central Contractor Registration (MAY 1999)
- 52.233-1 - Disputes (DEC 1998)
- 52.233-3 - Protest After Award (AUG 1996)
- 52.237-2 - Protection Of Government Buildings, Equipment, And Vegetation (APR 1984)
- 52.242-13 - Bankruptcy (JUL 1995)
- 52.243-1 - Changes - Fixed Price (AUG 1987) Alternate II (APR 1984)
- 52.245-1 - Property Records (APR 1984)
- 52.245-2 - Government Property (Fixed-Price Contracts) (DEC 1989)
- 52.246-23 - Limitation Of Liability (FEB 1997)
- 52.248-1 - Value Engineering (FEB 2000)52.249-2 - Termination For Convenience Of The Government (Fixed Price) (SEP 1996)
- 52.249-8 - Default (Fixed-Price Supply And Service) (APR 1984)
- 52.251-1 - Government Supply Sources (APR 1984)
- 52.252-6 - Authorized Deviations in Clauses (APR 1984) fill in Defense Federal Acquisition Regulation Supplement (48 CFR Chapter 2);
- 52.253-1 - Computer Generated Forms (JAN 1991)

DFARS CLAUSE TITLE

- 252.203-7001 - Prohibition On Persons Convicted Of Fraud Or Other Defense Contract Related Felonies (MAR 1999)
- 252.204-7003 - Control Of Government Personnel Work Product (APR 1992)
- 252.204-7004 - Required Central Contractor Registration (MAR 1998)
- 252.209-7000 - Acquisition From Subcontractors Subject To On-Site Inspection Under The Intermediate-Range Nuclear Forces (INF) Treaty (NOV 1995)
- 252.209-7004 - Subcontracting With Firms That Are Owned Or Controlled By The Government Of A Terrorist Country (MAR 1998)
- 252.215-7000 - Pricing Adjustments (DEC 1991)
- 252.223-7006 - Prohibition On Storage And Disposal Of Toxic And Hazardous Materials (APR 1993)
- 252.225-7001 - Buy American Act And Balance Of Payments Program (MAR 1998)
- 252.225-7002 - Qualifying Country Sources As Subcontractors (DEC 1991)
- 252.225-7009 - Duty-Free Entry - Qualifying Country Supplies (End Products And Components) (MAR 1998)
- 252.225-7012 - Preference for Certain Domestic Commodities (MAY 1999)
- 252.225-7016 - Restriction On Acquisition Of Ball And Roller Bearings (AUG 1998)
- 252.225-7031 - Secondary Arab Boycott Of Israel (JUN 1992)
- 252.227-7000 - Non-Estoppel (OCT 1966)
- 252.227-7001 - Release Of Past Infringement (AUG 1984)
- 252.227-7013 - Rights In Technical Data--Noncommercial Items (NOV 1995)
- 252.227-7016 - Rights In Bid or Proposal Information (JUN 1995)
- 252.227-7030 - Technical Data--Withholding Of Payment (OCT 1988)
- 252.227-7034 - Patents--Subcontracts (APR 1984)
- 252.227-7036 - Certification Of Technical Data Conformity (JAN 1997)
- 252.227-7037 - Validation Of Restrictive Markings On Technical Data (SEP 1999)
- 252.227-7039 - Patents--Reporting of Subject Inventions (APR 1990)
- 252.232-7004 - DoD Progress Payment Rates (FEB 1996)
- 252.233-7000 - Certification Of Claims And Requests For Adjustment Or Relief (MAY 1994)
- 252.242-7000 - Postaward Conference (DEC 1991)
- 252.243-7001 - Pricing Of Contract Modifications (DEC 1991)
- 252.243-7002 - Requests for Equitable Adjustment (MAR 1998)
- 252.245-7001 - Reports of Government Property (MAY 1994)
- 252.246-7001 - Warranty Of Data (DEC 1991)
- 252.247-7023 - Transportation Of Supplies By Sea (NOV 1995)
- 252.247-7024 - Notification Of Transportation Of Supplies By Sea (NOV 1995) *(will be included if the successful offeror made a negative response to the inquiry at DFARS 252.247-7022)*
- 252.248-7000 - Preparation of Value Engineering Change Proposals (MAY 1994)
- 252.251-7000 - Ordering From Government Supply Sources (MAY 1995)

I-2 FAR 52.223-11 - OZONE-DEPLETING SUBSTANCES (JUN 1996)**(a) Definitions.**

"Ozone-depleting substance", as used in this clause, means any substance designated as Class I by the Environmental Protection Agency (EPA) (40 CFR Part 82), including but not limited to chlorofluorocarbons, halons, carbon tetrachloride, and methyl chloroform; or any substance designated as Class II by EPA (40 CFR Part 82), including but not limited to hydrochlorofluorocarbons.

(b) The Contractor shall label products which contain or are manufactured with ozone-depleting substances in the manner and to the extent required by 42 U.S.C. 7671j (b), (c), and (d) and 40 CFR Part 82, Subpart E, as follows:

"WARNING: Contains (or manufactured with, if applicable) _____*, a substance(s) which harm(s) public health and environment by destroying ozone in the upper atmosphere."

* The Contractor shall insert the name of the substance(s).

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

- J-1** Attachment (1) - Statement of Work - 7 Pages, with **Exhibit A** – Performance Specification/Description for the Central Target Simulator Facility – 14 Pages, **Exhibit B** – SCRAMNet Interface Control for the Central Target Simulator Facility – 11 Pages and **Exhibit C** - DD Form 1423, Contract Data Requirements - 6 Pages.
- J-2** Attachment (3) - Accounting and Appropriation Data. 1 page (To be completed at time of award)

PART IV - REPRESENTATIONS AND INSTRUCTIONS**SECTION K****REPRESENTATIONS, CERTIFICATIONS
AND OTHER STATEMENTS OF OFFERORS OR RESPONDENTS****K-1 Representations, Certifications, and Other Statements of Offerors or Respondents**

Each Offeror must submit a completed Representations, Certifications, and Other Statements Of Offerors or Respondents with its proposal which is available electronically in full text at

<http://heron.nrl.navy.mil/contracts/rep&certs.htm>

K-2 FILL IN FOR FAR 52.219-1 - SMALL BUSINESS PROGRAM REPRESENTATIONS (MAY 1999)

The fill in information is as follows:

The standard industrial classification (SIC) code for this acquisition is 3823.

The small business size standard is 500.

SECTION L
INSTRUCTIONS, CONDITIONS, AND NOTICES TO OFFERORS OR RESPONDENTS

L-1 52.252-1 SOLICITATION PROVISIONS INCORPORATED BY REFERENCE (FEB 1998)

This solicitation incorporates one or more solicitation provisions 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. The offeror is cautioned that the listed provisions may include blocks that must be completed by the offeror and submitted with its quotation or offer. In lieu of submitting the full text of those provisions, the offeror may identify the provision by paragraph identifier and provide the appropriate information with its quotation or offer. Also, the full text of a solicitation provision may be accessed electronically at this/these address(es):

<http://www.arnet.gov/far>

<http://heron.nrl.navy.mil/contracts/home.htm>

FAR CLAUSE TITLE

52.204-6	-	Data Universal Numbering System (DUNS) Number (JUNE 1999)
52.215-1	-	Instructions to Offerors- Competitive Acquisition (FEB 2000) Alternate II (OCT 1997)
52.215-16	-	Facilities Capital Cost Of Money (OCT 1997)
52.237-1	-	Site Visit (APR 1984)

L-2 FAR 52.211-14 - NOTICE OF PRIORITY RATING FOR NATIONAL DEFENSE USE (SEP 1990)

Any contract awarded as a result of this solicitation will be a DX rated order; DO rated order certified for national use under the Defense Priorities and Allocations system (DPAS) (15 CFR 700), and the Contractor will be required to follow all of the requirements of this regulation.

L-3 FAR 52.215-20 REQUIREMENTS FOR COST OR PRICING DATA OR INFORMATION OTHER THAN COST OR PRICING DATA (OCT 1997)ALTERNATE IV (OCT 1997)

(a) Submission of cost or pricing data is not required.

- (b) Provide information described below :

Offerors should provide information to enable the Contracting Officer to determine that the proposed price is fair and reasonable. Such information could include published price lists, information on previous sales of the same or similar items, or the projected costs of fabricating and installing the item (material costs, labor costs, etc).

L-4 FAR 52.216-1 - TYPE OF CONTRACT (APR 1984)

The Government contemplates award of a Firm Fixed Price Supply contract resulting from this solicitation.

L-5 FAR 52.233-2 - SERVICE OF PROTEST (AUG 1996)

(a) Protests, as defined in Section 33.101 of the Federal Acquisition Regulation, that are filed directly with an agency, and copies of any protests that are filed with the General Accounting Office (GAO) shall be served on the Contracting Officer (addressed as follows) by obtaining written and dated acknowledgment of receipt from the Control Desk, Code 3200, Bldg. 222, Rm. 115, Naval Research Laboratory, 4555 Overlook Ave., S.W., Washington DC 20375-5326.

- (a) The copy of any protest shall be received in the office designated above within one day of filing a protest with the GAO.

L-6 DFARS 252.227-7017 - IDENTIFICATION AND ASSERTION OF USE, RELEASE, OR DISCLOSURE RESTRICTIONS (JUN 1995)

- (a) The terms used in this provision are defined in following clause or clauses contained in this solicitation--
- (1) If a successful offeror will be required to deliver technical data, the Rights in Technical Data--Noncommercial Items clause, or, if this solicitation contemplates a contract under the Small Business Innovative Research Program, the Rights in Noncommercial Technical Data and Computer Software--Small Business Innovative Research (SBIR) Program clause(2) If a successful offeror will not be required to deliver technical data, the Rights in Noncommercial Computer Software and Noncommercial Computer Software Documentation clause, or, if this solicitation contemplates a contract under the Small Business Innovative Research Program, the Rights in Noncommercial Technical Data and Computer Software--Small Business Innovative Research (SBIR) Program clause.
- (b) The identification and assertion requirements in this provision apply only to technical data, including computer software documents, or computer software to be delivered with other than unlimited rights. For contracts to be awarded under the Small Business Innovative Research Program, the notification requirements do not apply to technical data or computer software that will be generated under the resulting contract. Notification and identification is not required for restrictions based solely on copyright.
- (c) Offers submitted in response to this solicitation shall identify, to the extent known at the time an offer is submitted to the Government, the technical data or computer software that the Offeror, its subcontractors or suppliers, or potential subcontractors or suppliers, assert should be furnished to the Government with restrictions on use, release, or disclosure.

- d) The Offeror's assertions, including the assertions of its subcontractors or suppliers or potential subcontractors or suppliers shall be submitted as an attachment to its offer in the following format, dated and signed by an official authorized to contractually obligate the Offeror:
 Identification and Assertion of Restrictions on the Government's Use, Release, or Disclosure of Technical Data or Computer Software.
 The Offeror asserts for itself, or the persons identified below, that the Government's rights to use, release, or disclose the following technical data or computer software should be restricted:

Technical Data or Computer Software to be Furnished With Restrictions*	Basis for Assertion**	Asserted Rights Category***	Name of Person Asserting Restrictions****
(LIST)*****.	(LIST)	(LIST)	(LIST)

* For technical data (other than computer software documentation) pertaining to items, components, or processes developed at private expense, identify both the deliverable technical data and each such items, component, or process. For computer software or computer software documentation identify the software or documentation.

** Generally, development at private expense, either exclusively or partially, is the only basis for asserting restrictions. For technical data, other than computer software documentation, development refers to development of the item, component, or process to which the data pertain. The Government's rights in computer software documentation generally may not be restricted. For computer software, development refers to the software. Indicate whether development was accomplished exclusively or partially at private expense. If development was not accomplished at private expense, or for computer software documentation, enter the specific basis for asserting restrictions.

*** Enter asserted rights category (e.g., government purpose license rights from a prior contract, rights in SBIR data generated under another contract, limited, restricted, or government purpose rights under this or a prior contract, or specially negotiated licenses).

**** Corporation, individual, or other person, as appropriate.

***** Enter "none" when all data or software will be submitted without restrictions.

Date _____
 Printed Name and Title _____

Signature _____
 (End of identification and assertion)

- (e) An offeror's failure to submit, complete, or sign the notification and identification required by paragraph (d) of this provision with its offer may render the offer ineligible for award.
- (f) If the Offeror is awarded a contract, the assertions identified in paragraph (d) of this provision shall be listed in an attachment to that contract. Upon request by the Contracting Officer, the Offeror shall provide sufficient information to enable the Contracting Officer to evaluate any listed assertion.

L-7 GOVERNMENT-FURNISHED PROPERTY

No material, labor, or facilities will be furnished by the Government unless provided for in the solicitation.

L-8 INQUIRIES CONCERNING THE RFP

Any questions concerning the RFP must be submitted in writing to the Contracting Officer at the location noted in blocks 7 and 9 of the Standard Form 33, "Solicitation, Offer and Award," no less than fifteen (15) days before closing. The Government will not consider questions received after this date. Offerors are cautioned against directing any questions concerning this RFP to technical personnel at the Naval Research Laboratory.

L-9 INSTRUCTIONS FOR SUBMISSION AND INFORMATION REQUIRED TO EVALUATE PROPOSALS

- (1) Information for the technical/management proposal shall be placed in Volume I and be completely separate from the business proposal (Volume II).
- (2) Proposal Identification/Mailing - The proposal should be packaged for delivery so as to permit safe and timely arrival at destination. The proposal package should be sent to the address shown in Block 7 of the RFP face page and marked:

Solicitation No. N00173-00-R-DL01

Closing Date: As specified in Block 9, RFP face page

Attn: Code 3220.dl

- (3) Proposal Format and Length - No attempt is made to restrict the proposal format and style. However, the proposal should be written and organized so as to be compatible with the RFP. Offerors are encouraged to use recycled paper and maximize the use of double sided copying when preparing responses to solicitations.

L-10 VOLUME I - TECHNICAL/MANAGEMENT PROPOSAL

REQUIRED COPIES: 1 ORIGINAL AND 4 (FOUR) COPIES .

- (1) Include a matrix indicating proposed labor hours by skill category required to perform the statement of work.
- (2) The following information is required for evaluation of your technical/management :

TECHNICAL UNDERSTANDING Provide documentation to support hardware and/or software methods which ensure the safety of the operating personnel as well as the equipment mounted on the flight table. Provide identification of critical COTS components in the Replacement CTS flight-table

control system including specifications and technical performance data for these components presented and documentation to support the achievement of the system performance. Documentation of the ability to meet or exceed the SOW performance specifications. Demonstrate a thorough understanding of NRL's proposed system description and the inter-relationship of its components. Demonstrate an understanding of the SCRAMNet's interface, interrupts, and protocols.

CORPORATE EXPERIENCE/PAST PERFORMANCE (a) Offerors shall submit the following information as part of their proposal. (Offerors are encouraged to submit the information prior to other parts of the proposal to assist the government in reducing the length of the evaluation period.) Provide documentation to support successful projects involving similar motion-control equipment in all task areas set forth in the SOW. List the last two (2) contracts or subcontracts completed during the past three (3) years for services similar in nature to this requirement. Include in the two (2) any current contracts or subcontracts for similar services that were awarded at least one year prior to the date of this solicitation. Offerors that have no similar previous or current contracts should provide the requested information for proposed subcontractors that will perform major or critical aspects of the requirement or for the proposed project manager or key personnel responsible for major or critical aspects of the requirement.

1. Name of contracting organization.
2. Contract number
3. Contract type
4. Total contract value
5. Description of the contract work
6. Contracting officer and telephone number
7. Contracting officer's representative, program manager, or similar official and telephone number

(b) Offerors shall contact the contracting organizations identified pursuant to paragraph (a) as soon as possible and request them to send past performance information on the identified contracts to the address in Block 7 of the face page of this solicitation. The past performance report which is available electronically in full text at <http://heron.nrl.navy.mil/contracts/home.htm> is to be provided to the contracting organization for this purpose. If the contracting organization has already collected past performance information on the contract pursuant to FAR Subpart 42.15, the format used to collect the information may be used instead of the past performance report.

(c) Offerors may include in their proposals specific information relating to problems encountered in performing the identified contracts and any corrective actions by the offeror. Offerors should not provide general information on their performance on the identified contracts as this will be obtained from the contracting organizations.

PERSONNEL QUALIFICATION Provide resumes for all management, technical, and project personnel showing both engineering and program leadership skills. Show education and relevant work experience in subject tasks specified in the SOW. Provide evidence of pertinent work experience for the tasks specified in the SOW. Show capability of proposed personnel of providing project monitoring and control to effectively achieve task assignments and on-time completion.

L-11 VOLUME II - BUSINESS PROPOSAL

REQUIRED COPIES: 1 ORIGINAL AND 4 (FOUR) COPIES

(1) PRICE PROPOSAL

The offeror shall submit a business proposal that includes a price proposal with supporting information. The supporting breakdown should include such elements as materials, direct labor, indirect cost, and other costs such as travel. The offeror shall provide exhibits as necessary to substantiate the price

**SECTION M
EVALUATION FACTORS FOR AWARD****M-1 EVALUATION FACTORS FOR AWARD**

Proposals will be evaluated in accordance with the following criteria. The technical factor is more important than the price factor. The technical subfactors are listed in descending order of importance.

M-2-1. TECHNICAL/MANAGEMENT**TECHNICAL UNDERSTANDING**

Soundness of the offeror's technical understanding of the SOW with regard to personnel and equipment safety, critical components, specifications, system requirements, SCRAMNet interface, design, and potential risks.

CORPORATE EXPERIENCE/PAST PERFORMANCE

Past performance will be evaluated on the basis of the quality of the work performed or supplies delivered and timeliness of performance or delivery. The evaluation will be based on the information provided pursuant to Section L and other sources if available. Offerors that have no relevant performance history or for which past performance information is not available will not be evaluated favorably or unfavorably on past performance. The government may begin proposal evaluation prior to receipt of past performance information. If, after completion of proposal evaluation except evaluation of past performance, the contracting officer determines that evaluation of past performance will not affect the outcome of competitive selection, the contracting officer may waive its evaluation in accordance with FAR 15.304(c)(3)(iii).

PERSONNEL QUALIFICATIONS

Overall technical quality and merit of the proposed personnel relevant to each task described in The SOW as demonstrated by years of pertinent experience educational background and past Accomplishments.

M-2-2_ PRICE TO THE GOVERNMENT

Proposed estimated price to the Government.

M-2 AWARD BY FULL QUANTITY

An offeror must propose on all items in this solicitation to be eligible for award. Award will be made to that responsible offeror proposing the lowest total price for all items.

M-3 FAR 52.217-5 - EVALUATION OF OPTIONS (JUL 1990)

Except when it is determined in accordance with FAR 17.206(b) not to be in the Government's best interests, the Government will evaluate offers for award purposes by adding the total price for all options to the total price for the basic requirement. Evaluation of options will not obligate the Government to exercise the option(s).

**REPLACEMENT CTS
FLIGHT-TABLE CONTROL SYSTEM**

STATEMENT OF WORK

**For The
Central Target Simulator Facility**

**NAVAL RESEARCH LABORATORY
4555 Overlook Avenue, SW
Washington, DC 20375**

**Integrated Electronic Warfare Simulation Branch
Tactical Electronic Warfare Division**

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STATEMENT OF WORK

1 Background

1.1 The Naval Research Laboratory (NRL) in Washington, DC includes the Central Target Simulator (CTS) facility that is maintained and operated by the Integrated Electronics Warfare Simulation (IEWS) Branch within the Tactical Electronic Warfare Division (TEWD). The CTS facility is used to test and evaluate the performance of radar-guided antiship missile seekers via unique hardware-in-the-loop simulation environments as well as determine the effectiveness of EW countermeasures. This facility features a large anechoic chamber, a three-axis flight-motion-simulator (TAFS), RF signal generators, RF amplifiers and modulators, RF-switching networks, a 225-element antenna array, data-acquisition equipment, scenario-generation computers, and test-control computers. Using its anechoic chamber, the facility generates and radiates complex RF-signal patterns that simulate assorted ships, chaff, decoys, and jammers, which actual radar seekers may encounter in fast, complex real-world scenarios.

1.2 The emergence of very high-performance, advanced antiship radar-guided missiles requires NRL to properly maintain the three-axis flight-motion-simulator system, in anticipation of impending EW-readiness needs of the US Navy. However, the original subsystems have operated over 22 years and the time has arrived for upgrading and refurbishment.

2 Purpose

The purpose of this competitive procurement is the replacement of the present CTS flight-table control system and to integrate the new commercial-off-the-shelf (COTS) system with the present CTS host computer and the original CARCO Electronics three-axis flight-motion-simulator subsystem. The Replacement CTS Flight-Table Control System will significantly enhance the CTS facility's reliability. Figs. 1 and 2, in the attachment, are top-level block diagrams for the existing and upgraded TAFS, respectively.

3 Scope

The description/performance specification for the Replacement CTS Flight-Table Control System is given in paragraph 7.1, Exhibit A. The Systran SCRAMNet Interface Control document is given in paragraph 7.2, Exhibit B. Exhibits A and B are the technical basis for the Contractor's required and optional tasks. After (a) completion of all **required** basic and optional tasks in sections 4 and 5, below; (b) receipt of the **eleven** data deliverables in paragraph 7.3, Exhibit A; and (c) the issuance of the system warranty specified in section 8, the Government will certify completion of contract.

4 TASKS

The performance specification/description of the Replacement CTS Flight-Table Control System in Exhibit A shall be used for reference purposes. Table 2 includes the major parameters and corresponding performance specification for each of the three axes. In summary, the following five required tasks include qualitative testing of the existing system, delivery and installation of the upgraded system, system

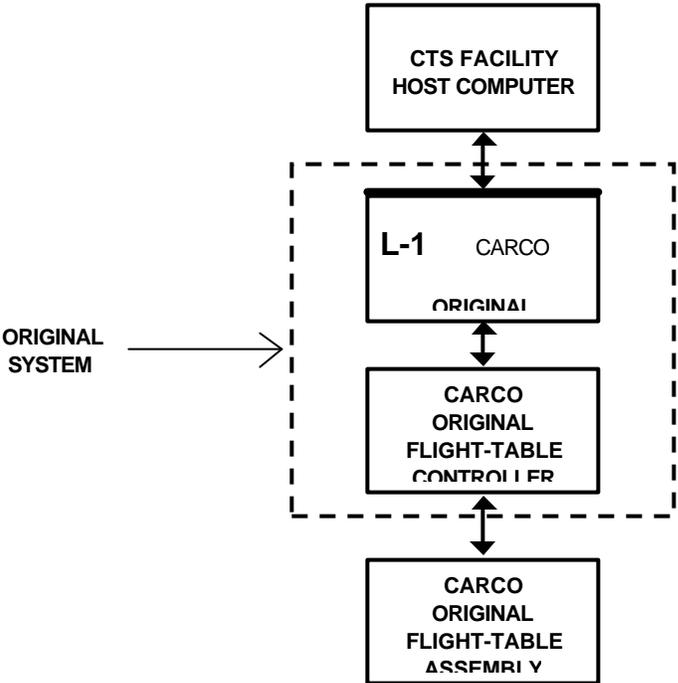


Fig. 1 – Top-Level Block Diagram of Existing CTS Facility Three-Axis Flight Table System

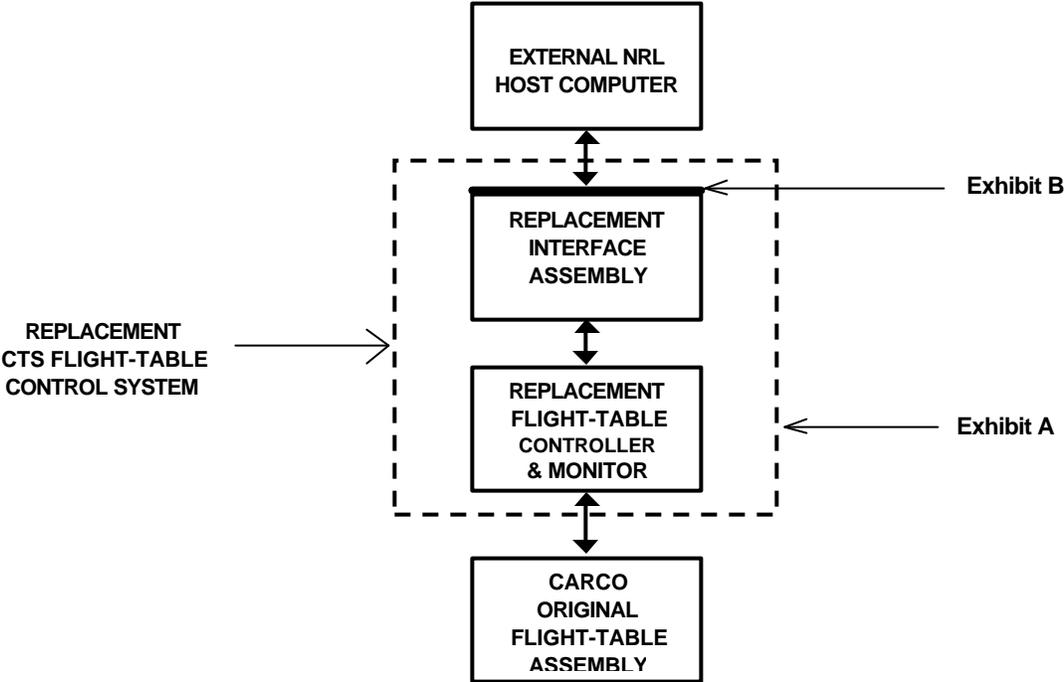


Fig. 2 – Top-Level Block Diagram: Upgraded CTS Flight-Table Control System in the CTS Facility Hardware-In-The-Loop Flight Simulator

- 4.1 **Task 1: Qualitative Operational Test and Evaluation of Existing CTS Flight Table System**. The Contractor shall establish current base-line performance of the existing CTS three-axis flight-motion-simulator system. This shall be accomplished by means of detailed inspections and the execution of critical system operational tests that shall include the following parameters: peak acceleration, peak velocity, and analog-mode closed-loop frequency response. The obtained results shall provide a comparative basis for the final (post-upgrade) system acceptance tests.
- 4.2 **Task 2: Preliminary System Acceptance Test at Contractor's Site**. The Contractor shall successfully conduct, at his site, the approved preliminary system acceptance test plan provided in CDRL, Exhibit A, Data Item No. A004.
- 4.3 **Task 3: Remove Unnecessary Electronic Components from Existing CTS Flight Table System**. The Contractor shall carefully remove all unnecessary electronic components from the existing CTS three-axis flight-motion-simulator system. The removed electronic components shall remain the property of the government. Also, all existing wiring on the TAFS shall be completely removed.
- 4.4 **Task 4: Deliver and Install the Replacement Control System**. The Contractor shall provide all necessary technical support to completely install and successfully integrate the Replacement CTS Flight-Table Control System with the existing flight-motion simulator assembly in the CTS facility. Also, all required wiring shall be installed. Finally, the Contractor shall provide precise laser-alignment of the TAFS, using the roll axis, with the CTS RF array. The Contractor shall use the specifications as described in the statement of work as technical guides and references.
- 4.5 **Task 5: System Acceptance Test at NRL**. The Contractor shall successfully implement the approved Acceptance Test Plan provided in the CDRL, Exhibit A, Data Item No. A005.

5 Optional Tasks

- 5.1 **Optional Task 1: Refurbishment of Existing TAFS System**. The Contractor shall provide the necessary labor and materials to refurbish the existing TAFS system to meet or exceed the 1977 CARCO Electronics performance specification.
- 5.2 **Optional Task 2: Provide Spare System Components**. The Contractor shall provide selected system spare components listed in the CDRL, Exhibit A, Data Item No. A011.

6 **Deliverables**. See Exhibit A: Contract Data Requirements List (DD Form 1423).

- 6.1 **Progress Report: Exhibit A, CDRL, Data Item No. A001**. The Contractor shall provide quarterly progress reports. Also, schedule slippage and milestone changes shall be provided.
- 6.2 **Interface/Integration Document: Exhibit A, CDRL, Data Item No. A002**. The Contractor shall provide detailed final documentation for all new interfaces, within 90 days after completion of all tasks.
- 6.3 **Preliminary Acceptance Test Plan: Exhibit A, CDRL, Data Item No. A003**. The Contractor shall submit the Preliminary Acceptance Test Plan that robustly exercises all critical performance items

contained in the Replacement CTS Flight-Table Control System Performance Specification. The preliminary test plan shall be provided within 3 months prior to preliminary acceptance testing at the contractor's site.

6.4 **Final Acceptance Test Plan: Exhibit A, CDRL, Data Item No. A004.** The Contractor shall submit the final acceptance test plan to NRL for review and approval, at least 45 days prior to final acceptance testing at NRL.

6.5 **Acceptance Test Data: Exhibit A, CDRL, Data Item No. A005.** Within 30 days after acceptance testing at NRL, the Contractor shall submit to NRL the relevant collected data.

6.6 **System Operational Manual: Exhibit A, CDRL, Data Item No. A006.** Within 90 days after the system is installed, the Contractor shall provide sufficient information pertaining to the following:

- System Description
- Operation Instructions
- Calibration Procedures
- BIT Description (if applicable)

All manuals, charts, and diagrams of acceptance test, and data files shall be delivered on Microsoft Windows, PC-compatible CD-ROM media and 2 hardcopy books.

6.7 **System Maintenance Manual: Exhibit A, CDRL, Data Item No. A007.** Within 90 days after the system is installed, the Contractor shall provide a system maintenance manual.

All manuals, charts, and diagrams of acceptance test, and data files shall be delivered on Microsoft Windows, PC-compatible CD-ROM media and 2 hardcopy books.

6.8 **Hardware Documentation: Exhibit A, CDRL, Data Item No. A008.** The Contractor's hardware documentation package shall include the following information within 90 days after the system is installed:

- Functional Block Diagrams
- Theory of Operation
- System-Level Block Diagrams, Figures, and Drawings
- Wiring Diagrams
- Connector Pin-Outs

All manuals, charts, and diagrams of acceptance test, and data files shall be delivered on Microsoft Windows, PC-compatible CD-ROM media and 2 hardcopy books.

6.9 **System Software Documentation: Exhibit A, CDRL, Data Item No. A009.** The Contractor shall provide, within 90 days after completion of the contract, significant software documentation, including the following information:

- Licensed copies (source disks and documentation) for all operating systems and commercial development (compiler) software.
- Flow charts for custom software
- Listings of custom software (hardcopy and softcopy; all software is commented and prepared in accordance w/good commercial practice)
- Software-user guides for commercial software
- The source codes of all noncommercial software used to develop and operate the system
- Backup copy of all software on CD-ROM
- All operations, software, and maintenance manuals associated with commercial equipment; and all custom software

backed up on CD-ROM

All manuals, charts, and diagrams of acceptance test, and data files shall be delivered on Microsoft Windows, PC-compatible CD-ROM media.

6.10 **List of Recommended Spare System Components: Exhibit A, CDRL, Data Item No. A010.** The Contractor shall provide a list of recommended spare system components, at least 60 days prior to contract completion.

6.11 **Final Report: Exhibit A, CDRL, Data Item No. A011.** In conjunction with submittal of DD Form 250, the contractor shall provide a brief final report within 90 days after completion of all contractual tasks.

7 Exhibits

7.1 **Exhibit A: Performance Specification/Description for the Replacement CTS Flight-Table Control System.**

7.2 **Exhibit B: SCRAMNet Interface Control Document**

7.3 **Exhibit C: Control Data Requirements List (DD Form 1423).**

EXHIBIT A

**REPLACEMENT CTS
FLIGHT-TABLE CONTROL SYSTEM**

PERFORMANCE SPECIFICATION/DESCRIPTION

**for the
Central Target Simulator Facility**

**NAVAL RESEARCH LABORATORY
4555 Overlook Avenue, SW
Washington, DC 20375**

**Integrated Electronic Warfare Simulation Branch
Tactical Electronic Warfare Division**

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PERFORMANCE SPECIFICATION/DESCRIPTION OF THE Replacement CTS Flight-Table Control System

1 Summary Description of the Replacement CTS Flight-Table Control System

1.1 **General.** The Replacement CTS Flight-Table Control System shall be a general-purpose, flexible, digital/analog control system designed to support the basic existing NRL CARCO Electronics Three-Axis Flight-Motion Simulator (TAFS). It shall be a commercial-off-the-shelf (COTS) system adapted to the existing NRL TAFS hardware.

1.2 **Specific.** The block diagram in fig. 1 shows the Replacement CTS Flight-Table Control System integrated with the existing NRL TAFS system. Hereafter, the Replacement CTS Flight-Table Control System shall be referred to as the New Control System (NCS).

1.2.1 **TAFS Access.** The NCS shall provide access to the TAFS's controlling and monitoring functions by the external NRL Host Computer. It shall also provide manual local and remote monitoring and control of the TAFS for CTS operators.

1.2.2 **Hardware-In-The-Loop (HWIL) Capability.** The NCS shall provide the TAFS with real-time, HWIL capability, minimal command transport delays and minimal phase delays to meet the specifications in Exhibit B.

1.2.3 **Accuracy and Repeatability.** For improved accuracy and repeatability, the NCS shall use current analog, digital, microprocessor, and digital signal processor (DSP) technology to achieve the high accuracy and repeatability specified in Tables 2 and 3. Smooth starts and stops, true position, velocity limits, and acceleration limits shall be accomplished by the NCS via intelligent control and monitoring of all TAFS movements.

1.2.4 **Graphical User-Interface (GUI).** The manual control of TAFS shall be achievable via a graphical user-interface (GUI) program that runs on a Microsoft WINDOWS[®]98 operating system. This GUI shall use a graphics screen on a RGB monitor, a computer keyboard, and a pointing device (trackball or mouse) to input commands, retrieve configuration parameters, receive status data, and receive position data. This GUI shall include the following features: (1) access to the NCS control parameters; (2) in all modes, continual display of TAFS and NCS statuses; (3) enable or disable TAFS control from the remote (slave) GUI; (4) the ability to ignore the status of, and withhold commands to, removed or unnecessary axes; and (5) initialize and monitor the auxiliary processor (see Table 5).

1.2.5 **SCRAMNet Interface.** The SCRAMNet interface shall provide the real-time status and control interface for the NCS. This interface shall enable the NRL External Host Computer to control the TAFS, via the NCS, during HWIL simulations, open-loop tests, and CTS facility calibration. The SCRAMNet interface uses a loop-through fiber-optic cable to connect multiple nodes into a network. The NRL External Host Computer, via SCRAMNet, has the capability to control the TAFS or receive TAFS status. SCRAMNet control of the TAFS, via the NCS, shall be based on a dual fiber-optic ring with a VME SCRAMNet interface adapter to join the NCS, as a peripheral node, to the existing CTS SCRAMNet

network. An additional auxiliary processor shall handle the transfer of data between the VME SCRAMNet interface board and the NCS digital memory. The required specifications of the SCRAMNet interface are listed in Table 4.

1.2.6 Remote GUI. Manual control of the TAFS shall also be available from the remote (slave) GUI, via a serial link, that shall run on an NRL-supplied PC computer that utilizes the Microsoft WINDOWS[®]98 operating system. The serial link must be compatible with the existing NRL computer (located in the CTS Operations and Control Room) and the interface hardware shall be supplied by the Contractor. Remote GUI control shall be accomplished via the master GUI software.

1.2.7 System Composition. The NCS shall include all the necessary electrical and mechanical hardware, computer software, microprocessor software/firmware, and DSP firmware to directly monitor and control the TAFS, as well as to control the TAFS from the NRL External Host Computer. Additional software (and hardware, if required) on the GUI computer shall provide diagnostic testing of the NRL TAFS and the NCS.

1.2.8 Control Capability. The control capability (local, remote, or NRL External Host Computer) of the NCS shall exceed the capability of the present NRL TAFS. The present NRL TAFS has only position-mode control from the NRL External Host Computer, via the SCRAMNet interface. In addition to position mode, the NCS shall provide the following command modes: hard position, soft position, soft velocity, clear error, acceleration-to-position, and rate-to-position. See Exhibit B section 3.4.3. To control each axis, the NCS shall use current analog, digital, microprocessor, and DSP technology. Each axis-processor shall (1) accept and process positional and rate data from angular feedback sensors and differential pressure sensors mounted on its axis, (2) close the servo loop, and (3) develop an error signal. Using the error signal and appropriate hardware, a servo control interface shall (1) monitor and control operational servo modes and (2) using acquired data, generate analog command signals to dither and drive the analog TAFS hydraulic servo-valves. The TAFS and the NCS shall function properly whenever the roll axis is removed or when an axis is non-functional or disabled. When the roll axis is removed, a shorting plug shall be connected onto the roll axis connector (see Section 1.2.13) with the appropriate wiring to tell NCS the roll axis has been removed. The NCS hardware shall include manual knobs on the NCS front panel to allow manual operator control of each axis. The NCS shall also accept an external analog voltage to control the TAFS position. This voltage shall (1) be used by itself, (2) summed with the output of the manual knob, or (3) summed with the digital control hardware-output. Analog voltage representations of the TAFS position and velocity feedback shall also be available on the front panel. Input and output analog voltages shall be limited to ± 10 Vdc. These voltages shall be internally scaled with reference to parameters used in the GUI and/or the configuration file.

1.2.9 Feedback Sensor Pick-Off Assemblies. The NCS shall include COTS position/rate feedback sensors (or calculate rate in real-time), differential pressure sensors, and axis-motion limit switches. Any other sensors/controls required for proper operation of the upgraded TAFS shall also be provided. These feedback sources shall allow the NCS to meet or exceed all specifications listed in tables 2 and 3. These sensors shall be packaged for proper attachment to the existing NRL TAFS; and, without damage, these sensors shall function to maintain the physical tolerances and limitations of the existing hardware and environment. All required modifications to the existing NRL TAFS for installing the NCS, as well as all required sensors/controls for correct operation, shall be included.

1.2.10 **System Diagnostics.** The NCS shall perform a built-in test (BIT) during each system start-up. BIT failures shall be identified to the operator as either critical or non-critical. If the system fails the BIT with a critical failure, the TAFS shall not be allowed to be initialized. For a non-critical failure (for example, failure of one axis), the operator shall be given options that include: acknowledgement of failure, compensation of failure, and completion of the TAFS's initialization sequence. During operation, if any monitored component fails, the system shall perform a controlled shutdown (if possible) and notify the operator of the nature of the failure. The operator shall then have the option to correct the error. The vendor shall also include diagnostic software (also hardware, if required) to allow (1) direct, real-time manipulation of the NCS, (2) direct, real-time TAFS operation, and (3) system closed-loop data collection for real-time Bode analysis of dynamic system closed-loop responses. This software shall (1) generate a plotted display on the GUI screen to show the collected data and (2) store the data for future analysis by NRL. The diagnostic software may be included within the GUI software.

1.2.11 **Configuration File.** The NCS shall provide a configuration file, store it on the master GUI PC, and download it to non-volatile memory whenever the NCS is turned on. This file shall contain standard operational control settings that affect system operation. Settings contained in this file shall include, but not be limited to, the following parameters:

- a) Pitch Axis Physical Position Limit - up
- b) Pitch Axis Physical Position Limit - down
- c) Yaw Axis Physical Position Limit - left
- d) Yaw Axis Physical Position Limit - right
- e) Roll Axis Physical Position Limit - clockwise
- f) Roll Axis Physical Position Limit - counter-clockwise
- g) Pitch Axis Physical Absolute Velocity Limits
- h) Yaw Axis Physical Absolute Velocity Limits
- i) Roll Axis Physical Absolute Velocity Limits
- j) D/A Scaling for Pitch Position Feedback Voltage Monitoring
- k) D/A Scaling for Yaw Position Feedback Voltage Monitoring
- l) D/A Scaling for Roll Position Feedback Voltage Monitoring
- m) D/A Scaling for Pitch Velocity Feedback Voltage Monitoring
- n) D/A Scaling for Yaw Velocity Feedback Voltage Monitoring
- o) D/A Scaling for Roll Velocity Feedback Voltage Monitoring
- p) A/D Scaling for Pitch Position External Voltage Input
- q) A/D Scaling for Yaw Position External Voltage Input
- r) A/D Scaling for Roll Position External Voltage Input
- s) A/D Scaling for Pitch Velocity External Voltage Input
- t) A/D Scaling for Yaw Velocity External Voltage Input
- u) A/D Scaling for Roll Velocity External Voltage Input
- v) Pitch Axis Error Voltage Limit
- w) Yaw Axis Error Voltage Limit
- x) Roll Axis Error Voltage Limit

1.2.11 **Packaging.** The NCS shall be packaged in a new, black, standard, 19" control rack that includes all the NCS components. The control console shall include, but not be limited to, the following electronic components or voltages:

- Power controllers and power supplies
- PC – with GUI function and an additional serial interface to support the Remote (slave) GUI
- GUI keyboard and pointing device (trackball or mouse) – to provide an operator interface to the GUI computer
- The NCS control hardware – a processor and a set of circuit boards to provide digital closed-loop control and analog servo commands to the NRL TAFS
- The NCS SCRAMNet interface hardware – auxiliary system interface circuit boards with an auxiliary processor plus a VME SCRAMNet interface board to interface with the NRL External Host Computer, via SCRAMNet, to control the TAFS
- System control panel – includes hydraulic system control, monitoring, interlock and safety functions
- GUI display monitor – for operator to monitor the GUI computer
- External analog voltage control input – to control position and velocity
- External analog voltage feedback output – to monitor position feedback and velocity feedback

1.2.12 **Roll-Axis Wiring.** All wiring that is used solely for the roll axis shall pass through a sealed connector to allow easy removal of the roll axis from the remainder of the TAFS. The sealed connector shall be accompanied by a shorting plug and shall be connected whenever the roll axis is removed. This shorting plug shall perform the functions described in Section 1.2.8.

1.2.13 **Safety Features.** The NCS shall include certain minimum, built-in safety features to protect the TAFS, the test articles on the TAFS, and the CTS operators. Any time the NCS predicts the TAFS shall exceed the positional limit on any axis, the NCS shall automatically decelerate the TAFS to avoid exceeding the limit and send an error indication to the operator or the NRL Host Computer. The NCS shall continuously monitor TAFS operation and if the NCS predicts, or detects, a problem such as an out-of-tolerance critical signal, then it shall immediately conduct an orderly shutdown.

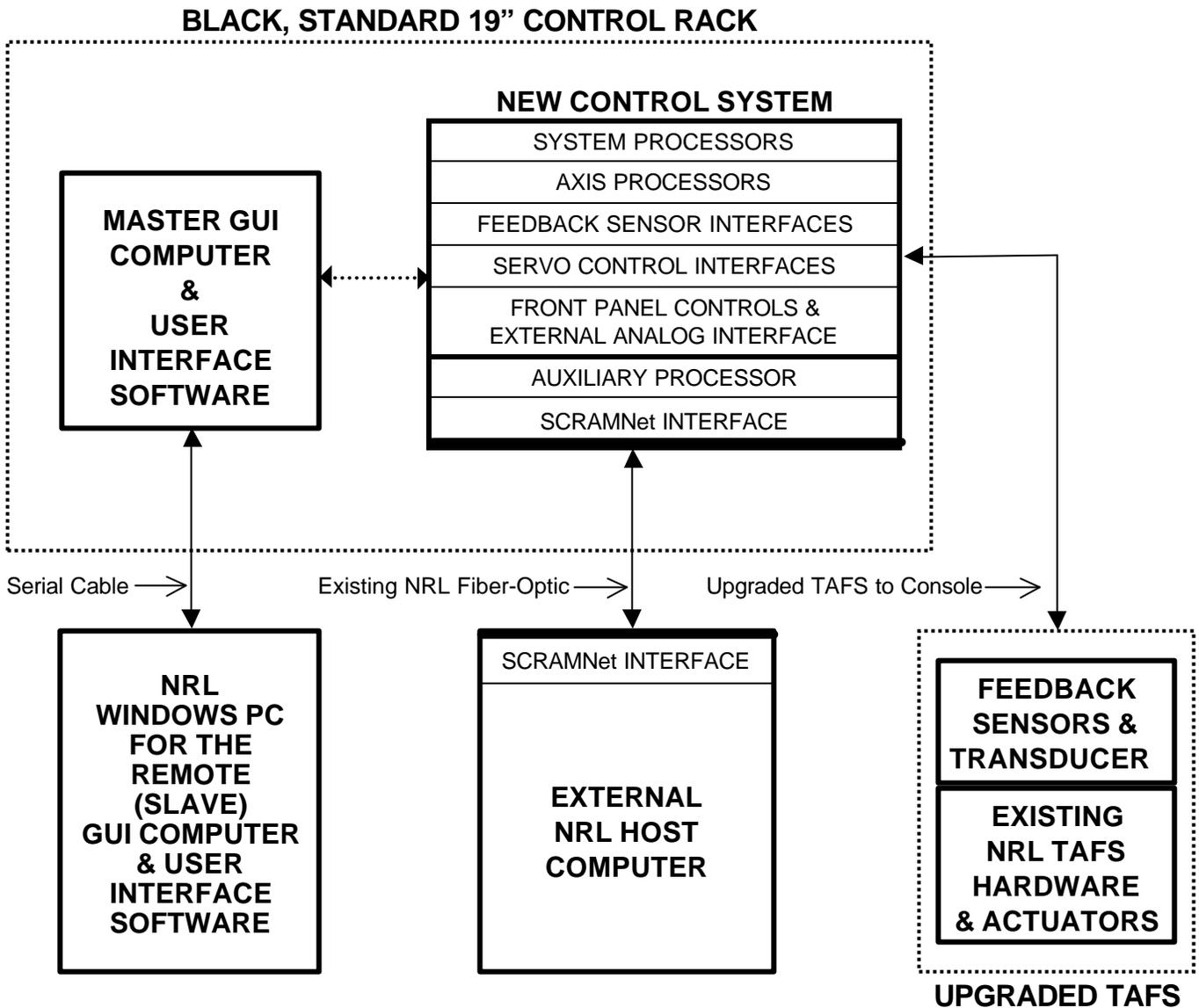


Fig. 1 – Block Diagram: The New Control System integrated with the CTS facility’s HWIL flight

2 Performance Specification for Existing NRL TAFS System. The existing NRL CARCO Electronics TAFS System includes type 1, closed-loop, analog servo amplifiers with on-axis digital-position optical encoders, high-resolution analog potentiometers, and high-resolution analog tachometers. These components operate in conjunction with high-voltage analog control electronics to provide TAFS control. Digital control is achieved, via analog control circuits, by (1) digitally generating position and velocity errors, (2) digital-to-analog conversion, and (3) applying analog control signals to analog amplifiers. The present obsolete configuration has the performance specification listed in Table 1. This Table is a reference point for the existing NRL TAFS.

Table 1

PERFORMANCE SPECIFICATION FOR EXISTING NRL TAFS SYSTEM			
PARAMETER	ROLL AXIS	PITCH AXIS	YAW AXIS
Load Information (all specifications below are defined using this load)			
Size: 16-inch diameter x 60-inch length Weight: 150 pounds			
Inertia (slug-feet ² , D=14)	1.5	15	15
Physical Flight Table Information			
Displacement (degrees)	±120	±45	±50
Maximum velocity (degrees/second)	±700	±200	±200
Maximum acceleration (degrees/second/second)	37,000	10,400	11,000
Orthogonality of axes: ± 0.005 degrees Intersection of axes: ± 0.02 inches			
DIGITAL POSITION MODE			
Minimum velocity (degrees/second)	0.002	0.002	0.002
Resolution (degrees)	0.0055	0.0055	0.0055
Repeatability (degrees)	±0.005	±0.005	±0.005
Drift, maximum, over one hour (degrees)	±0.005	±0.005	±0.005
Position accuracy (degrees)	±0.01	±0.01	±0.01
DIGITAL RATE MODE			
Minimum velocity (degrees/second)	0.002	0.002	0.002
Accuracy, averaged over 10 seconds, ± minimum velocity (percent)	±1	±1	±1
Resolution (degrees/second)	0.022	0.011	0.011

3 Performance Specification for the NRL TAFS Using the NCS. The upgraded TAFS shall be digitally controlled by the NCS with analog drivers for the TAFS servo amplifiers. The new TAFS control shall provide greater flexibility, reliability, and repeatability. The NRL TAFS, under the control of the NCS, shall meet or exceed the performance specification listed in Table 2.

Table 2

PERFORMANCE SPECIFICATION FOR NRL TAFS SYSTEM USING THE NEW CONTROL SYSTEM UPGRADE			
PARAMETER	ROLL AXIS	PITCH AXIS	YAW AXIS
Load Information (all specifications below are defined using this load)			
Size: 16-inch diameter x 60-inch length Weight: 150 pounds			
Inertia (slug-feet ² , D=14)	1.5	15	15
Physical Flight Table Information			
Displacement (degrees)	±120	±45	±50
Maximum velocity (degrees/second)	±700	±200	±200
Maximum acceleration (degrees/second/second)	37,000	10,400	11,000
Orthogonality of axes: ± 0.005 degrees Intersection of axes: ± 0.02 inches			
DIGITAL POSITION MODE			
Minimum velocity (degrees/second)	0.001	0.001	0.001
Resolution (degrees)	0.001	0.001	0.001
Repeatability (degrees)	±0.001	±0.001	±0.001
Drift, maximum, over one hour (degrees)	±0.01	±0.01	±0.01
Position accuracy (degrees)	±0.01	±0.01	±0.01
DIGITAL RATE MODE			
Minimum velocity (degrees/second)	0.001	0.001	0.001
Accuracy, averaged over 10 seconds, ± minimum velocity (percent)	±0.1	±0.1	±0.1
Resolution (degrees/second)	0.001	0.001	0.001
ANALOG FRONT PANEL CONTROL & FEEDBACK CONVERSION			
Analog input command (converted to digital) resolution (bits) {scale factor defined by the configuration file and/or GUI}	16	16	16
Analog output (converted from digital) resolution (bits) {scale factor defined by the configuration file and/or GUI}	16	16	16

- 4 **Performance Specification for the NCS.** Table 3 is the system performance specification for the NCS. The NCS shall meet or exceed the performance specification listed in Table 3.

TABLE 3

PERFORMANCE SPECIFICATION FOR THE NEW CONTROL SYSTEM	
DIGITAL OPERATING MODES	
OFF MODE (INTERNAL SERVO LOOPS OPEN)	
POSITION MODE (INTERNAL SERVO LOOPS CLOSED)	
Command range	0.00000 degrees to 359.99995 degrees or 0.00000 degrees to +/-179.99995 degrees (configurable)
Resolution	0.00005 degrees
Accuracy	<1 arc seconds, RSS
Slew Rate	0 to ±200 degrees/second
RATE MODE (INTERNAL SERVO LOOPS CLOSED)	
Command Range	0.00000 degrees/second to ±1499.99995 degrees/second
Resolution	0.00005 degrees/second, full range
Stability	0.001% over 360 degrees
DATA READOUT CAPABILITY	
POSITION ENCODER SYSTEM	
Feedback Transducer Accuracy	±1 arc-second
ABSOLUTE POSITION ENCODING SYSTEM	
Internal System update rate	3.6 kilohertz, basic
Closed-loop phase lag	3.5 degrees at 4 hertz
Stability	±0.19 arc-second
Quantization	0.19 arc-second
Accuracy, peak	0.73 arc-second + feedback sensor
Velocity error	<1.0 arc-second /100 degrees/second
Acceleration error	0.13 arc-second/radian/second ² (6.4×10^{-7} x acceleration)
Range	0.0000 degree to 359.99995 degree absolute angle
Digital Resolution	0.00005 degrees

5 Performance Specification for SCRAMNet Interface Hardware. The SCRAMNet interface shall provide a high-performance, real-time status and control interface for the NCS. This interface shall enable the NRL External Host Computer to control the TAFS, via the NCS, during HWIL simulations, open-loop tests and CTS facility calibration. Also, the interface shall use a loop-through fiber-optic cable to connect multiple nodes into a network. The NRL External Host Computer has the capability to (1) control the TAFS or receive TAFS status. SCRAMNet control of the TAFS, via the NCS, shall be based on a dual fiber-optic ring, with a SCRAMNet interface adapter to join the NCS, as a peripheral node, to the NRL SCRAMNet network. An additional auxiliary processor shall handle the transfer of data between the VME SCRAMNet interface board and the NCS digital memory. For the NCS, the required performance specification of the SCRAMNet board is listed in Table 4.

TABLE 4

PERFORMANCE SPECIFICATION FOR SCRAMNET INTERFACE HARDWARE	
Board type	SCRAMNet PLUS (VME)
Replicated shared-memory size	1 Megabyte
Maximum number of nodes	256
Transmission medium	Standard fiber – paired 62.5-micron core multi-mode fiber cable
Maximum node separation	Standard fiber – 300 meters
Network data bandwidth	6.5 megabytes/second (4 bytes/packet)
Node latency (per node)	250 – 800 nanoseconds (4 bytes/packet)
Memory interface	Replicated memory
Media access board type	Fiber-optic media card using standard 820-nanometer wavelength

6 Required Features for the PC GUI (Master and Remote) Interfaces. Tables 5 and 6 provide the minimum features required for NRL operator control of the NCS, via the PC GUI interface. The master GUI (located in the CTS TAFS room) will allow continuous monitoring (at a minimum update rate of 5 hertz) and manual control of the NCS. The remote (slave) GUI (located in CTS’s operator control room) shall provide continuous monitoring (at a minimum update rate of 5 hertz) and manual control of the NCS, via the master GUI, only when allowed by the master GUI. Control of the GUI shall be achievable with the following: pointing device (trackball or mouse), keyboard, and menu selection. The GUI interface features shall meet or exceed those listed in Tables 5 and 6.

TABLE 5

GUI INTERFACE – OPERATIONAL MONITORING FEATURES
MASTER GUI DISPLAY (1 each for the Roll, Pitch & Yaw axis)
Display Position in degrees (0.001 degree resolution)
Display Velocity in degrees/second (0.001 degree/second resolution)
Axis Gain (high or low)
Axis Control Mode (digital or external analog)
Soft Limit Settings for Position and Velocity
Current Axis Status
MASTER GUI DISPLAY – System Level
System Status (operating status & failure modes)
Operating Mode (local GUI, remote GUI, NRL external host computer)
Auxiliary Processor Operational Status
REMOTE GUI DISPLAY (1 each for the Roll, Pitch & Yaw axis)
Display Position in degrees (0.001 degree resolution)
Display Velocity in degrees/second (0.001 degree/second resolution)
Axis Gain (high or low)
Axis Control Mode (digital or external analog)
Soft Limit Settings for Position and Velocity
Current Axis Status
REMOTE GUI DISPLAY – System Level
System Status (operating status and failure modes)
Operating Mode (local GUI, remote GUI, NRL external host computer)

TABLE 6

GUI INTERFACE – OPERATIONAL CONTROL FEATURES
MASTER GUI CONTROL/DISPLAY (1 each for the Roll, Pitch and Yaw axis)
Commanded Position in degrees (0.001 degree resolution)
Commanded Velocity in degrees/second (0.001 degree/second resolution)
Set Axis Gain (high or low)
Set Axis Control Mode (digital or external analog)
Input Soft Limit Settings for Position (0.001 degree resolution)
Input Soft Limit Settings for Velocity (0.001 degree/second resolution)
Use Axis (on or off)
MASTER GUI CONTROL/DISPLAY – System Level
Set Lock Out of Remote GUI (yes or no)
Set Operating Mode (local GUI, remote GUI, NRL external host computer)
Auxiliary Processor Reset
REMOTE GUI CONTROL/DISPLAY (1 each for the Roll, Pitch and Yaw axis)
Commanded Position in degrees (0.001 degree resolution)
Commanded Velocity in degrees/second (0.001 degree/second resolution)
Set Axis Gain (high or low)
Set Axis Control Mode (digital or external analog)
Input Soft Limit Settings for Position (0.001 degree resolution)
Input Soft Limit Settings for Velocity (0.001 degree/second resolution)
Use Axis (on or off)
REMOTE GUI CONTROL/DISPLAY – System Level
Set Operating Mode (local GUI, remote GUI, NRL external host computer)

EXHIBIT B

**REPLACEMENT CTS
FLIGHT-TABLE CONTROL SYSTEM**

SCRAMNet INTERFACE CONTROL

**For The
Central Target Simulator Facility**

**NAVAL RESEARCH LABORATORY
4555 Overlook Avenue, SW
Washington, DC 20375**

**Integrated Electronic Warfare Simulation Branch
Tactical Electronic Warfare Division**

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PERFORMANCE SPECIFICATION/DESCRIPTION

OF THE

SCRAMNET INTERFACE CONTROL

1 SUMMARY DESCRIPTION OF THE SCRAMNET INTERFACE CONTROL

1.1 Overview

The host communications interface permits multiple host computers to send commands and receive status/configuration information from the New Control System (NCS) through a Systran SCRAMNet replicated shared-memory hardware interface. While multiple host computer systems may be attached to the NCS through SCRAMNet, only one host computer system shall be able to issue commands to the NCS during a session. For the purpose of describing the host communications interface, the NCS hardware consists of the NCS's main computer processor, feedback interface, timing generator, and three-axis computer register interfaces.

2. HARDWARE REQUIREMENTS

Host communications hardware shall consist of an auxiliary VME processor board and a Systran SCRAMNet shared-memory interface and a VME 6U interface chassis. The vendor may select any current production Intel/AMD Pentium/x86 or Motorola 68040/PowerPC VME 6U processor board that meets software requirements, as outlined in this specification. The Systran shared-memory interface shall be a SCRAMNet Plus SC150 Series with one megabyte of on-board shared memory and standard fiber-optic media interface. The vendor must select the VME 6U or PCI Mezzanine Card (PMC) bus interface for the SCRAMNet Plus adapter. Since all SCRAMNet communications variables and structures (in this and associated documents) are described in terms of Intel's Pentium/x86 little-endian byte and bit-field ordering, a Pentium/x86 processor with a PMC interface is recommended. The vendor shall provide both the auxiliary VME processor and SCRAMNet interface as part of the delivered system. Both the auxiliary processor and SCRAMNet shall be installed inside the VME chassis for host computer communications to the NCS hardware.

3. COMMUNICATIONS SOFTWARE

3.1 GENERAL

The purpose of the auxiliary processor is to process remote host communications from the SCRAMNet interface to the NCS system. Thus, all host-communications software shall execute exclusively on the auxiliary processor and all direct access to the SCRAMNet interface board shall be performed by the auxiliary processor. The auxiliary processor shall be slaved to the NCS's main processor for the purpose of initialization and status monitoring. After NCS initialization, the auxiliary processor shall wait for host commands through SCRAMNet, execute those commands, and return results of success or failure through the SCRAMNet interface. Software developed for the auxiliary processor shall exclusively be C-

program language source (no C++ or assembly source) and developed with WindRiver Systems VxWorks version 5.3, or higher.

3.2 SCRAMNET EEPROM INITIALIZATION

At power on, the SCRAMNet interface shall be initialized, via its on-board EEPROM, to disable transmission and reception of messages on the network, and not be inserted on the network ring. The SCRAMNet interface-interrupts and shared-memory address shall also be disabled via its on-board EEPROM.

3.3 MAIN-TO-AUXILIARY PROCESSOR COMMUNICATIONS

Main-to-auxiliary processor communications shall provide three functions: auxiliary processor reset, auxiliary processor activity counter, and, optionally, NCS configuration parameters. Communications between the processors shall be provided by the main processor dual-port RAM (DPRAM) and a mailbox interrupt.

3.3.1 Mailbox Interrupt

The main processor shall generate the mailbox interrupt at a one-Hertz rate. After the auxiliary processor completes initialization of SCRAMNet communications, the auxiliary processor receives and processes the interrupt by first checking for a reset command in DPRAM (see Section 3.3.2). If the main processor previously sent a reset command, then the auxiliary processor shall reset itself and reinitialize the SCRAMNet interface. If the main processor did not send a reset command to the auxiliary processor, then the auxiliary processor shall increment the activity counter (see Section 3.3.3) and cease mailbox-interrupt processing. The auxiliary processor mailbox-interrupt shall have a higher priority interrupt than any SCRAMNet communications interrupt or task.

3.3.2 AUXILIARY PROCESSOR RESET

At NCS-system power on or VME-hardware reset, the auxiliary processor shall wait for a reset command from the main processor before initializing and executing any host communications software. The main processor shall issue the reset command to the auxiliary processor during initialization, using a full handshaking routine with the DPRAM. Also, while the host communications software executes on the auxiliary processor, it shall be possible to accept and perform a reset command from the main processor, using the mailbox interrupt and DPRAM. Note that the main processor shall have a console-mounted graphical user interface (GUI) which includes a function to only reset the auxiliary processor.

3.3.3 AUXILIARY PROCESSOR ACTIVITY COUNTER

While the auxiliary processor executes host communications software it shall maintain an activity counter to indicate it is operating properly. The activity counter shall have a memory location in the main processor's DPRAM. The counter shall be incremented one count per mailbox interrupt if no reset command was issued from the main processor. A changing count on the main processor indicates the

auxiliary processor is operating properly. The operational status of the auxiliary processor shall be visible on the main processor console GUI. Additionally, if programmable status LED's are available on the auxiliary processor board, then they shall indicate the operational status of the auxiliary processor.

3.3.4 NCS CONFIGURATION PARAMETERS (OPTIONAL)

The vendor may optionally propose a procedure to allow the auxiliary processor to obtain current configuration parameters or files from the DPRAM on the main processor. Access to the configuration parameters may only be read by the auxiliary processor. The auxiliary processor transports the configuration parameters to a requesting SCRAMNet host computer, using the Real-Time Network (RTN) communications protocol.

3.4 AUXILIARY PROCESSOR-TO-NCS COMMUNICATIONS

3.4.1 NCS Registers Access

After the master processor completes total initialization, the auxiliary processor shall be capable of communicating with the NCS hardware through register locations identified in Table 1. The VME address locations for these registers shall be defined in C header file ncs_ports.h. Only the main processor's console-mounted GUI shall have the access and ability to enable or disable command writes to each axis when the auxiliary processor writes to command registers. In other words, if the auxiliary processor writes to an axis whose command registers have been disabled by the GUI console, the VME write-bus operation will be completed but no data will be transferred to the NCS hardware for action. The auxiliary processor at all times shall be capable of reading status information from NCS registers after auxiliary processor initialization.

Table 1: SCRAMNet remote command and status registers

Description	Size	Operation
Roll Commanded Position	32 bits	read/write
Roll Commanded Velocity	32 bits	read/write
Roll Commanded Acceleration	32 bits	read/write
Roll Commanded Mode	32 bits	read/write
Roll Status Position	32 bits	read only
Roll Status Velocity	32 bits	read only
Roll Status Acceleration	32 bits	read only
Roll Processing Status	32 bits	read only
Pitch Commanded Position	32 bits	read/write
Pitch Commanded Velocity	32 bits	read/write
Pitch Commanded Acceleration	32 bits	read/write
Pitch Commanded Mode	32 bits	read/write
Pitch Status Position	32 bits	read only
Pitch Status Velocity	32 bits	read only
Pitch Status Acceleration	32 bits	read only
Pitch Processing Status	32 bits	read only
Yaw Commanded Position	32 bits	read/write
Yaw Commanded Velocity	32 bits	read/write

Yaw Commanded Acceleration	32 bits	read/write
Yaw Commanded Mode	32 bits	read/write
Yaw Status Position	32 bits	read only
Yaw Status Velocity	32 bits	read only
Yaw Status Acceleration	32 bits	read only
Yaw Processing Status	32 bits	read only

3.4.2 NCS Data Register Formats

Referring to Table 1, command and status data for each axis position, velocity, and acceleration registers shall have 32-bit two's complement integer notation and attributes specified in Table 2. Note the numeric range of each data type in Table 2 can be further constrained by the physical characteristics of each axis.

Data Type	Resolution	Range
Position	0.00005 degree, maximum	± 179.99995 degrees, minimum
VELOCITY	0.00005 degrees/second, maximum	$\pm 3,000$ degrees/second, minimum
ACCELERATION	0.00005 degrees/second/second, maximum	100,000 degrees/sec/sec, minimum

Table 2: Data register representations.

3.4.3 NCS Control and Status Registers Format

Each axis shall include a 32-bit commanded-mode register as shown in Table 1. All bits in the register do not have to be used, but, as a minimum, the bits shall command/indicate the following modes:

- a) Hard Position: Command the axis to move to the position register value without exceeding the current acceleration and velocity limit parameters;
- b) Soft Position: Command the axis to move to the position register value, using the acceleration register value to achieve the velocity register value. As the axis approaches the commanded position, it shall decelerate at the acceleration register value to stop at the commanded position;
- c) Soft Velocity: Command the axis to move at the rate of the velocity register value, using the acceleration register value to achieve the velocity register value. The axis shall continue to move at the velocity register value until a change to a new velocity, mode, or a limit condition is reached;
- d) Gain Selection: Command the axis servo feedback gain to low or normal (high) gain; and
- e) Clear Error: Clear the non-fatal errors indicated in the processing status register. Note fatal errors shall require a manual restart of the axis software/hardware.

Each axis shall include a 32-bit processing status register as shown in Table 1. All bits in the register need not be used but, as a minimum, the bits must indicate the following statuses:

- a) Remote host-command interface enabled/disabled. This bit shall indicate whether the auxiliary processor may issue commands to the axis. Note the auxiliary processor shall issue commands on behalf of SCRAMNet remote hosts;
- b) Error codes, if any, from the most recent axis commanded operation. One bit of this code shall indicate whether an error was fatal or non-fatal;
- c) Axis Servo Status: Bits that shall indicate whether the axis servo is operating on position, velocity and/or acceleration commands. Also, indicates whether the axis is in low or normal (high) gain; and
- d) Command Complete: This bit indicates whether the last issued command has been completed on the axis.

3.4.4 NCS Data Register Transfers

The vendor shall incorporate hardware logic interlocks to prevent the auxiliary processor from reading status registers (position, velocity, acceleration, and processing status) while being updated by NCS. Additionally, if two or more accesses are required to read the 32-bit NCS status registers, hardware logic interlocks shall be incorporated to prevent the auxiliary processor from reading partial updates written by the NCS.

The vendor shall incorporate hardware logic interlocks to prevent the NCS from reading command registers (position, velocity, acceleration, and commanded mode) while being updated by NCS. Additionally, if two or more accesses are required to write the 32-bit NCS command registers, hardware logic interlocks shall be incorporated to prevent the NCS from reading partial commands written by the auxiliary processor.

The maximum time to read or write valid data on a hardware-interlocked 32-bit NCS register shall not exceed 4 microseconds. The NCS shall apply new command data, written by the auxiliary processor, into the axis motion dynamics within 300 microseconds, if the command data is valid. Axis motion dynamics shall be updated to the NCS status registers within 300 microseconds.

3.5 Real-Time Network (RTN) Communications Protocol

The RTN Communications Protocol is a custom-designed real-time communications protocol development that shall use SCRAMNet hardware to communicate with the existing facility's three-axis flight simulator (TAFS). The RTN protocol shall permit a host computer to control (or master) a slave computer that operates specific facility hardware (such as data acquisition systems, RF signal generators, flight tables, etc.) when interconnected through SCRAMNet. Each slave computer shall be a task/resource that can be acquired by the host computer to command and receive data. The protocol shall encapsulate, transport, as well as validate command and status data moving between the host and slave computers. Slave computers shall write commands to (and read status from) specific hardware registers, ports, and memory locations on the facility hardware. In the NCS upgrade to TAFS, the auxiliary processor shall be a slave computer that provides communications between SCRAMNet and the NCS. The NCS registers and main processor DPRAM acts as registers, ports, and memory to be controlled and read.

Pseudocode.doc (Appendix A) shall be the processing specification for the auxiliary processor executing the RTN communications protocol on the NCS system. C-source code sections identified in pseudocode.doc shall be incorporated as indicated; the remaining code is for reference only. The C-

source code describes a detailed implementation of RTN communication protocol on the existing TAFS slave system that is not interrupt-driven. In the NCS upgrade to TAFS, the RTN communications protocol shall be interrupt-driven; data received on the NCS SCRAMNet interface shall cause an interrupt for the auxiliary processor to process the incoming data.

3.5.1 AUXILIARY PROCESSOR AND SCRAMNET COMMUNICATIONS BUFFERS

The RTN communications protocol shall be implemented through three buffers maintained on the SCRAMNet dual-port memory of the NCS. The buffers are NCS communications status, NCS command input, and NCS data output. Offsets for the location of buffers in SCRAMNet shall be provided in file `rtn_node.h` (Appendix C). Structures for the buffers are defined in file `rtn_stru.h` as `comm_status_buf_def`, `cmd_input_buf_def` and `data_output_buf_def`. A description of the data elements that make up the buffers shall be located in `SCRAMNet_structures.doc` (Appendix B). The communication status buffer shall maintain SCRAMNet network status and shall be “shadowed” in the auxiliary-processor local memory for reliability. Host commands to the NCS shall be placed in the command-input buffer in which the auxiliary processor verifies the buffer input and transfers the command data structure to local memory for further processing. NCS-status data output shall be constructed in the auxiliary-processor local memory and then transferred to NCS-data output buffer for reading by the host computer. Only data structures, defined by `rtn_stru.h` and offsets defined by `rtn_node.h`, shall be placed in SCRAMNet dual-port memory. All memory data transfers between the auxiliary processor and the SCRAMNet shared-dual-port 32-bit memory shall be on a 32-bitwide data bus.

3.5.2 AUXILIARY PROCESSOR COMMAND INPUT BUFFER STRUCTURES

User command data received from the host computer via SCRAMNet shall be validated as it is copied into auxiliary-processor local memory as `usercmddata[56]`; refer to `rtn_stru.h`. Based upon `cmdkey`, the data in `usercmddata[56]` shall be processed, if applicable, to that specific `cmdkey`. The `cmdkey` shall determine the structure of `usercmddata[56]`, if required. Command input `framenum` shall be used for status output `framenum` when a command produces the status output.

3.5.3 AUXILIARY PROCESSOR STATUS OUTPUT BUFFER STRUCTURE

Status data from the NCS system shall be generated as a result of host computer commands. Based upon host-requested information, the auxiliary processor shall build an appropriate status output structure defined in `rtn_stru.h`. The structure shall be built into auxiliary-processor local memory as `userstatusdata[56]`. The interpretation of `userstatusdata[56]` shall be determined by status type; and the command `framenum` to produce this status output shall be included.

3.5.4 AUXILIARY PROCESSOR VARIABLES AND HEADER DEFINITIONS

Global structures, variables, and bit-fields declared for the auxiliary-processor RTN protocol shall use definitions provided in `tafsstru.h` and `rtn_stru.h`. Note multiple byte members within structures shall follow Intel Pentium/x86 “little-endian” byte ordering and bit-fields within a byte, word, or double word. Such allocations shall begin with the least significant bit (bit position 0) of an integer byte, word, or double

word. The vendor shall preserve “little-endian” byte ordering and bit-field allocations of structures defined in tafsstru.h and rtn_stru.h.

In this document and pseudocode.doc, “local” or “shadow” refers to variables stored in the auxiliary processor’s on-board memory whereas “buffer” refers to variables stored in SCRAMNet dual-port memory as structure members. During RTN communications processing, local shadow communications variables shall always be created/updated first and then copied to the SCRAMNet dual-port memory buffers. A header definition (.h file) shall contain defined values for initializing SCRAMNet hardware control registers for node identification number (csr3) and transmit timeout (csr5). The same header file shall contain definitions for RTN protocol heartbeat refresh rate (HEARTRATE, in tenths of seconds) and RTN protocol link timeout (NETTIMEMAX, in seconds).

3.6 AUXILIARY PROCESSOR PROCESSING

3.6.1 General

Refer to pseudocode.doc for the protocol processing specification. After initialization of the auxiliary processor, the auxiliary processor shall be driven by at least three interrupting tasks. The three interrupt tasks are (1) new command input buffer data, (2) RTN protocol heartbeat, and (3) RTN protocol link timeout.

3.6.2 Initialization

After the NCS main processor initializes the auxiliary processor, the auxiliary processor shall initialize the SCRAMNet adapter interface. SCRAMNet control registers csr3 and csr5 shall be initialized with values from the header file. This initialization should also initialize auxiliary-processor hardware such as interrupts and timers. Initialization of the RTN communications protocol is accomplished by setting logging variables, a random number generator, and the shadow communications status variables.

3.6.3 Interrupt Tasks

The three required interrupting tasks are described in pseudocode.doc as New_Command_Input, Heartbeat_Update and Link_Timeout. The tasks are listed in the order of highest to lowest priority. When one of these tasks begins to execute, it shall be completed before either the other two tasks can begin to execute (typically referred to as task mutual-exclusion). Interrupt processing shall be implemented such that higher-priority tasks do not wait an indefinite period of time for a lower-priority task to be completed (typically referred to as priority-inversion). Note both task mutual-exclusion and prevention of task priority-inversion can be implemented with WindRiver VxWorks’ mutual-exclusion semaphores. Prevention of task priority-inversion and task mutual-exclusion is a software requirement not explicitly stated in pseudocode.doc.

The three required interrupt service routines (ISRs), which run in a special context (not a task context) in VxWorks, merely give semaphores to the associated pending tasks. Once a specific task is given a semaphore, the task processes relevant information associated with that interrupt and then reenters a pending state for the next interrupt-given semaphore.

3.6.4 NCS Command Keys (cmdkey)

Commands for the NCS system shall be invoked through the `rtns_command` located in Source Code Section E. TAFS cmdkeys in the range of 1000 to 1007 shall be replaced with NCS cmdkeys in the range of 1010 to 1030. Pseudocode.doc describes the new NCS cmdkeys and their operations. NCS cmdkeys 1023 and 1025 shall complete commanded operations and output status on SCRAMNet within 500 microseconds when no fatal errors have occurred.

Commands and status output on the NCS system, using the RTN communications protocol, shall be in engineering units of degrees for position, degrees/second for velocity, and degrees/second/second for acceleration. All engineering units are represented as IEEE floating-point values as outlined in `rtn_stru.h`. Therefore, the vendor shall incorporate algorithms to convert to/from RTN protocol engineering units and the NCS hardware data registers. Axis motion conventions for RTN commands and status are defined in Table 3, when standing behind the flight table and facing toward the antenna array, as follows:

	Roll Axis	Pitch axis	Yaw Axis
Positive Positions	clockwise from "noon"	up from antenna array center	right of antenna array center
Negative Positions	counter-clockwise from "noon"	down from antenna array center	left of antenna array center
Positive Velocity	clockwise movement	up movement	right movement
Negative Velocity	counter- clockwise movement	down movement	left movement

Table 3: RTN protocol command and status conventions.

4. Diagnostics Software

The vendor shall provide Systran SCRAMNet Plus software (or a functional equivalent) for the delivered auxiliary VME processor and SCRAMNet adapter interface. This software consists of a complete SCRAMNet diagnostics utility, EEPROM initialization utility, interrupt handler, and an interactive utility to read/write SCRAMNet resources.

5. Software Deliverables

The vendor shall deliver on a compact disk (CD-ROM), readable by Microsoft Windows NT 4.0, C source code, header, and other applicable development files used to create the SCRAMNet communications and diagnostics software for the auxiliary processor. All C library routines that are not part of WindRiver's VxWorks C developer library routines, or a VxWorks board support package (BSP), shall have their C source code included on the CD-ROM.

Appendix A: Pseudocode.doc

A Microsoft Word file which describes detailed processing steps for the NCS auxiliary processor to perform host computer communications through the SCRAMNet interface. This makes reference to Appendix B: C Source Language Code for code that is to be incorporated in the NCS SCRAMNet software interface. {Submitted in electronic format on Microsoft MS-DOS floppy or CD-ROM.}

Appendix B: SCRAMNet_structures.doc

A Microsoft Word file that describes SCRAMNet shared-memory data structures required for host computer communications. {Submitted in electronic format on Microsoft MS-DOS floppy or CD-ROM.}

Appendix C: C-Source Language Code

The collection of C-Source Language Code (text format) used to create the current TAFS SCRAMNet host communications interface. Sections of code identified by Appendix A: Pseudocode.doc shall be incorporated into the NCS SCRAMNet interface software. Additionally, source code that must be integrated into NCS shall be identified in comment statements with the word "NCS". {Submitted in electronic format on Microsoft MS-DOS floppy or CD-ROM.}

CONTRACT DATA REQUIREMENTS LIST

(2 Data Items)

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Public reporting burden for this collection of information is estimated to average 220 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503. Please DO NOT RETURN your form to either of these addresses. Send completed form to the Government issuing Contracting Officer for the Contract/PR No. listed in Block E.

A. CONTRACT LINE ITEM NO.		B. EXHIBIT C		C. CATEGORY: TDP _____ TM _____ OTHER _____			
D. SYSTEM / ITEM SEE BLOCK 16			E. CONTRACT / PR NO.		F. CONTRACTOR		
1. DATA ITEM NO. A005	2. TITLE OF DATA ITEM ACCEPTANCE TEST DATA			3. SUBTITLE N/A			
4. AUTHORITY (Data Acquisition Document No.) N/A			5. CONTRACT REFERENCE SOW, PARA. 6.5		6. REQUIRING OFFICE NRL. COR		
7. DD 250 REQ NO	9. DIST STATEMENT REQUIRED	10. FREQUENCY ONCE		12. DATE OF FIRST SUBMISSION			
8. APP CODE N/A		11. AS OF DATE SEE BLOCK 16		13. DATE OF SUBSEQUENT SUBMISSION N/A			
14. DISTRIBUTION			b. COPIES				
a. ADDRESSEE			Draft			Final	
						Reg	
16. REMARKS D. REPLACEMENT CTS FLIGHT-TABLE CONTROL SYSTEM 11. THE CONTRACTOR SHALL SUBMIT ALL RELEVANT TEST DATA WITHIN 30 DAYS AFTER FINAL ACCEPTANCE TEST			COR, CODE 5762			2	
15. TOTAL →						2	
1. DATA ITEM NO. A006	2. TITLE OF DATA ITEM SYSTEMS OPERATIONAL MANUAL			3. SUBTITLE N/A			
4. AUTHORITY (Data Acquisition Document No.) N/A			5. CONTRACT REFERENCE SOW, PARA. 6.6		6. REQUIRING OFFICE NRL. COR		
7. DD 250 REQ NO	9. DIST STATEMENT REQUIRED	10. FREQUENCY ONCE		12. DATE OF FIRST SUBMISSION			
8. APP CODE N/A		11. AS OF DATE SEE BLOCK 16		13. DATE OF SUBSEQUENT SUBMISSION N/A			
14. DISTRIBUTION			b. COPIES				
a. ADDRESSEE			Draft			Final	
						Reg	
16. REMARKS 11. WITHIN 90 DAYS AFTER ACCEPTANCE TESTING AT NRL, THE CONTRACTOR SHALL SUBMIT THE FOLLOWING DOCUMENTS: a. SYSTEM DESCRIPTIONS b. OPERATION INSTRUCTIONS c. CALIBRATION PROCEDURES d. BIT DESCRIPTION ALL MANUALS, CHARTS, AND DIAGRAMS OF ACCEPTANCE TEST AND DATA FILES SHALL BE DELIVERED ON MICROSOFT WINDOWS, PC-COMPATIBLE CD-ROM MEDIA AND 2 HARDCOPY BOOKS.			COR, CODE 5762			2	
15. TOTAL →						2	
G. PREPARED BY Code 5762			H. DATE 02-24-00		I. APPROVED BY		J. DATE

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18. ESTIMATED TOTAL PRICE

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A. CONTRACT LINE ITEM NO.		B. EXHIBIT		C. CATEGORY:		
		C		TDP _____ TM _____ OTHER _____		
D. SYSTEM / ITEM			E. CONTRACT / PR NO.		F. CONTRACTOR	
SEE BLOCK 16						
1. DATA ITEM NO.	2. TITLE OF DATA ITEM			3. SUBTITLE		
A007	SYSTEMS MAINTENANCE MANUAL			N/A		
4. AUTHORITY (Data Acquisition Document No.)			5. CONTRACT REFERENCE		6. REQUIRING OFFICE	
N/A			SOW, PARA. 6.7		NRL. COR	
7. DD 250 REQ	9. DIST STATEMENT REQUIRED	10. FREQUENCY	12. DATE OF FIRST SUBMISSION		14. DISTRIBUTION	
NO		ONCE				
8. APP CODE		11. AS OF DATE	13. DATE OF SUBSEQUENT SUBMISSION	a. ADDRESSEE	b. COPIES	
N/A		SEE BLOCK 16	N/A	Draft	Final	
16. REMARKS D. REPLACEMENT CTS FLIGHT-TABLE CONTROL SYSTEM 11. WITHIN 90 DAYS AFTER THE MADES SYSTEM IS INSTALLED, THE CONTRACTOR SHALL SUBMIT A SYSTEM MAINTENANCE MANUAL ALL MANUALS, CHARTS, AND DIAGRAMS OF ACCEPTANCE TEST, AND DATA FILES SHALL BE DELIVERED ON MICROSOFT WINDOWS, PC-COMPATIBLE CD-ROM MEDIA AND 2 HARDCOPY BOOKS				Reg	Repro	
				COR, CODE 5762	2	
				15. TOTAL	2	

1. DATA ITEM NO.	2. TITLE OF DATA ITEM		3. SUBTITLE			
A008	HARDWARE DOCUMENTATION		N/A			
4. AUTHORITY (Data Acquisition Document No.)			5. CONTRACT REFERENCE		6. REQUIRING OFFICE	
N/A			SOW, PARA. 6.8		NRL. COR	
7. DD 250 REQ	9. DIST STATEMENT REQUIRED	10. FREQUENCY	12. DATE OF FIRST SUBMISSION		14. DISTRIBUTION	
NO		ONCE				
8. APP CODE		11. AS OF DATE	13. DATE OF SUBSEQUENT SUBMISSION	a. ADDRESSEE	b. COPIES	
N/A		SEE BLOCK 16	N/A	Draft	Final	
16. REMARKS 11. WITHIN 90 DAYS AFTER THE MADES SYSTEM IS INSTALLED, THE CONTRACTOR SHALL SUBMIT THE FOLLOWING INFORMATION: a. FUNCTIONAL BLOCK DIAGRAMS b. THEORY OF OPERATION c. SYSTEM-LEVEL BLOCK DIAGRAMS, FIGURES, AND DRAWINGS d. WIRING DIAGRAMS e. CONNECTOR PIN-OUTS ALL MANUALS, CHARTS, AND DIAGRAMS OF ACCEPTANCE TEST, AND DATA FILES SHALL BE DELIVERED ON MICROSOFT WINDOWS, PC-COMPATIBLE CD-ROM MEDIA AND 2 HARDCOPY BOOKS				Reg	Repro	
				COR, CODE 5762	2	
				15. TOTAL	2	

G. PREPARED BY		H. DATE	I. APPROVED BY		J. DATE
Code 5762		02-24-00			

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CONTRACT DATA REQUIREMENTS LIST

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A. CONTRACT LINE ITEM NO.	B. EXHIBIT	C. CATEGORY: TDP _____ TM - _____ OTHER _____
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D. SYSTEM / ITEM SEE BLOCK 16	E. CONTRACT / PR NO.	F. CONTRACTOR
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1. DATA ITEM NO. A009	2. TITLE OF DATA ITEM SYSTEMS SOFTWARE DOCUMENTATION	3. SUBTITLE
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4. AUTHORITY (Data Acquisition Document No.) N/A	5. CONTRACT REFERENCE SOW. PARA. 6.9	6. REQUIRING OFFICE NRL. COR
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7. DD 250 REQ NO	9. DIST STATEMENT REQUIRED	10. FREQUENCY ONCE	12. DATE OF FIRST SUBMISSION	14. DISTRIBUTION	
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8. APP CODE N/A	11. AS OF DATE SEE BLOCK 16	13. DATE OF SUBSEQUENT SUBMISSION N/A	14. DISTRIBUTION		
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16. REMARKS	15. TOTAL →																								
<p>D. REPLACEMENT CTS FLIGHT-TABLE CONTROL SYSTEM</p> <p>11. WITHIN 90 DAYS AFTER COMPLETION OF THE CONTRACT, THE CONTRACTOR SHALL SUBMIT THE FOLLOWING ITEMS:</p> <p>a. LICENSED COPIES (SOURCE DISKS AND DOCUMENTATION) FOR ALL OPERATING SYSTEMS AND COMMERCIAL DEVELOPMENT (COMPILER) SOFTWARE</p> <p>b. FLOW CHARTS FOR CUSTOM SOFTWARE</p> <p>c. LISTINGS OF CUSTOM SOFTWARE (HARDCOPY AND SOFTCOPY; ALL SOFTWARE IS COMMENTED AND PREPARED IN ACCORDANCE WITH GOOD COMMERCIAL PRACTICE)</p> <p>d. SOFTWARE-USER GUIDES FOR COMMERCIAL SOFTWARE</p> <p>e. THE SOURCE CODES OF ALL NONCOMMERCIAL SOFTWARE USED TO DEVELOP AND OPERATE THE SYSTEM</p> <p>f. BACKUP COPY OF ALL SOFTWARE ON CD-ROM</p> <p>g. ALL OPERATIONS, SOFTWARE, AND MAINTENANCE MANUAL ASSOCIATED WITH COMMERCIAL EQUIPMENT; AND ALL CUSTOM SOFTWARE BACKED UP ON CD-ROM</p> <p>ALL MANUALS, CHARTS, AND DIAGRAMS OF ACCEPTANCE TEST, AND DATA FILES SHALL BE DELIVERED ON MICROSOFT WINDOWS, PC-COMPATIBLE CD-ROM MEDIA AND 2 HARDCOPY BOOKS.</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">a. ADDRESSEE</td> <td style="width: 10%;">Draft</td> <td colspan="2" style="width: 40%;">b. COPIES</td> </tr> <tr> <td style="text-align: center;">COR, CODE 5762</td> <td></td> <td colspan="2"></td> </tr> <tr> <td></td> <td></td> <td colspan="2" style="text-align: center;">Final</td> </tr> <tr> <td></td> <td></td> <td style="text-align: center;">Reg</td> <td style="text-align: center;">Repro</td> </tr> <tr> <td></td> <td></td> <td style="text-align: center;">2</td> <td></td> </tr> <tr> <td colspan="2" style="text-align: right;">15. TOTAL →</td> <td colspan="2" style="text-align: center;">2</td> </tr> </table>	a. ADDRESSEE	Draft	b. COPIES		COR, CODE 5762						Final				Reg	Repro			2		15. TOTAL →		2	
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