AD/A-006 932

DATACOMPUTER SUPPORT OF SEISMIC DATA ACTIVITY

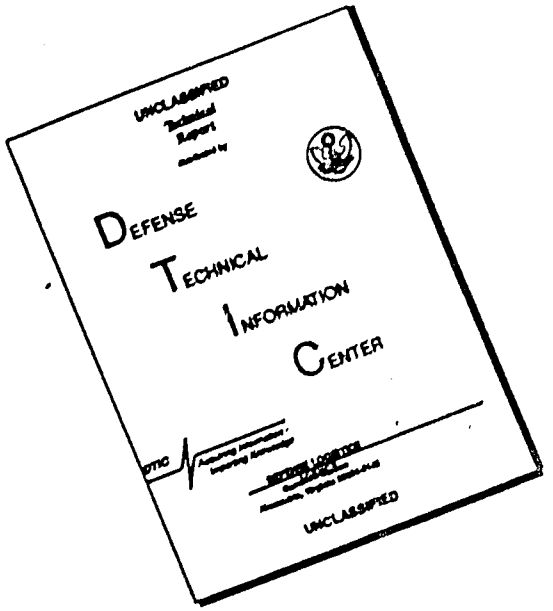
Computer Corporation of America

Prepared for:

Defense Advanced Research Projects Agency

21 March 1975

DISCLAIMER NOTICE



THIS DOCUMENT IS BEST QUALITY AVAILABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

Unclassified
Security Classification

AD/A006932

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)	2a. REPORT SECURITY CLASSIFICATION
Computer Corporation of America	Unclassified
	2b. GROUP

3. REPORT TITLE

DATACOMPUTER SUPPORT OF SEISMIC DATA ACTIVITY

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Quarterly Technical Report, November 1, 1974 to January 31, 1975

5. AUTHOR(S) (First name, middle initial, last name)

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
March 21, 1975		

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
MDA903-74-C-0227	
b. PROJECT NO.	
c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d.	

10. DISTRIBUTION STATEMENT

Distribution of this document is unlimited

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	Defense Advanced Research Projects 1400 Wilson Boulevard Arlington, Virginia 22209

13. ABSTRACT

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
datacomputer						
seismic data base						
seismic input processor (SIP)						
Ampex TBM						

Computer Corporation of America
575 Technology Square
Cambridge, Massachusetts 02139

Datacomputer Support of Seismic Data Activity
Quarterly Technical Report
November 1, 1974 to January 31, 1975

This research is supported by the Advanced Research Projects Agency of the Department of Defense under Contract No. MDA903-74-C-0227. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the Defense Advanced Research Projects Agency of the U.S. Government.

Table of Contents

1. Overview

1.1 Project Goals

The purpose of the project is to support the ARPA-NMRO Seismic Data Activity by providing data storage and retrieval services. The Arpanet will be used as the communication channel. As part of the service, seismic data will be (a) collected from the Arpanet; (b) stored; and (c) made available to computers on the Arpanet in a convenient and timely manner. These services represent a special application of the Arpanet Datacomputer implemented by CCA under Contract No. MDA903-74-C-0225.

The Datacomputer will require no special programming for the seismic data application, beyond that which has already been planned for the time period being considered. However, the amount of seismic data to be kept on-line necessitates the addition of a tertiary storage mass memory. An Ampex Terabit Memory System (TBM) with a capacity of almost two hundred billion bits will be installed at CCA in 1975.

Also needed for this project is a small Seismic Input Processor (SIP). The SIP will collect data over the network on a round-the-clock basis. It will reformat the data and buffer it. At regular intervals, the SIP will generate a datalanguage update request and burst the data to the datacomputer via the TIP (see Fig. 1).

1.2 Status of the Project

The activity on the project to date has been primarily in two areas: hardware acquisition and coordination with the seismic community.

Ampex Corporation and CCA signed a contract on January 21, 1975 for the purchase of a TBM Memory System to be incorporated into the Datacomputer. The initial configuration of the TBM is one

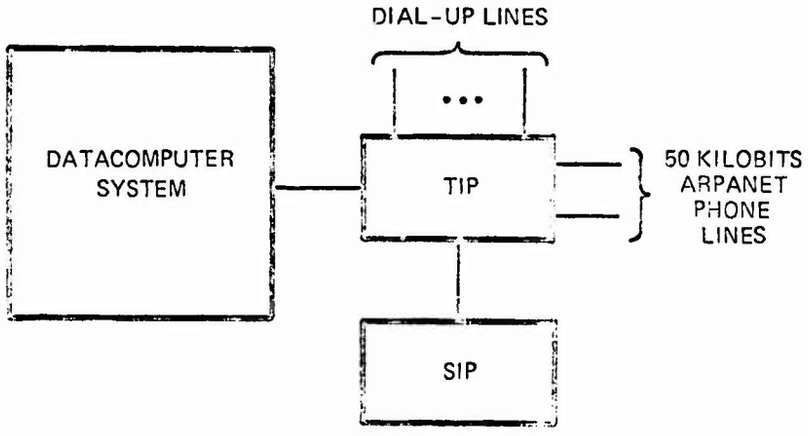


Figure 1 - CCA Installation

transport driver, two dual transport modules, one data channel, and a Communications and Control System (CCS). The CCS contains a Storage Control Processor and a Channel Interface Unit. The contract calls for delivery of the TBM Memory System in August 1975 and acceptance in September 1975.

The SIP hardware consists of a DEC PDP-11 with 28K core, two RP04 disks with a storage capacity of 176 million bytes, and an Arpanet interface. Installation of the PDP-11 and peripherals is completed, and SIP software development has begun. The SIP is expected to be interfaced to the Arpanet in March 1975.

CCA continues to work closely with the seismic community to determine requirements for data storage and retrieval services. Efforts are still under way to specify suitable file formats for storage of the seismic data. These formats reflect the way in which the data is collected, the way in which it will be used, and the most efficient ways of using the Datacomputer hardware and software.

In order to gain operational experience with seismic data, several sample seismic databases, corresponding to different file formats, have been loaded onto the Datacomputer. These databases will be used for demonstrations, testing and measurement.

Efforts are also under way to determine the specification of the CCP-SIP protocol. This is a special-purpose protocol that will allow for faster transmission of real-time data than the standard host-host protocol.

2. TBM

In order to satisfy the requirement for a large, on-line seismic database, an Ampex Terabit Memory System (TBM) will be installed at CCA as a part of the Datacomputer system. The TBM consists of two parts: A Data Storage Section (DSS), which is the repository of all data stored within the TBM, and a Communications and Control System (CSS), which provides message and data interfaces between the PDP-10 and the TBM.

The contract for the purchase of the TBM was signed during the present reporting period. The contract specifies price, delivery dates, acceptance criteria, software components, interface, and the like. The contract is included in the Appendix.

The first milestone under the Ampex-CCA contract is facilities specification. Ampex and CCA are cooperating in determining TBM requirements for power, air conditioning, floor height and other environmental factors as well as a mutually agreeable site plan. Once this task is done, site preparations for the TBM can begin.

3. SIP

Seismic data will be collected from the Arpanet and buffered by a small Seismic Input Processor (SIP) before retransmission to the Datacomputer. The SIP will have two 3330-type spindles, which allow for 24-hour buffering of a 15 kb/second data stream. This will ease requirements for both the Datacomputer and the Central Communications Processor (CCP) at SDAC.

The SIP is a host on CCA's IMP. The SIP communicates with the Datacomputer as any other host would, that is, using data-language, network data connections, and the standard Arpanet host-host protocol. Transfer rates are much higher than normal network communication, however, since no phone lines are involved.

The SIP communicates with the CCP at SDAC using a data transfer protocol which is specially developed for this purpose. This protocol will be more efficient for real-time data than the standard Arpanet host-host protocol. CCA continues to cooperate with VSC and BBN in specifying the CCP-SIP protocol.

Except for the Arpanet interface, the SIP hardware was installed during the current reporting period. This includes the PDP-11 with 28K core and two RP04 disks. DEC is expected to deliver the Arpanet interface for the SIP in February. In addition, CCA is negotiating with BBN and ARPA IPTO for the purchase of a Distant Host Interface will be installed in March.

As a temporary measure, the SIP has been connected to the CCA TIP, appearing as a terminal instead of as a host. This allows for transfers between the PDP-11 and the PDP-10, which are required for SIP software development. FRUG, the debugging package needed for programming the SIP, has been loaded onto the PDP-11 and is operational.

4. Coordination with the Seismic Community

Although no special Datacomputer programming is required for the seismic application, the amount of data to be collected necessitates that the data be handled as efficiently as possible if the application is to be feasible. Design of the application requires a thorough understanding of how the data is to be collected and how it is to be used. Towards this end, CCA continues to work closely with VSC, SDAC, BBN and others to identify the data storage and retrieval requirements for the seismic application.

Preliminary versions of the seismic data files are described in "SDAC On-Line Processing with Datacomputer Proposal" by Emily McCoy, SDAC. CCA has commented on the file formats and met with the organizations involved to improve the data organizations. Based on the outcome of the discussions, SDAC is preparing an updated version of the memorandum.

CCA has obtained seismic data from SDAC and Lincoln Labs that corresponds to the information to be stored in the Array Long Period File and the Preliminary Event Summary File respectively. This data has been loaded into the Datacomputer, and the user program SMART will be modified to access the data. This will give us operational experience with the seismic data and the current proposed file formats.

Appendix

Ampex-CCA Contract

January 17, 1975

Serial No. TWS-3/001

Computer Corporation of America
575 Technology Square
Cambridge, Mass. 02139

JAN 20 1975

Attention: Dr. Thomas Merrill

Subject: Agreement Dated December 12, 1974

Gentlemen:

Submitted herewith is a copy of the subject agreement which has been signed by Ampex.

The acceptance of this contract by Ampex is made with the understanding that the following changes to the agreement and the Statement of Work are acceptable.

ARTICLE XII Liquidated Damages

Inasmuch as CCA can cancel the contract if total delivery does not take place within 180 days of schedule completion of delivery, then it is also felt that a more reasonable limitation should be put on the application of liquidated damages.

Therefore, the first paragraph of Article XII is modified to read:

> If SELLER fails to deliver and install equipment within the time specified in this Agreement, or any extension thereof, the SELLER shall pay BUYER as fixed, agreed, and liquidated damages for each calendar day of delay, the amount of one hundred ($100.00) dollars, for a period not to exceed 360 days.

ARTICLE XIII Option

The Liquidated Damages and cancellation provision of Article XII above will not be applicable to the option equipment.

Statement of Work

Paragraph C4 (b) Unrecoverable Errors is modified to read:

Ampex Corporation • 1020 Kifer Road • Sunnyvale, California 94086
Telephone (408) 738-4910 • TWX: 910-378-5920 • Telex 34-8464

"Error conditions which cannot be corrected through intervention, corrective measures and/or equipment repair are considered as unrecoverable errors."

No more than one block in 4×10^{11} bits transferred.

Paragraph V A Schedule

Ampex agrees to make every effort to comply with the schedule as stated herein, however, due to the delay in reaching agreement concerning the specification a 30 day extension of the schedule shall be applicable before the provision of Article XII may be applied.

Also, add item 3, Automatic Alignment Program, delivered within 14 months ARO.

Within the Agreement and the Statement of Work there is an obligation for either Ampex or CCA to provide certain documents, however, because of the delay in resolving the specifications the required dates for these documents is modified as follows.

Floor Plan (Article VII) furnished to SELLER no later than 45 days ARO.

Software Functional Specification (Para. III C), Submitted for BUYER approval 120 days ARO.

Paragraph X Diagnostics

Add the following, subparagraph F

"F. The Automatic Alignment Program will be implemented as an SCP function which can be initiated from the PDP-10".

It should be noted that the liquidated damages and cancellation provisions of Article XII of the Contract shall not be applicable to the Automatic Alignment Program.

Paragraph XI Acceptance Test Procedure and Standard of Performance

Add the following to the first paragraph on Page 26.

"There will be no more than three equipment failures over the seven day acceptance test period. There will also be at least three consecutive days without equipment failures".

Please indicate the acceptance of the above changes by signing as provided below and return one copy to us for our records.

Very truly yours,

AMPEX CORPORATION

William J. Cassell
Manager, System Contracts

WJC:gs

ACCEPTED:

Computer Corporation of America

_____ _____

Date

_____

Title

THIS AGREEMENT dated [illegible], is between Ampex Corporation, a California corporation (hereinafter called "SELLER"), having an office and place of business at 1020 Kifer Road, Sunnyvale, California, and Computer Corporation of America, a Massachusetts corporation (hereinafter called "BUYER"), having an office and place of business at 575 Technology Square, Cambridge, Massachusetts.

ARTICLE I Statement of Work and Consideration

SELLER agrees to design, engineer, fabricate and deliver to BUYER the system and documentation in accordance with the attached Statement of Work designated as Exhibit II.

In the event of any inconsistency in this Agreement, the inconsistency shall be resolved by giving precedence in the following order: (a) the contract agreement (Articles I through IV, Exhibit I and Exhibit II); (b) Ampex Proposal Amendment 9490-R-00167-1 dated 4/5/74; (c) Ampex Proposal No. 9490-R-00167 (TBMP 73-02) dated 8/3/73; (d) CCA Request for Proposal dated 7/17/73; (e) other provisions of the contract whether incorporated by reference or otherwise.

ARTICLE II Delivery

Title to all equipment described in the Statement of Work, designated as Exhibit II, shall pass to BUYER upon acceptance by BUYER. Delivery schedule and acceptance conditions shall be as shown in the Statement of Work, providing all actions required of BUYER have been accomplished.

ARTICLE III Progress Payments

BUYER shall make monthly Progress Payments to SELLER based on the percentage of Selling Price of work accomplished. Invoices will be submitted monthly and terms of payment shall be NET 30 DAYS From Invoice date. Of the invoice amount, 15% will be withheld by BUYER until final inspection and acceptance of the equipment items and documentation. BUYER is granted the right to physically inspect the equipment at SELLER's facility at any reasonable time. If the system fails to pass the acceptance criteria and contract is therefore terminated, all funds previously paid to SELLER will be refunded.

ARTICLE IV Sales or Similar Taxes

SELLER's prices do not include sales, use, excise, or similar taxes; consequently, in addition to the price specified herein, the amount of any present or future sales, use, excise, or other similar tax applicable to the sale, delivery, or installation of the equipment hereunder shall be paid by the BUYER, or in lieu thereof, the purchaser shall provide SELLER with a tax execption certificate acceptable to the tax authorities.

ARTICLE V Warranty

SELLER warrants that, at the time of acceptance, products of its manufacture will be free from defect in material and workmanship and agrees to repair or replace any product, or part thereof, which is so defective. This warranty shall commence to run from the time the equipment is accepted by BUYER and shall continue thereafter for a time period of 90 (ninety) days. Replacement equipment or parts thereof, supplied under this warranty, carry only the unexpired portion of the original warranty.

SELLER shall have no liability with respect to any product that has been installed, repaired, maintained, operated or modified, other than in accordance with SELLER's installation, operation and maintenance procedures unless installed, repaired, maintained, operated or modified by SELLER's own agents.

THE ABOVE WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED AND STATUTORY. SELLER'S SOLE WARRANTY LIABILITY SHALL BE TO REPAIR OR REPLACE DEFECTIVE PRODUCTS OR PARTS IN ACCORDANCE WITH THE TERMS OF THIS WARRANTY. IN NO EVENT SHALL SELLER BE LIABLE FOR CONSEQUENTIAL OR OTHER DAMAGES ARISING OUT OF USE OR LOSS OF USE OF THE EQUIPMENT.

ARTICLE VI Patent Indemnity

SELLER shall hold harmless and defend the BUYER and its customers from all loss, damage or liability for, or by reason of, any actual or alleged infringement of any United States patent, arising out of the use or sale of SELLER's equipment, delivered to BUYER hereunder; provided that the BUYER promptly notifies SELLER in writing of such suit or threat thereof and cooperates by giving SELLER any requested authority, information, and assistance. The foregoing indemnity shall not apply in instances in which normally non-infringing SELLER's equipment is rendered infringing:

a. by BUYER's alteration, combination with other equipment, or use of said equipment, or

b. as the result of SELLER's compliance with BUYER's detail design or stated requirement for specific structure.

SELLER shall have no liability with respect to patent or trademark rights of countries foreign to the United States except such obligation as may be agreed to in writing in specific instances. SELLER's sole obligation with respect to patent and trademark claims shall be full compliance with the above.

ARTICLE VII Installation

A scale drawing of the installation site for the system shall be submitted to SELLER no later than fifteen (15) days after date of contract. This drawing shall indicate all obstructions such as posts, walls, ramps, air conditioner units, doors, etc. Within fifteen (15) days after receipt of this drawing, the SELLER will prepare and submit for BUYER's approval, an equipment floor plan. The BUYER will approve the floor plan within fifteen (15) days after receipt and thereafter the SELLER will prepare and submit detailed installation data which will assist the BUYER in preparation of the installation site.

The BUYER will provide (in accordance with local electrical and/or building codes as required) at no cost to SELLER, and in accordance with the specifications contained in SELLER's installation data for the designated equipment, a suitable place of installation and environment (including under-floor cold air plenum), all electrical service, compressed air and vacuum equipment and facilities and connections and other utilities and facilities necessary to operate the equipment. SELLER's responsibility therefore will be to provide and connect power cabling between equipment sections and from the sections to power receptacles in conformance with local electrical codes. In addition, BUYER will provide SELLER's personnel with access to the site at all times during the installation period, and assure that physical clearances are sufficient to allow passage of the equipment. The equipment shall conform to the physical specifications described in Ampex Proposal No. 9400-R-00167 (TDMP 73-02), dated August 3, 1973. SELLER will provide liaison services with BUYER to assist in site preparation. SELLER will supervise the placement, make connection of the system, and will provide all necessary on-site adjustments of the system to complete the installation.

ARTICLE VIII Equipment Configuration

SELLER reserves the right to modify the system, in whole or in part at any time prior to delivery thereof, provided that such change or alteration will not adversely affect the required physical clearances, facilities, environmental conditions, system performance, delivery schedule, price, or changes that may affect the interface software.

ARTICLE IX Inspection and Acceptance

Acceptance by BUYER will be upon satisfactory completion of acceptance tests in accordance with Statement of Work (Exhibit II), Section XI. In the event total acceptance by BUYER does not take place sixty (60) days after the start of testing, the BUYER shall have the option to cancel this Agreement and all funds previously paid SELLER will be refunded to BUYER.

ARTICLE X Progress Reports

SELLER will prepare progress reports and submit to BUYER by the tenth (10th) of each month. These reports will give a brief narrative description of progress made during the previous month, and will identify any problems incurred and any plan of action to resolve problems.

ARTICLE XI Maintenance

SELLER will supply BUYER with maintenance services in accordance with the Statement of Work (Exhibit II), Section IX.

ARTICLE XII Liquidated Damages

If the SELLER fails to deliver and install equipment within the time specified in this agreement, or any extension thereof, the SELLER shall pay BUYER as fixed, agreed, and liquidated damages for each calendar day of the delay, the amount of one hundred ($100.00) dollars. In no case will the liquidated damages exceed the total value of the contract.

The SELLER shall not be charged with liquidated damages when the delay arises out of causes beyond the control and without the fault or negligence of the SELLER. Such causes may include, but not be restricted to, acts of God or of the public enemy, acts of the Government in either its sovereign or contractual capacity, acts of the BUYER, fires, floods,

epidemics, quarantine restrictions, strikes, freight embargoes, and unusually severe weather; but in every case the failure to perform must be beyond the control and without the fault or negligence of the SELLER. If the failure to perform is caused by the default of a subcontractor, and if such default arises out of causes beyond the control of both the SELLER and subcontractor, and without the fault or negligence of either of them, the SELLER shall not be liable for any liquidated damages, unless the supplies or services to be furnished by the contractor were obtainable from other sources in sufficient time to permit the SELLER to meet the required delivery schedule.

In the event total delivery by SELLER does not take place one hundred eighty (180) days after scheduled completion of delivery, the BUYER shall have the option to cancel this agreement and all funds previously paid SELLER will be refunded to BUYER.

ARTICLE XIII Option

An option for a Dual Transport Module at the unit price of $74,728.00 shall remain in effect for one year subsequent to acceptance of initial system and delivery will be made no later than six (6) months after exercise of option by BUYER.

ARTICLE XIV Government Provisions

Except as herein amended, this agreement is subject to the requirements of the following additional provisions which are incorporated herein by reference. In the application of these provisions the Government or the Contracting Officer will mean BUYER and contractor will mean SELLER. This is with the exception of any provision which may require the examination of SELLER's books or records wherein the BUYER may request the appropriate Government agency to conduct such examination.

CLAUSE TITLE	DATE	ASPR REFERENCE
Definitions	62 Feb	7-103.1
Inspection	58 May	7-103.5
Assignment of Claims	62 Feb	7-103.8
Examination of Records by Comptroller General	71 May	7-104.15
Utilization of Small Business Concerns	58 Jan	7-104.14
Termination	69 Aug	7-103.11 & 7-103.21
Renegotiation	59 Oct	7-103.13(a)

CLAUSE TITLE	DATE	ASPR REFERENCE
Buy American Act	64 May	7-104.3
Convict Labor	49 Mar	7-104.17
Walsh-Healey Public Contracts Act	58 Jan	7-103.17
Contract Work Hours and Safety Standards Act-Overtime Compensation	69 Nov	7-103.16
Officials Not to Benefit	49 Jul	7-103.19
Convenant Against Contingent Fees	58 Jan	7-103.20
Authorization and Consent	64 Mar	7-103.22
Notice and Assistance Regarding Patent and Copyright Infringement	65 Jan	7-103.23
Rights in Technical Data	72 Apr	7-104.9(a)
Utilization of Labor Surplus Area Concerns	70 Jun	7-104.20(a)
Competition in Subcontracting	62 Apr	7-104.40
Audit by Department of Defense	71 Apr	7-104.41(a)
Price Reduction for Defective Cost or Pricing Data	70 Jan	7-104.29(a)
Subcontractor Cost and Pricing Data	70 Jan	7-104.42(a)
Gratuities	52 Mar	7-104.16
Interest	72 May	7-104.39
Scope Work Order	71 Apr	7-105.3(c)
Changes	58 Jan	7-103.2
Equal Opportunity	72 Aug	7-103.18(a)
Filing of Patent Applications	69 Dec	7-104.6
Title and Risk of Loss	68 Jun	7-103.6
Technical Data-Withholding of Payment	73 Apr	7-104.9(h)
Priorities, Allocations and Allotments	71 Apr	7-104.18
Payment of Interest on Contractor's Claims	72 May	7-104.82
Listing of Employment Openings	73 Sep	7-103.27
Cost Accounting Standards	74 Jan	7-104.83
Equal Opportunity Pre-Award Clearance of Subcontractors	71 Oct	7-104.22

ARTICLE XV Limitations, Rights and Remedies

This document and all documents incorporated herein by reference constitute the entire agreement between the parties hereto pertaining to the subject matter hereof. Any and all agreements now existing between the parties pertaining thereto are expressly cancelled. There are no oral or implied agreements or representations. All modifications of this agreement must be in writing and signed by both parties hereto.

All rights and remedies of SELLER conferred upon SELLER by any provision in this agreement, or by law, shall be cumulative and in addition to every other right and remedy available to SELLER.

APPROVED AND AGREED TO THIS 13 day of January, 1975.

Computer Corporation of America
575 Technology Square
Cambridge, Massachusetts 02139

BY: _____

TITLE: _____

ATTEST: _____

TITLE: _____

(BUYER)

Ampex Corporation
1020 Kifer Road
Sunnyvale, California

BY: Walter G. Reinhardt

TITLE: Vice President

ATTEST: _____

TITLE: Manager, System Contracts

(SELLER)

Subject to provisions as stated in Ampex letter dated 1/17/75

PRICE SCHEDULE

EXHIBIT I

1.	Communications and Control System (CCS)	$115,000.00
2.	Data Storage Section (DSS)	297,600.00
3.	Shipping	2,500.00
4.	Installation and checkout	12,601.00
5.	Operator Training	6,248.00
6.	Special Tooling and Test Equipment	7,334.00
7.	Maintenance Training (Ampex Personnel)	8,122.00
8.	Maintenance (for period of one year commencing upon acceptance of the system)	38,00 .00
	TOTAL	$489,3 .00
	Option	
9.	Dual Transport Module	$ 74.72 .00

TBM* MEMORY SYSTEM FOR THE

CCA DATACOMPUTER SYSTEM

STATEMENT OF WORK

Exhibit II

I. Scope and Purpose

This Statement of Work defines the work to be performed and the system to be delivered by SELLER under this contract. This document makes reference to and incorporates by reference Ampex Proposal No. 9490-R-00167, TBMP 73-02, entitled "Mass Storage for CCA Datacomputer System", dated August 3, 1973, and Amendment No. 9490-R-00167-1, entitled "TBM* Memory System Channel Interface Unit", dated April 5, 1974, except as herein amended.

Figure 1.0 attached shows the TBM* Memory System Block diagram.

II. Equipment

A. TBM* Memory System (hereinafter called TMS-3):

Functionally the TMS-3 system can be viewed as consisting of the Communications and Control Section (CCS) and the Data Storage Section (DSS) as more fully defined below. Note: The CCS as referred to herein was formerly referred to as the Channel Interface Unit (CIU) as described in Ampex Proposal Amendment 9490-R-00167-1. Additionally, the Data Channel Interface as described in Ampex Proposal Amendment No. 9490-R-00167-1 is now referred to as the Channel Interface Unit (CIU). These are nomenclature changes only.

1. Communications and Control Section (CCS):

(a) One Storage Control Processor (SCP)

(1) Digital Equipment Corporation PDP-11/35 (see note below) and peripheral components:

KD11-A Central Processor with at least 16K word Core Memory

ASR33 Teletype writer (or equivalent)

TA11-AA Dual DECassettes (or equivalent)

(2) One Transport Driver Interface (TDIF)--as described in Paragraph 2.1.3 of Ampex Proposal Amendment 9490-R-00167-1.

Note: Ampex is presently committed to furnish the PDP-11/05. For reasons of compatibility with the remaining product line, serious consideration is being given to substituting this with the PDP-11/35.

(b) One Channel Interface Unit (CIU) formerly Data Channel Interface as described in Paragraph 2.1.2 of Ampex Proposal Amendment No. 9490-R-00167-1.

2. Data Storage Section (DSS):

(a) One Transport Driver

(b) Two Dual Transport Modules

(c) One Data Channel

(d) Miscellaneous TMS-3 System Components (e.g., TMS-3 cables, switches, etc.).

B. Auxiliary equipment as described in Attachments 2 and 3 of Ampex Proposal Amendment No. 9490-R-00167-1 is hereby deleted.

C. Specific Performance Capabilities

1. (a) Initial TMS-3 system capacity: at least 1.8×10^{11} bits of user information.

(b) Expanded TMS-3 system capacity: at least 2.7×10^{11} bits of user information upon execution of option for additional Dual Transport Module.

2. (a) Average random TBMTAPE search time: 17 seconds.

(b) Maximum TBMTAPE search time: 45 seconds.

3. Sustained data transport rate: 5.5×10^6 bits/second.

4. Data accuracy: TMS-3 data accuracy specifications only apply to tests conducted with TBMTAPEs prepared/initialized and used in accordance with Ampex-approved procedures.

   (a) Undetectable errors. The TMS-3 error correction/detection system should be designed to provide an undetectable error rate of 1 in 10^{15} bits.

   (b) Unrecoverable errors, that is, errors that persist after redundancy, error correction logic, and rereads.

   No more than one block in error in 4×10^{11} bits transferred.

   (c) Rereads. No more than 1 reread in 250 blocks read based on a sample of at least 25,000 blocks read.

III. Software

A. Programs

1. A DEC PDP-11 operating system with the required input/output device handlers will be provided. I/O handlers will be provided for the teletype, tape cassettes, transport driver and data channel interfaces.
2. Command analysis and process initiation routines will be provided for analyzing commands received from the PDP-10 channel and initiating the processes to execute those commands. In addition to command analysis and process initiation, routines will be provided to allow the operator to configure and maintain the TMS-3 system.
3. Command optimization. Commands are processed in their order of arrival at the PDP-11.
4. Command processors. Routines to process commands initiated by the TMS-3 operator console, the PDP-10 channel, or a change in TMS-3 system status will be provided.
5. Device allocation. Routines will be provided to allocate TMS-3 devices for processing specific PDP-10 commands and to maintain device status.

B. Software Functions

1. Channel-interface functions. The software will be capable of executing the PDP-10 channel-initiated functions. These functions are specified in

Attachment 1 of Ampex Proposal Amendment No. 9490-R-00167-1.

2. Operator-initiated TMS-3 system functions. The TMS-3 operator will be capable of initiating functions for configuration control, diagnostics, maintenance, and utility programs. These functions will be specifically defined in the Software Function Specification (referenced III.C. below).

3. Status-initiated TMS-3 system functions. Certain functions will be initiated automatically upon change of status in the system. An example of this would be a function to notify the operator in the event the software detects a component failure in the TMS-3 system. In some cases, this function will also inform the PDP-10 channel (e.g., when a previous requested device becomes available). These functions will be specifically defined in the Software Functional Specifications (reference III.C. below).

C. Software Functional Specifications

1. Software functional specifications of operator-initiated and status-initiated TMS-3 system functions will be prepared by SELLER and submitted for approval to BUYER within ninety (90)

days after date of contract. Delay by the BUYER in approval of these specifications will be considered an excusable delay under the provision of Article XII of this agreement.

IV. Documentation

A. System Documentation

The following documentation will be provided.

1. System Information. The intent of this manual is to define the TMS-3 system for administrative personnel who need to know how the system works to plan for hardware and software programming support of the system. It defines the TMS-3 system, its major components (hardware and software), how they work together, any input (operator or programmer supplied) needed to initiate the system, and the output produced by the system.

B. Hardware Documentation

The following documentation will be provided.

1. Theory of Operation Manuals and Maintenance Documentation for the following:

   (a) DSS:

      1. System Manual
      2. Dual Transport Module
      3. Transport Driver Module
      4. Data Channel Module

   (b) CCS:

      1. Storage Control Processor
         a. DEC equipment
         b. Transport driver interface unit

The Theory of Operation Manuals describe the overall functioning of each hardware module plus a detailed operational description of all major subassemblies within that module (equipment rack). Maintenance documentation comparable to that normally provided to a SELLER's Customer Service Engineer and adequate to maintain the TMS-3 system will be furnished.

C. Software Documentation

The following documentation will be provided.

1. Programming Guide. This manual is intended to assist system programmers or analysts to develop and maintain TMS-3 application programs. It desdribes the commands transmitted between the PDP-10 and TMS-3 system, data and record formats, addressing techniques used, information transfer, input/output operation, system logs, and recovery procedures.

2. Operator Guides. This manual is intended for the TMS-3 system operator. It describes the console, the procedures needed to get the system up and running and the procedures needed to recover from errors, equipment malfunctions, or conditions requiring operator intervention.

V. Installation and Checkout

A. Schedule

1. Shipment and installation: Completed at eight (8) months ARO.

2. Integration and test with PDP-10: Completed at nine (9) months ARO.

B. General Approach

1. SELLER will provide personnel to accomplish the installation and checkout of the TMS-3 system at BUYER's facility.

2. BUYER support is required in the following area: Accomplish site facilities preparation in sufficient time to enable SELLER to install TMS-3 system in accordance with the schedule.

3. During checkout, SELLER estimates they will require access to the PDP-10 for a period of three (3) weeks for one (1) full eight (8) hour shift, per day, plus weekends. BUYER's PDP-10 software support personnel will also be required during checkout. During the same period, a minimum of one (1) full eight (8) hour shift, per day, will be provided to allow BUYER personnel access to the TMS-3 system for the purpose of checking out their PDP-10 interface and diagnostic software. SELLER's support personnel will also be required during this time.

VI. Training

Operator training will be conducted at BUHLER's facility under the direct supervision of SELLER personnel. This training will consist of a combination of formal classroom training and on-the-job training and shall not be less than one hundred twenty (120) hours. Schedule of training will be determined at a later date.

VII. Interface

A. The TMS-3 system Communications and Control Section (CCS) interprets and executes IBM-compatible channel commands received from the physically attached SA-10 IBM-compatible channel of the PDP-10.

B. Cables:

1. Bus-in/Bus-out, one each

2. Tag-in/Tag-out, one each

NOTE: Maximum length is seventy-five (75) feet each.

VIII. Physical Requirements

Necessary facilities required for the TMS-3 system, vacuum blower, air compressor, spare parts, test equipment, and TMS-3 service personnel shall be provided by BUYER in accordance with the Site Plan specification for the TMS-3 system.

IX. Maintenance

A. SELLER shall train the SELLER Field Service Representative so as to be capable of providing adequate maintenance at the beginning of the maintenance period.

B. SELLER shall provide one Field Service Representative for on-site maintenance support which shall commence ninety (90) days after acceptance in accordance with Section XI and continue for a period of one (1) year subsequent. During this period, the SELLER Field Service Representative shall be available for a single first-shift of forty (40) hours per week or an equivalent time schedule to be mutually agreed upon by BUYER and SELLER.

C. Special Test Equipment

1. A transport driver simulator will be supplied by SELLER to facilitate checkout and adjustment of certain portions of the TMS-3 system equipment to minimize the use of other system equipment in support of maintenance activities. This unit serves as a substitute for a transport driver when performing some of the checkout and adjustment functions which may be required on dual transport modules.

2. TMS-3 tool kit. To be supplied by SELLER.

X. Diagnostics

A. The maintenance/diagnostic system will be a collection of programs used to checkout and maintain the TMS-3 equipment, diagnose hardware failures, and support engineering debugging. These tests will provide the following.

1. An on-line capability to load all TMS-3 test programs.
2. An on-line capability to execute TMS-3 test programs in accordance with available TMS-3 system resources.
3. An off-line capability to load TMS-3 test programs.

B. The maintenance/diagnostic system will be implemented based on the following:

1. A console device will be attached to the test processor during execution of a test program.
2. All processors and devices required to execute a test program will be off-line to the TMS-3 system.
3. All test programs will be stored on a data set media within the TMS-3 system.

C. The on-line capability will be under control of the maintenance task executor, will be an integral part of the SCP operating system, will be invoked by operator command, will do off-line device state verification, will load test programs into any

processor, will initiate on-line test execution, and will cause minimal interference in user operations.

D. The off-line capability will also be under control of the maintenance task executor, will load test programs into any processor, but will not provide off-line device state verification or on-line test execution.

E. Test programs will be organized in groups by function:

1. DEC PDP-11 tests.
2. Data General NOVA tests.
3. CCS tests.
4. DSS tests.
5. On-line tests.

XI. Acceptance Test Procedure and Standard of Performance

After installation, BUYER shall operate the system and run certain tests to provide assurance that the system functions in accordance with the system specifications described in this Statement of Work (Exhibit II) and approved modifications thereto.

An Acceptance Test Procedure shall be prepared for the purpose of providing a procedure for recording test results on a daily basis. This procedure shall be prepared by SELLER and submitted for BUYER's review no later than ninety (90) days prior to delivery, and BUYER shall furnish its written approval thereof within thirty (30) days after receipt of the procedure.

SELLER shall certify in writing that the system is installed and is ready for use and acceptance testing. The performance period shall begin at the discretion of the BUYER no later than seven (7) days after receipt of certification, unless the BUYER is not prepared to start acceptance testing as a result of causes beyond the control and without the fault or negligence of the BUYER. Such causes may include, but are not restricted to, acts of God or of the public enemy, acts of the Government, in either its sovereign or contractual capacity, acts of the SELLER, fires, floods, epidemics,

quarantine restrictions, strikes, and unusually severe weather; but in every case the failure to perform must be beyond the control and without the fault or negligence of the BUYER. The performance period shall end when the equipment has met the standard of performance for a period of seven (7) consecutive days, twenty-four hours per day, by operating in conformance with this Statement of Work at an availability of 90% or more, excluding scheduled preventive maintenance (no more than one (1) hour per day) and BUYER-caused failures.

In the event the equipment does not meet the standard of performance during the initial seven (7) consecutive days, the standard of performance test shall continue on a day-by-day basis until the standard of performance is met for a total of seven (7) consecutive days.

The availability level for the system is computed by dividing the operational use time by the sum of that time plus system failure downtime.

Operational use time for performance testing of the system is defined as the accumulated time during which the TMS-3 system is available for operation.